FINAL

ENVIRONMENTAL ASSESSMENT

For

UNDERWATER ELECTROMAGNETIC MEASUREMENT SYSTEM

At

NAVAL BASE GUAM, APRA HARBOR, GUAM

May 2022

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DEPARTMENT OF DEFENSE
DEPARTMENT OF THE NAVY

FINDING OF NO SIGNIFICANT IMPACT FOR THE UNDERWATER ELECTROMAGNETIC MEASUREMENT SYSTEM, NAVAL BASE GUAM, APRA HARBOR, GUAM

Pursuant to the Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) implementing the National Environmental Policy Act (NEPA) and Department of the Navy (DON) NEPA regulations (32 CRF Part 775), DON gives notice that an Environmental Assessment (EA) has been prepared and an Environmental Impact Statement (EIS) is not required for the Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor, Guam. This action will be implemented as set out in Alternative 1 (Preferred Alternative).

Proposed Action: The United States (U.S.) Navy proposes to install and operate an underwater electromagnetic measurement system (UEMMS) to service DON surface ships and submarines homeported, forward deployed, or visiting Naval Base Guam (NBG), Apra Harbor, Guam. The Proposed Action would include both in-water and shoreside infrastructure to measure vessels' electromagnetic signatures and transmit data to facilities on land. Project installation is anticipated to begin in 2022, with operation starting in 2024.

Purpose and Need: The purpose of the Proposed Action is to provide the capability at NBG to measure the electromagnetic signatures of DON homeported, forward-deployed, or transient ships and submarines to meet the magnetic silencing limits specified in Office of the Chief of Naval Operations Instruction (OPNAVINST) 8950.2 series. The Proposed Action is needed to minimize the electromagnetic signature, i.e., on-board system calibrations, which ensures that ships and submarines comply with electromagnetic signature limits. This service is not currently available at NBG, which results in operational inefficiencies for U.S. 7th Fleet forward-deployed and transient ships and submarines.

Alternatives Analyzed: Alternatives were developed for analysis based upon the following reasonable alternative screening factors: Proximity to ships and submarines homeported or forward deployed to NBG; meets technical parameters for accurately measuring electromagnetic signatures of ships and submarines; complies with NBG Port Operations navigation safety requirements; uses existing U.S. Department of Defense (DoD)-controlled land for shore infrastructure; avoids shipping routes, strong tidal currents, and valuable coral reef habitats; minimizes potential adverse effects on protected marine biological species and habitats; meets budget limits for acquisition of this type of technology; consistent with NBG infrastructure planning; ease and efficiency of construction; low construction risk; local availability of construction assets; and ease of maintenance and repair.

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, the No Action Alternative and two action alternatives were carried forward for detailed analysis in the EA.

No Action Alternative: Under the Under the No Action Alternative, the Proposed Action would not occur and NBG will continue to be out of compliance with OPNAVINST 8950.2 series. NBG would not be able to provide a service essential for homeported and forward-deployed DON vessels to meet OPNAVINST magnetic silencing limits. This would prolong a situation that detracts from Fleet readiness and mission effectiveness by requiring additional days of transit time to installations that have underwater electromagnetic measurement capability (e.g., Japan and Hawaii). The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA, the No Action Alternative was carried forward in the EA analysis. The No Action Alternative was used to analyze the consequences of not undertaking the Proposed Action, not simply conclude no impact, and serves to establish a comparative baseline for analysis.

Alternative 1 (Preferred Alternative): In this alternative, electromagnetic triaxial sensors, magnetometer triaxial sensors, and a conductivity, depth, and temperature (CDT) sensor would be installed in an array on the seafloor of Outer Apra Harbor northwest of Polaris Point. Subsea data transmission cables would be routed from the array to a

new below-grade transition vault located onshore at Polaris Point. The subsea cables would be secured to the seafloor with concrete anchor discs placed on the substrate. Onshore, the cables would connect to data acquisition equipment located in an existing building and the data transferred to a fiber optic cable. The fiber optic cable would follow a terrestrial route entirely in existing below grade conduits to existing facilities at Polaris Point, where the data from the sensor array would be collected, processed, and archived. A two-inch diameter, approximately eight-foot-long duct would be installed approximately two feet below grade between the cable transition point building and an adjacent building to supply power to the UEMMS equipment in the cable transition point building. The excavated material would be placed on scows for transfer, screened for Munitions and Explosives of Concern (MEC) and/or Material Potentially Presenting Explosive Hazard (MPPEH), and disposed of either at the Guam Deep Ocean Disposal Site (G-DODS) or an approved upland confined disposal facility (CDF) at NBG. This alternative would have fewer impacts to marine resources (e.g., corals and other benthic marine biota) than Alternative 2 and is DON's Preferred Alternative.

Alternative 2: This alternative is the same as Alternative 1 except the subsea cables would be secured to the seafloor using concrete block mats, which would result in approximately 21,400 square feet more seafloor disturbance than in Alternative 1. All other components would be the same as in Alternative 1. Because this alternative would likely have greater impacts to marine resources than Alternative 1 due to the much larger seafloor area affected by its subsea cable anchoring system, it is not DON's preferred alternative. This alternative meets project criteria and screening factors and is considered a reasonable alternative.

Alternatives Considered but Dismissed from Further Consideration: The following alternatives were considered, but not carried forward for detailed analysis in this EA because they do not meet the purpose and need for the project and satisfy the reasonable alternative screening factors:

- Installation at alternate sites (other Pacific or Indian Ocean locations; other Apra Harbor sites)
- Alternate installation methodologies (subsea cable horizontal directional drilling; trenched subsea cables; subsea cable earth anchor system; directionally drilled terrestrial conduit; trenched terrestrial conduit; pole suspended cables)

Environmental Effects: No significant direct, indirect, or cumulative environmental impact would occur from implementing the proposed action. Because potential impacts were considered negligible or nonexistent, the following resources were not evaluated in detail in this EA: geological resources, land use, visual resources, airspace, infrastructure, public health and safety, socioeconomics, and environmental justice. Potential environmental impacts on air quality, water resources, cultural resources, biological resources, noise, transportation, and hazardous materials and wastes are summarized here.

Air Quality: The Proposed Action would result in insignificant air quality impacts in the construction and operational periods. Additional emissions associated with the Preferred Alternative were assessed to estimate project impacts. As the Preferred Alternative would potentially involve sulphur dioxide (SO_2)-emitting activities in the Piti-Cabras SO_2 nonattainment area, DON conducted a Clean Air Act General Conformity Rule applicability analysis. The analysis indicated that annual SO_2 emissions from the Preferred Alternative would not exceed the general conformity threshold for SO_2 in the Piti-Cabras nonattainment area; therefore, the Preferred Alternative is exempt from the Clean Air Act General Conformity Rule. A Record of Non-Applicability is included in EA Appendix A. Greenhouse gas emissions during the construction and operational periods were estimated to be well below the CEQ threshold of 25,000 metric tons per year.

Water Resources: The Proposed Action would result in insignificant impacts to water resources. Installation of the proposed sensor array and associated marine and terrestrial infrastructure would include in-water excavation and backfilling of the sensor array site (an area of approximately 7,900 square feet), trenching and subsurface work at the cable bundle shoreline transition area, and ocean and land disposal of excavated material. The sensor cables would be routed on land from the cable transition point to the cable termination point entirely via existing below-grade conduits and require minimal ground disturbance in this route. The use of construction best management

practices (BMPs) (see detailed list in EA Appendix C) would minimize the transport of resuspended sediments in the water column, soil erosion, and runoff and avoid adverse impacts to marine water resources.

During the operational period, the proposed sensor array and associated cable infrastructure would function passively, either buried beneath the seafloor or revetment armoring material, or contained within subsurface cables and conduits. Therefore, there would be little to no potential to degrade or change physical or chemical characteristics of marine or other receiving waters.

Cultural Resources: The Proposed Action would have no impacts to cultural resources during project construction or operation. No archaeological resources, historic architectural resources, or traditional cultural properties exist in the project area. During the operational period, the electromagnetic measurement and data transfer activities taking place at the UEMMS sensor array and related infrastructure would be passive and self-contained within the components. Any maintenance or repair activities needed during the operational period would occur in areas with no archaeological sensitivity.

In accordance with Section 106 of the National Historic Preservation Act (NHPA), the DON consulted with the Guam State Historic Preservation Officer (SHPO) regarding the Preferred Alternative. The DON determined that there would be no historic properties affected by the Preferred Alternative under NHPA Section 106. By letter dated July 5, 2019 (Reference No. RC2019-0180), the Guam SHPO concurred with the DON's determination.

Biological Resources: The Proposed Action would result in less than significant impacts to biological resources. The study area for analysis of effects to biological resources associated with the Preferred Alternative included:

- Approximately 0.18 acres (7,900 square feet [sq ft]) of the Outer Apra Harbor seafloor in the navigational channel to Inner Apra Harbor (installation of sensor array)
- Approximately 0.07 acres (3,080 sq ft) of the Outer Apra Harbor seafloor between the sensor array and the cable duct (path of the subsea cable bundle)
- Approximately 225 cubic yards of sea floor and boulder riprap revetment of Polaris Point (shore landing of cable bundle)
- G-DODS (disposal of excavated material)
- Approximately 144 sq ft around the cable bundle transition vault
- Approximately 4,000-linear foot fiber optic cable path from the cable transition point to the cable termination point on Polaris Point (installation of cable bundle within existing conduits)
- Orote Airfield CDF and Field 5 CDF sites (alternative sites for upland disposal of excavated material)
- Approximately one acre on Polaris Point (construction staging area)

Most construction period impacts would be temporary and reversible; mitigation measures will be implemented to offset unavoidable adverse impacts. During the operational period, the system would require minimal maintenance. The sensor array is designed to passively acquire data and would not emit electromagnetic radiation during operation. Because the UEMMS is a passive system with no mechanical parts, repairs are anticipated to be minimal and would be conducted on an as-needed basis. The installation and operation of the sensor array would not increase ship traffic to or from Apra Harbor by either homeported or transient vessels. During the operational period, project-related activities (e.g., maintenance and repair) would be minimal and infrequent due to the passive nature of UEMMS operations, resulting in less than significant impacts to terrestrial or marine biological resources.

Terrestrial Vegetation and Wildlife

Minor and temporary impacts to terrestrial vegetation would occur from land-based construction activities; project construction activities would occur in locations that have been previously disturbed and do not include limestone forest. No impacts would occur to any federal- or Guam-listed endangered plant because there are no protected terrestrial vegetation species known to occur in the region of influence.

Minor and temporary impacts to terrestrial wildlife would occur from land-based construction activities; however, there is no native terrestrial wildlife in the project area. No foraging, nesting, or roosting sites for protected animals were identified in the project area. No impacts would occur to any federal- or Guam-listed threatened or endangered animal, birds protected under the Migratory Bird Treaty Act, and Guam-designated species of greatest conservation need.

Marine Wildlife

The project area includes three sites within Outer Apra Harbor: sensor array site, subsea cable route, and cable shore landing at Polaris Point. The project would directly impact approximately 16,000 sq ft of benthic substrate in Outer Apra Harbor, including impacts to corals and soft-sediment infauna. Indirect impacts from in-water construction activity are presumed in the marine waters adjacent to and up to an approximately 410-foot (ft) radius of the in-water work.

Marine Mammals. The Proposed Action is unlikely to result in significant adverse effects to marine mammals, as they are not known to be common in Apra Harbor. Planned BMPs would further minimize risks to these animals that have a low probability of being present in the project area.

Corals. The Preferred Alternative would result in the physical removal of 7,680 coral communities (7,535 in the sensor array footprint and 145 in the cable shore landing footprint) and increased suspended sediments that would adversely impact corals in and adjacent to the project area (i.e., the region of influence [ROI]) during the construction period. Although unlikely to occur, the following environmental stressors on coral in the ROI may result from Preferred Alternative during the construction period: wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and unexploded ordnance (UXO).

The implementation of avoidance, minimization, and offset actions would result in less than significant impacts to coral communities in the ROI. Avoidance measures include establishing a subsea cable route that avoids corals and utilizing diver-guided cable installation to avoid sensitive benthic resources. Minimization measures include revising the project design to reduce the excavation area needed to install the sensor array; relocating the CTD sensor closer to the array to reduce impacts to coral resources; selecting a subsea cable attachment method that has fewer impacts to benthic communities; and translocating about 6,300 corals and maintaining and monitoring the translocated corals (described in following paragraph).

Of the 7,680 corals estimated at the array site and shore line landing, about 1,380 colonies are not candidates for translocation due to their small size or growth form that cannot be safely transported (i.e., encrusting). The DON would minimize loss of the remaining 6,300 corals by moving as many as possible (along with large sponges and mobile invertebrates that can be collected) to a coral pinnacle in Outer Apra Harbor called Mound 9, which is located to the southwest of Western Shoals. Due to their large size and the difficulty with moving the colonies extensive distances, select larger corals may be moved to areas adjacent to the UEMMS array area instead of to Mound 9. At the Polaris Point shore landing site, about 103 coral would be translocated to similar habitat to the east and west of the construction area. The DON would periodically remove algae competing with corals and reattach living coral.

The DON conducted multiple Habitat Equivalency Analyses (HEA) using software that calculates the amount of compensatory restoration required to provide services that are equivalent to the interim loss of natural resource services following the impacts of the project (see EA Appendix C). The HEA analysis identified approximately 35,240 sq ft of replacement habitat needed to provide equivalent ecological services lost due to the Preferred Alternative (including about 24,590 sq ft to offset the loss of coral cover and 10,650 sq ft to offset adverse temporary and permanent loss of benthic habitats contributing to Essential Fish Habitat [EFH]). The DON will offset temporary losses of biological services through habitat restoration and conservation of 35,240 sq ft at Mound 9 (see Attachment 1 for description of Mound 9 restoration and conservation actions). During the operational period,

project-related activities (e.g., maintenance and repair) would be minimal and infrequent due to the passive nature of UEMMS operations, resulting in less than significant impacts to coral.

Fish. The Proposed Action would result in less than significant, temporary construction period impacts on fish occurring in the ROI from the following environmental stressors: increased suspended sediments and elevated underwater noise levels. The following environmental stressors on fish populations in the ROI are possible but unlikely to occur: wastes and discharges and aquatic invasive species. Project BMPs would avoid or minimize adverse impacts to fish from these stressors. During the operational period, the UEMMS would be a passive system, with infrequent maintenance and repair (less than once a year); therefore, no operational period impacts to fish are expected.

Marine Vegetation and Non-Coral Benthic Habitat

Biological surveys conducted in 2020 identified and analyzed percent cover of macroalgae, cyanobacteria and non-coral invertebrate species in the direct and indirect UEMMS array areas and Polaris Point shore landing area, as summarized in the table below.

	Percent Cover			
Site	*Macroalgae*	*Cyano-bacteria*	*Sponges*	*Sessile Invertebrates*
UEMMS Array Direct Impact Area	13.2	4.9	4.1	3.0
UEMMS Array Indirect Impact Area	16.1	4.1	4.3	5.8
Shore Landing Area	12.0	6.7	2.5	1.2

Due to the length of the cable route, percent cover was not able to be generated with divers reporting general findings and observations. The benthic habitat transitioned from reef to fine sediments at about 66-ft depth, with large numbers of small polychaete worm, shrimp, and goby burrows appearing at about 72- to 80-ft depths.

The Proposed Action would require the removal of marine vegetation and non-coral benthic invertebrates through dredging and construction activities. None of the macroalgae or non-coral benthic fauna present are considered protected by federal or territorial statute. The benthic community at the shore landing site would be preserved through the temporary relocation of habitat outside of the construction area. The placement of concrete anchor discs to secure the cable bundles along the cable route and excavation of the UEMMS array site would result in the loss of approximately 9,930 sq ft of the benthic community. The DON found that it is reasonable to conclude that the benthic community and ecosystem functions and services would appear within a short time in areas providing structure after construction activities. Avoidance, minimization, and offset actions described above for coral communities are also relevant to the project's physical removal of benthic communities (i.e., marine vegetation and non-coral benthic invertebrates). This includes creation of about 10,650 sq ft of replacement habitat at Mound 9 to provide ecological services that offset the temporary and permanent loss of benthic community resulting from the Preferred Alternative.

The Proposed Action would also have the potential for adverse impacts to marine vegetation and non-coral benthic invertebrates due to project-related wastes and discharges, chemical contaminants, hypoxia, and UXO. However, with the implementation of proposed BMPs, maintenance programs, DON regulations and management plans, the short construction duration, and expected volume of excavated material, these effects are likely to be temporary, minimal, controllable, and/or of low probability or likelihood.

Therefore, the project would have less than significant impacts on marine vegetation and non-coral benthic invertebrates during the construction or operational period.

Essential Fish Habitat

The project has the potential to affect EFH through physical removal (likely), increased suspended sediments (likely), elevated underwater noise levels (unlikely), wastes and discharges (unlikely), aquatic invasive species (unlikely), chemical contaminants (unlikely), hypoxia (unlikely), and UXO (unlikely). With the implementation of avoidance and minimization measures proposed by the DON, the impacts would be temporary and indirect in all cases except the physical removal of marine invertebrate community. The DON conducted EFH consultation with NMFS and determined that the project would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for Bottomfish and Seamount Groundfish Management Unit Species and Pelagic Management Unit Species within Apra Harbor (see EA Appendix C for consultation correspondence). The indirect adverse effects to EFH from project-related degradation of water quality would be minimized through implementation of appropriate silt-containment BMPs. Unavoidable loss of ecosystem function and services that support Management Unit Species would be minimized through implementation of the proposed coral transplantation plan. Due to the containment of impacts to Apra Harbor, the quantity and quality of the EFH within the harbor, the size and scale of the impacts, implementation of temporary and permanent avoidance and minimization measures built into the project and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion of 10,650 sq ft at Mound 9), the DON determined that the anticipated impacts do not have the potential to cause substantial adverse effects to EFH.

During the operational period, the project would have less than significant impacts on EFH in Apra Harbor. Operation of the UEMMS would not involve additional structural changes to the benthic habitat, increased sediment resuspension, elevated noise levels, additional waste, discharge, or chemical contaminants, exposure to aquatic invasive species, hypoxia, or UXO.

By letter dated July 21, 2021, National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) agreed with DON's EFH determination that the Proposed Action would adversely affect EFH and result in unavoidable loss (see EA Appendix C) and agreed that DON's proposed mitigation that includes avoidance (BMPs), minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. In its July 2021 letter, NMFS also proposed conservation measures to ensure that adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated. A summary of these conservation measures and DON's corresponding response follow.

Conservation Recommendation 1: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. The DON should consider coordinating this monitoring plan with actions listed in the 2019 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) and consider including Mound 9 surveys in the next INRMP update.

Discussion: The DON will develop a two-year monitoring and maintenance plan consistent with the five-year adjacent monitoring for the Lima, Mike, and November Wharves translocation project at Mound 9. The Navy agrees that the monitoring plan for all Mound 9 projects should consider aligning with the 2019 JRM INRMP, and will consider including funding to support long-term monitoring events at Mound 9 within the next update to the JRM INRMP.

Conservation Recommendation 2: The Navy should ensure that in-water construction and mitigation activities avoid any unnecessary contact with marine organisms by divers and/or materials, and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Discussion: The DON agrees with this Conservation Recommendation and will ensure that the appropriate BMPs are implemented during coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, and cable deployment and anchoring activities to avoid unnecessary contact with marine

organisms. To the best of their ability, all divers will avoid exposing corals directly or indirectly to toxicopathological agents.

Conservation Recommendation 3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event.

Discussion: The DON agrees with this Conservation Recommendation and will ensure that subject monitoring reports will be provided to NMFS upon completion of the coral translocation and after both subsequent monitoring events (at 12 and 24 months). The DON agrees to coordinate with NMFS if the rate of survival does not meet the 70% survivorship target after the final monitoring period.

Threatened and Endangered Species

There is no designated critical habitat in Apra Harbor, including the project area. Only three ESA-listed species (green sea turtle [*Chelonia mydas*], hawksbill sea turtle [*Eretmochelys imbricata*], and scalloped hammerhead shark [*Sphyrna lewini*]) have reasonable potential to occur where most of the Proposed Action would occur. No ESA-listed coral species (e.g., *Acropora globiceps*) were observed within the project area. Based on the anticipated low occurrence of ESA-listed species within the project area, the DON determined that project has the potential to affect, but is not likely to adversely affect ESA-listed species, as such adverse effects have been determined either insignificant or discountable. By its letter dated October 6, 2021, NMFS concurred with the DON's determination that the Proposed Action is not likely to adversely affect ESA-listed species.

Critical Habitat

There is no designated critical habitat within the project area. However, there is a possibility that a vessel and/or crane barge may be brought to Guam from the Main Hawaiian Islands, which would likely transit through Main Hawaiian Islands Insular False Killer Whale Distinct Population Segment (MHI IFKW DPS) critical habitat. Underwater noise has the potential to adversely affect the critical habitat characteristic for sound. However, for the limited inter-island barge/vessel movements to transport equipment to and from Apra Harbor, the Proposed Action would result in increased underwater sound levels that would not significantly impair false killer whales' use or occupancy of the habitat. Therefore, DON determined that the Proposed Action is not likely to adversely affect any essential feature or characteristic of the MHI IFKW DPS critical habitat in any meaningful way, and the effects are discountable. By its letter dated October 6, 2021, NMFS concurred with DON's determination that the Proposed Action is not likely to adversely affect MHI IFKW.

The entire island of Guam has been designated a "coastal zone" under the Federal Coastal Zone Management Act (CZMA) of 1972. The CZMA requires that all construction and operational activities be consistent, to the maximum extent practicable, with the Guam Coastal Management Program (GCMP) policies to guide the use, protection, and development of land and ocean resources within Guam's coastal zone (Guam Bureau of Statistics and Plans [GBSP], 2011). In accordance with the CZMA, the Navy determined that the Preferred Alternative is consistent to the maximum extent practicable with the federally approved enforceable policies of the GCMP. The Navy submitted a Coastal Consistency Determination on the Proposed Action to GBSP, and GBSP issued conditional concurrence with the Navy's determination by letter December 23, 2021. After supplemental coordination with the Navy, consultation was concluded by GBSP by letter dated April 8, 2022 (see Appendix E of the EA).

Noise: The Proposed Action would result in less than significant impacts to the noise environment during the construction or operational periods. Construction of the Proposed Action would generate noise primarily associated with the use of dredging and excavation equipment, and construction vessels and vehicles. Construction would not increase aviation training or aircraft operations at NBG and no changes in existing noise contours are expected. Results of planning level assessment of ocean- and land-based construction noise impacts estimated the combined sound from the simultaneous operation of the loudest equipment (i.e., tugboat and excavator) to be about 49 decibels

(dB) at the nearest noise-sensitive locations. Applying the typical sound level reduction of 24 dB of buildings, sound levels from construction activities would be reduced to about 25 dB indoors at the noise-sensitive locations, similar to a library or bedroom at night. Operation of the UEMMS would not involve noise generation detectible at noise sensitive receptors, as it would passively acquire electromagnetic field readings below the seafloor, and transmit and analyze data in subsea HDPE conduits, via below-grade conduits, and in interiors of buildings.

Transportation: The Proposed Action would result in less than significant impacts to transportation during the construction or operational periods. During the construction period, there may be temporary, minor impacts to traffic volumes on roadways immediately surrounding the project area as well as roadways leading to and from the Polaris Point project area and between Inner Apra Harbor wharves (including the MEC/MPPEH screening areas) and the CDFs as construction vehicles, equipment, and workers access the Polaris Point project area. Operation of the UEMMS would not generate additional water-based vessel traffic or land-based vehicle traffic.

About 20 vehicles per day would be added to the existing traffic volumes to and from the project area due to construction staff. Construction vehicles and equipment would infrequently be transferred to and from the project site generally during off-peak traffic hours to minimize disruption to traffic on public roadways. The contractor will also develop, obtain approval for, and comply with a traffic control plan that mitigates project-related impacts to vehicle traffic patterns. Land transport of dewatered and MEC screened excavated material from Inner Apra Harbor wharves to the CDF sites would likely occur during non-peak hours, on an as-needed basis.

In-water construction activities would be coordinated with DON's Contracting Officer to accommodate movements of Naval vessels when necessary. Private or commercial vessels would continue to have ample area to navigate around the in-water construction area. U.S. Coast Guard-approved aids to navigation and notices to mariners would be implemented and issued, as required, which would minimize impacts to mariners in the area.

Hazardous Materials and Wastes: The Proposed Action would result in less than significant impacts involving hazardous materials and wastes. There are no known hazardous materials or waste contamination sites at the terrestrial project areas. The Proposed Action is not expected to encounter hazardous materials during installation. If material(s) that may be hazardous to human health upon disturbance are encountered during installation operations, that portion of work would immediately stop and the Contracting Officer notified. During ground disturbing activities on land or in-water, the Construction contractor would comply with the appropriate Explosive Safety Submission (ESS) requirements. During the operational period, activities related to measuring and transmitting magnetic signatures and electric fields from DON ships would generally be passive and would not disturb or create hazardous materials or waste.

Mitigation Measures: Mitigation measures are proposed for biological resources to avoid or reduce the impacts of the Proposed Action to less than significant levels. The proposed mitigation measures are included in Attachment 1.

Public Outreach: The DON released the Draft EA for a 30-day public review from October 21, 2021 to November 20, 2021 to inform the public of the Proposed Action and to allow the opportunity for public review and comment. A notice of availability of the Draft EA was published in the Guam Pacific Daily News on October 21, 24, and 25, 2021 and copies of the Draft EA were made available through a DON webpage and at the Nieves Flores Memorial Library in Hagatna, Guam. No public comments were received on the Draft EA during the 30-day public comment period.

Finding: Based on the analysis presented in the EA, which has been prepared in accordance with the requirements of NEPA and DON policies and procedures (32 CFR Part 775), DON finds that implementation of the proposed action as set out in Alternative 1 (Preferred Alternative) will not significantly impact the quality of the human environment. This analysis fulfills the requirement of NEPA and CEQ regulations; therefore an EIS will not be prepared.

Electronic copies of this EA and Finding of No Significant Impact may be obtained by written request to: Attention: Code EV21, Naval Facilities Engineering Systems Command Pacific, 258 Makalapa Drive, Suite 100, JBPHH, HI 96860

09 JUNE 2022
Date

Benjamin Nicholson
Rear Admiral, U.S. Navy
Commander, Joint Region Marianas

ATTACHMENT 1

The following is a summary of proposed mitigation measures for biological resources impacts. The proposed mitigation measures for biological resources are those included in the Endangered Species and Essential Fish Habitat Assessment found in Appendix C of the EA that would offset the unavoidable temporary losses of EFH (including coral cover and benthic habitats) resulting from the Preferred Alternative.

The Navy will perform the following offset mitigation at Mound 9 (note that measurements and quantities are approximate due to irregularities of surfaces and variability in natural systems):

- Remove anthropogenic debris scattered within the restoration area prior to stabilization.
- Stabilize 1,235.89 m2 (13,303.01 ft2) of the substrate to:
    - reduce the rubble mobility on top of the mound
    - create a consistent, stable surface to which marine fauna may attach and thrive.
- Increase rugosity and habitat complexity by placing 615 locally-sourced, limestone boulders on the newly-stabilized area on top of Mound 9.
    - If feasible, the use of boulders with an "elongated cube shape" with an average exposed surface area (does not include bottom surface) of 3.32 m2 would be used. Therefore, 615 boulders will add approximately 2,041.8 m2 (21,977.75 ft2) of hard surface area to the top of Mound 9. The actual number of boulders utilized will be dependent upon final boulder sizes and will vary due to limits and imprecision in quarrying techniques.
    - The Navy will optimize boulder placement and stability by working with coastal engineers to determine best methods to withstand current and wave stresses.
- Based on their attachment and growth morphologies, attach transplanted corals to boulders as well as the stabilized substrate.
- Design the boulder layout and stabilized areas to create sections or regions that will facilitate DON or other parties in future monitoring of transplanted corals and cordoning of potential adverse health vectors. One region of the restored area will be allowed to develop without transplants or maintenance to allow DON to observe and determine the natural progression of recovery at Mound 9.
- Establish a reference baseline site and conduct subsequent monitoring surveys of existing coral community adjacent to the restoration site at Mound 9.
- Monitor (i.e., quantify and assess the resource conditions) fish and benthic community at the Mound 9 restoration site at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).
- Monitor (i.e., quantify and assess the resource conditions) transplanted coral at Mound 9, Grid 20 and/or 27 and Polaris Point at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).
- After each monitoring event, provide a status report to NMFS on the condition of coral, algae, and fish at the Mound 9 restoration site and conditions of translocated corals at Grid 20 and/or 27 and Polaris Point.
- Manage macroalgae and competing invertebrate populations that threaten to overgrow transplanted corals at Mound 9, Grid 20 and/or 27 and Polaris Point (including "weeding" and removing algae, sponges, competing invertebrates, etc. at 3-6 month intervals up to two years after translocation).
- Manage corallivore species populations (e.g., crown-of-thorns starfish, *Drupella* sp. snails, etc.) at the Mound 9 restoration site.
- Design restoration and translocation plans at Mound 9 to ensure optimal and available habitat to receive future coral transplants from other DON projects that seek to avoid and minimize adverse effects to corals and EFH.
- Avoid coral translocation during coral spawning seasons.

Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Underwater Electromagnetic Measurement System
Project Location:	Naval Base Guam
Lead Agency for the EA:	Department of the Navy
Affected Region:	Apra Harbor, Guam
Action Proponent:	Naval Base Guam
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Date:	May 2022

U. S. Naval Base Guam, a Command of the U.S. Navy (hereinafter, jointly referred to as the Navy) has prepared this Environmental Assessment in accordance with the National Environmental Policy Act, as implemented by the Council on Environmental Quality Regulations and Navy regulations for implementing National Environmental Policy Act. The Proposed Action would install an underwater electromagnetic measurement system (UEMMS), which would support compliance of U.S. Navy submarines and surface ships homeported or forward deployed at Naval Base Guam with the electromagnetic signature limits specified in Office of the Chief of Naval Operations Instruction 8950.2 series. The UEMMS would consist of a subsea sensor array, subsea and terrestrial data transmission cables, and shoreside data acquisition equipment. Project installation would begin in 2022 and would be operational in 2024. This Environmental Assessment evaluates the potential environmental impacts associated with the two action alternatives (Concrete Anchor Disc Alternative [Preferred Alternative] and Concrete Block Mat Alternative) and the No Action Alternative to the following resource areas: air quality, water resources, cultural resources, biological resources, noise, transportation, and hazardous materials and waste.

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EXECUTIVE SUMMARY

ES.1 Proposed Action

The United States (U.S.) Navy proposes to install and operate an underwater electromagnetic measurement system (UEMMS) to service Navy surface ships and submarines homeported, forward deployed, or visiting Naval Base Guam (NBG), Apra Harbor, Guam. The Proposed Action would include both in-water and shoreside infrastructure to measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a steel-hulled vessel's susceptibility to certain seaborne influenced mines as well as magnetic anomaly detection threat systems. Project installation would start in 2022 and would be operational in 2024.

ES.2 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to provide the capability at NBG to measure the electromagnetic signatures of Navy homeported, forward-deployed, or transient ships and submarines to meet the magnetic silencing limits specified in Office of the Chief of Naval Operations Instruction 8950.2 series.

The Proposed Action is needed to minimize the electromagnetic signature, i.e., on-board system calibrations, which ensures that ships and submarines comply with electromagnetic signature limits. Naval Base Guam is a vital forward operational and logistic support hub for U.S. 7th Fleet forward-deployed and transient ships and submarines. Although NBG provides a wide variety of services in support of Fleet readiness for visiting and homeported U.S. Navy ships and submarines, it is not currently able to measure their electromagnetic field signatures—a capability that would improve the protection of these vessels from detection and threats by hostile forces. If the Proposed Action is not implemented, Navy ships operating from or in waters near Guam will continue to steam over 1,500 miles north to Yokosuka Naval Complex in Japan or 3,500 miles east to Joint Base Pearl Harbor-Hickam in Hawaii for electromagnetic field signature measurements. This practice results in unacceptable operational inefficiencies and could adversely affect the Fleet's responsiveness to emergent situations in the Western Pacific, Philippine Sea, and points west. The lack of UEMMS infrastructure at NBG has the potential to contribute to vessels' susceptibility to mines and detection, puts the operational mission and the lives of sailors at increased risk, limits the capability of executing a tasked mission due to the unknown state of the electromagnetic signature of the vessels, and increases the risk of physical harm to U.S. Navy personnel and damage to Navy vessels as they traverse the operational area.

ES.3 Alternatives Considered

Alternatives were developed for analysis based upon the following reasonable alternative screening factors: Proximity to ships and submarines homeported or forward deployed to NBG; meets technical parameters for accurately measuring electromagnetic signatures of ships and submarines; complies with NBG Port Operations navigation safety requirements; use of existing U.S. Department of Defense (DoD)-controlled land for shore infrastructure; avoids shipping routes, strong tidal currents, and valuable coral reef habitats; minimizes potential adverse effects on protected marine biological species and habitats; meets budget limits for acquisition of this type of technology; consistent with NBG infrastructure planning; ease and efficiency of construction; low construction risk; local availability of construction assets; and ease of maintenance and repair.

The Navy is considering two action alternatives that meet the purpose of and need for the Proposed Action and a No Action Alternative. In Alternative 1 (Preferred Alternative), electromagnetic triaxial sensors, magnetometer triaxial sensors, and a conductivity, depth and temperature sensor would be installed in an array on the seafloor of Outer Apra Harbor northwest of Polaris Point. Subsea data transmission cables would be routed from the array to a new below-grade transition vault located onshore at Polaris Point. The subsea cables would be secured to the seafloor with concrete anchor discs placed on the substrate. Once on shore, the cables would connect to data acquisition equipment located in an existing building and the data transferred to a fiber optic cable. The fiber optic cable would follow a terrestrial route entirely in existing below grade conduits to existing facilities at Polaris Point, where the data from the sensor array would be collected, processed, and archived. A two-inch diameter, approximately eight-foot-long duct would be installed approximately two feet below grade between the cable transition point building and an adjacent building to supply power to the UEMMS equipment in the cable transition point building.

Alternative 2 is the same as Alternative 1 except the subsea cables would be secured to the seafloor using concrete block mats. All other components would be the same as in Alternative 1. Under the No Action Alternative, the UEMMS would not be installed and NBG will not be able to provide a service essential for homeported and forward-deployed Navy vessels to meet Navy magnetic silencing requirements specified in Office of the Chief of Naval Operations Instruction 8950.2 series.

ES.4 Summary of Environmental Resources Evaluated in the EA

Council on Environmental Quality regulations, National Environmental Policy Act, and Navy instructions for implementing the National Environmental Policy Act, specify that an Environmental Assessment (EA) should address those resource areas potentially subject to impacts. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact.

The following regulated and non regulated resources (e.g., that require mitigation measures, consultations, and concurrence) were analyzed in this EA: threatened and endangered species, coral, Essential Fish Habitat, protected migratory birds, historic properties eligible for listing on the National Register of Historic Places, coastal zone, and air quality nonattainment status.

The following resource areas have been addressed in detail in this EA: air quality, water resources, cultural resources, biological resources, noise, transportation, and hazardous materials and wastes. Because potential impacts were considered negligible or nonexistent, the following resources were not evaluated in detail in this EA: geological resources, land use, visual resources, airspace, infrastructure, public health and safety, socioeconomics, and environmental justice.

ES.5 Summary of Potential Environmental Consequences of the Action Alternatives and Major Mitigating Actions

Table ES-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

ES.6 Public Involvement

The Navy has coordinated with the National Oceanic and Atmospheric Administration , U.S. Army Corps of Engineers, Government of Guam Bureau of Statistics and Plans, and Guam Environmental Protection Agency in the preparation of this EA. In addition, a notice of availability of the Draft EA was published in

the local news media on October 21, 24, and 25, 2021 and copies of the Draft EA were made available through a Navy webpage and at the Nieves Flores Memorial Library in Hagatna, Guam. No public comments were received on the Draft EA during the 30-day public comment period that ended on November 20, 2021 (Chamorro Standard Time).

Table ES-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Concrete Anchor Disc Alternative (Preferred Alternative*	*Concrete Block Mat Alternative*
Air Quality	No impact	Less than significant temporary construction period impacts due to equipment, vessel, and vehicle exhaust and minor ground disturbance. Less than significant operational period impacts as UEMMS operations are passive and are not expected to induce additional vehicle trips to and from the project area.	Less than significant temporary construction period impacts similar to the Preferred Alternative due to equipment, vessel, and vehicle exhaust and minor ground disturbance. Slightly higher construction period pollutant emissions due to a longer construction duration. Same insignificant operational period impacts as the Preferred Alternative.
Water Resources	No impact	Less than significant temporary construction period impacts on marine waters due to in-water work (e.g., excavation and backfilling of the seafloor to install UEMMS equipment) and shoreside ground disturbance (i.e., to install the terrestrial transmission cable in a below-grade transition vault). Construction period BMPs would avoid or minimize water quality impacts from both the in-water and shoreside construction activities. No operational period water quality impacts are expected because of the passive nature of the UEMMS operation.	Less than significant temporary construction period impacts, similar to the Preferred Alternative. This alternative would result in more resuspended sediments during construction along the cable bundle route as the concrete block mats are placed on the seafloor. Same operational period impacts as the Preferred Alternative.
Cultural Resources	No impact	Less than significant construction and operational period impacts. No historic properties affected.	Same insignificant impacts as the Preferred Alternative.
Biological Resources	No impact	Less than significant construction and operational period impacts with implementation of BMPs and mitigation measures, including avoidance, minimization, and offset measures.	Greater, but insignificant, construction and operational period impacts than the Preferred Alternative due to greater loss of benthic habitat along the subsea cable bundle route from the concrete block mats.

Resource Area	*No Action Alternative*	*Concrete Anchor Disc Alternative (Preferred Alternative*	*Concrete Block Mat Alternative*
Noise	No impact	Less than significant construction period impacts from tugboats and subsea and terrestrial excavating equipment. Less than significant operational period impacts.	Similar insignificant construction period impacts as the Preferred Alternative; construction equipment and vessels would be operated for a longer duration than in the Preferred Alternative, resulting in a longer duration of increased noise levels. Same insignificant operational period impacts as the Preferred Alternative.
Transportation	No impact	Less than significant temporary construction period impacts on roadways immediately surrounding the shoreside project area and on roadways leading to and from Polaris Point and between Inner Apra Harbor wharves and the CDFs. Less than significant marine transportation impacts. Less than significant operational period impacts.	Similar insignificant construction period impacts as the Preferred Alternative; however, this alternative would require several more personnel and a longer construction duration, which would increase traffic on affected roadways from additional personal vehicles commuting to the work site. Same less than significant operational period impacts as in the Preferred Alternative.
Hazardous Materials and Wastes	No impact	Less than significant construction and operational period impacts. BMPs would be employed in the event MEC is encountered during construction.	Same insignificant construction and operational period impacts as the Preferred Alternative.

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Environmental Assessment

Underwater Electromagnetic Measurement System

Naval Base Guam, Apra Harbor, Guam

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Abbreviations and Acronyms

Acronym	Definition	Acronym	Definition
AAQS	ambient air quality standards	CTD	conductivity, temperature, and depth
AFB	Air Force Base	CWA	Clean Water Act
AICUZ	Air Installation Compatible Use Zone	CY	cubic yard(s)
AIS	aquatic invasive species	CZMA	Coastal Zone Management Act
APE	Area of Potential Effect	dB	decibel
APZ	Accident Potential Zone	dBA	A-weighted sound level
ATFP	Antiterrorism Force Protection	DDT	Dichlorodiphenyltrichloro-ethane
BMP	best management practice	DERP	Defense Environmental Restoration Program
BMUS	Bottomfish and Seamount Groundfish Management Unit Species	DEV	Developed vegetation category
BSP	Bureau of Statistics and Plans	DNL	day-night average sound level
BTS	brown tree snake	DO	dissolved oxygen
CAA	Clean Air Act	DoD	United States Department of Defense
CAF	*Causarina* Forest	DON	United States Department of the Navy
CATEX	Record of Categorical Exclusion	DPS	Distinct Population Segment
CCA	crustose coralline algae	EA	Environmental Assessment
CCTV	closed-circuit television	EEZ	Exclusive Economic Zone
CDF	confined disposal facility	EFH	Essential Fish Habitat
CEQ	Council on Environmental Quality	EIS	Environmental Impact Statement
CFR	Code of Federal Regulations	EMT	electromagnetic triaxial
cm/yr	centimeters per year	EO	Executive Order
CMUS	Crustaceans Management Unit Species	ER-L	effects range low
CNEL	Community Noise Equivalent Level	ER-M	effects range medium
CNMI	Commonwealth of the Northern Mariana Islands	ESA	Endangered Species Act
CO	carbon monoxide	ESS	Explosive Safety Submission
CO_2	carbon dioxide	FEIS	Final Environmental Impact Statement
COPC	chemicals of potential concern	FEP	Fishery Ecosystem Plan
CREMUS	Coral Reef Ecosystems Management Unit Species	FHWA	Federal Highways Administration
		FMP	fishery management plan

Acronym	Definition
FONSI	Finding of No Significant Impact
FRP	fiberglass reinforced plastic
GAPCSR	Guam Air Pollution Control Standards and Regulations
GCMP	Guam Coastal Management Program
G-DODS	Guam Deep Ocean Disposal Site
GEPA	Guam Environmental Protection Agency
GHG	greenhouse gas
GovGuam	Government of Guam
GPA	Guam Power Authority
GRHP	Guam Register of Historic Places
GWQS	Guam Water Quality Standards
HAP	hazardous air pollutant
HAPC	habitat areas of particular concern
HDPE	high density polyethylene
HEA	Habitat Equivalency Analysis
Hz	Hertz
ICRMP	Integrated Cultural Resources Management Plan
IFKW	Insular False Killer Whale
INRMP	Integrated Natural Resources Management Plan
JRM	Joint Region Marianas
kW	kilowatt
LEF	*Leucaena* Forest
Leq	equivalent sound level
Leq(9hr)	9 hour equivalent sound level
Leq(24)	24 hour equivalent sound level
Lmax	maximum A-weighted sound level
LOS	level of service
LPI	Line Point-Intercept
MARAMP	Mariana Archipelago Reef Assessment and Monitoring Program
MBTA	Migratory Bird Treaty Act
MEC	munitions and explosives of concern
mg/l	milligram per liter
mgd	million gallons per day
MHI	Main Hawaiian Islands
MILCON	Military Construction Project
MLLW	Mean Lower Low Water
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
µPa	micropascal
MPPEH	material potentially presenting an explosive hazard
MSAT	Mobile Source Air Toxics
MT	magnetometer triaxial
MUS	Management Unit Species
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NAVFAC Pacific	Naval Facilities Engineering Systems Command, Pacific
NBG	U.S. Naval Base Guam
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NIPTS	Noise Induced Permanent Threshold Shift
NMFS	National Marine Fisheries Service
NNE	non-nesting emergence
NO_2	nitrogen dioxide

Acronym	Definition
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OPNAV	Office of the Chief of Naval Operations
OPNAVINST	Office of the Chief of Naval Operations Instruction
OSG	Other Shrub/Grassland
PAG	Port Authority of Guam
PAH	polynuclear aromatic hydrocarbons
Pb	lead
PCB	polychlorinated biphenyl
PIRO	Pacific Islands Regional Office
PM_{10}	particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
PMUS	Pelagic Management Unit Species
POV	privately owned vehicle
PTS	permanent threshold shifts
ROD	Record of Decision
ROI	region of influence
SEARCH	Southeastern Archaeological Research, Inc.
SEL	sound exposure level
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	sulfur dioxide
SOGCN	species of greatest conservation need
SOP	standard operating procedure
SPL_{RMS}	root-mean-square
sq ft	square foot (feet)
SRF	Ship Repair Facility
TBD	to be determined
TCP	Traditional Cultural Property
TMDL	Total Maximum Daily Load
tpy	tons per year
TSS	Total suspended solids
TTS	temporary threshold shifts
UEMMS	underwater electromagnetic measurement system
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USINDOPACOM	U.S. Indo-Pacific Command
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USMC	U.S. Marine Corps
USSA	Upland Staging and Screening Area
UXO	unexploded ordnance
VOC	volatile organic compound
WPRFMC	Western Pacific Regional Fishery Management Council

1 Purpose of and Need for the Proposed Action

1.1 Introduction

United States Naval Base Guam (NBG), a Command of the United States (U.S.) Navy (hereinafter, jointly referred to as the Navy) proposes to install and operate an underwater electromagnetic measurement system (UEMMS) at Outer Apra Harbor, Naval Base Guam. Project installation is anticipated to begin in 2022 and would be operational in 2024.

The UEMMS would support the requirements of Commander, Submarine Force, U.S. Pacific Fleet and Commander, Naval Surface Force, U.S. Pacific Fleet by measuring the electromagnetic field signatures of homeported and forward deployed surface ships and submarines as they enter and exit NBG to ensure they meet the magnetic signature limits specified in Office of the Chief of Naval Operations Instruction (OPNAVINST) 8950.2 series.

The Navy has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations and Navy regulations for implementing NEPA.

1.2 Background

All vessels emit electromagnetic fields, which are propagated through water. Magnetic fields are inherent in the ferrous metals of vessel hulls and additional magnetic fields are induced by internal stresses and movement of normal daily operation and movement through the earth's magnetic field. Electromagnetic fields associated with Navy ships and submarines may be detected by enemy sensor systems and magnetically influenced bottom and moored sea mines if their magnetic signatures are not controlled and managed within the limits specified in OPNAVINST 8950.2 series.

The magnetic signature of a submarine or surface ship is measured on a sensor range, and if the signature is out-of-specification, it must be treated to neutralize or remove the excess magnetism. As a result of resurgence of threats in the Asia-Pacific region, the Department of the Navy (DON) increased its presence in the area, including ships and submarines forward deployed to and transiting through Guam. Naval Base Guam is homeport to numerous Navy commands supporting the U.S. Pacific Fleet in the 7th Fleet's area of responsibility, including Los Angeles-class attack submarines under the command of Commander, Submarine Squadron Fifteen. Due to the lack of a UEMMS at their homeport, these vessels—along with other forward-deployed or transient U.S. Pacific Fleet vessels at NBG—must transit to U.S. naval installations in Japan or more distant locations to have their electromagnetic field signatures measured.

1.3 Location

The Navy on Guam supports naval activities to maintain operational readiness—maintaining the ability of units to respond to regional threats and to protect interests of the U.S. and its allies. Naval Base Guam is located on the southwest coast of Guam around Apra Harbor, and includes Orote Peninsula, Polaris Point, fueling piers and facilities at the western end of Dry Dock Island, and a low, largely marshy area along the east side of the harbor. Naval Base Guam encompasses 4,500 acres and serves as the forward deployment base and logistics hub to include the main munitions storage and distribution center for sea, land, and air forces operating in Asia and the Western Pacific (see Figure 1-1 for location).

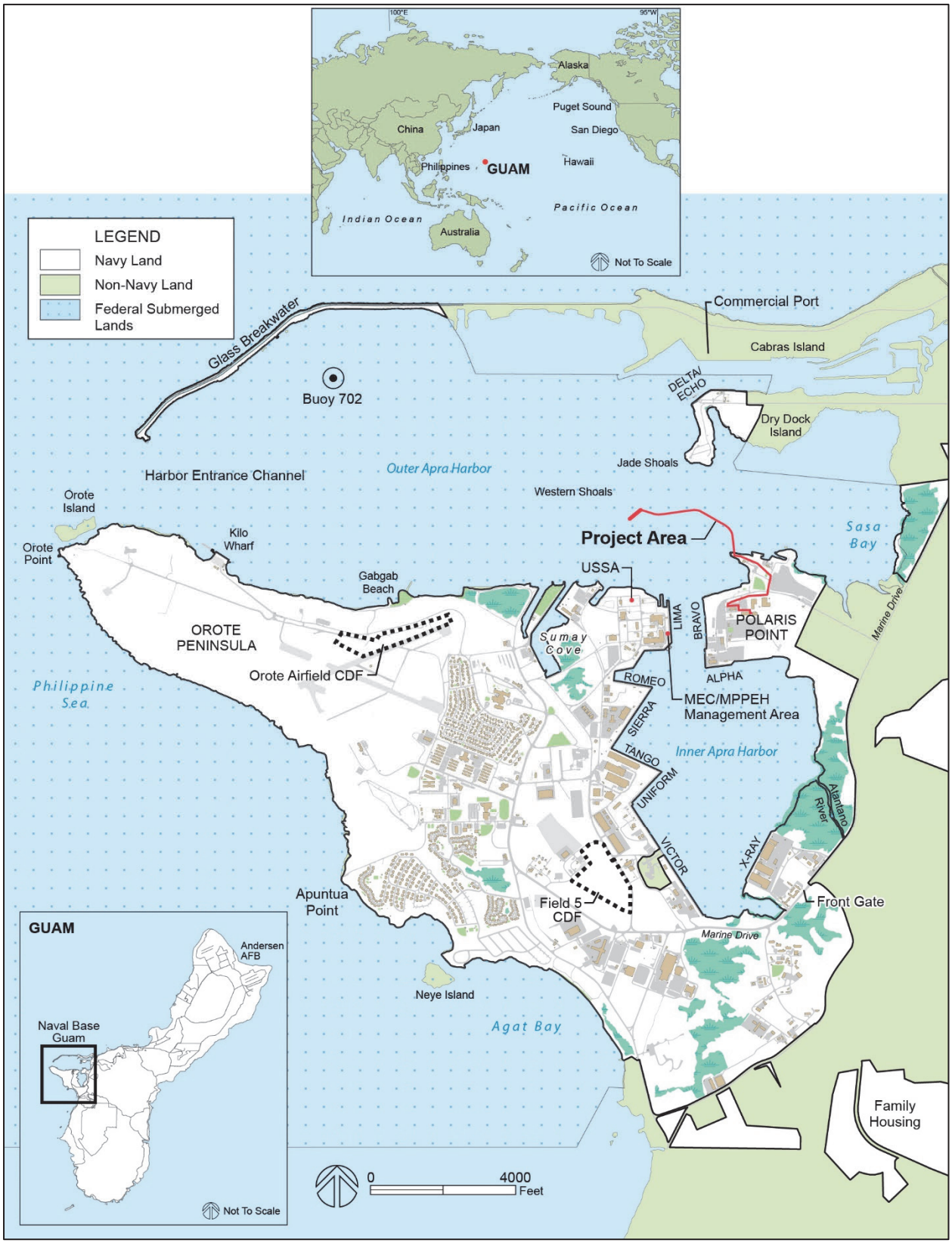

Figure 1-1 Location Map

Navy-controlled lands at Apra Harbor have land uses ranging from industrial to recreational.

1.4 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to provide the capability at NBG to measure the electromagnetic signatures of Navy homeported, forward-deployed, or transient ships and submarines to meet the magnetic silencing limits specified in OPNAVINST 8950.2 series.

The Proposed Action is needed to minimize the electromagnetic signature, i.e., on-board system calibrations, which ensures that ships and submarines comply with electromagnetic signature limits. Naval Base Guam is a vital forward operational and logistic support hub for U.S. 7th Fleet forward-deployed and transient ships and submarines. Although NBG provides a wide variety of services in support of Fleet readiness for visiting and homeported U.S. Navy ships and submarines, it is not currently able to measure their electromagnetic field signatures—a capability that would improve the protection of these vessels from detection and threats by hostile forces. If the Proposed Action is not implemented, Navy ships operating from or in waters near Guam will continue to steam over 1,500 miles north to Yokosuka Naval Complex in Japan or 3,500 miles east to Joint Base Pearl Harbor-Hickam in Hawaii for electromagnetic field signature measurements. This practice results in unacceptable operational inefficiencies and could adversely affect the Fleet's responsiveness to emergent situations in the Western Pacific, Philippine Sea, and points west. The lack of UEMMS infrastructure at NBG has the potential to contribute to vessels' susceptibility to mines and detection, puts the operational mission and the lives of sailors at increased risk, limits the capability of executing a tasked mission due to the unknown state of the electromagnetic signature of the vessels, and increases the risk of physical harm to U.S. Navy personnel and damage to Navy vessels as they traverse the operational area.

1.5 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternatives and the No Action Alternative. The environmental resource areas analyzed in this EA include air quality, water resources, cultural resources, biological resources, noise, transportation, and hazardous materials and waste. The study area for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance, the study area for geological resources may only include the construction footprint of a building whereas the noise study area may expand out to include areas that may be impacted by airborne, range, or construction noise.

1.6 Key Documents

Key documents are sources of information incorporated into this EA. Documents are considered to be key because of similar actions, analyses, or impacts that may apply to this Proposed Action. Council on Environmental Quality guidance encourages incorporating documents by reference. Documents incorporated by reference in part or in whole include:

- Final Environmental Impact Statement for Designation of an Ocean Dredged Material Disposal Site Offshore of Guam, March 2010 (USEPA, 2010). The U.S. Environmental Protection Agency (USEPA) prepared this Environmental Impact Statement (EIS) to evaluate the environmental impacts of designating a new ocean dredged material disposal site (the Guam Deep Ocean Disposal Site, or "G-DODS"). The site selected is located approximately 11 nautical miles northwest of Apra Harbor and was chosen as the location that best avoids environmental impacts while still being close enough to

Guam to be affordable to use (USEPA 2011 in NBG, 2014). Only projects having non-toxic dredged material may be permitted to use G-DODS, and only when project-specific alternatives (including beneficial reuse) are not practicable.

- Final EA for X-Ray Wharf Improvements MILCON P-518 and P-519, April 2014 (NBG, 2014). Improvements to X-Ray Wharf at NBG were needed to accommodate the T-AKE class of multi-purpose auxiliary support ships. The Proposed Action included use of dredged material confined disposal facilities (CDF) at NBG to manage dredged material resulting from the improvements project. Two of the same CDFs evaluated in the X-Ray Wharf Improvements EA are being considered for the UEMMS Proposed Action (i.e., Orote Airfield and Field 5 CDFs).
- Final EA for Alpha and Bravo Wharves' Improvements (MILCON P-431), February 2006 (COMNAV Marianas, 2006). Upgrades and extension of berthing facilities at Alpha and Bravo Wharves at Polaris Point to meet depth requirement of new submarines. The Proposed Action included construction dredging of the Apra Harbor entrance channel and along the wharf faces, and disposal of dredged material in CDFs. One of the CDFs (Field 5) evaluated in the EA is being considered for use in the UEMMS Proposed Action.

1.7 Relevant Laws and Regulations

The Navy has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, including the following:

- National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] sections 4321–4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations parts 1500–1508) (1978, as amended in 1986 and 2005)
- Navy regulations for implementing NEPA (32 Code of Federal Regulations part 775), which provides Navy policy for implementing Council on Environmental Quality regulations and NEPA
- Clean Air Act (42 U.S.C. section 7401 et seq.)
- Clean Water Act (33 U.S.C. section 1251 et seq.)
- Rivers and Harbors Act (33 U.S.C. section 407)
- Coastal Zone Management Act (16 U.S.C. section 1451 et seq.)
- National Historic Preservation Act (54 U.S.C. section 306108 et seq.)
- Abandoned Shipwrecks Act (43 U.S.C. § 2105)
- Endangered Species Act (16 U.S.C. section 1531 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (16 U.S.C. section 1801 et seq.)
- Marine Mammal Protection Act (16 U.S.C. section 1361 et seq.)
- Migratory Bird Treaty Act (16 U.S.C. section 703–712)
- Comprehensive Environmental Response and Liability Act (42 U.S.C. section 9601 et seq.)
- Emergency Planning and Community Right-to-Know Act (42 U.S.C. sections 11001–11050)
- Resource Conservation and Recovery Act (42 U.S.C. section 6901 et seq.)

- Toxic Substances Control Act (15 U.S.C. sections 2601–2629)
- Guam Air Pollution Control Standards and Regulations (GAPCSR) (Guam Administrative Rules, Title 22-1)
- Executive Order (EO) 11988, Floodplain Management
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13089, Coral Reef Protection
- EO 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis
- EO 14008, Tackling Climate Crisis at Home and Abroad

A description of the Proposed Action's consistency with these laws, policies, and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Chapter 5 (Table 5-1).

1.8 Public and Agency Participation and Intergovernmental Coordination

Regulations from the CEQ direct agencies to involve the public in preparing and implementing their NEPA procedures. The Navy prepared a Draft EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. The 30-day Draft EA review period began on October 21, 2021 with a public notice published in the local news media indicating the availability of the Draft EA and the locations where public review copies were available. The Draft EA was also available on the following website: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information.html. No comments on the Draft EA were received during the public comment period that ended on November 20, 2021 (Chamorro Standard Time).

The Navy consulted with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and Guam Historic Preservation Officer regarding the Preferred Alternative. A Coastal Consistency Determination was submitted to Guam Bureau of Statistics and Plans (BSP) and BSP issued conditional concurrence with the Navy's determination by letter December 23, 2021. After supplemental coordination with the Navy, consultation was concluded by Guam BSP by letter dated April 8, 2022.

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2 Proposed Action and Alternatives

2.1 Proposed Action

The Navy proposes to install and operate an underwater electromagnetic measurement system (UEMMS) to service Navy surface ships and submarines homeported, forward deployed, or visiting NBG, Apra Harbor, Guam. The Proposed Action would include both in-water and shoreside infrastructure to measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a steel-hulled vessel's susceptibility to certain seaborne influenced mines as well as magnetic anomaly detection threat systems. Project installation would begin in 2022 and would be operational in 2024.

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally proposed action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis.

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

A. Proximity to ships and submarines homeported or forward deployed to Naval Base Guam
B. Meets technical parameters for accurately measuring electro-magnetic signatures of ships and submarines
    1. Free of magnetic sources surrounding sensor array (i.e., a "clean" electromagnetic background) during the time a vessel being measured is transiting over the array
        a. Due to their significant underwater electromagnetic fields that could contaminate the electromagnetic measurements and invalidate the data analysis, support tugboats must be able to standoff outside an exclusion zone of at least three vessel lengths from the ship while it is transiting the array
        b. The three-vessel length standoff zone from the sensor array protects the integrity of the target vessels' measurements from extraneous electromagnetic fields associated with the tugboats
    2. Meets water depth requirements with consistent depth along length of array (i.e., plateau)
    3. Straight line ship traverse route
    4. Perpendicular to navigation channel
    5. Sufficient navigable water on each side of array line to allow the vessel being measured to maintain a constant shaft revolutions per minute and heading for a distance equal to two times (for submarines) or three times (for surface ships) the vessel's overall length
    6. Sufficient navigable water on each side of array line to allow ships being measured to safely change its heading (with tugboat assistance) to enter Inner Apra Harbor.
    7. Adequate navigational freedom for the measured vessel to come up to speed and course to effectively navigate over the array
C. Complies with NBG Port Operations navigation safety requirements

1. Sufficient distance between the array and Inner Apra Harbor channel entrance to allow safe change of heading of arriving vessels and re-engagement by supporting tugboats—identified by NBG Port Operations as a minimum of three vessels lengths from south end of the array

D. Use of existing U.S. Department of Defense (DoD)-controlled land for shore infrastructure

E. Avoids shipping routes, strong tidal currents, and valuable coral reef habitats

F. Minimizes potential adverse effects on protected marine biological species and habitats, including coral

G. Meets budget limits for acquisition of this type of technology

H. Consistent with NBG infrastructure planning

I. Constructability (i.e., ease, efficiency, and feasibility of construction)

J. Low construction risk (i.e., planned construction means and methods are likely to result in successful implementation)

K. Local availability of construction assets

L. Ease of maintenance and repair

Various alternatives were evaluated against the screening factors. The general categories of alternatives considered include:

- No Action
- Installation at alternate sites
- Alternate installation methodologies

Section 2.3 describes alternatives carried forward for analysis in this EA and Section 2.4 discusses alternatives considered but not analyzed in this EA and the reasons for their dismissal.

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, two action alternatives were identified and are analyzed in this EA.

2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and NBG will continue to be out of compliance with OPNAVINST 8950.2 series. NBG would not be able to provide a service essential for homeported and forward-deployed Navy vessels to meet OPNAVINST magnetic silencing limits. This would prolong a situation that detracts from Fleet readiness and mission effectiveness by requiring additional days of transit time to installations that have underwater electromagnetic measurement capability (e.g., Japan and Hawaii). The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA. The No Action Alternative is used to analyze the consequences of not undertaking the Proposed Action, not simply conclude no impact, and serves to establish a comparative baseline for analysis.

2.3.2 Concrete Anchor Disc Alternative (Preferred Alternative)

This alternative consists of three general components: (1) subsea sensor array, (2) subsea transmission cables, and (3) terrestrial data acquisition equipment. In this alternative, electromagnetic triaxial (EMT) sensors, magnetometer triaxial (MT) sensors, and a conductivity, temperature, depth (CTD) sensor

would be installed in an array on the seafloor of Outer Apra Harbor northwest of Polaris Point (see Figure 2-1 for Vicinity Map). To transfer data collected by the sensor array, subsea transmission cables would be routed from the array to a new below-grade transition vault located onshore at Polaris Point. (Note: "Concrete Anchor Disc" refers to the method of securing the subsea cable bundle to the seafloor using reinforced concrete anchor discs. See Section 2.3.2.1 below for details of the subsea cable installation methodology.) Once on shore, the cables would connect to data acquisition equipment located in an existing Polaris Point facility and the data transferred to a single fiber optic cable. The fiber optic cable would follow a terrestrial route entirely in existing below grade conduits from the cable transition point to another existing building further inland on Polaris Point, where the system would terminate and the data from the sensor array would be collected, processed, and archived. An approximately one-acre area around the cable transition point building would be made available as a staging area for the installation of the cables (see Figure 2-1 for location).

As used in this EA, the term "project area" is defined as the sensor array footprint, subsea cable route, shore cable landing at Polaris Point, footprint of the terrestrial below grade cable infrastructure (vault, conduit), dredged material temporary offloading and screening areas, CDFs, and Polaris Point staging area, cable transition point building and cable termination point building.

After the installation, the system would require minimal maintenance. The sensor array is designed to passively acquire data and would not emit electromagnetic radiation during its operation. Because the UEMMS would be a passive system with no mechanical parts, repairs are anticipated to be minimal and would be conducted on an as-needed basis. The extent and timing of any future upgrades cannot be anticipated at this time and are not addressed in this NEPA document.

During the operational period, use of the sensor array would not increase ship traffic from either homeported or transient vessels at NBG. The sensor array would have no effect on the frequency of ship traffic at NBG. The specifications of the UEMMS at NBG would be customizable and operations of the array is not expected to effect on-base or on-island staffing levels because current NBG staff would assume the role of collecting its data. Data acquisition would take place in a dedicated room in an existing building on Polaris Point. If it becomes necessary to hire new staff, about two additional personnel would be required, who would likely currently reside in Guam.

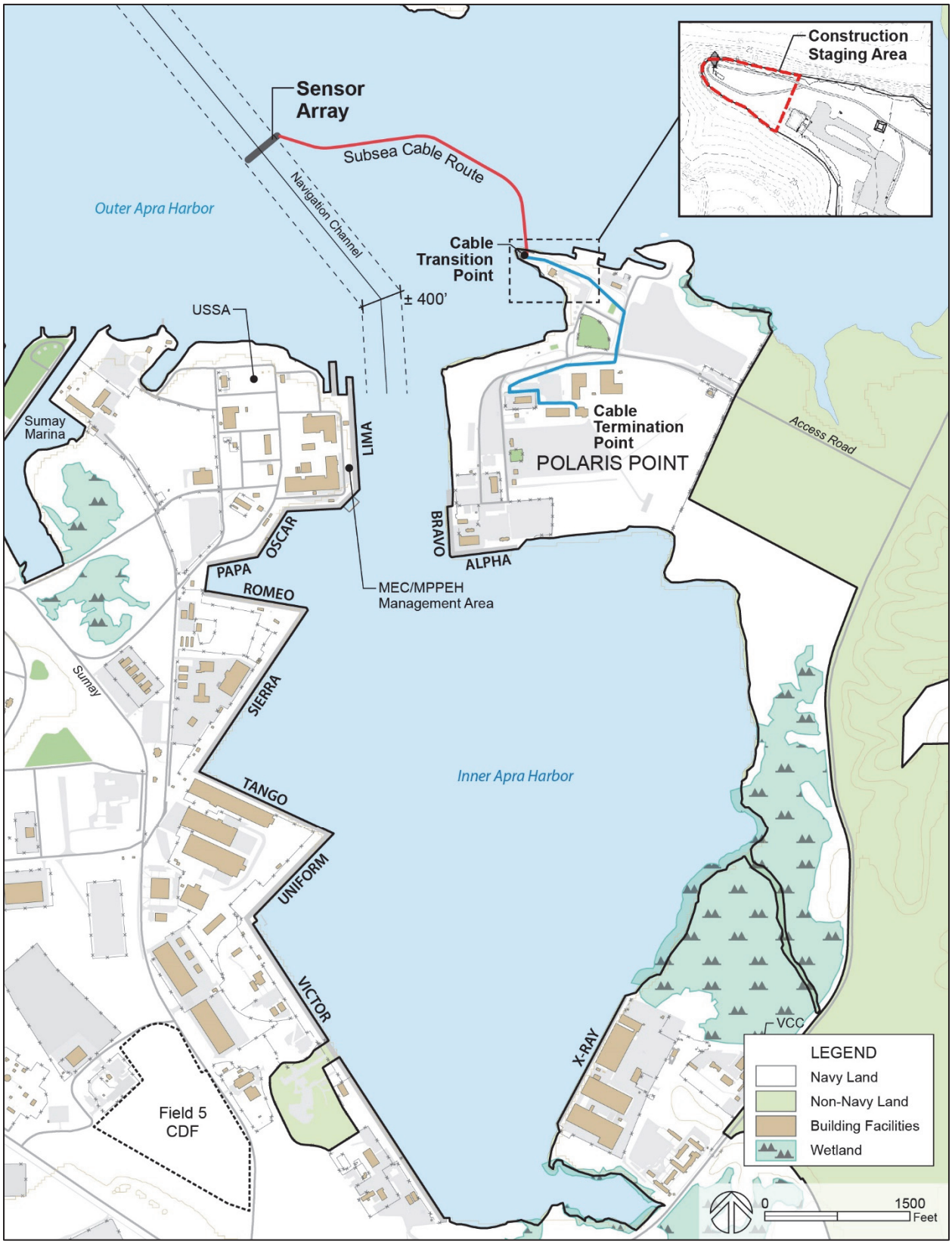

Figure 2-1 Vicinity Map: Naval Base Guam and Inner Apra Harbor Entrance Channel

2.3.2.1 Components and Installation Methodology

Table 2-1 summarizes the measurements of the major Concrete Anchor Disc Alternative components.

Table 2-1 Concrete Anchor Disc Alternative Components

Component	*No. or Size*	*Unit*	*Notes*
Sensor Array			
EMT sensors	13	ea	
MT sensors	8	ea	
CTD sensor	1	ea	
Excavation volume (approx.)	1,200	cubic yards	
Excavation footprint (approx.)	0.18	acres	7,900 sq ft
Total Sensor Array Footprint (approx.)	0.34	acres	approx. 420 feet x 35 feet, including excavation footprint, MT sensors, cable bundle
Subsea Cables	27	ea	to be bundled together and secured to the seafloor
Route length	about 3,700	feet	along seafloor (includes sections within array footprint, from array to shore transition conduit, and through conduit into Force Protection Tower)
Cable bundle width (approx.)	1	ft	in contact with seafloor
Number of concrete anchor discs (approx.)	±29	ea	at approximately 100-foot intervals along the seafloor route
Footprint of 29 concrete anchor discs	about 365	sq ft	4-foot diameter disc = 12.57 sq ft
Shore landing cable duct diameter	28	inches	
Shore landing cable duct length (approx.)	125	feet	approx. 60 feet of conduit (i.e., shoreward segment) to be buried beneath shoreline
Total Subsea Cable and Anchor Footprint (approx.; excludes segments within array footprint and shore transition conduit)	0.08	acres	cable bundle: 3,100 feet x 1 foot concrete anchor discs: 365 sq ft
Terrestrial Infrastructure			
Shore landing excavation volume (approx.)	225	cubic yards	transition vault excavation (includes approx. 125 CY of shoreline riprap to be removed and replaced)

Component	*No. or Size*	*Unit*	*Notes*
Length (approx.)	4,000	feet	in existing below grade conduits
Transition vault area of disturbance (approx.)	144	square feet	12 feet x 12 feet
Project Staging Area (approx.)	1	acre	adjacent to cable transition point (Polaris Point)

Sensor Array

Description

The sensor array comprises 13 EMT sensors, 8 MT sensors, and 1 CTD sensor, which would be aligned in a single row and secured to or suspended within sensor tubes embedded in the seafloor (see Figure 2-2). The 13 EMT sensors would each be mounted to the top of a sensor tubes. They would be flanked on each side by 4 MT sensors, which would each be suspended inside a sensor tube. The CTD sensor would be installed in line with the sensor array, offset to the east of MT1 (easternmost sensor), outside the navigational channel and at a depth that would not affect local vessel traffic (highest point would be about -45 ft MLLW). The sensors would be spaced approximately 20 feet apart, on center, for a total array width of about 420 feet (including CTD sensor). The EMT and MT sensors would measure the electromagnetic field signatures of vessels passing overhead. The CTD sensor would provide real-time measurements of water metrics.

The EMT sensors would be mounted on top of sensor tubes, which would be embedded into the seafloor. The EMT assembly would comprise a protective dome, EMT sensor, top mounting assembly, and sensor cable. Each MT sensor would be suspended inside a sensor tube embedded in the seafloor. See Figure 2-3 for illustrations of the MT and EMT sensor tube assemblies. The final elevation of the top of the EMT sensor tubes would be approximately 49 feet below Mean Lower Low Water (MLLW), covered by nonmagnetic backfill material with a final elevation of -49 feet MLLW (see Figure 2-3). As shown in Figure 2-2, the MT sensors would be embedded into the seafloor and not require excavation of the seafloor. After installation, the top of the MT sensors would extend no more than six inches above the existing harbor bottom. Sensor tubes would be made of fiberglass reinforced plastic (FRP) and be approximately 20 feet long and 12 inches in diameter.

A single CTD sensor would be installed on the outside edge of the navigation channel and would extend approximately 4 feet above the harbor floor. The UEMMS requires accurate, real-time measurements of water conductivity, depth (pressure) and temperature, and the CTD sensor is a high-accuracy recorder designed for moorings or other long-duration, fixed-site deployments. The 22.2-inch by 5.5-inch sensor would be attached to an elevated sensor tube to avoid silt and sedimentation. The CTD unit would require regular maintenance to manually remove fouling flora and fauna from the sensor so that accurate measurements and water flow are achieved.

All 22 sensors would have an associated sensor cable guide stake installed perpendicularly 10 feet to the southeast of the sensor positions (see Figure 2-2 for EMT guide stake locations). The guide stakes would designate the paths of the sensor cables, as well as secure coils of service cable—extra length of cable coiled in a loop on the seafloor that can be used to raise it above water for repair or replacement. Within the backfilled sensor array area, the guide stakes would be completely buried. For the CTD and MT, the cables would be secured to the sensor tube and the guide stakes would be removed.

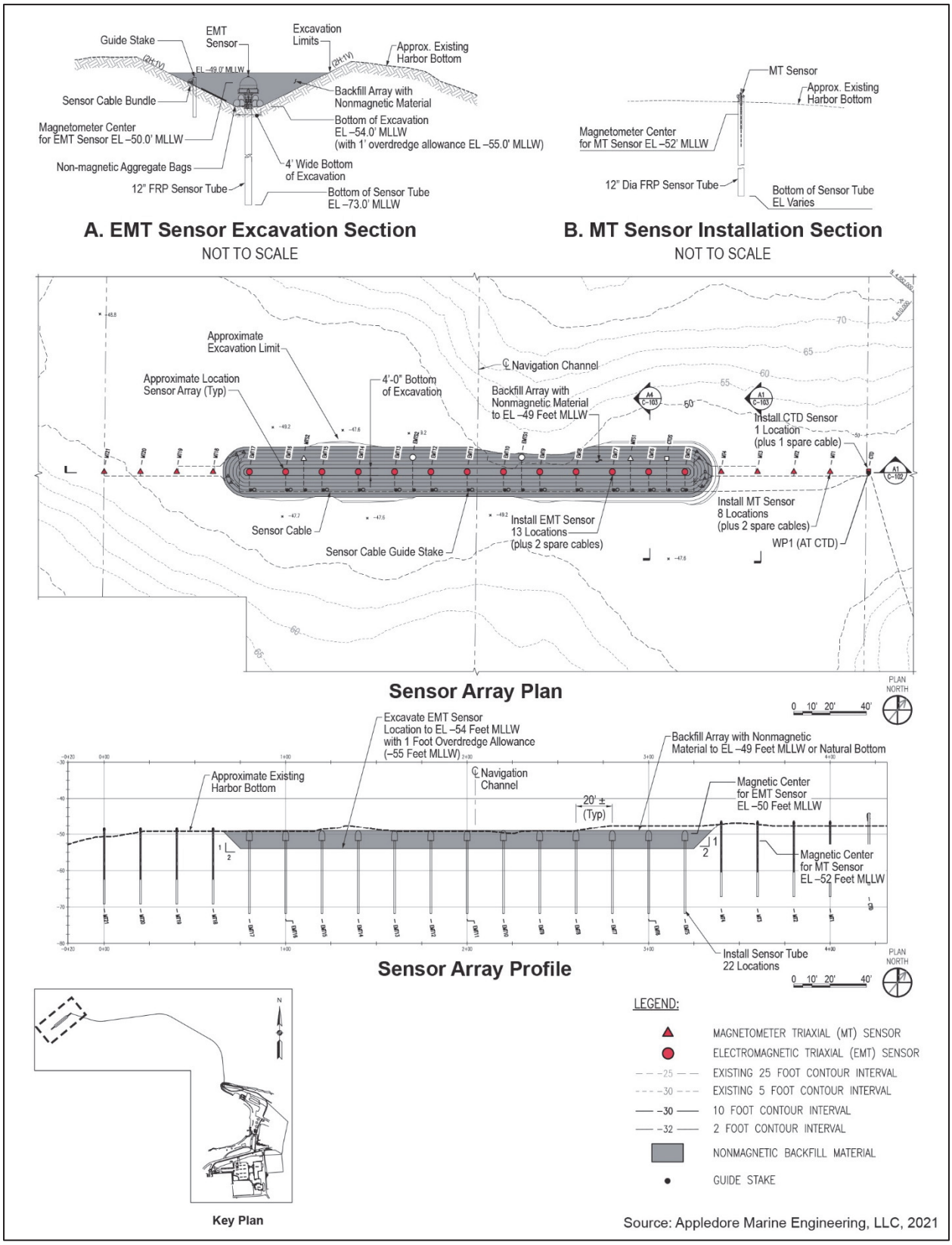

Figure 2-2 Sensor Array Plan and Profile

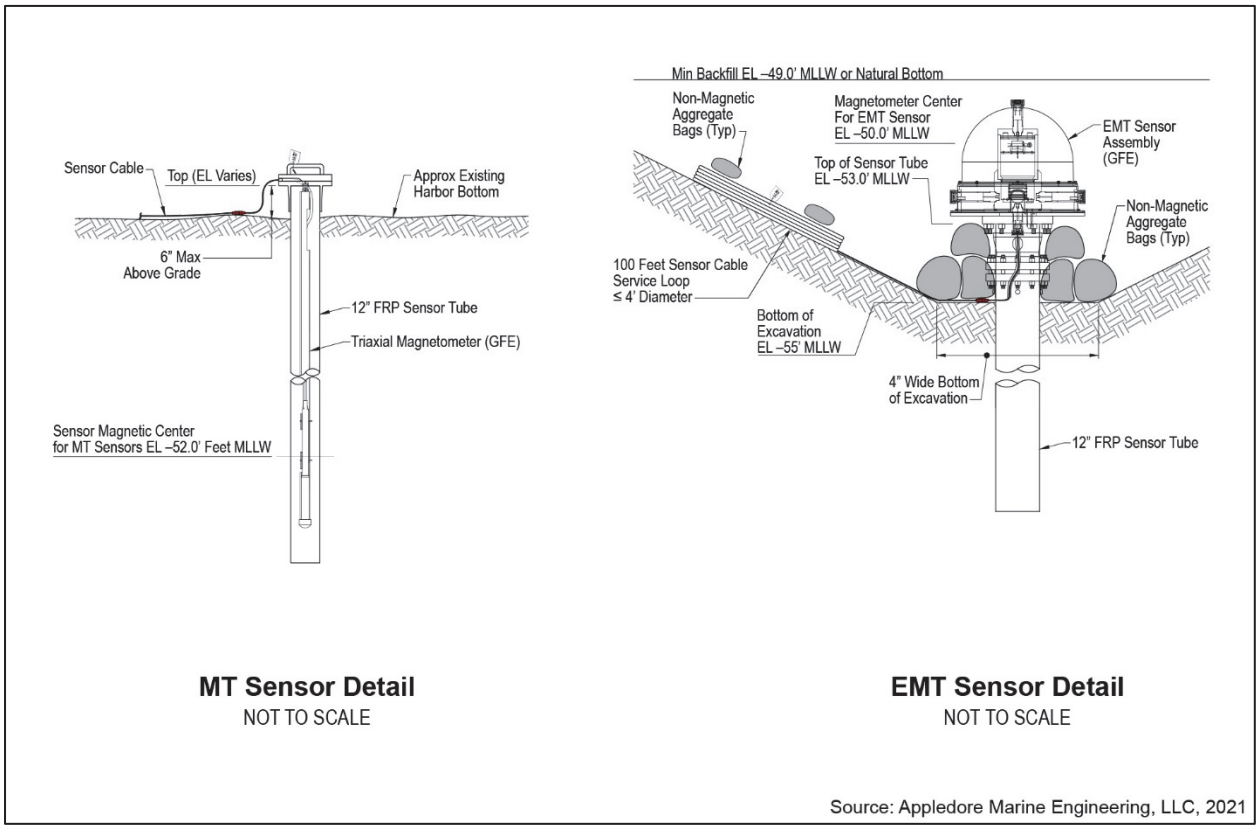

Figure 2-3 MT and EMT Sensor Installation Detail

Installation Methodology

A portion of the sensor array site would require excavation in order to be below the current maintenance dredge depth and to achieve the optimal distance between the EMT sensors and the vessels that would be measured, while maintaining the current navigational depth of the Inner Apra Harbor entrance channel. The area that would require excavation is shown in Figure 2-2. Approximately 1,200 cubic yards (CY) of material are anticipated to be removed over an area of about 7,900 square feet (sq ft). The process would involve mechanical excavation using a closed bucket excavator operating from a barge. The installation contractor would select the mooring or anchor type and locations for the mooring system to ensure that the affected seabed would be void of protected resources and sensitive habitats. Anchors for vessels and silt curtains would be set on hard or soft-sand bottom void of corals and seagrass and anchor locations would take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. The “stop and slow” method would be used during dredging to limit suspension of sediments in the water column, and 25-foot length silt curtains would be installed immediately adjacent to the dredge barge.

The excavated material would be placed on scows for transfer and later disposal. Best management practices (BMPs) to prevent accidental release of spoils or return flow from the scows are listed in Section 2.5. The excavated material would be disposed of either at the Guam Deep Ocean Disposal Site (G-DODS) or an approved upland confined disposal facility (CDF) at NBG (see Figure 1-1 for potential CDF locations). The G-DODS is a USEPA-authorized ocean disposal site located approximately 11 nautical

miles northwest of Apra Harbor. For ocean disposal, once each scow is filled, it would be towed during the day to the G-DODS.

The G-DODS regional bathymetry includes a conical seamount to the northwest and is over a gentle slope that descends towards the southeast. The disposal site has a circular footprint (located on the seafloor) centered at 13° 35.500 N and 144° 28.733 E with a 2.98-mile radius (Weston Solutions, Inc., 2010). If the excavated material is disposed of in an existing upland facility, it would be transferred to the receiving CDF for dewatering and later become available for beneficial reuse applications (e.g., fill or landfill capping).

The proposed UEMMS sensor array site has been determined as having a high to moderate likelihood of encountering Munitions and Explosives of Concern (MEC) and/or Material Potentially Presenting Explosive Hazard (MPPEH). A mechanical screening method at the scow will be used to reduce the Hazardous Fragmentation Distance from a 5-inch projectile to a 3-inch projectile so that the dredged material can be further mechanically screened at the previously approved Upland Staging and Screening Area (USSA) to remove smaller MEC and/or MPPEH items down to a 20-millimeter (mm) projectile. After the barge pre-screening operation is completed and the scow is filled, the scow will be taken to the MEC/MPPEH Management Area and dredged material off loaded. A crane/excavator will be used to transfer dredged material from the scow to dump trucks at the MPPEH Management Area to be transported to the designated USSA for MEC/MPPEH screening and subsequent disposal (see Figures 1-1 and 2-1 for approved USSA and MEC/MPPEH Management Area locations).

After the sensor array site is excavated to the appropriate depth (-54 feet MLLW plus a 1-foot overdredge allowance for EMT sensors [i.e., to -55 feet MLLW]; no excavation for the MT sensors), divers would install the sensor tubes followed by guide stakes into the seafloor. EMT guide stakes (i.e., 6-inch diameter FRP pipes) would be embedded in the seafloor to a depth of at least 4 feet below the seafloor within the excavated and backfilled area; no part of the guide stakes would extend above the backfilled area (see Figure 2-2 for EMT guide stake locations).

Divers would install the sensor tubes and guide stakes using a handheld hydraulic breaker in a process known as “water jetting.” Water jetting uses a high-pressure water stream to create a void into which the sensor tube is pushed by a large steel pipe. It is typically completed by a crane-supported metal pipe with a water hose connection. The water hose is connected to a hydraulic water pump located on the barge, and outputs water at a higher hydraulic pressure than it takes in. This higher-pressure water is pumped into the pipe to the bottom, loosening bottom material and allowing the sensor tube to be pushed into the bottom. Alternatively, a vibratory hammer may be used to drive the sensor tubes or guide stakes into the substrate.

If water jetting cannot successfully embed the sensor tubes due to seafloor characteristics, approximately 12-inch diameter pilot holes would be drilled into the seafloor and marine grout would be applied to secure the tubes. The sensor tube would then be installed within the cored hole and grouted in position with non-shrink grout using a tremie pour method in which a small amount of grout is placed at the bottom of the hole and a grout hose placed in the grout. The poured grout from the hose would displace water as grout fills the hole. The sensors would then be installed in the tubes, along with their individual cables.

A crane on the work barge would lower the EMT sensors with sensor cable attached and a diver would guide the sensor to their corresponding sensor tubes. The MT sensors and cable would also be hand-guided by diver to their corresponding sensor tubes.

After the sensors are installed and guide stakes are in place, non-magnetic material would be placed to weight down sensor cable service loops and to support the exposed sensor tubes of the EMT sensors at the mudline (see Figure 2-3 for illustration). As seen in Figure 2-2, the excavated area would be backfilled using non-magnetic material to at least one foot above the tops of the EMT sensors for protection. The backfill material would be locally-sourced and certified as free of contaminants prior to use. (Note: While 0.5-inch non-magnetic stone aggregate has been used in other UEMMS installations, the ultimate size and material would be determined in consultation with the appropriate resource agencies.) The final seafloor elevation at the sensor array would be a minimum of -49 feet below MLLW, restoring the existing harbor bottom to original depth.

Subsea Cables

Description

Each sensor would have an associated subsea cable, and five additional cables would be installed as spares (two MT spares, two EMT spares, and one CTD spare). The cables would be shielded and sheathed copper wires with diameters of about one inch. The cables would extend from each sensor to a common path marked by the guide stakes, and aligned parallel to and on the southeast side of the array. The 27 cables (10 MT, 15 EMT, 2 CTD, including spares) would then be bundled together and extend approximately 3,150 feet to the top of the shore protection riprap at Polaris Point. The cable bundle would be held together by two-inch polypropylene webbing at each sensor, guide stake and as necessary throughout the cable path (see Figure 2-4 for cable bundle detail).

The subsea cable bundle would be laid by divers on the seafloor and be routed to the northwest point of Polaris Point (Figure 2-1). The subsea cable bundle would be secured to the seafloor at about 100-foot intervals by concrete anchor discs and polypropylene webbing (see Figure 2-4 for detail of concrete anchor discs). The concrete anchor discs would be approximately four feet in diameter and two feet high, with a hooked bar on the side that would be used to secure the cable bundles with polypropylene webbing. Up to five additional PVC guide stakes with no more than one foot of pipe exposed above the seafloor would be installed at either end of the cable route (three stakes at the sensor array end and two stakes at the Polaris Point end) to secure the cable bundles at these areas of significant slope.

At a depth of -35 feet MLLW as it approaches the Polaris Point shoreline, the cable bundle would transition into an approximately 125-foot-long high density polyethylene (HDPE) duct, consisting of individually-encased, three-inch diameter HDPE conduits (see detail in Figure 2-4). The HDPE conduits and duct would protect them from damage in the high wave energy environment and debris along the shoreline. A stainless steel anchor band would span the top half of the HDPE duct and be secured to the seafloor by approximately five pairs of earth anchors, which have an expandable splay (or similar) that rotates and locks into position after being driven into the seafloor (see Figure 2-4 for detail). The exposed footprint of each anchor would have a diameter of approximately one inch. The HDPE duct would continue onshore, buried in an excavated trench for about 80 feet to a transition vault (see Figure 2-5 for shore landing detail). The shoreline transition of the sensor cables is described in detail below in the “Cable Shore Landing” section.

Installation Methodology

The subsea cable bundle would be installed by divers. Contractor divers would lay an initial “cable guide path” on the seafloor using line and guide stakes or small weights. During the establishment of the “cable guide path,” contractor divers would select the locations for approximately 29 reinforced

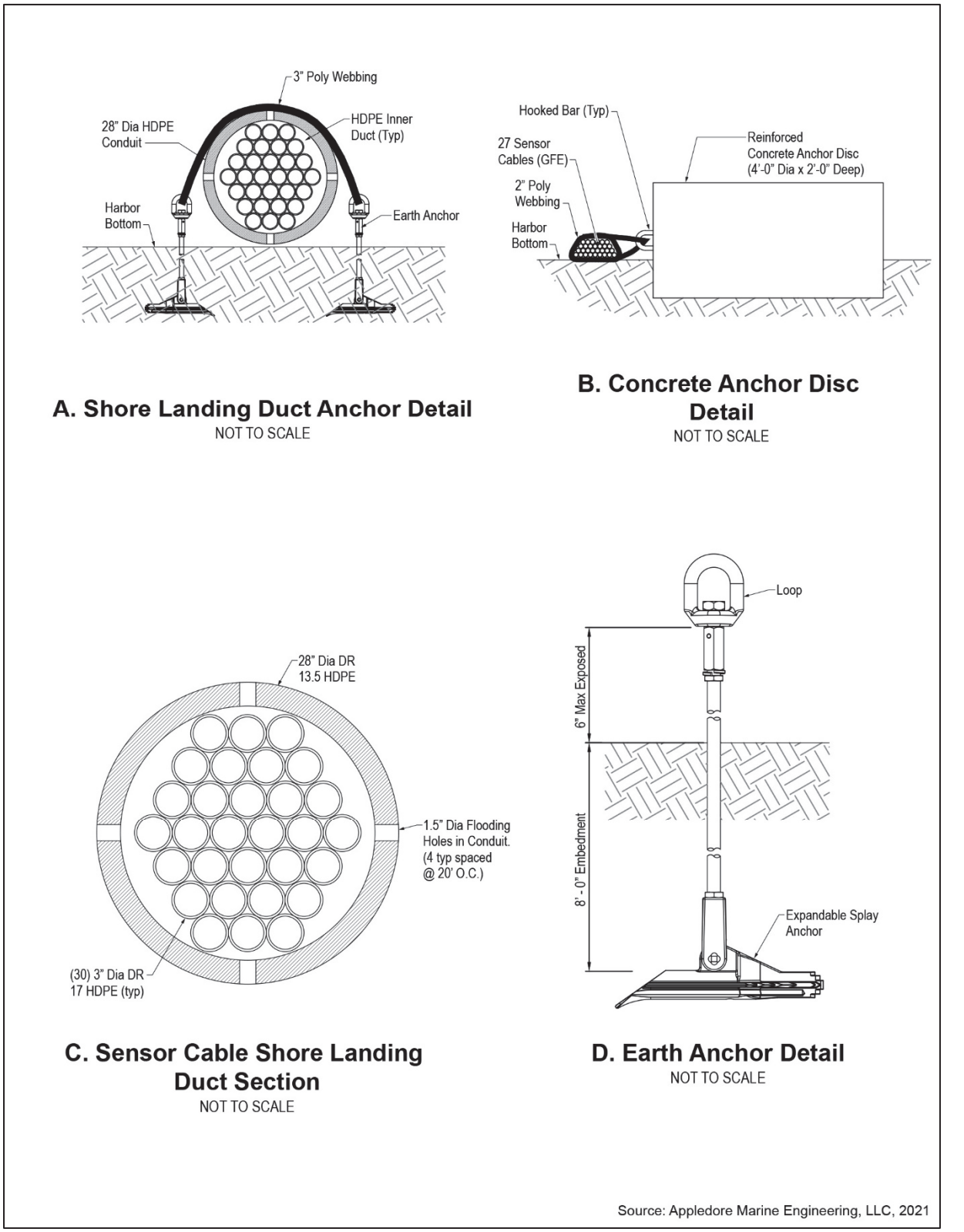

Figure 2-4 Preferred Alternative Subsea Cable Duct and Anchor Detail

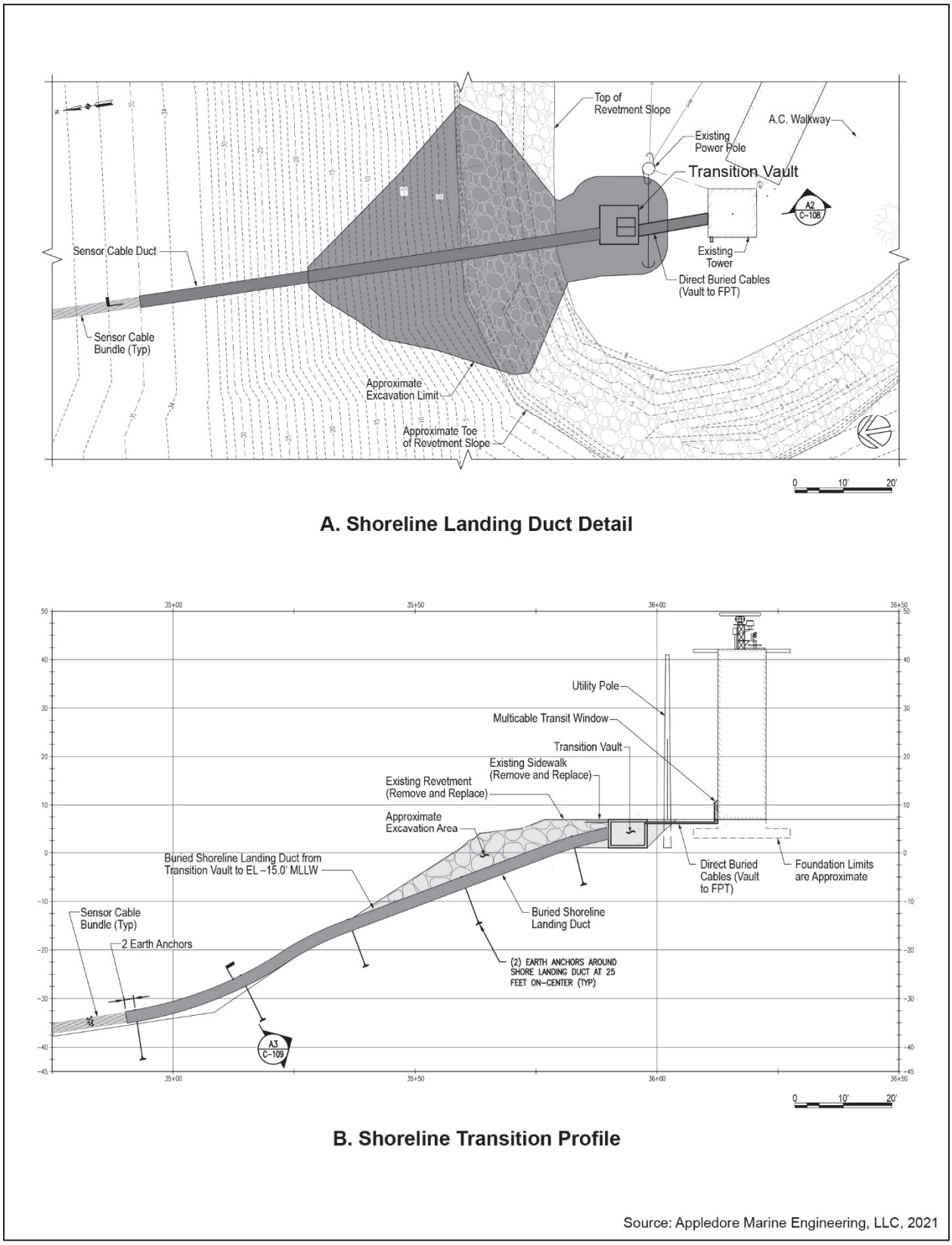

Figure 2-5 Preferred Alternative and Reasonable Alternative Cable Shore Landing

concrete anchor discs to avoid areas with coral cover. Once the "guide path" is established, contract divers would hand-lay the cable bundle in place and route the cables through the shoreline duct. The concrete anchor discs would then be lowered into place using a crane and barge at the identified locations, with contractor divers verifying each anchor location prior to placement and verification after placement. Divers would then secure the cable bundle to the seafloor at the anchoring points.

The earth anchors used to secure the HDPE duct to the seafloor as it approaches Polaris Point would be installed from a barge or vessel through a water jetting process or by vibratory hammer to embed the anchors approximately eight feet into the substrate.

Cable Shore Landing

Description

Figure 2-5 shows plan and profile views of the cable transition to shore. At a depth of approximately -35 feet MLLW near the north shoreline of Polaris Point, the seafloor-mounted cable bundle conduit would transition into a 28-inch diameter, approximately 125-foot long HDPE duct (see Figure 2-5). Each cable would be individually encased in 3-inch-diameter HDPE conduits, and the individual 3-inch conduits bundled into the 28-inch-diameter HDPE duct (see Figure 2-4). The HDPE duct would be secured to the substrate at about 25-foot intervals. Each anchoring point would include a stainless steel anchor band that would span the top half of the HDPE duct and be secured to the substrate by a pair of earth anchors (Figure 2-4). Approximately 80 linear feet of the cable duct would be installed below ground from the -15 foot MLLW depth to the point it enters the Force Protection Tower. As shown in Figure 2-5, the buried shoreline landing duct would enter a new below-grade, concrete transition vault, where the individual sensor cable conduits would exit the HDPE duct and be routed into an existing building on Polaris Point that would serve as the cable transition point.

Installation Methodology

To install the HDPE cable bundle duct below ground at the Polaris Point shoreline, an approximately 55-foot wide by 50-foot long by 10-foot deep oblique trench would be excavated from the below-grade transition vault location to a water depth of -15 feet MLLW (see Figure 2-5 for profile). The geometry of the trench would provide the slope necessary for contractor safety. The excavation is likely to be conducted by a long-reach, closed bucket excavator situated on land. Prior to trench excavation, approximately 60 CY of existing shoreline revetment material—consisting of large, placed limestone blocks—would be removed by the shore-based excavator and stored under water adjacent to the project area in substrate devoid of protected resources. (See Photo 2-1 for a photo of the existing revetment area.) The original revetment material would later be re-used as backfill material to restore the revetment to its original configuration to the maximum extent practicable.

Photo 2-1 Existing Shoreline Revetment

The transition vault would be constructed of pre-cast or cast-in-place concrete. An excavator or backhoe would excavate the area for the transition vault similar to the process for the shore landing cable duct. A total of about 225 CY of subbase material (including the transition vault excavation) would be excavated and later used as backfill to bury the cable conduit duct. This total includes about 125 CY of revetment material expected to be removed and replaced after the cable bundle conduit is installed. It is anticipated that the excavated material would be stored on shore in a lined dewatering facility, if required, that would allow the water from the material to evaporate. Excavation of the shoreline landing duct and cable transition vault is estimated to require about five weeks. Best management practices for construction activities are described in Section 2.5.

Terrestrial Infrastructure

Description

The individual cables would be routed from the vault into an existing building at Polaris Point via four 6-inch conduits and provide a transition point from the individual cables to a fiber optic cable (see profile view in Figure 2-5). Proposed modifications to the transition point building include installation of a service platform and data acquisition equipment, electrical upgrades, and closed-circuit television (CCTV) cameras.

From there, the fiber optic cable would be routed to its termination point in another existing Polaris Point building entirely via existing below-grade conduits where computers would collect and analyze the transmitted data. A two-inch diameter, approximately eight-foot-long duct would be installed approximately two feet below grade between the cable transition point building and an adjacent building to supply power to the UEMMS equipment in the cable transition point building.

Installation Methodology

The service platform would be installed in the interior of the cable transition point building and the cable protective housing constructed on the exterior. Data acquisition and other electronic and telecommunications equipment would be installed in the interior. The fiber optic cable would be installed in existing below-grade conduits leading from the cable transition point to the cable termination point buildings. Along with hand tools, a linear cable winch is anticipated to be used to pull the fiber cables through the conduits. No ground disturbing work is anticipated for the fiber optic cable installation. Installation methodology for the eight-foot-long below-grade power supply duct would be determined by the construction contractor, but would likely involve a small trench excavated by hand or using equipment similar to a backhoe.

Installation Equipment, Personnel, Staging Areas, and Schedule

Typical equipment and vessels used in Installation activities required for the Proposed Action include barge with crane secured in four-point moor, crew boat, small boat, cable reel boat, tugboat, excavator (mounted to barge crane), skid steer, material barge, backhoe, compressors for jetting in sensor tubes,

air compressor for divers, diesel generator, linear cable winch, contractor crew private vehicles, and possibly dump trucks to haul excavated material to the CDF.

An approximately one-acre construction staging area may be established at Polaris Point, in the area surrounding the cable transition point (see Figure 2-1 for location). Approximately 15 to 20 personnel may be onsite at any one time, depending on the phase of installation. Installation is expected to take approximately ten months (including weather and other contingency delays) but would vary based on equipment testing requirements and results. In-water work (e.g., sensor array excavation and installation, cable installation, subsurface cable trenching, sensor array backfill, etc.) would take approximately five months, including about 19 weeks for sensor array excavation, sensor array installation/testing/validation, and backfilling of the excavated area. The shoreline transition work would take about six weeks. All installation activities are expected to occur on Monday through Saturday during typical daytime work hours.

The work would be conducted in the following general order; some in-water and shoreside work may occur concurrently:

1. Onshore work (i.e., transition vault, cable transition building improvements, fiber optic cable installation)
2. Shoreside cable landing duct
3. Layout site and working points
4. Excavate sensor array
5. Install sensor tubes
6. Install sensors and sensor cables
7. Sensor testing and validation
8. Backfill sensor array
9. Sensor testing and validation

In October 2006, the Department of Defense (DoD) issued Instruction number 2000.16, “DoD Antiterrorism Standards,” requiring all DoD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats. The intent of these building standards is to integrate greater resistance to a terrorist attack into all inhabited buildings. That philosophy affects the general practice of designing inhabited buildings. Because the project does not involve the occupation of project facilities by Navy personnel or changes in land use, Antiterrorism Force Protection (ATFP) requirements do not apply to this project. ATFP standards consist of restrictions for onsite planning, including standoff distances, building separation, unobstructed space, drive-up and drop-off areas, access roads, and parking; structural design; structural isolation; and electrical and mechanical design.

Construction projects would incorporate Leadership in Energy and Environmental Design, commonly referred to as LEED, and sustainable development concepts to achieve optimum resource efficiency, sustainability, and energy conservation.

2.3.3 Concrete Block Mat Alternative

In this alternative (which was identified in an early conceptual study for the project), the components, installation methodology, terrestrial infrastructure, and operation would be the same as the Preferred Alternative except in how the subsea cables that lead from the sensor array to shore are secured to the seafloor. In this alternative, instead of securing the sensor cable bundle to the seafloor using concrete anchor discs (as in the Preferred Alternative), the cable bundle (also wrapped at regular intervals by polypropylene webbing) would be secured by having articulated concrete block mats placed atop the cables along the length of the route.

2.3.3.1 Components and Installation Methodology

The Concrete Block Mat Alternative would have the same components as the Preferred Alternative for the sensor array and shore landing facilities, with the exception of the subsea cable anchoring system. Terrestrial components would be the same in both alternatives.

Sensor Array

The sensor array location, capacity, number, and type of individual instruments, sensor cables, guide stakes, backfill material, and installation methodology of the sensor array would be identical to the Preferred Alternative, including disposal of the excavated material from excavating the sensor array site.

Subsea Cables

The subsea cable specifications would be identical to those in the Preferred Alternative. The cable bundle would be routed from the sensor array to shoreline transition point in the same approximate alignment as in the Preferred Alternative (see Figure 2-1 for alignment). However, due to the size and limited flexibility of the concrete block mats, there would be less ability to adjust the ultimate routing to avoid corals or other sensitive benthic organisms along the route.

The concrete blocks would consist of trapezoidal concrete blocks, approximately 15.5 inches wide by 15.5 inches long by 8.5 inches high, connected by synthetic or stainless steel cable into 8-foot by 16-foot mats (see Figure 2-6 for plan and section views of articulated concrete block mats and a schematic cross section of the sensor cable bundle covered by the mat). The concrete blocks would be precast at a local batch plant and transferred to barges to be transported to the project location. Divers would lay the cable bundle along the prescribed route from the sensor array to shore transition site at Polaris Point—a length of about 3,700 feet (including the sensor array and transition to shore). A barge-based crane with spreader bars would lower the articulated concrete block mats over the sensor cables along the route, guided by divers in the water who would ensure that each mat abuts the adjoining mat. About 3,100 linear feet of the subsea cable would be secured by concrete block mats (i.e., excludes sensor array footprint and transition to shore). A material barge and tugboat would also be required for subsea cable installation in this alternative. Approximately 30 total contractor personnel may be onsite at any one time in this alternative.

The installation duration would be approximately three weeks longer than that for the Preferred Alternative and additional personnel would be required (i.e., additional vessel captain to transport the mats to the project site and a crane operator to lower the mats to the seafloor). The weight of the concrete blocks would secure the cable to the seafloor. This alternative would impact approximately 24,830 sq ft, or 0.57 acres, of the seafloor where the cable bundles are covered with the concrete block mats and one-foot-wide cable bundle (3,100 ft long⁄16 ft per mat = 194 mats; 194 mats x 128 sq ft per

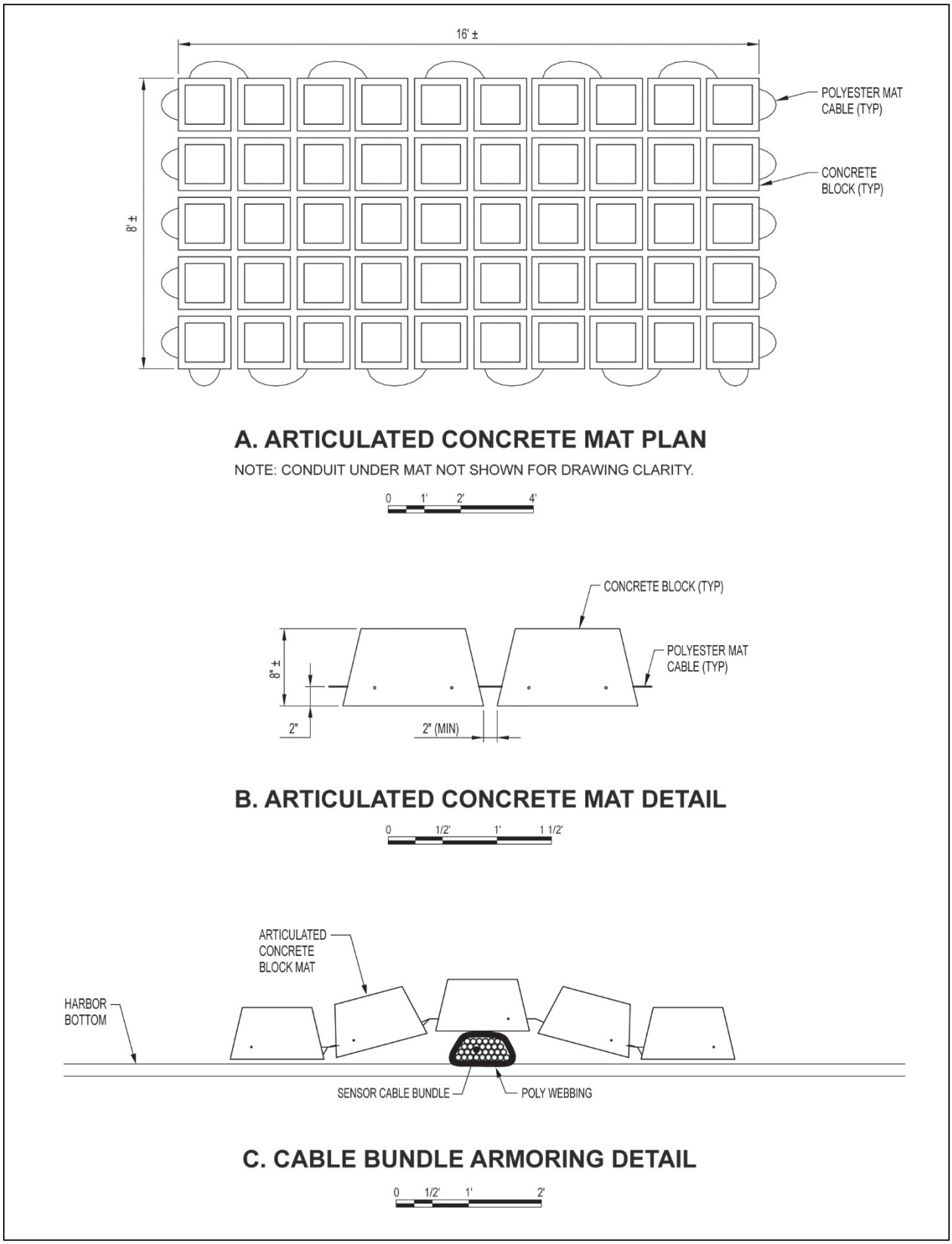

Figure 2-6 Concrete Block Mat Plan and Details

mat = 24,832 sq ft). This is approximately 21,400 sq ft (or 0.49 acres) more seafloor disturbance than in the Preferred Alternative.

Cable Shore Landing

As in the Preferred Alternative, in this alternative, the individual sensor cables bundle would enter a 28-inch HDPE conduit at a depth of approximately -35 feet MLLW near the northern shoreline of Polaris Point. The cable shore landing materials and installation methodology would be identical to the Preferred Alternative. See Figure 2-5 for shoreline landing duct detail and shoreline transition profile.

Terrestrial Infrastructure

In this alternative, the terrestrial infrastructure would be the same as in the Preferred Alternative (including installation methodology), including the excavated material screening and disposal.

Installation Equipment, Personnel, Staging Areas, and Schedule

This alternative would have the same installation equipment, personnel, and staging area requirements as the Preferred Alternative with a few exceptions in the crew size, vehicles, equipment, vessels, and duration. As noted in earlier sections, the differences would be about 10 additional personnel (additional vessel captain for transporting the mats to the project site, crane operator to lower the mats to the seafloor, additional subsea cable installation crew), material barge, tugboat, additional privately owned personnel vehicles, and approximately three-week longer installation duration.

Because this alternative would likely have greater impacts to marine resources (e.g., corals and other benthic marine biota) due to the much larger seafloor area affected by concrete block mats than the Concrete Anchor Discs, it is not the Navy's Preferred Alternative. This alternative meets project objectives and screening criteria and is considered a reasonable alternative. Therefore, it is carried forward for detailed analysis in this EA.

2.4 Alternatives Considered but not Carried Forward for Detailed Analysis

The following alternatives were considered, but not carried forward for detailed analysis in this EA as they did not meet the purpose and need for the project and satisfy the reasonable alternative screening factors presented in Section 2.2.

- Installation at alternate sites
- Alternate installation methodologies

2.4.1 Installation at Alternate Sites

In addition to the Preferred Alternative, the Navy considered constructing a UEMMS at other locations, as described below.

2.4.1.1 Other Pacific or Indian Ocean Locations

Under this alternative, a UEMMS would be constructed at another location within the U.S. Indo-Pacific Command (USINDOPACOM) area of responsibility. However, this alternative would not meet the screening factor of proximity to service ships and submarines homeported or forward deployed to NBG. As described in Section 1.4, the lack of electromagnetic field signature measuring capability at NBG results in unacceptable operational efficiencies and increased risks as ships and submarines homeported or forward-deployed to NBG must travel to Japan or Hawaii for electromagnetic field signature

measurements. Because NBG is a vital U.S. forward deployment base and logistics hub for sea, land, and air forces operating in Asia and the Western Pacific, the primary screening factor for the Proposed Action is locational—the UEMMS should be sited where it would most efficiently serve U.S. Navy ships and submarines forward-deployed or transiting through NBG. Establishing a UEMMS elsewhere in the Pacific or Indian Oceans would perpetuate current Fleet operational inefficiencies and risks to its responsiveness in emergent situations. Therefore, this alternative is not carried forward in the EA analysis.

2.4.1.2 Other Apra Harbor Locations

Outer Apra Harbor Sites

Three other sites in Outer Apra Harbor were considered for the UEMMS and evaluated earlier by Navy biologists for their potential impacts to marine biological resources (see Figure 2-7 for locations).

"Site 1" is located approximately 1,000 feet southeast of the proposed (preferred) UEMMS site, closer to the Inner Apra Harbor entrance channel. "Site 2" is located approximately 1,000 feet northwest of the Preferred Alternative site, just south of Jade Shoals. "Site 3" is located approximately 4,600 feet northwest of the Preferred Alternative site.

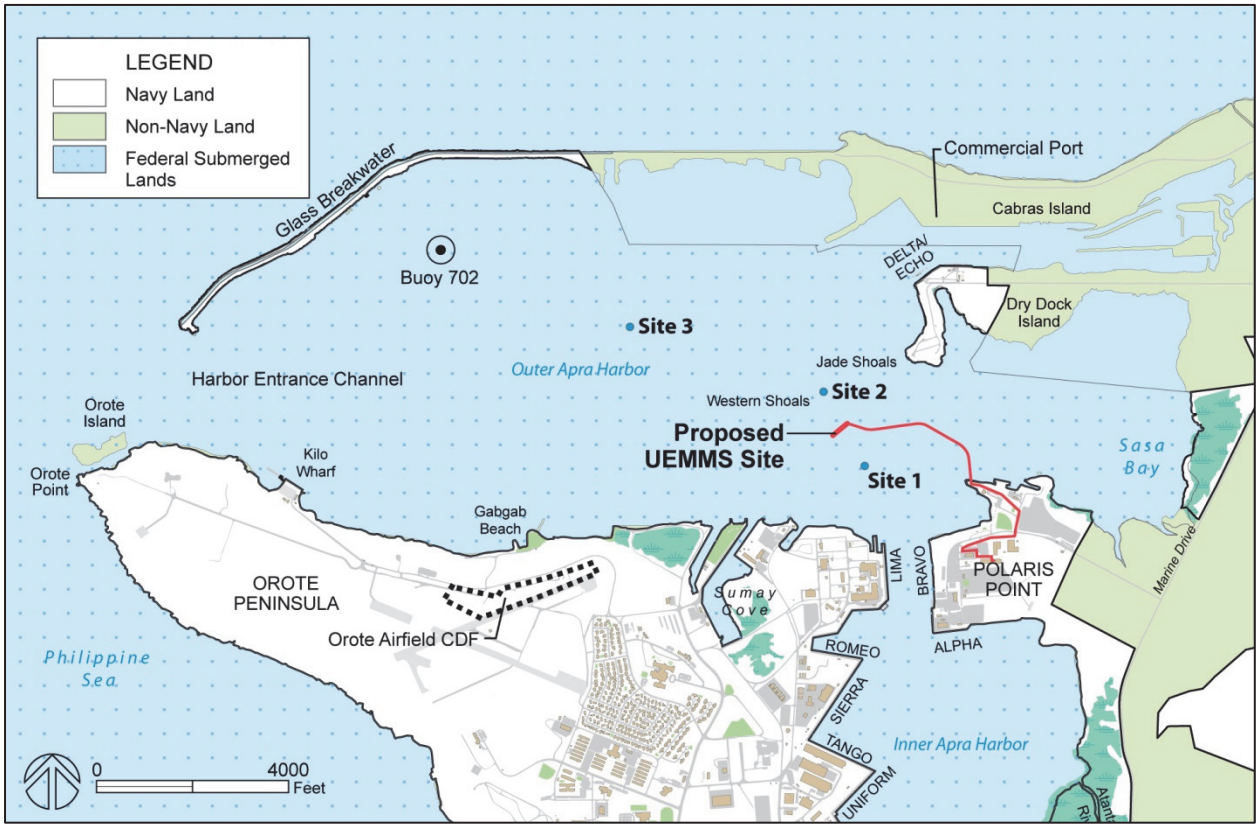

Figure 2-7 Outer Apra Harbor Alternative Sites

The biologists evaluated the three sites against the following marine natural resources criteria:

1. percentage of the sea floor covered by corals, coral diversity, apparent coral health, coral, and sea floor topography and complexity

2. fin fish biomass, diversity and apparent health, suitability for designation as Habitat Area of Particular Concern (HAPC)
3. presence of threatened and endangered sea turtles and their preferred forage and resting habitat and
4. proximity of each site to the (formerly) designated HAPC at Jade Shoals, and their proximity to other well developed reefs within Apra Harbor, such as Western Shoals and Dry Island Dock Reef.

Based on the criteria applied, the biologists identified Site 1 as presenting the fewest potential concerns to marine natural resources of the three sites evaluated at that time, followed by Site 3 and lastly Site 2. However, when operational and navigation requirements were applied to Site 1, UEMMS would not be operationally practicable. At this site, tugboats would have to be alongside or near the target platform (i.e., vessel being measured) to safely guide them into Inner Apra Harbor. The tugboats represent magnetic sources that would result in "fouled" or invalid electromagnetic signature measurements of the target platform if they are not located a sufficient distance away (i.e., two boat lengths for submarines and three boat lengths for surface ships). Because Site 1 is 1,000 feet closer to the Inner Apra Harbor entrance channel than the Preferred Alternative, it provides less time for tugboats to engage/disengage the target platform and would create a greater risk of invalid measurements, which could subsequently result in incorrect electromagnetic calibration of the vessels screened at the UEMMS (i.e., non-compliance with electromagnetic signature limits, which poses risks to physical harm to U.S. Navy personnel and damage to Navy vessels). This situation would not meet the screening factor of meeting parameters for accurately measuring electro-magnetic signatures of ships and submarines while complying with NBG Port Operations requirements. For these reasons, this site does not meet the screening factors that make the alternative operationally practicable. However, in eliminating Site 1, the marine reconnaissance surveys were used to shift the site north along the navigational channel to the current Preferred Alternative site location, which meets operational requirements for tugboat assistance and navigation into Inner Apra Harbor.

Site 2 is in a location with restricted space and would not allow enough width between Jade Shoals and Western Shoals for sensor array installation; this site does not meet the screening factor of constructability.

At a depth of over -100 feet MLLW, Site 3 is too deep for a sensor array to correctly capture electro-magnetic signature readings of ships and submarines that would pass overhead (ideally -60 feet MLLW). Addressing the depth by installing the sensors on fill material or a structure to bring the sensor array to an acceptable depth would subject it to vibration, which increases the system's noise floor and causes the magnetically-aligned electric field sensors to misalign from magnetic north. This system noise and magnetic misalignment would make the data gathered by the sensor array unusable. The depth of this site would create technical challenges for the installation, as well as for operational period maintenance and repair. In addition, placing the sensor array on pilings or fill material would subject it to damage by anchors, propellers, or other subsea physical hazards. Site 3 does not meet the screening factors of meeting technical parameters for the sensor array, constructability, and ease of maintenance and repair.

Therefore, Sites 1, 2 and 3 were dismissed from further consideration and are not carried forward for detailed analysis in the EA. However, the reconnaissance level marine biological surveys conducted for

these sites were used in identifying the current location of the Preferred Alternative, which meets all operational requirements.

Inner Apra Harbor

Locating the UEMMS within Inner Apra Harbor was considered, but dismissed because no site in Inner Apra Harbor would meet the technical parameters of the sensor array. Inner Apra Harbor would present numerous magnetic sources (e.g., ships' hulls) that would render the data collected unusable. Furthermore, ships entering Inner Apra Harbor are generally accompanied by tugboats, which would also affect readings by the UEMMS. Therefore, no Inner Apra Harbor sites are carried through the EA analysis.

2.4.2 Alternate Installation Methodologies

In addition to alternate UEMMS sites, alternate installation methodologies were considered for installing the sensor cable bundle from the sensor array to shore, securing the cable bundle to the seafloor, and for the terrestrial cable route, as described below.

2.4.2.1 Subsea Cable Horizontal Directional Drilling

In this alternative, instead of laying the sensor cable HDPE duct on the seafloor, a conduit would be directionally drilled to transfer the cable bundle from the sensor array to the Polaris Point transition vault. This would entail using large capacity directional drill equipment to bore an approximately 4.9-foot diameter hole underground for a length of 3,900 feet. There is no equipment available locally in Guam that could bore the required diameter. This would add significant time and cost to mobilize (30 to 60 days). Although horizontal directional drilling has previously been employed to install subsea cables for this type of project, the technology is untested at the required length (i.e., almost 4,000 linear feet), which is about double the length of previous projects. This situation presents substantial construction risk for the project because of its unproven technology and lack of contractor experience for the required drilling length (i.e., the method may fail during installation). This alternative may have a smaller impact on the seafloor and the marine biological environment than other methods to install or secure the subsea cables (e.g., trenching or securing them on the surface). This is because it would not involve covering existing benthic habitat with the subsea cable bundle and its associated anchoring system or removing benthic habitat along the cable route through trenching (see trenching description in following section); thereby avoiding impacts to biological resources along the subsea cable route. However, the ultimate installation process may result in greater impacts to the seafloor if the drilling must be done in several segments and the drilling equipment has to surface above the seafloor in several locations. Furthermore, estimated at over $23 million, its installation cost would be more than double the cost of the entire proposed project. This alternative fails to meet several screening factors: constructability, low installation risk, local availability of construction assets, and budget limits for acquisition of this type of technology. Therefore, it was abandoned in favor of more constructable alternatives and is not being carried forward for detailed analysis in the EA.

2.4.2.2 Trenched Subsea Cables

In this alternative, the sensor cables would be routed from the array to shore by excavating a trench and directly burying the cables below the seafloor. The trench would be backfilled with non-magnetic material to match the original harbor bottom depth. This alternative would require the use of a cable burial trenching sled, which would use a water jet to excavate material and propel the sled forward. A

burial trenching sled is equipped with water jet nozzles through which water is injected into the substrate to loosen and to fluidize the sediments in front of and around the sled while it is being towed from a surface vessel. This alternative would cut about 1,570 cubic yards of seafloor material and swath of the sled would impact about 21,500 sq ft where the trench is jetted. A small vessel with jet pumps, cable-laying sled umbilical, and sensor cables would support the process from above water.

This installation technology would indiscriminately impact coral and marine biological resource habitat within the sled footprint as it is towed. With the subsea trenching alternative, the fluidization of the benthos and disturbance from the sled would create secondary stressors on nearby corals through the resulting high volumes of sedimentation. The swath of the sled would impact approximately 21,500 sq ft of seafloor to install the cable bundle, whereas the Preferred Alternative would impact approximately 3,500 sq ft of seafloor habitat for the subsea cable bundle (approximately 3,100 sq ft for the cable bundle and 365 sq ft of concrete anchor discs). Under the Preferred Alternative, the subsea cable bundle would be manually guided by divers, who would be able to lay the cable bundle in such a way to avoid coral colonies. The Preferred Alternative would generate minimal sediment dispersal at each cable securing position, with each 4-foot-diameter concrete anchor disc lowered into place using a barge and crane (with specific siting and alignment verified by divers) at approximately 100-foot intervals along the cable route. In this way, the Preferred Alternative would minimally impact benthic marine habitats along the subsea cable route. Because this alternative would directly affect a larger seafloor footprint than the Preferred Alternative, it is not carried forward in the EA analysis.

2.4.2.3 Subsea Cable Earth Anchor System

In this alternative, instead of securing the cable bundle to the seafloor by tying it to concrete anchor discs at regular intervals, toggle bolt-like anchors (i.e., “earth anchors”) would be driven into the substrate to secure the subsea cable bundle to the seafloor. The cable bundle would be bound together using with two-inch polypropylene webbing at regular intervals. The webbing would be attached to two stainless steel earth anchors (one on each side of the cable), which would be installed into the seafloor. A set of two earth anchors would be installed at approximately 100-foot intervals along the subsea cable route. Each earth anchor has an expandable splay (or similar) that rotates and locks into position in the substrate after being driven into the seafloor. Divers would install the earth anchors, likely using a water jetting process or by the weight of a hammer only to embed the anchors approximately eight feet into the substrate to ensure a secure attachment. Because the exposed footprint of each anchor would be approximately one inch in diameter, this alternative would result in the disturbance of a smaller seafloor footprint than the Preferred Alternative.

Safety concerns arise due to munitions and explosives of concern (MEC) or unexploded ordnance (UXO) as small as 20 millimeters in diameter that may be present in the seafloor areas where the earth anchors would be driven. Because the anchors would be installed by human divers, the route must be surveyed for the presence of MEC prior to installation in order to avoid exposing installation divers to accidental MEC detonations that could occur if they were struck by installation equipment. However, due to the final depth of the earth anchors and the limitations of the magnetometers, an adequate MEC survey of the subsea cable route cannot be conducted for the use of earth anchors to secure the cable bundle. This is because magnetometers capable of detecting the smallest size MEC potentially present along the subsea cable route are not able to penetrate the substrate to a depth of -8 feet below the seafloor (i.e., the depth to which the earth anchors would be driven). Therefore, the use of earth anchors to secure the subsea cable bundle is not a feasible installation method and is not carried through the EA analysis.

2.4.2.4 Directionally Drilled Terrestrial Conduit

This alternative would utilize directional drilling to transfer shoreside homerun cables between the Polaris Point transition vault to the cable termination point via a 18-inch, 1,300-foot-long hole. The hole would have to avoid existing infrastructure and pile foundations. This alternative was considered, but is not carried forward in the EA analysis because the Preferred Alternative would utilize existing below-grade conduits for the terrestrial cable route and would avoid ground disturbance, with the exception of a short new underground power supply duct between the cable termination point building and the adjacent building. This new underground segment would also be needed in this alternative.

2.4.2.5 Trenched Terrestrial Conduit

Similar to the directionally drilled conduit, this alternative would provide a new underground cable route between the cable transition point and termination buildings at Polaris Point. The trench would be excavated with a small backhoe or excavator that would dig a trench approximately three feet deep. The trench would then be backfilled, compacted, and provided with topsoil and seeding to restore grassy surface areas. Trenching presents constructability challenges due to multiple underground utilities in the affected area. This alternative was dismissed from further consideration and not addressed further in this EA because the Preferred Alternative would use existing underground conduits between the cable transition point and termination point buildings at Polaris Point, thereby avoiding the additional ground disturbance, cost, and constructability issues associated with this alternative.

2.4.2.6 Pole Suspended Cables

This alternative would route homerun cables from the Polaris Point cable transition point building to the termination point building on existing utility poles and require a utility company to elevate the cables and secure them to the poles. This alternative would have the benefit of making the cables easily accessible if repair or replacement is needed. However, Naval Base Guam has long-term plans to place all utilities underground for protection from severe weather events that are common in Guam. Therefore, because this alternative is not consistent with NBG's plans for infrastructure, it was dismissed and is not carried through the EA analysis.

2.5 Best Management Practices Included in Proposed Action

This section presents an overview of the best management practices (BMPs) that are incorporated into the Proposed Action in this document. BMPs are existing policies, practices, and measures that the Navy would adopt to reduce the environmental impacts of designated activities, functions, or processes. Although BMPs mitigate potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from potential mitigation measures because BMPs are (1) existing requirements for the Proposed Action, (2) ongoing, regularly occurring practices, or (3) not unique to this Proposed Action. In other words, the BMPs identified in this document are inherently part of the Proposed Action and are not potential mitigation measures proposed as a function of the NEPA environmental review process for the Proposed Action. The following BMPs would be implemented as part of the Proposed Action. Mitigation measures are discussed separately in Chapter 3. Detailed descriptions of the Navy's proposed BMPs are listed in Appendix C.

2.5.1 BMPS to Avoid and Minimize Impacts to Endangered Species Act (ESA)-Listed Species

A. Constant vigilance would be kept for the presence of ESA-listed marine species to minimize effects from the project on protected species during in-water activities such as boat operations, operating

excavation equipment, diving, and deployment of anchors and mooring lines.

1. The Contractor's Project Manager, site foreman, or site superintendent (herein, Project Manager) would be responsible for ensuring these protocols are adhered to. The Project Manager has stop work authority.
2. Prior to start of installation, Contractor and subcontractor personnel shall attend a Natural Resources Training provided by NBG.
3. The Project Manager would designate at least one marine observer who attended the Natural Resources Training to survey the areas adjacent to the proposed action for ESA-listed marine species during all Project activities.
4. At least one dedicated marine observer would be on-site (stationed on a boat) during all offshore construction phases of the project (e.g., coral translocation, trench excavation and sensor installation, offshore disposal of excavated material, and cable installation). During the installation of the sensor cable underground at the shore, the marine observer would be stationed onshore or on a boat.
5. Project-related personnel would not attempt to disturb, touch, ride, feed, or otherwise intentionally interact with any protected species.
6. Project-related personnel would stay more than 50 yards away from sea turtles that haul-out on land.
7. NBG would document and report to NMFS, all interactions with ESA-listed species (monthly), including the disposition of any listed species that are injured or killed (within 24 hours).

B. In-water operations would employ measures to reduce potential collisions with ESA-listed marine species.
   1. Vessel operators would halt or alter course to remain at least 50 yards from ESA-listed marine species.
   2. Vessel operators would reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals, and to 5 knots or less when piloting vessels in areas of known or suspected turtle activity. Operators would be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity. Ocean disposal transit speeds for a vessel or tugboat towing the scow/barge would be generally at slow speeds (i.e., less than 10 knots) to reduce potential collisions with ESA-listed marine species.
   3. If approached by a ESA-listed marine species, the vessel operator would put the engine in neutral until the animal is at least 50 feet away, and then slowly move way to 50 yards from the animal.
   4. Vessel operators would not encircle or trap ESA-listed marine species between multiple vessels or between vessels and the shore.

C. In-water operations would employ measures to reduce potential direct physical impacts to ESA-listed species
   1. In-water tethers and mooring lines for vessels and marker buoys would be kept to the minimum lengths necessary and would remain deployed only as long as needed to accomplish the task.

2. Before any equipment or material enters the water, a responsible party (i.e., the Project Manager) would verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the substrate.
3. All objects lowered to the bottom would be lowered in a controlled manner. This would be achieved by the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
4. With the exception of the actual dredging apparatus (e.g., clamshell buckets), any heavy equipment would be operated from above and out of the water.
5. Anchor lines from installation vessels would be deployed with appropriate tension to avoid entanglement with ESA-listed species. Construction related equipment that may pose an entanglement hazard would be removed from the project site if not actively being used.

2.5.2 BMPs to Avoid and Minimize Impacts on the Marine Environment

The following BMPs are considered a part of the proposed action and would be implemented, as applicable, to avoid and/or minimize adverse impacts, specifically to Essential Fish Habitat (EFH). Rationale for implementation of each BMP as it related to EFH is also provided.

A. Coral transplantation and all in-water activities would cease during the primary Guam coral spawning events each year for hard (scleractinian) corals. The coral spawning period is estimated to be 21 days total, including 8 days prior to the full moon and 14 days after:
   - 2022 Coral Spawning Season: July 5–27 (Full moon July 13–14)
   - 2023 Coral Spawning Season: June 25–July 18 (Full moon July 2–3).

B. All anchors (e.g., for vessels and silt curtains) are set on hard or soft, sandy bottom void of corals and seagrass, and that chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. If practicable, all intertidal work would be conducted at low and/or slack tides.

C. Work platforms and barges would be oriented to minimize shading to the most reasonable extent practicable. The Navy would attempt to position vessels so that the path of the sun would cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.

D. A Storm Water Pollution Prevention Plan (SWPPP) would be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation. The SWPPP would include, at a minimum, the following BMPs:
   1. Silt socks, filter fabric, or an approved equivalent would be used around all topside construction located near waters of the U.S.
   2. All anchors (e.g., for vessels and silt curtains) are set on hard or soft, sandy bottom void of corals and seagrass, and that chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides.
   3. Work platforms and barges would be oriented to minimize shading to the most reasonable extent practicable. The Navy would attempt to position vessels so that the path of the sun

would cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.

4. A plan to prevent trash and debris from entering the marine environment during the project would be included in the SWPPP and implemented throughout execution of the Project.
5. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout execution of the Project.

E. A temporary floating debris boom would be installed around all work located below the high tide line. The location of the boom would shift as in-water work shifts during project phasing.

F. Silt containment would be installed at three different sites within the action area: a silt curtain immediately adjacent to and around the dredge barge; a silt fence around the cable excavation area at Polaris Point; and silt barriers along the shoreline at Polaris Point. These silt containment devices would isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. If a plume is observed outside of the silt curtains, project activity would stop and corrective action would be taken immediately. Work would not resume until after the correction is made. The Project Manager would inform NBG if a plume is observed.

G. As practicable, work would be conducted during calm sea states with work stoppages during high surf, winds, and currents. In the event of approaching foul weather (i.e., tropical storms and typhoons), equipment would be either removed from the project site or adequately secured. Guam utilizes the severe weather alert system levels I-IV (provided below). A Condition Level IV is the lowest alert level and indicates a possible threat of destructive winds within 72 hours and a Condition Level I is the highest alert that indicates destructive winds are expected within 12 hours. In order to provide 48 hours leeway preparation, work activities would immediately begin the appropriate removal and/or securement of all in water equipment, vessels, and barges once a Condition Level III is triggered. Once post storm activities permit a safe assessment of equipment and conditions of the project sites, as feasible, that would be evaluated for a safe return to work providing reports of any additional adverse storm impacts.

Guam Typhoon Conditions:

- Condition Level I: A typhoon is expected to hit the island within 12 hours.
- Condition Level II: A typhoon is expected to hit the island within 24 hours.
- Condition Level III: A typhoon may possibly hit the island within 48 hours.
- Condition Level IV: Guam is always in Condition IV. A typhoon may develop and hit the island within 72 hours.

H. The portions of the equipment that enter the water would be clean and free of pollutants, including aquatic invasive species (AIS). All vessels and equipment (including barges, dry docks, and dredging equipment) would be free from fouling organisms before entering Guam's coastal waters. A biofouling management plan would be developed for all vessels entering Guam waters. The Project Manager and the heavy equipment operator 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.

I. Divers would select the anchor locations (along the cable route) for the mooring system and ensure that the locations are void of protected resources and circumvent around coral colonies. The Navy would require the contractor to verify that anchors are not being placed on substrate that supports coral growth. Also, the Navy would require the contractor to ensure that anchor chains do not scour the environment where sensitive benthic organisms could occur.

J. During ocean disposal of excavated material to the G-DODS, the following BMPs would be implemented:

1. Transportation of excavated material to the G-DODS shall only be allowed when weather and sea state conditions would not interfere with safe transportation and would not create risk of spillage, leak, or other loss of excavated material in transit to the G-DODS. No disposal vessel trips shall be initiated when the National Weather Service has issued a gale warning for local waters during the time period necessary to complete dumping operations.
2. Excavated material shall not be leaked or spilled from disposal vessels during transit to the G-DODS.
3. When excavated material is discharged within the G-DODS, no portion of the vessel from which the materials are to be released (e.g., hopper dredge or towed barge) can be further than 1,500 feet from the center of the surface disposal zone designated in the permit. The center of the G-DODS is also the center of the surface disposal zone for disposal.
4. No more than one disposal vessel may be present within the permissible dumping target area at any time.
5. The Contractor shall obtain, operate, and maintain a primary disposal tracking system for recording ocean disposal operations data that is disposal-vessel (e.g., scow) based.
6. An appropriate Global Positioning System (GPS) shall be used to indicate the position of the disposal vessel with a minimum accuracy of 11.5 feet during all transportation and disposal operations.
7. The Contractor shall complete an EPA and USACE approved Scow Certification Checklist Form that documents:
   i. the amount of material excavated and loaded into each barge for disposal
   ii. the location from which the material in each barge was excavated
   iii. the weather report for and sea-state conditions anticipated during the transit period
   iv. the time that each vessel departs for, arrives at, and returns from the G-DODS
   v. the exact coordinates and time of each disposal
   vi. and the volume of material disposed at the G-DODS during each disposal trip.
8. An authorized and responsible representative of the Contractor (not a subcontractor) or Navy shall inspect each disposal vessel prior to its departure for the G-DODS. The authorized representative shall certify (along with the disposal vessel captain) whether the specifications on the approved Scow Certification Checklist have been met.
9. The Navy shall report any variances from mandatory or special conditions during disposal operations to the District Engineer and the Regional Administrator within 24 hours.

10. Within 20 days of the completion of ocean disposal operations, the Navy shall prepare and submit to the District Engineer and Regional Administrator a report that includes complete records of all dredging, transport and disposal activities.

2.5.3 Miscellaneous BMPs

1. Comply with applicable federal and territorial regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.
2. Contractor to prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains.
3. Contractor to conduct operations in a manner that would not close any thoroughfare or interfere in any way with traffic on highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date.
4. Contractor to provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval.
5. Contractor to avoid interfering with peak traffic flows from 6:00 AM to 8:00 AM and from 3:00 PM to 6:00 PM without notification to and approval by the Contracting Officer.
6. Dust control methods and procedures would be employed by the contractor to prevent or minimize the release of fugitive dust from construction.

3 Affected Environment and Environmental Consequences

This chapter presents a description of the environmental resources and baseline conditions that could be affected from implementing any of the alternatives and an analysis of the potential direct and indirect effects of each alternative.

All potentially relevant environmental resource areas were initially considered for analysis in this Environmental Assessment (EA). In compliance with the National Environmental Policy Act, the Council on Environmental Quality, and Department of Navy guidelines; the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

"Significantly," as used in NEPA, requires considerations of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (e.g., human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant.

This section includes air quality, water resources, cultural resources, biological resources, noise, transportation, and hazardous materials and wastes.

The potential impacts to the following resource areas are considered to be negligible or non-existent so they were not analyzed in detail in this EA:

Geological Resources: Construction of both action alternatives would involve excavation of seafloor substrate to install the sensors and at the manmade Polaris Point shoreline to install the sensor cables and underground cable vault. However, both the subsea and terrestrial excavated areas would be backfilled to generally match their pre-construction bathymetry/topography and no beach erosion or land subsidence is expected to result at the Polaris Point shoreline. During shoreside construction (including any disposal of excavated material at existing CDFs), BMPs would be implemented to avoid soil erosion and offsite stormwater discharge.

The project area does not include any prime farmland and no existing agricultural lands would be affected by either action alternative. Because both action alternatives would result in relatively minor changes to geological or topographic features in the project area, they would not increase the likelihood of seismic activity and related liquefaction impacts. During the operational period, the electromagnetic measurements and data transfer would occur passively in both action alternatives and would have little or no impact on drainage, erosion, prime farmland, land subsidence, beach stability and erosion, and seismic activity. Therefore, geological resources do not require additional analysis in this EA.

Land Use: Under all the alternatives evaluated in this EA, land and water use would remain the same as under existing conditions. The proposed sensor array and subsea transmission cables would be passive systems located on or beneath federal submerged lands in Outer Apra Harbor. These components would

not alter existing uses of the navigational channel, water column, or submerged lands. Terrestrial components of the project involve passive telecommunications infrastructure support that would be located entirely below grade or within existing buildings. Project-related excavated material disposal would occur at existing land-based or ocean disposal facilities (i.e., CDF or G-DODS). Therefore, land use requires no additional analysis in this EA.

Visual Resources: All the project components would be located under water, below grade (onshore), or within existing facilities. Onshore disposal of excavated material resulting from project construction would occur in existing permitted facilities (Orote Airfield CDF or Field 5 CDF), which are generally screened from public view points by vegetation. Therefore, no additional analysis of visual resources is needed in this EA.

Airspace: Construction and operation of the Proposed Action would not involve impacts to military or civilian airspace or facilities. The proposed project location is not proximal to military or civilian airfield or airspace. At approximately 10 miles to the northeast, A.B. Won Pat International Airport is the nearest airport to the project area. The proposed UEMMS would not extend into any of the airport's approach or departure surfaces. Orote Airfield is located on Orote Peninsula over two miles to the west of the project area. It consists of improved expeditionary runways and taxiways used in field training exercises by helicopters and some fixed-wing aircraft (DON, 2010). There is a helipad in the southeast corner of Polaris Point. Project construction equipment and operations would not impede air operations at Orote Airfield or Polaris Point. UEMMS operations would take place in underwater, below grade, or existing Polaris Point structures and have no potential to affect the airspace or operations of helicopter or fixed-wing aircraft operations at Orote Peninsula or Polaris Point. Therefore, no additional analysis is required with respect to airspace impacts.

Infrastructure: Construction and operation of the Proposed Action would have minimal impacts on existing utilities or facilities at NBG. Neither action alternative involves changes to potable water or wastewater systems, and any interruptions to electrical or telecommunications services would be temporary and limited to specific facilities. Stormwater BMPs would be implemented and, if needed, the construction contractor would establish temporary drainage features during construction. Construction and operational period solid waste is expected to be minimal as no demolition of structures is planned and the UEMMS would operate passively, generating no direct solid waste. The interiors of two existing facilities at Polaris Point would be altered to accommodate UEMMS data acquisition equipment, but no other existing facilities would be affected. There would be a marginal increase in electrical power demand but this would not affect existing service to other users, reach or exceed current system capacity, or require development of facilities and sources beyond those existing or currently planned. Therefore, no additional analysis is required with respect to infrastructure.

Public Health and Safety: Safety protocols, standard operating procedures (SOPs), and BMPs would be observed during the construction period under both action alternatives (e.g., notification of the U.S. Coast Guard [USCG] District 14 requesting a Local Notice to Mariners, contractor vessel movement coordination with NBG Port Operations Harbor Master, compliance with base foul weather hazard requirements, signage, temporary barricades and safety fencing at terrestrial construction site, access control). Due to the nature of the proposed UEMMS operations (i.e., passive data collection and transmission below grade, within secured facilities, or encased within HDPE conduits secured to the seafloor), no new risks to inhabitants or users of adjacent or nearby land and water areas are expected.

Due to the secured premises and general inaccessibility of the UEMMS components and construction areas to the general public, the Proposed Action would not increase the likelihood that a child would come in contact with or ingest products or substances that present environmental health and safety risks to children during the construction or operational periods. The Navy has determined that there are no environmental health and safety risks associated with the Proposed Action that would disproportionately affect children. Because both action alternatives would pose low risks to public health and safety, no further analysis is required in this EA.

Socioeconomics: Construction and operation of the Proposed Action would not impact population; employment/industry characteristics; demand for schools, housing, recreational facilities; or demographic, economic, or fiscal conditions of the Territory of Guam. Economic benefits of construction job creation would be temporary and associated with project construction. After its completion, the proposed UEMMS would passively gather electromagnetic signature data from surface ships and submarines that pass overhead. These data would be analyzed onsite by approximately two DoD personnel or contractors and would not drive substantial new employment either in Guam or at remote locations. Therefore, the project would not result in secondary impacts related to increasing development capacity or population growth.

Environmental Justice: Consistent with Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (February 11, 1994), EO 13045, Protection of Children from Environmental Health and Safety Risks (April 21, 1997), and EO 14008, Tackling the Climate Crisis at Home and Abroad (February 1, 2021), the Navy has evaluated the Proposed Action and determined that it would not cause disproportionately high and adverse human or environmental effects of its actions on minority and low-income populations.

Both action alternatives (including any disposal of excavated material in NBG CDFs) would occur within Navy-controlled lands and waters (including submerged lands) and secured to prevent public access. Any ocean disposal of excavated material at G-DODS would adhere to USCG and USEPA safety and environmental regulations and controls, and would not introduce new environmental hazards to minority or low income populations. The type and nature of UEMMS operations would not substantively change existing land and water use or the type, tempo, and nature of NBG operations and activities. Therefore, no additional evaluation is required with respect to Environmental Justice.

3.1 Air Quality

This discussion of air quality includes criteria pollutants, standards, sources, permitting, and greenhouse gases. Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

Most air pollutants originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires.

3.1.1 Regulatory Setting

3.1.1.1 Criteria Pollutants and Ambient Air Quality Standards

The principal pollutants defining the air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). CO, SO_2, Pb, NO_2, and some particulates are emitted directly into the atmosphere from emissions sources. Ozone, NO_2, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for these pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

Effective April 9, 2018, USEPA designated a portion of Guam in the Piti-Cabras area as being in nonattainment of the 2010 1-hour SO_2 primary NAAQS. The Piti-Cabras nonattainment area includes two facilities (i.e., electrical power plants) that are sources of SO_2 emissions and comprises a 6.074-kilometer (approximately 3.8-mile) radius centered on UTM Easting 249,601.60 m, and UTM Northing 1,489,602.00 m (UTM Zone 55N) (see Figure 3-1). The nonattainment area was determined based on modeling analysis of hourly actual emissions, which included marine vessels associated with the DON's facilities at NBG (USEPA, 2017). The rest of the Territory is designated as in attainment/unclassifiable.

The CAA requires states to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as State Implementation Plans (SIPs), are developed by state and local air quality management agencies, and submitted to USEPA for approval. SIPs must be developed and submitted to USEPA within 18 months of the effective date of the designation—i.e., October 9, 2019 for the Piti-Cabras SO_2 nonattainment area. SIPs must meet the requirements of the CAA and provide for attainment of the NAAQS as expeditiously as practicable, but no later than five years from the effective date of the designation.

The Territory of Guam regulates ambient air quality standards (AAQS) defined in Title 22-1, Article 3 of the Guam Administrative Rules. Guam standards have been established for SO_2, particulate matter (measured as PM_{10}), CO, ozone, NO_2, and Pb. The Guam AAQS are given in terms of primary standards, which define levels of air quality necessary "with an adequate margin of safety, to protect the public health" and secondary standards, which define levels of air quality necessary "to protect the public welfare from any known or anticipated adverse effects of a pollutant."

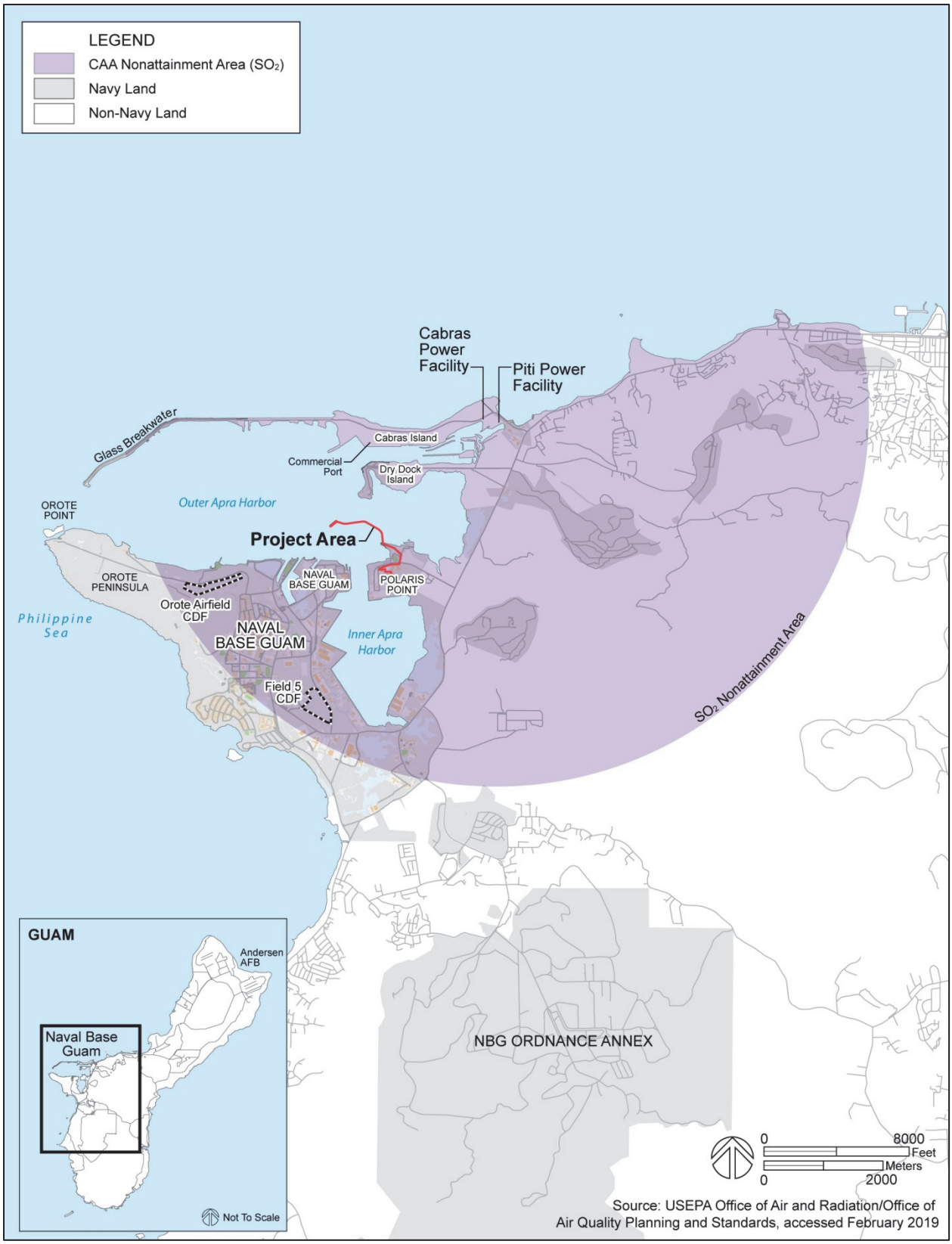

Figure 3-1 Clean Air Act SO_2 Nonattainment Area

3.1.1.2 Mobile Sources

Hazardous air pollutants (HAPs) emitted from mobile sources are called Mobile Source Air Toxics (MSAT). MSAT are compounds emitted from motor vehicles that are known or suspected to cause cancer or other serious health and environmental effects. In 2001, USEPA issued its first MSAT Rule, which identified 201 compounds as being HAPs that require regulation. A subset of six of the MSAT compounds was identified as having the greatest influence on health and included benzene, butadiene, formaldehyde, acrolein, acetaldehyde, and diesel particulate matter. More recently, USEPA issued a second MSAT Rule in February 2007, which generally supported the findings in the first rule and provided additional recommendations of compounds having the greatest impact on health. The rule also identified several engine emission certification standards that must be implemented (40 CFR parts 59, 80, 85, and 86; Federal Register Volume 72, No. 37, pp. 8427–8570, 2007). Unlike the criteria pollutants, there are no NAAQS for benzene and other HAPs. The primary control methodologies for these pollutants for mobile sources involves reducing their content in fuel and altering the engine operating characteristics to reduce the volume of pollutant generated during combustion.

3.1.1.3 General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a federal action must be supported by a conformity determination. This is typically done by quantifying applicable direct and indirect emissions that are projected to result due to implementation of the federal action. Indirect emissions are those emissions caused by the federal action and originating in the region of interest, but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. The location of such emissions is known and the emissions are quantifiable, as described and documented by the federal agency based on its own information and after reviewing any information presented to the federal agency. If the results of the applicability analysis indicate that the total emissions would not exceed the *de minimis* emissions thresholds, then the conformity evaluation process is completed. The *de minimis* threshold for SO_2 (i.e., the only criteria pollutant that has a nonattainment or maintenance designation in Guam) is presented in Table 3-1.

Table 3-1 SO_2 General Conformity *de minimis* levels

Pollutant	*Area Type*	*tpy*
SO_2	All nonattainment & maintenance	100

tpy = tons per year

3.1.1.4 Permitting

Title V (Operating Permit)

The Title V Operating Permit Program consolidates all CAA requirements applicable to the operation of a source, including requirements from the SIP, preconstruction permits, and the air toxics program. It applies to stationary sources of air pollution that exceed the major source emission thresholds, as well as other non-major sources specified in a particular regulation. The program includes a requirement for payment of permit fees to finance the operating permit program whether implemented by USEPA or a state or local regulator. Navy installations subject to Title V permitting shall comply with the requirements of the Title V Operating Permit Program, which are detailed in 40 CFR Part 70 and all specific requirements contained in their individual permits.

3.1.1.5 Greenhouse Gases

Greenhouse gases (GHGs) are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

USEPA issued the Final *Mandatory Reporting of Greenhouse Gases Rule* on September 22, 2009. GHGs covered under the Final *Mandatory Reporting of Greenhouse Gases Rule* are carbon dioxide (CO_2), methane, nitrogen oxide (NO_x), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. The equivalent CO_2 rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of mobile sources and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions as carbon dioxide equivalent (CO_2e) are required to submit annual reports to USEPA.

Pursuant to EO 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, CEQ rescinded its 2019 Draft NEPA Guidance on Consideration of Greenhouse Gas Emissions and is reviewing, for revision and update, the 2016 Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews. Under CEQ's August 1, 2016 guidance ("Memorandum for Heads of Federal Departments and Agencies," federal agencies were to consider, "(1) The potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g., to include, where applicable, carbon sequestration); and (2) The effects of climate change on a proposed action and its environmental impacts."

In an effort to reduce energy consumption, reduce GHGs, reduce dependence on petroleum, and increase the use of renewable energy resources the Navy has implemented a number of renewable energy projects. Examples of Navy-wide GHG reduction projects include energy efficient construction, thermal and photovoltaic solar systems, geothermal power plants, and the generation of electricity with wind energy. The Navy continues to promote and install new renewable energy projects.

3.1.2 Affected Environment

Criteria pollutants at the national level include carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter measured as PM_{10}, ozone, and lead. As seen in Figure 3-1, a large portion of NBG is located within the 2010 1-hour SO_2 primary NAAQS nonattainment area for SO_2, including the UEMMS project area. The Guam Piti-Cabras area, in which the project area is located, has also been designated unclassified for particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, and unclassifiable/attainment for carbon monoxide, ozone, nitrogen dioxide, lead, and particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

Ambient air quality conditions around Apra Harbor and Naval Base Guam are affected by a combination of on base mobile emission sources, including vessels and on-road vehicles, and stationary sources in the area.

There is currently no emissions inventory for the island of Guam, although the Guam Environmental Protection Agency (GEPA) is working towards producing an annual emissions inventory for the island.

3.1.2.1 Apra Harbor

In addition to the mobile sources around Apra Harbor, there are several major stationary emission sources, including the Guam Power Authority's (GPA) Cabras Power Plant in Piti Point area with two steam turbines and two slow speed diesel generators. In the same area, the Taiwan Electrical and Mechanical Engineering Services Power Plant operates a 40-megawatt (MW) combustion turbine known as Piti #7, and the Marianas Energy Company Power Plant operates two slow speed diesel generators, each rated at 44 MW (also known as Piti #8 and #9). Piti Power Plant also has two units #4 and #5 previously operated by GPA, but currently not in operation. Table 3-2 provides permitted emissions for each plant. All of these major power facilities require a Title V operating permit.

Table 3-2 Non-DoD Power Stations: Existing Permitted Major Source Emissions

Station Name	*Permitted Annual Emissions (tpy)*				
	SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
Cabras	17,577.5	1,140.6	1,364.0	12,341.8	877.8
Taiwan Electrical and Mechanical Engineering Services (Unit #7)	1,008.1	38.2	76.5	316.3	n/a
Marianas Energy Company (Units #8 and #9)	6,778.6	549.2	1,473.9	12,236.2	n/a

Source: GEPA Title V Permit Nos. FO-002, final dated May 11, 2009 (Cabras) in DON, 2010 (Table 5.1-8).

3.1.2.2 Naval Base Guam

As noted earlier, ambient air quality conditions at Naval Base Guam are affected by a combination of on base mobile emission sources, including vessels and on-road vehicles, and stationary sources in the area. Because there are no air quality monitoring stations in Apra Harbor, existing pollutant levels from non-permitted sources—such as mobile emissions sources from vessels operating in Apra Harbor and vehicles operating on NBG roadways—are not available.

Naval Base Guam has two emergency generators (one 100 kilowatt [kW] and one 125 kW, respectively). Additionally, the Navy's Orote Point Power Plant has several air permits with combined permitted emissions exceeding 100 tpy for both NOx and volatile organic compounds (VOC). The sources covered by these separate air permits under the Orote Point Power Plant are as follows:

- Three emergency diesel generators that can operate up to 1,350 hours per year combined for all three units, one black start emergency generator, a 196,000-cubic yard (CY) sanitary landfill and shredder. Permitted emissions from these sources are included in a Title V permit and summarized in Table 3-3.
- Two boilers and one 200 kW emergency generator.
- Various boilers and emergency diesel generators.

Table 3-3 Orote Point Power Plant Title V Permitted Emissions

Permitted Annual Emissions (tpy)				
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
23.0	6.1	0.7	96.0	7.4

Source: GEPA Title V Permit No. FO-015F in DON, 2010, Table 5.1-9
Key: tpy = tons per year

Recent annual criteria pollutant emissions for NBG as reported by the DON to GEPA are shown in Table 3-4.

Table 3-4 NBG Air Emissions Inventory

Year	*NOx (tpy)*	*VOC (tpy)*	*CO (tpy)*	*SO_x (tpy)*	*PM10 (tpy)*	*$PM_{2.5}$ (tpy)*
2016	29.0	13.5	3.6	0.1	0.7	0.0
2017	21.7	10.8	4.4	0.1	0.8	0.0
2018	19.3	10.3	4.5	0.0	0.7	0.0

Sources: Naval Facilities Engineering Command Marianas Annual Air Pollution Emissions and Fee Summary Reports for CY 2016, CY 2017, CY 2018 and NBG Annual Air Pollution Emissions and Fee Summary Reports for CY 2016, CY 2017, and CY 2018. Reported to nearest 1/10 of a ton. Various dates.
Key: tpy = tons per year.

3.1.3 Environmental Consequences

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The region of influence (ROI) for assessing air quality impacts is the air basin in which the project is located, the NBG air basin.

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations.

3.1.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline air quality. Therefore, no impacts to air quality or air resources would occur with the No Action Alternative.

3.1.3.2 Concrete Anchor Disc Alternative

Air quality impacts under the Preferred Alternative were assessed by evaluating the additional emissions associated with the proposed construction. Table 3-5 summarizes the estimated air emissions under the

Preferred Alternative with excavated material disposal at G-DODS. Appendix A-1 contains detailed worksheets.

During the operational period, use of the sensor array would not increase ship traffic from either homeported or transient vessels at NBG. The specifications of the UEMMS at NBG would be customized to the requirements of the vessels homeported at NBG, which would be measured within their normal deployment schedules. In other words, the UEMMS would not increase the movements to or from Apra Harbor of NBG homeported vessels and would not generate demand for field signature measurement of transient vessels.

Operation of the UEMMS is not expected to affect on-base or on-island staffing levels because current NBG staff would assume the role of collecting its data. Data acquisition would take place in a dedicated room in an existing building in the interior of Polaris Point. If it becomes necessary to hire new staff, an additional two personnel would be required, who would likely currently reside on Guam.

The proposed action would be implemented over a two-year period starting in 2021 with pre-construction surveys.

Table 3-5 Estimated Preferred Alternative Air Emissions

	Emissions (tpy)									
Year	***CO***	***NO_x***	***PM_{10}***	***$PM_{2.5}$***	***SO_2***	***VOC***	***CO_2***	***CH4***	***N_2O***	***CO_2e***
2021	0.99	6.10	0.15	0.15	0.004	0.20	513.90	0.01	0.02	519.60
2022	2.32	3.14	0.09	0.08	0.003	1.06	352.38	0.02	0.008	355.19
2023	0.08	0.36	0.008	0.008	0.0004	0.02	40.90	0.001	0.00	40.93

General Conformity

The 1990 amendments to the CAA require federal agencies to ensure that their actions conform to the SIP in a nonattainment area. As the Proposed Action would potentially involve SO_2 emitting activities in the Piti-Cabras sulfur dioxide (SO_2) nonattainment area (see Figure 3-1), the General Conformity Rule applies to the proposed activities within the nonattainment area. Therefore, a subsequent general conformity applicability analysis is required.

The *de minimis* level established by USEPA applicable to the non-attainment area on Guam (Piti-Cabras), is 100 TPY of SO_2. If the total direct and indirect emissions of a pollutant are above the *de minimis* level, a formal general conformity determination is required for that pollutant. The net increase in SO_2 emissions with potential to emit from the proposed action within the SO_2 nonattainment area was predicted for operational and construction activities with potential air pollutant emissions (see Appendix A-1 for calculations). Annual SO_2 emissions from the Preferred Alternative would not exceed the *de minimis* criterion of 100 TPY of SO_2 in the Piti-Cabras nonattainment area. Therefore, the Preferred Alternative is exempt from the Clean Air Act General Conformity Rule because its projected emissions are below the applicable de minimis threshold (see Appendix A-1). (Note: Annual SO_2 emissions would be the same whether excavated material were disposed of at G-DODS or an NBG CDF.)

Greenhouse Gases

Implementation of the Preferred Alternative would contribute directly to emissions of GHGs from the combustion of fossil fuels. As seen in Table 3-5, construction activities would generate well under 25 metric tons of CO_2e annually. Once the facility is operational, routine activities would generate annual GHG emissions less than the CEQ threshold of 25,000 metric tons. This limited amount of emissions would not likely contribute to global warming to any discernible extent. (Note: Land-based disposal of excavated material would result in slightly greater, but less than significant, annual CO_2e emissions in 2022 than for ocean disposal at G-DODS [364.81 tpy vs. 355.19 tpy]. Annual CO_2e emissions in 2021 and 2023 would be the same for both disposal methods.)

Therefore, implementation of the Preferred Alternative would not result in significant impacts to air quality.

3.1.3.3 Concrete Block Mat Alternative

Potential Impacts

The Concrete Block Mat Alternative would have slightly higher, but non-significant impacts as the Preferred Alternative (including for GHG emissions) because it would use the same construction equipment, vessels, and vehicles, but have a longer construction duration (approximately 20 additional work days of in-water work). The difference would result in a minor increase in annual GHG emissions (less than 100 tpy CO_2e) and no change in annual SO_2 emissions. Table 3-6 summarizes the estimated air emissions from this alternative and Appendix A-2 contains detailed tables.

Table 3-6 Estimated Concrete Block Mat Alternative Air Emissions

	Emissions (tpy)									
Year	***CO***	***NO_x***	***PM_{10}***	***$PM_{2.5}$***	***SO_2***	***VOC***	***CO_2***	***CH4***	***N_2O***	***CO_2e***
2021	0.99	6.10	0.15	0.15	0.004	0.20	513.90	0.01	0.02	519.60
2022	2.74	3.39	0.10	0.09	0.003	1.21	401.48	0.02	0.009	404.59
2023	0.08	0.36	0.008	0.008	0.0004	0.02	40.90	0.001	0.000	40.93

Note: Annual CO_2e emissions from excavated material disposal at an NBG CDF are estimated to be slightly higher, but insignificant, than in ocean disposal in 2022 (414.21 tpy vs. 404.59 tpy); annual emissions in 2021 and 2023 are estimated to be the same for both disposal methods. Annual SO_2 emissions are estimated to be the same in both disposal methods.

Therefore, implementation of this action alternative would not result in significant impacts to air quality.

3.2 Water Resources

This discussion of water resources includes groundwater, surface water, marine waters, wetlands, floodplains, and shorelines. This section also discusses the physical characteristics of marine waters; wildlife and vegetation are addressed in Section 3.4, Biological Resources.

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater is used for water consumption, agricultural irrigation, and industrial applications. Groundwater properties are often described in terms of depth to aquifer, aquifer or well capacity, water quality, and surrounding geologic composition. Sole source aquifer designation provides limited protection of groundwater resources which serve as drinking water supplies.

Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. A Total Maximum Daily Load (TMDL) is the maximum amount of a substance that can be assimilated by a water body without causing impairment. A water body can be deemed impaired if water quality analyses conclude that exceedances of water quality standards occur.

Marine waters would typically include estuaries, waters seaward of the historic height of tidal influence, and offshore high salinity waters. Marine water quality would be described as the chemical and physical composition of the water as affected by natural conditions and human activities. Additionally, marine waters may include an area within a National Marine Sanctuary requiring an action proponent to avoid adverse water quality impacts in order to prevent damage to resources within the sanctuary.

Wetlands are jointly defined by USEPA and USACE as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include "swamps, marshes, bogs and similar areas."

Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. Floodplain delineation maps are produced by the Federal Emergency Management Agency and provide a basis for comparing the locale of the Proposed Action to the floodplains.

Shorelines can be located along marine (oceans), brackish (estuaries), or fresh (lakes) bodies of water. Physical dynamics of shorelines include tidal influences, channel movement and hydrological systems, flooding or storm surge areas, erosion and sedimentation, water quality and temperature, presence of nutrients and pathogens, and sites with potential for protection or restoration. Shoreline ecosystems are vital habitat for multiple life states of many fish, birds, reptiles, amphibians, and invertebrates. Different shore zones provide different kinds and levels of habitat, and when aggregated, can significantly influence life. Organic matter that is washed onto the shore, or "wrack," is an important component of shoreline ecosystems, providing habitat for invertebrates, soil and organic matter, and nutrients to both the upland terrestrial communities and aquatic ecosystems.

3.2.1 Regulatory Setting

The Safe Drinking Water Act is the federal law that protects public drinking water supplies throughout the nation. Under the Safe Drinking Water Act, The USEPA sets standards for drinking water quality. Groundwater quality and quantity are regulated under several statutes and regulations, including the Safe Drinking Water Act.

The CWA establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES) program, on the amounts of specific pollutants that can be discharged into surface waters to restore and maintain the chemical, physical, and biological integrity of the water. The NPDES program regulates the discharge of point (i.e., end of pipe) and nonpoint sources (i.e., stormwater) of water pollution.

The Guam NPDES stormwater program requires construction site operators engaged in clearing, grading, and excavating activities that disturb one acre or more to obtain coverage under an NPDES Construction General Permit for stormwater discharges. Construction or demolition that necessitates an individual permit also requires preparation of a Notice of Intent to discharge stormwater and a Stormwater Pollution Prevention Plan that is implemented during construction. As part of the 2010 Final Rule for the CWA, titled *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category*, activities covered by this permit must implement non-numeric erosion and sediment controls and pollution prevention measures.

Wetlands are currently regulated by the USACE under Section 404 of the CWA as a subset of all "Waters of the United States." Waters of the United States are defined as (1) traditional navigable waters, (2) wetlands adjacent to navigable waters, (3) nonnavigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow perennially or have continuous flow at least seasonally (e.g., typically 3 months), and (4) wetlands that directly abut such tributaries under Section 404 of the CWA, as amended, and are regulated by USEPA and the USACE. The CWA requires that Guam establish a Section 303(d) list to identify impaired waters and establish TMDLs for the sources causing the impairment.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredge or fill into wetlands and other Waters of the United States. Any discharge of dredge or fill into Waters of the United States requires a permit from the USACE.

Section 438 of the Energy Independence and Security Act establishes storm water design requirements for development and redevelopment projects. Under these requirements, federal facility projects larger than 5,000 sq ft must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Section 10 of the Rivers and Harbors Act provides for USACE permit requirements for any in-water construction. USACE and some states require a permit for any in-water construction. Permits are required for construction of piers, wharfs, bulkheads, pilings, marinas, docks, ramps, floats, moorings, and like structures; construction of wires and cables over the water, and pipes, cables, or tunnels under the water; excavation; any obstruction or alteration of navigable waters; depositing fill and dredged material; filling of wetlands adjacent or contiguous to waters of the U.S.; construction of riprap, revetments, groins, breakwaters, and levees; and transportation of dredged material for dumping into ocean waters.

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Act is notable for safeguarding the special character of these rivers, while also recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection.

The Coastal Zone Management Act of 1972 (CZMA) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones. Actions occurring within the coastal zone commonly have several resource areas that may be relevant to the CZMA. The CZMA regulatory setting discussion is discussed in Section 5.1.1.

Executive Order 11990, *Protection of Wetlands,* requires that federal agencies adopt a policy to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction and modification of wetlands and to avoid the direct and indirect support of new construction in wetlands whenever there is a practicable alternative.

Executive Order 11988, *Floodplain Management*, requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative. Flood potential of a site is usually determined by the 100-year floodplain, which is defined as the area that has a one percent chance of inundation by a flood event in a given year.

3.2.2 Affected Environment

The following discussion provides a description of the existing conditions for marine waters. (Note: Groundwater, surface water, wetlands, floodplains, and shorelines are not discussed as these water resources are not located in the project area and/or have little to no potential to be affected by the Proposed Action. The Proposed Action would return excavated shore areas generally to their pre-construction conditions, would not change shoreline topography, or introduce new above ground structures that would affect the existing floodplain area or function.)

3.2.2.1 Marine Waters

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

Guam tides are semidiurnal with a mean range of 1.6 feet and diurnal range of 2.3 feet. Extreme predicted tide range is about 3.5 feet (GEPA, 2006). Surface seawater temperatures on Outer Apra Harbor are typically 79 to 86 degrees Fahrenheit (Smith et al., 2013 in DON, 2018). Temperature fluctuations are more pronounced at the eastern stations compared to those toward the mouth of the harbor.

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Nutrients are chemicals necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. Water pollutants alter the basic chemistry of seawater in various ways (DON, 2010).

The vast expanse of offshore waters, their distance from the shore, and mixing and transport effects of currents work together to maintain a generally high quality of water. The major chemical parameters of marine water quality include pH, amount of dissolved oxygen, and nutrient concentrations. The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution.

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

Apra Harbor receives freshwater inflows from the Atantano, Sasa, Aguada, and Laghas rivers, with the Atantano River emptying into Inner Apra Harbor (and the other three emptying into Sasa Bay). These rivers primarily drain the areas around the municipalities of Piti and Santa Rita. Stormwater runoff from these areas carries large amounts of sediments, most of which originates from the widespread soil erosion that occurs in the highlands and from improperly managed construction activities within the drainage basin (Guam DPW, 2010, as cited in HDR, 2011). Over time, the sediments deposited by rivers and streams flowing into the inner harbor and Sasa Bay are transported by the combined actions of winds, waves, currents, and tides to the outer harbor where they adversely impact in-harbor water quality and coral reefs (HDR, 2011).

Guam Water Quality Standards (GWQS), adopted by GEPA in 2001, establish three categories of waters: groundwater, marine waters, and surface waters. The waters of Outer Apra Harbor are categorized as "marine waters." Marine waters include all coastal waters off-shore from the mean high water mark, including estuarine waters, lagoons, bays, brackish areas, wetlands and other special aquatic sites, and other inland waters that are subject to tidal influence. Marine waters are further divided into three sub-categories: Excellent (M-1), Good (M-2) and Fair (M-3). The waters within Outer Apra Harbor—including the project area—are designated M-2. According to the GWQS, water in the M-2 category must be of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals and other reef related resources, and whole body contact recreation. Other important and intended uses include mariculture activities, aesthetic enjoyment, and related activities. The Piti Channel empties into Outer Apra Harbor and is characterized as M-3 (Fair), which is defined as being marine waters that are intended for general, commercial, and industrial use, while allowing for protection of aquatic life, aesthetic enjoyment, and compatible recreation with limited body contact. Specified intended uses of M-3 waters include shipping, boating and berthing, industrial cooling water and marinas. Saltwater acute, saltwater chronic and human health standards are applicable to all toxic pollutants discharged in M-3 waters.

Physical and water quality parameters of marine waters around Guam were measured in 2005 and 2007 by NOAA Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Division under its Mariana Archipelago Reef Assessment and Monitoring Program (MARAMP), including within Outer Apra Harbor. Compared with waters along the north and east coasts of the island, temperatures in the southwestern measurement areas (such as Apra Harbor) were higher and salinities relatively low. These areas are sheltered by mountains in southern Guam from easterly winds, which contribute to mild vertical mixing upward of deeper, cooler waters in waters along the east side of the island (Brainard et al., 2012). Nutrients measured in the 2005 and 2007 MARAMP surveys included chlorophyll-a, total nitrogen, nitrate, nitrite, phosphate, and silicate. Turbidity was low at most locations around Guam; however, measurements at Apra Harbor indicated the highest turbidity around the island (Brainard et al., 2012). Compared with conditions elsewhere around Guam, Apra Harbor had higher concentrations of

chlorophyll-a, phosphate, and silicate and lower concentrations of nitrogen, likely a result of high residence times within this protected harbor and possibly an outcome of receiving high volumes of runoff (Brainard et al., 2012).

Water quality within Apra Harbor has not been consistently monitored over time, and therefore no comprehensive spatial or temporal data are available to determine discernable trends. Sediment and biological tissue samples collected from selected locations within the harbor were previously analyzed for heavy metals, polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs) (Denton et al. 1997, 1999, as cited in HDR, 2011). Sponges, soft corals, sea cucumbers and fish collected from within the harbor showed elevated levels of PCBs. Invertebrate tissue samples showed elevated concentrations of arsenic. Relatively high levels of copper and zinc were also recorded in oyster tissues collected from Apra Harbor. None of the fish or shellfish tissue samples, however, exceeded U.S. Food and Drug Administration food standards or guidance limits (GEPA 2000b, as cited in HDR, 2011).

Total suspended solids (TSS) monitoring data from two locations off Kilo Wharf in Apra Harbor indicated that annual average TSS concentrations for surface, mid-depth and bottom samples ranged from 3.6 to 4 milligram per liter (mg/l). Maximum concentrations measured at the two monitoring stations were 15.2 mg/L and 42.3 mg/l, respectively (Sea Engineering 2011, as cited in HDR, 2011). These results are consistent with TSS measurements conducted by Marine Research Consultants (2005) in the vicinity of Kilo Wharf, which ranged from 2 to 13 mg/L and averaged 5 mg/l (Marine Research Consultants, 2005, as cited in HDR, 2011).

A baseline set of water samples in the vicinity of eastern Outer Apra Harbor, Guam were collected in November 2007 and January 2008 (TEC, Inc. – Joint Venture, 2009). Results of analyses of turbidity and TSS reveal overall relatively low values throughout the area. Most values of turbidity were below 1 Nephelometric Turbidity units, and most values of TSS were below 2 mg/l. Measures of turbidity and TSS indicated very little vertical or horizontal stratification within the region of study. Results indicated little effect on turbidity and TSS within the Outer Harbor from either the Inner Harbor or Sasa Bay. Vertical profiles of temperature, salinity, dissolved oxygen, and pH revealed influences of the Inner Harbor and Sasa Bay. A surface layer of low salinity, low temperature water was present in the Inner Harbor, but rapidly dispersed beyond the Inner Harbor entrance. A similar surface layer of low salinity, but not cooler water was present at the eastern end of the study area, revealing influence of westward flow from Sasa Bay. Overall, the effects from the freshwater sources were minor beyond the sources, and the uniform conditions characterized the surveyed area.

Characterized by the 2008 baseline study, water quality in outer Apra Harbor was within the limits of compliance of the GWQS. Several of the measured constituents exceeded specific criteria limits for marine water designated with the M-2 classification, which includes the area of Outer Apra Harbor in the vicinity of the Proposed Action. It is likely that water quality would change as a result of changing seasonal conditions, particularly following episodic rainfall and runoff events. (TEC, Inc. – Joint Venture, 2009).

In a 2006 sediment study (NAVFAC Pacific 2006, as cited in DON, 2018), Aroclor-1260 was detected at a low level in Outer Apra Harbor sediment adjacent to the Ship Repair Facility, and tributyltin was detected at low levels in sediment of the channel connecting Inner and Outer Apra Harbor. Other contaminants, such as PCBs (both individual congeners and other aroclors), chlorinated pesticides, organo-tins, phenols, and phthalates were either not detected or were estimated at concentrations below their respective reporting limits in sediment samples. In all areas, oil and grease and total

recoverable petroleum hydrocarbons were below detection limits. Metals that have exceeded the effects range low (ER-L) but not effects range medium (ER-M) levels were measured in front of Polaris Point. The most common metal to exceed ER-L is nickel. However, the 2006 sediment study reported that it "…is common for nickel to be found at concentrations greater than the ER-M in material determined to be suitable for ocean disposal" (DON, 2018).

In 2009, an additional sediment coring study was performed in the turning basin, directly in front of Polaris Point, and directly in front of the Ship Repair Facility (NAVFAC Pacific 2010b, as cited in DON, 2018). For the majority of analytes, concentrations were either not detected or lower than ER-L values. Only three metals (copper, lead, and mercury), two polyaromatic hydrocarbon compounds (acenapthene and fluorine), four organochlorine pesticides (4,4'-Dichlorodiphenyltrichloroethane [DDT], total detectable chlordane, and total detectable DDTs), and total detectable PCBs exceeded ER-Ls in any of the samples. There were only two occurrences of a single analyte exceeding the ER-M value (4,4'-DDT; DON, 2018).

Sediment cores and water column samples were collected from within the excavation footprint in 2017 to determine if the excavated material is suitable for ocean disposal (ERA, 2018). Metals, PCBs, dioxins, and furans were detected in the sediment, but at levels suitable for ocean disposal. Toxicity Characteristic Leaching Procedure analysis had detections of arsenic and lead, but did not exceed regulatory value. Amphipod survival bioassay results did not meet the acceptability criterion, but juvenile polychaete survival bioassay did meet the acceptability criterion. Mysid shrimp bioassay, juvenile fish bioassay, and bivalve larval development bioassay meet limiting permissible concentration requirements for ocean disposal. Metals, PCBs, dioxins, and furans were detected in the water column samples, but the values did not exceed corresponding Criteria Continuous Concentration or Criteria Maximum Concentration values (ERA, 2018).

Although depositional processes predominate in Apra Harbor, the sediment accumulation rates are relatively low. The harbor is a relatively low-energy system with multiple sediment inputs separated from a single outlet to the sea by deep water and relatively long distances. This geography alone promotes sedimentation. The low levels of wave and tidal energy, combined with the multi-basinal morphology, promotes settling of the mixed carbonate and clastic sediment load. Therefore, in the absence of anthropogenic impact (i.e., discharge of contamination from land-based sources), clean sediment input would eventually cover contaminated sediments in the harbor. The Inner Harbor is significantly more sheltered than the Outer Harbor, has a southward-dominant bottom current, and receives the two largest sediment loadings in the Apra Harbor system (i.e., Atantano River and the storm drain outfall at the corner of Sierra and Tango Wharves). Therefore, sedimentation rates in the Inner Harbor are higher than those in the Outer Harbor, with the highest estimated sedimentation rate for the Inner Harbor at 3.2 centimeters per year (cm/yr) and the highest estimated sedimentation rate for the Outer Harbor at 1.3 cm/yr (DON 2016, as cited in AECOM, 2018).

3.2.3 Environmental Consequences

In this EA, the analysis of water resources focuses on the potential impacts on marine waters. Groundwater analysis focuses on the potential for impacts to the quality, quantity, and accessibility of the water. The analysis of surface water quality considers the potential for impacts that may change the water quality, including both improvements and degradation of current water quality. The analysis includes potential changes to physical and chemical characteristics.

3.2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline water resources. Therefore, no impacts to water resources would occur with the No Action Alternative.

3.2.3.2 Concrete Anchor Disc Alternative (Preferred Alternative) Potential Impacts

The study area for the analysis of effects to water resources associated with the Preferred Alternative includes Outer Apra Harbor waters in the vicinity of the sensor array, subsea cable, and cable transition to shore.

Installation of the proposed sensor array and associated marine and terrestrial infrastructure would include in-water excavation and backfilling of the sensor array site (an area of approximately 7,900 square feet), trenching and subsurface work at the cable bundle shoreline transition area, and ocean and land disposal of excavated material. The sensor cables would be routed on land from the cable transition point to the cable termination point entirely via existing below-grade conduits and require minimal ground disturbance in this route. The use of construction BMPs listed in Section 2.5 (see detailed list in Appendix C) would minimize the transport of resuspended sediments in the water column, soil erosion, and runoff and avoid adverse impacts to marine water resources.

Construction of the Preferred Alternative would temporarily affect the Polaris Point shoreline in the vicinity of the cable transition point due to excavation for the sensor cables landing. However, the excavated area would be backfilled with existing material or similar, and restored to match existing conditions and elevations (i.e., armor stone revetment along the shoreline). Best management practices during construction would avoid or minimize erosion, sedimentation, and other water quality and indirect ecological effects, including from the screening and management of MEC/MPPEH. The CDF sites are contained within earthen berms and stormwater runoff is properly managed to avoid sediment or pollutant transport offsite.

During the operational period, the proposed sensor array and associated cable infrastructure would function passively, either buried beneath the seafloor or revetment armoring material, or contained within HDPE cables and conduits. Because of this, there would be little to no potential to degrade or change physical or chemical characteristics of marine waters.

Therefore, implementation of the Preferred Alternative would not result in significant impacts to water resources.

3.2.3.3 Concrete Block Mat Alternative Potential Impacts

The study area for the analysis of effects to water resources associated with the Concrete Block Mat Alternative includes the same Outer Apra Harbor and cable shore transition sites as the Preferred Alternative.

As in the Preferred Alternative, the Concrete Block Mat Alternative would include in-water excavation and backfilling of the sensor array site, trenching and subsurface work at the cable bundle shoreline transition area, and ocean and land disposal of excavated material. The only difference would be the use of concrete block mats to secure the subsea cable bundle to the seafloor, which may result in additional temporary minor resuspension of sediments as the mats are placed onto the sea floor along the subsea cable bundle route in areas with fine silty material. After the mats are placed, these resuspended sediments are expected to settle out of the water column or be transported by prevailing currents. As in

the Preferred Alternative, the use of construction BMPs listed in Section 2.5 would minimize the transport of resuspended sediments in the water column, soil erosion, and runoff and avoid adverse impacts to surface water and marine resources. During the operational period, there would be no difference between the two action alternatives; therefore, there would be little to no potential to degrade existing surface water quality or change physical or chemical characteristics of marine waters from the Concrete Block Mat Alternative.

Therefore, implementation of this alternative would not result in significant impacts to water resources.

3.3 Cultural Resources

This discussion of cultural resources includes prehistoric and historic archaeological sites; historic buildings, structures, and districts; and physical entities and human-made or natural features important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources can be divided into three major categories:

- Archaeological resources (prehistoric and historic) are locations where human activity measurably altered the earth or left deposits of physical remains.
- Architectural resources include standing buildings, structures, landscapes, and other built-environment resources of historic or aesthetic significance.
- Traditional cultural properties may include archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that Native Americans or other groups consider essential for the preservation of traditional culture.

3.3.1 Regulatory Setting

Cultural resources are governed by other federal laws and regulations, including the National Historic Preservation Act (NHPA), Archeological and Historic Preservation Act, American Indian Religious Freedom Act, Archaeological Resources Protection Act of 1979, and the Native American Graves Protection and Repatriation Act of 1990. Federal agencies' responsibility for protecting historic properties is defined primarily by sections 106 and 110 of the NHPA. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties. Section 110 of the NHPA requires federal agencies to establish—in conjunction with the Secretary of the Interior—historic preservation programs for the identification, evaluation, and protection of historic properties. Cultural resources also may be covered by state, local, and territorial laws.

3.3.2 Affected Environment

Cultural resources listed in the National Register of Historic Places (NRHP) or eligible for listing in the NRHP are "historic properties" as defined by the NHPA. The list was established under the NHPA and is administered by the National Park Service on behalf of the Secretary of the Interior. The NRHP includes properties on public and private land. Properties can be determined eligible for listing in the NRHP by the Secretary of the Interior or by a federal agency official with concurrence from the applicable State Historic Preservation Office (SHPO). A NRHP-eligible property has the same protections as a property listed in the NRHP. The historical properties include archaeological and architectural resources.

The area of potential effect (APE) for cultural resources is the geographic area or areas within which an undertaking (project, activity, program, or practice) may cause changes in the character or use of any historic properties present. The APE is influenced by the scale and nature of the undertaking and may be

different for various kinds of effects caused by the undertaking. By letter dated June 6, 2019, the DON determined that the Proposed Action is an "undertaking" as defined by 36 CFR 800.16(y) (see Appendix B for Section 106 consultation correspondence). For this Proposed Action, the Navy determined that the APE includes underwater and terrestrial components. The underwater locations include the sensor array site within the navigational channel and the routing of the sensor cable from the array to the onshore facilities at Polaris Point. The APE took into consideration multiple variables that have the potential to affect historic properties including the direct effects from construction, as well as visual and auditory effects.

3.3.2.1 Archaeological Resources

Guam's oldest archaeological sites are from the Pre-Latte Period of Chamorro occupation, perhaps 3000 years prior to western contact in 1521 (Carson, 2014 in SEARCH, 2015). Other archaeological and architectural resources show evidence of the Latte Period between Anno Domini (AD) 800 and 1521. While the Mariana archipelago's status as a former possession of Spain occurred for over three centuries (Farrell 2011 in SEARCH, 2015), several structures attest to Guam's first administration by the U.S from 1898 to 1941, then Japan's occupation from 1941 to 1944, and followed by the second U.S. administration during and after WWII to present (Rogers 1995 in SEARCH, 2015).

Apra Harbor

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, tugs, landing craft utility vessels, British passenger ships, World War II Japanese freighters or transport ships, and two plane wrecks with a total of 3 planes (DON, 2009a). The SMS Cormoran and the Tokai Maru are listed on both the Guam Register (GRHP, 2008) and the NRHP (National Register Information System, 2008). The SMS Cormoran was a German ship anchored in Apra Harbor near the beginning of World War I. When the U.S. joined the war in 1917, the SMS Cormoran's crew was ordered to turn over the ship; they destroyed it instead with nine crewmen dying in the incident. The Tokai Maru, a Japanese passenger-cargo freighter built in 1930, was used to transport military supplies during World War II. The Tokai Maru was sunk in Apra Harbor in 1943 by a U.S. submarine.

There are no known underwater archaeological resources within the APE. Although no known shipwrecks are within the area of the sensor array or the route of the subsea transmission cables, a magnetic survey of these areas was conducted to determine if there were any present. No large magnetic return signals were observed within 200 feet of the navigation range, with most detected features being debris (Ocean Surveys, 2009; see Enclosure 5 in Appendix B). Although magnetic anomalies were detected within the area of the sensor array, this area is within the navigational channel and is dredged when necessary. Any subsurface archaeological resources in the channel would have been removed by past maintenance dredging.

Naval Base Guam

Naval Base Guam covers about 4,500 acres on the west-central coast of Guam. It surrounds Apra Harbor and includes all of Orote Peninsula, as well as a low, largely marshy area along the east side of the harbor. It consists largely of lands that were created by dredging during and immediately after WWII. Only the areas immediately west of Marine Drive on the west side of the inner harbor are part of the original landform. There are over two thousand buildings and structures/facilities at Naval Base Guam, built between 1944 and 2008 (DON, 2010).

According to the Integrated Cultural Resources Management Plan for Naval Base Guam (SEARCH, 2015), previous archaeological, cultural, and historical studies at NBG installations have resulted in the identification of 894 archaeological sites and/or potential traditional cultural properties (TCPs). These sites and/or TCPs include Pre-Contact, Spanish, First American Administration, Japanese Administration, Second American Administration, undatable sites, and 20 potential TCPs. Many sites have multiple temporal components (SEARCH, 2015). Of 286 archaeological sites recorded at NBG, 142 have been determined eligible for listing in the NRHP, 110 are not eligible for NRHP listing, and 34 were not evaluated (SEARCH, 2015).

There are no known archaeological resources identified either underwater or terrestrially within the project's APE. The onshore route of the data transmission cables is within an area that has been determined to have no archaeological sensitivity (SEARCH, 2015). Polaris Point is an artificial land segment constructed of dredged fill material from Apra Harbor during the late 1940s (Helgesson, 1964). There is no integrity to these sediments and therefore no possibility of Pre-Contact or WWII sites and it is unlikely that archaeological resources are present in the vicinity of the terrestrial portion of the project area, either above or below the ground surface (see Enclosure 3 of Appendix B).

3.3.2.2 Architectural Resources

Equipment for the UEMMS would be installed within two existing buildings on Polaris Point. Neither of the facilities or the structures along the route of the data transmission cables are eligible for inclusion on the NRHP (Mason Architects, 2009).

3.3.2.3 Traditional Cultural Properties

National Register Bulletin 38 defines a traditional cultural property as "…one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King, 1998). A traditional cultural property (TCP) study for Guam was conducted in 2009, which included interviews, existing information on archaeological sites, ethnographic associations, and Chamorro myths (Griffin et al., 2010 in SEARCH, 2015). The study is considered preliminary in scope and additional research and consultation would be required to further define and evaluate the potential TCPs identified therein. According to the 2015 ICRMP, the remains of Sumay Village (Guam Register of Historic Places Site No. 66-03-1038) was the only site located at NBG identified as a potential TCP in Griffin et al. (2010). Sumay Village is a documented 17th century community located on the north coast of Orote Peninsula. The potential TCP includes subsurface deposits associated with the village, Sumay Church, and the Sumay Cemetery (Griffin et al., 2010 in SEARCH, 2015). Sumay Village is over one mile southeast of the sensor array and subsea and terrestrial cable route. It is about 5,000 feet northwest of Field 5 CDF and 2,000 feet east of Orote Airfield CDF.

3.3.3 Environmental Consequences

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment that contribute to the importance of the resource, introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting), or neglecting the resource to the extent that it deteriorates or is destroyed.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to cultural resources. Therefore, no impacts to cultural resources would occur with the No Action Alternative.

3.3.3.2 Concrete Anchor Disc Alternative (Preferred Alternative) Potential Impacts

The Preferred Alternative would require dredging of approximately 0.18 acres of seafloor within the Apra Harbor navigational channel and securing about 3,150 linear feet of data cable bundle to the seafloor using earth anchors installed at 100-foot intervals or less. The Preferred Alternative also involves excavating a portion of shoreline revetment and fill material at the Polaris Point cable shore landing, and installing data acquisition equipment in existing subsurface and above ground facilities.

The Preferred Alternative would have no impacts to cultural resources during project construction or operation. No archaeological resources, historic architectural resources, or TCPs exist in the project area, including the construction staging area. During the operational period, the electromagnetic measurement and data transfer activities taking place at the UEMMS sensor array and related infrastructure would be passive and self-contained within the components. Any maintenance or repair activities needed during the operational period would occur in areas with no archaeological sensitivity.

In accordance with Section 106 of the NHPA, the DON consulted with the Guam SHPO regarding the undertaking. In consideration of the information on terrestrial and underwater archaeology and the built environment, DON determined that there would be no historic properties affected by the Proposed Action under NHPA Section 106. By letter dated July 5, 2019 (Reference No. RC2019-0180), the Guam SHPO concurred with the Navy's determination (see correspondence in Appendix B).

In the unlikely event that any historic properties are inadvertently discovered within the project's APE during activities associated with the subject undertaking, then the Standard Operating Procedures contained within the Final Integrated Cultural Resources Management Plan Naval Base Guam, Joint Region Marianas would be followed, as well as provisions of 36 CFR 800.13 Post-Review Discoveries.

Therefore, implementation of the Preferred Alternative would not result in significant impacts to cultural resources.

3.3.3.3 Concrete Block Mat Alternative Potential Impacts

As in the Preferred Alternative, the Concrete Block Mat Alternative would be implemented in areas with no archaeological resources, historic architectural resources, or TCPs. Operational period activities would be the same as those of the Preferred Alternative, and thus, no historic properties would be affected in the Concrete Block Mat Alternative.

Therefore, implementation of this action alternative would result in the same less than significant impacts to cultural resources.

3.4 Biological Resources

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

Within this EA, biological resources are divided into five major categories: (1) terrestrial vegetation, (2) terrestrial wildlife, (3) marine vegetation, (4) marine wildlife, and (5) threatened, endangered, and other special status species.

3.4.1 Regulatory Setting

Special-status species, for the purposes of this assessment, are those species listed as threatened or endangered under the Endangered Species Act (ESA), and species afforded federal protection under the Marine Mammal Protection Act (MMPA) or the Migratory Bird Treaty Act (MBTA).

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the U.S. Fish and Wildlife Service (USFWS) or National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of designated critical habitat. Critical habitat cannot be designated on any areas owned, controlled, or designated for use by the DoD where an Integrated Natural Resources Management Plan has been developed that, as determined by the Department of Interior or Department of Commerce Secretary, provides a benefit to the species subject to critical habitat designation.

All marine mammals are protected under the provisions of the MMPA. The MMPA prohibits any person or vessel from "taking" marine mammals in the United States or the high seas without authorization. The MMPA defines "take" to mean "to harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal."

Birds, both migratory and most native-resident bird species, are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186 (Migratory Bird Conservation). Under the MBTA it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess migratory birds or their nests or eggs at any time, unless permitted by regulation. The 2003 National Defense Authorization Act gave the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from the incidental taking of migratory birds during authorized military readiness activities. The final rule authorizing the DoD to take migratory birds in such cases includes a requirement that the Armed Forces must confer with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate adverse effects of the proposed action if the action will have a significant negative effect on the sustainability of a population of a migratory bird species.

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of the fisheries. Under the Act, Essential Fish Habitat (EFH) consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. An area within the designated EFH that is particularly important and/or sensitive is a Habitat Area of Particular Concern (HAPC). Regional Fishery Management Councils, established under the Act, are responsible for preparing and amending fishery management plans (FMPs) for each fishery under their authority that requires conservation and management. The Western Pacific Regional Fishery Management Council (WPRFMC) developed the Mariana Archipelago Fishery Ecosystem Plan as an FMP, consistent with the Act and the national standards for fishery conservation and management. Federal actions that would adversely affect EFH (i.e., direct or indirect physical, chemical, or biological alterations) are subject to consultation

requirements with NMFS. An adverse effect to EFH includes adverse changes to waters or substrate, species and their habitat, other ecosystem components, and quality and/or quantity of EFH.

See Section 5.1.1 for the discussion regarding the CZMA.

3.4.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under biological resources at NBG. Threatened and endangered species are discussed in Section 3.4.2.6 with a composite list applicable to the Proposed Action provided in Table 3-15.

3.4.2.1 Terrestrial Vegetation

Vegetation includes terrestrial plant as well as freshwater aquatic communities and constituent plant species. There are no freshwater aquatic communities in the project area.

As described in the Integrated Natural Resources Management Plan for Joint Region Marianas (JRM) (INRMP) (DON, 2018), NBG Main Base consists of coastal lowlands and limestone headlands (on Orote Peninsula). In 2015, classifications used to describe vegetation communities for most JRM-administered lands on Guam were updated and synchronized (NAVFAC Marianas, 2014; 2015). Much of the terrestrial area of NBG is vegetated with communities that have undergone previous disturbance (e.g., limestone degraded forest and developed). As shown in Figure 3-2, the vegetation community within the project area on Polaris Point (i.e., shoreside cable landing and transmission route and Polaris Point construction staging area) is considered "Developed" urban land (DEV). The vegetation communities at the Orote Airfield CDF site are mapped as DEV, "*Causarina* Forest" (CAF), and Other Shrub/Grassland" (OSG). The vegetation communities at Field 5 CDF site include *Leucaena* Forest (LEF), OSG, and DEV. The USSA and MEC/MPPEH areas are categorized as DEV (urban land).

A general description of the vegetation categories present in the project area on NBG, described in the INRMP (DON, 2018) is provided below (NAVFAC Marianas, 2014; 2015).

Developed (DEV)

These are human-occupied or otherwise highly disturbed areas that include lawns and other landscaped areas or actively maintained areas (e.g., mowed fields, utility corridors), buildings, roads, parking lots, and other paved areas.

Causarina Forest (CAF)

Ironwood (*Casuarina equisetifolia*), also known as Australian pine, tolerates dry and salty or exposed conditions. It forms a sparse forest or woodland with little understory.

Other Shrub/Grassland (OSG)

This community is characterized by the presence of shrubs and grasses. Other shrub/grassland community is often present in degraded forest areas as clearings with herbaceous vegetation and

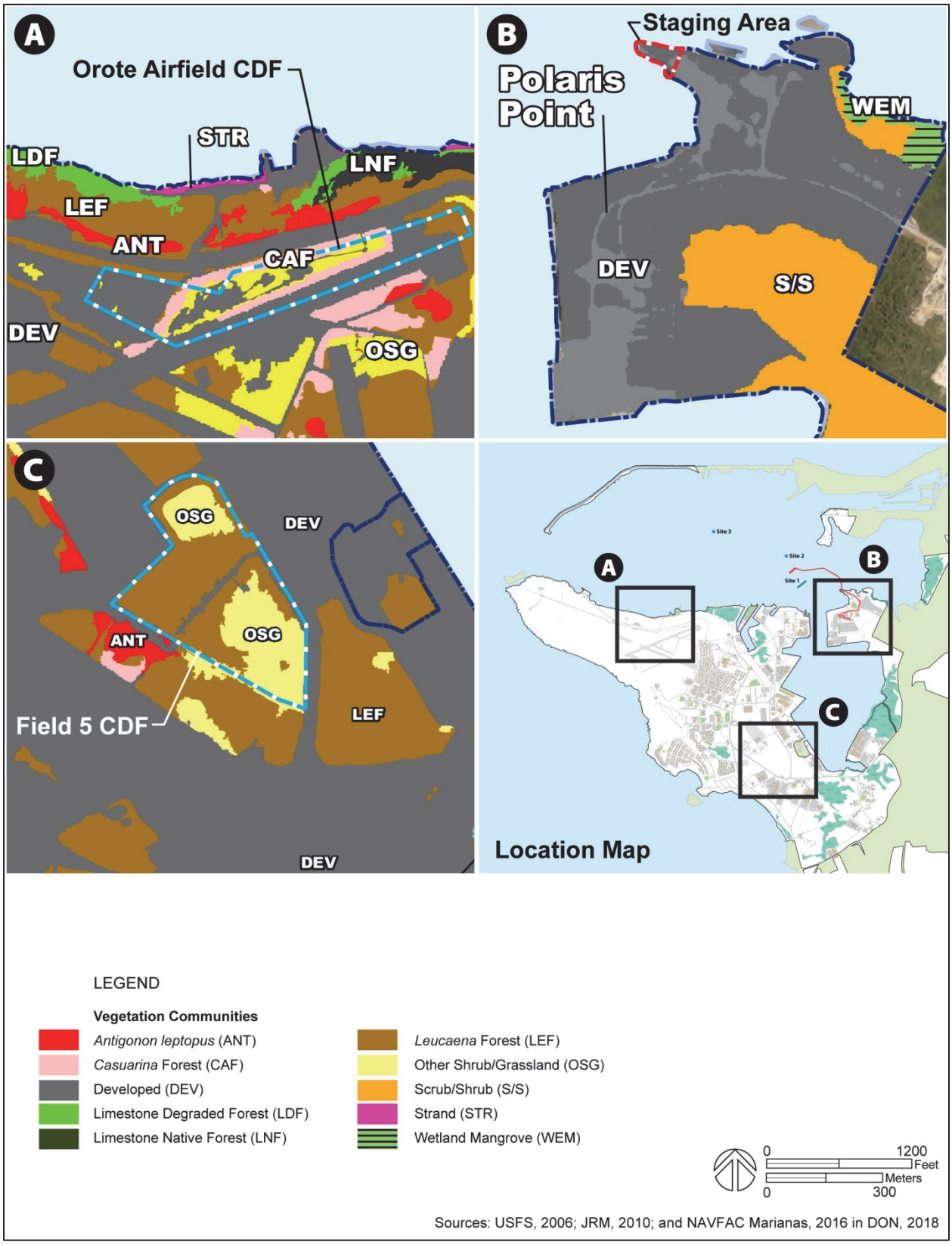

Figure 3-2 Vegetation Communities

scattered shrubs. Also included in this category are areas that have been cleared in the relatively recent past or are being mowed periodically to prevent forest regeneration. These areas may consist primarily of grassland with limited regrowth of woody species. Areas dominated by swordgrass (*Miscanthus floridulus*) are not included and instead are separated into the savanna complex community.

Leucaena Forest (LEF)

This plant community typically occurs on limestone and is dominated by the small, non-native tangantangan. This plant community is most abundant on Orote Peninsula where it forms large and often pure stands. In some places where it is found adjacent to native forest, it is invading the native forest and mixing with native woody species. *Leucaena* forests are habitat favorable to the brown tree snake or BTS (*Boiga irregularis*) (COMNAV Marianas, 2006).

No species listed, proposed for listing, or candidates under the federal ESA or species designated by legislative authority in the Territory of Guam as species that are endangered or threatened ("listed species"), or species designated by Guam as species of greatest conservation need (SOGCN), are known to occur or have the potential to occur ("listed" species only) in the terrestrial project area (NAVFAC Pacific, 2004 in DON, 2018).

3.4.2.2 Terrestrial Wildlife

Terrestrial wildlife includes all animal species (i.e. insects and other invertebrates, freshwater fish, amphibians, reptiles, birds, and mammals) focusing on the species and habitat features of greatest importance or interest.

Animals described in this section include all common species and all listed, proposed for listing, or candidates under the federal ESA or species designated by legislative authority in the Territory of Guam as species that are endangered or threatened ("listed species"), species afforded federal protection under the MBTA, and SOGCN as identified in the Guam Comprehensive Wildlife Conservation Strategy that are present in the project area or likely to occur in the project area. To address the importance and problems associated with the introduction of non-native species to Guam and their impacts on native species, the wildlife discussion is subdivided into non-native and native and species.

Insects and Other Invertebrates

Native Species

Native land hermit crab (*Coenobita brevimanus*) and coconut crab (*Birgus latro*) are present on Orote Peninsula and in coastal and estuarine areas (COMNAV Marianas, 2008). Mangrove crab or mud crab (*Scylla serrata*) inhabit mud substrate in the coastal areas (Wiles and Ritter, 1993).

Non-native Species

African land snail (*Achatina fulica*), quilted melania (*Tarebia granifera*), coconut rhinoceros beetle (*Oryctes rhinoceros*), scarab beetles (*Protaetia pryeri* and *P. orientalis*), Erythrina gall wasp (*Quadrastichus erythrinae*), cycad scale (*Aulacaspis yasumatsui*), New Guinea flatworm (*Platydemus manokwari*), and over 26 species of ants are non-native invertebrates known on Guam (DON, 2018).

Reptiles and Amphibians

Non-native

Brown Tree Snake (BTS). Because the current distribution, diversity, and abundance of wildlife species on Guam is directly related to the occurrence of the introduced BTS (*Boiga irregularis*), a thorough discussion of the BTS is included here. BTS affects the economy, human health, and island ecology of Guam. This species was inadvertently introduced around 1949 from cargo that originated in New Guinea. Issues associated with the BTS create numerous economic and safety considerations (Fritts & Leasman-Tanner, 2001). Prior to implementation of BTS control measures at substations, BTS-caused power outages between 1978-1997 resulted in an estimated outage at substations every one out of three days, with more than 1,600 snake-caused outages at costs of up to several million dollars per year. In addition, BTS is known to prey on eggs and birds. Regarding human health, BTS is a mildly venomous species, which has resulted in approximately 1 in 1,000 emergency room visits.

BTS was known to occur on Guam in the 1950s to 1980s, but the species was not seen as a threat because this was the first known instance of a predatory snake arriving on an isolated island. BTS hunts and lives in trees, and is active at night. BTS has severely impacted 17 of 18 native bird species; 12 of the 18 species are likely extirpated from the wild on Guam due to the direct impact of BTS (Wiles, Bart, Beck, Jr., & Aguon, 2003). As a result of these impacts, Guam Department of Aquatic and Wildlife Resources took into captivity the endemic Guam rail or ko'ko' (*Gallirallus owstoni*) and Guam Micronesian kingfisher or sihek (*Halcyon cinnamomina cinnamomina*) to form the basis of a captive breeding program.

Efforts to control BTS are mostly limited to preventing BTS from leaving Guam in cargo, by ship or air. DoD has collaborated with other partners and participated in the development of BTS-specific trapping techniques, including BTS detection using sniffer dogs, fence design, and development of toxicants and delivery methods. While these efforts have had success, BTS originating on Guam have been found or sighted in Kwajalein, Pohnpei, Hawaii (Oahu), Diego Garcia, Spain, Alaska, Texas, Oklahoma, and on Rota, Tinian, and Saipan in the Commonwealth of the Northern Mariana Islands (CNMI).

BTS has been determined as the greatest limiting factor to reintroduction and/or recovery of both Guam Micronesian kingfisher and Mariana crow or aga (*Corvus kubaryi*) on Guam (USFWS 2005, 2008 in DON, 2010). Recovery plans for Mariana crow, Guam Micronesian kingfisher, Mariana fruit bat or fanihi (*Pteropus mariannus*), Island swiftlet or yayaguak (*Aerodramus vanikorensis bartschi*), Guam rail, and Mariana common moorhen or pulattat (*Gallinula chloropus guami*) call for BTS suppression and eradication.

Unfortunately, over the last three decades, there has been limited funding for research on: (1) life history of BTS on Guam; (2) detection of snakes at low densities; and (3) heavy suppression over large geographic areas. In addition, there has not been a concentrated effort to eradicate BTS island-wide because appropriate technology does not exist. As a consequence, the few recovery efforts for ESA-listed species on Guam that have been attempted have been unsuccessful. The ultimate goals of the recovery plans are to have Guam species successfully reproducing with individuals in the wild. Although habitat exists for these species, until BTS levels are controlled and other constraints are removed (e.g., feral cats, poaching), recovery and/or reintroduction of ESA-listed bird species cannot occur. In addition, BTS numbers did not decrease after the loss of native birds because they eat a wide variety of prey. Now, the most abundant prey animals are introduced reptiles (e.g., skinks and geckos) that are common throughout the island.

The Navy provides annual funding to support a BTS trapping program. NBG has installation-wide instructions regarding procedures for BTS control and awareness (COMNAV Marianas, 2005). NBG cooperates with the U.S. Department of Agriculture Animal Plant and Health Inspection Service and USDA Wildlife Services to conduct daily inspections with detector dog teams for all outbound cargo in order to help prevent the spread of BTS. USDA Wildlife Services conducts trapping and removal of the BTS on Navy property. These efforts include the placement of BTS traps within the interior of the NBG and around ports of exit and cargo facilities on Navy property to reduce the local population of BTS that might occur as possible stowaways within outbound cargo.

Other Non-native Species. In addition to BTS, three other non-native reptile and two non-native amphibian species are known from the forested areas of Orote Peninsula, the vicinity of Dadi and Tipalao beaches, and Polaris Point: marine toad or cane toad (*Rhinella marina*), crab-eating frog (*Fejervarya limnocharis*), Gunther's Amoy frog (*Sylvirana guentheri*), the cryptogenic monitor lizard (*Varanus indicus*), curious skink (*Carlia fusca*), and house gecko (*Hemidactylus frenatus*) (NAVFAC Pacific 2010).

Native Species

Due to predation by the introduced BTS, of the 13 terrestrial reptile species originally found on Guam that are considered to be native, only 6 are known to currently occur on DoD lands (DON, 2018).Five native terrestrial species have been documented from NBG Main Base (see Table 3-7) (DON, 2018). Green sea turtle (*Chelonia mydas*) adults and hatchlings occur at Spanish Steps, Dadi Beach, and Family Beach. Hawksbill turtle (*Eretmochelys imbricata*) has historically nested on NBG Main Base beaches. These sea turtle species are both federal ESA-listed and discussed in further detail in Section 3.5.2.4 Marine Wildlife. The native Pacific blue-tailed skink (*Emoia caeruleocauda*), mutilating gecko (*Gehyra mutilata*), and mourning gecko (*Lepidodactylus lugubris*) can be found in virtually all habitats on Guam.

Guam has no native amphibian species.

Table 3-7 lists reptiles and amphibians documented from NBG Main Base, along with their residence status (DON, 2018).

Table 3-7 Reptile and Amphibian Species Recorded on NBG Main Base

Common Name/Chamorro Name[(1)]	***Scientific Name***	***Residence Status***	***Orote Peninsula***	***Main Base[(2)]***	***Polaris Point***
AMPHIBIANS					
Marine toad or Cane toad/Kairo	*Rhinella marina*	Non-native	✓	✓	✓
Crab-eating frog/Kairo	*Fejervarya limnocharis*	Non-native	--	✓	--
Gunther's Amoy frog/Kairo	*Sylvirana guentheri* = *Hylarana guentheri*	Non-native	--	✓	--
REPTILES					
Monitor lizard/Hilitai	*Varanus indicus*	?Naturalized Cryptogenic	✓	✓	✓
Curious skink/Gualiek halumtano	*Carlia ailanpalai*	Non-native	✓	✓	✓
Pacific blue-tailed skink/Gualiek halumtano	*Emoia caeruleocauda*	**Native**	✓	✓	✓
Mutilating gecko/Achiak	*Gehyra mutilata*	**Native**	✓	--	✓
Mourning gecko/Achiak	*Lepidodactylus lugubris*	**Native**	✓	--	--
House gecko/Achiak	*Hemidactylus frenatus*	Non-native	✓	✓	✓

Common Name/Chamorro Name[1]	***Scientific Name***	***Residence Status***	***Orote Peninsula***	***Main Base[2]***	***Polaris Point***
Brown tree snake/Kolepbla	*Boiga irregularis*	Non-native	✓	✓	✓
Green sea turtle/Haggan betde	*Chelonia mydas*	**Native**	✓	--	--
Hawksbill sea turtle/Haggan karai	*Eretmochelys imbricata*	**Native**	--	✓ [3]	--

Notes: **Bold** = Native species
(1) Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clarke (2015), Topping et al. (1975), and USFWS (2015).
(2) Main Base includes the area of NBG Main Base east of the Orote Airfield and south of the Atantano River and wetlands.
(3) Historical records only.
Sources: DON, 2018; USFWS, 1986; AECOS, Inc. and Wil Chee Planning, Inc., 2009; NAVFAC Pacific, 2010a; NAVFAC Marianas, 2013, 2014a.

Mammals

Non-native Species

Common non-native small mammals found throughout Guam are also expected be found on NBG, including Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), Polynesian rat (*Rattus exulans*), house mouse (*Mus musculus*), and musk shrew (*Suncus murinus*; USFWS, 1986; Wiles, 2005; Wiewel, Adams and Rodda, 2009). Feral cat (*Felis cattus*), dog (*Canis familiaris*), and pig (*Sus scrofa*) also occur on NBG (DON, 2018).

Native Species

The only native terrestrial mammal that occurs on Guam is the Mariana fruit bat. A possible observation of a Mariana fruit bat was made at NBG in 2007 (Brook, 2008). No native terrestrial mammals occur on Polaris Point.

Birds

The majority of bird species on NBG are native to the region; however, most are seasonal visitors, annually migrating to either winter or summer destinations (DON, 2018). Standardized bird surveys conducted on NBG Main Base between 2008 and 2014 have documented 38 bird species. Table 3-8 lists bird families documented from NBG Main Base (DON, 2018).

Table 3-8 Bird Families Recorded on NBG Main Base

Category/Family[1]	***No. of Species***
Federal ESA-Listed	
Rallidae (Rails, Coots, Gallinules)	1
Total listed under Federal ESA	1
Listed under MBTA	
Scolopacidae (Sandpipers and Snipes)	15
Charadriidae (Plovers)	1
Laridae (Gulls and Terns)	6
Ardeidae (Herons and Bitterns)	6
Sulidae (Boobies and Gannets)	1
Rallidae (Rails, Crakes, and Coots)	1
Recruvirostridae (Stilts and Avocets)	1
Accipitridae (Hawks, Eagles, and Kites)	1

Category/Family[(1)]	***No. of Species***
Strigdae (Owls)	1
Total listed under Federal ESA	33
Guam ESA-Listed	
Rallidae (Rails, Coots, Gallinules)	1
Total listed under Guam ESA	1
Guam SOGCN	
Scolopacidae (Sandpipers and Snipes)	15
Charadriidae (Plovers)	1
Ardeidae (Herons and Bitterns)	1
Sulidae (Boobies and Gannets)	1
Rallidae (Rails, Crakes, and Coots)	1
Sturnidae (Starlings)	1
Total Guam SOGCN	20
Native Breeding Resident	
Laridae (Gulls and Terns)	1
Ardeidae (Herons and Bitterns)	1
Rallidae (Rails, Crakes, and Coots)	1
Sturnidae (Starlings)	1
Total Native Breeding Resident	4
Non-Native Breeding Resident	
Passeridae (Old World Sparrows)	1
Dicruridae (Drongos)	2
Columbidae (Doves and Pigeons)	1
Phasianidae (Pheasants and Allies)	1
Total Non-Native Breeding Resident	5
Non-Breeding Visitor	
Scolopacidae (Sandpipers and Snipes)	15
Charadriidae (Plovers)	1
Laridae (Gulls and Terns)	5
Ardeidae (Herons and Bitterns)	5
Sulidae (Boobies and Gannets)	1
Recruvirostridae (Stilts and Avocets)	1
Accipitridae (Hawks, Eagles, and Kites)	1
Strigdae (Owls)	1
Total Non-Breeding Visitor	30

Note: (1) Families overlap between categories.
Key: ESA = Endangered Species Act; MBTA = Migratory Bird Treaty Act; No. = Number
Sources: SOGCN = species of greatest conservation need
Guam Division of Aquatic and Wildlife Resources (DAWR), 2006; Eggleston, 2009; NAVFAC Pacific, 2010; NAVFAC Marianas, 2011; Brindock, 2012; Brindock, Migratory bird monitoring, Naval Base Guam, 2013; Wenninger, 2016 in DON, 2018.

Non-native Species

Eurasian Tree Sparrow, Island Collard Dove, and Black Francolin were observed at NBG in forested areas during surveys for the Guam and CNMI military relocation environmental impact statement (NAVFAC Pacific, 2010) and black drongo (*Dicrurus macrocercus*) is a common non-native breeding resident on NBG (DON, 2018).

Native Species

Common migratory seabird species seen on or in the vicinity of NBG include brown noddy (*Anous stolidus*), white tern (*Gygis alba*), and brown booby (*Sula leucogaster*). Brown noddy nests and roosts on steep cliffs and on rocky offshore islets, such as Orote Island (COMNAV Marianas, 2008). Many of the native species that previously nested on NBG Main Base (such as the brown noddy and certain egrets) are no longer able to successfully nest due to the presence of the BTS, which preys on eggs and young.

Numerous other migratory shore birds use the wetland and mangrove areas of Apra Harbor for resting and feeding, including Pacific reef heron (*Egretta sacra*), little egret (*Egretta garzetta*), intermediate egret (*Ardea intermedia*), and great egret (*A. alba*). The indigenous yellow bittern (*Ixobrychus sinensis*) and Pacific reef heron feed along the shore of Apra Harbor. Mariana common moorhen or pulattat (*Gallinula chloropus guami*) inhabits natural and man-made freshwater habitat throughout Guam. The Pacific reef heron, along with the brown booby, white-tailed tropicbird (*Phaethon lepturus*), and Mariana common moorhen are listed as SOGCN (Guam Division of Aquatic and Wildlife Resources (DAWR), 2006). Exposed tidal mudflats and estuarine banks provide seasonal foraging and loafing habitat to any number of migratory shore birds, which are also listed as SOGCN (DAWR, 2006). Annual migrants to Guam that occur at NBG are Pacific golden-plover (*Pluvialis fulva*), common greenshank (*Tringa nebularia*), Mongolian plover (*Charadrius mongolus*), gray-tailed tattler (*T. brevipes*), whimbrel (*Numenius phaeopus*), ruddy turnstone (*Arenaria interpres*), and cattle egret (*Bubulcus ibis*; COMNAV Marianas, 2008; Eggleston, 2009; NAVFAC Pacific, 2010).

3.4.2.3 Marine Wildlife

Along with literature from prior studies, the marine biological resources information presented in Sections 3.4.2.3 through 3.4.2.6 includes the results of 2015 and 2020 scientific dive surveys of the project area by HDR & CSA and NMFS. In 2015, scientific divers conducted a survey of the UEMMS project area to characterize the benthos, determine coral species and abundance, and assess relative percent cover of coral, macroalgae, sponges, and non-living substrate (HDR & CSA, 2020). Also in 2015, a concurrent scientific dive group from NMFS conducted a survey of the UEMMS Action Area to determine coral species and assess relative percent cover. A second HDR and CSA-led marine biological survey effort in 2020 marine survey documented the overall benthic habitat, coral density and cover, sponge, macroalgae, biofouling communities, fish species, and protected species within the project's expected areas of direct and indirect impacts. The 2020 survey used orthomosaic imagery techniques to further characterize the benthos, coral species abundance, and assess relative percent cover of the modified project footprint (HDR & CSA 2020).

The 2020 HDR & CSA survey area comprised the sensor array footprint (direct and indirect impact areas), subsea cable route, and shore landing site at Polaris Point. (Note: The "direct impact area" refers to the approximately 400- by 50-foot seafloor footprint that would be disturbed by the installation of the sensor array. The "indirect impact area" refers to the seafloor area outside the UEMMS array excavation footprint that could be indirectly impacted by UEMMS construction activities. See Figure 17 of NAVFAC Pacific, 2021 in Appendix C). The indirect impact area ranges from about 3.3 to 100 feet in distance from the direct impacts area footprint.

For the 2020 surveys, the UEMMS excavation footprint and surrounding habitat was divided into contiguous grid cells with dimensions of approximately 20 feet by 49 feet (approximately 984 square-foot cells) for the collection of photomosaic imagery. Sixteen grid cells were established over the excavation footprint and included the direct impact area. An additional 16 non-contiguous indirect area

grid cells were identified as areas with notable coral cover in the surrounding and adjacent areas to the UEMMS excavation footprint (indirect impact area) at water depths ranging from about 46 to 29.5 feet.

Mammals

Jurisdiction over marine mammals is maintained by NMFS and the USFWS. NMFS maintains jurisdiction over whales, dolphins, porpoises, seals, and sea lions. The USFWS maintains jurisdiction for certain other marine mammal species, including walruses, polar bears, dugongs, sea otters, and manatees. Additional discussion of ESA-protected species is presented in Section 3.4.2.6.

Marine mammals are frequently seen in the waters outside of Apra Harbor, but have not been observed within the harbor. Anecdotal information suggests that a pod of spinner dolphin (*Stenella longirostris*) moves up and down the west coast of Guam between Double Reef and Agat (Eldredge, 2003). Sperm whales and baleen whales (i.e., blue, fin, and sei) are not expected to occur within Apra Harbor, but rather may be encountered during the ocean disposal operations and open-ocean vessel and barge movements (if needed). If a crane barge is needed from outside Guam, vessels would likely travel from Honolulu, Hawaii, and through critical habitat for the Main Hawaiian Islands (MHI) Insular False Killer Whale (IFKW) Distinct Population Segment (DPS).

Sperm whale (*Physeter microcephalus*) is the most frequently sighted ESA-listed marine mammal around Guam (National Marine Fisheries Service (NMFS) Office of Protected Resources, 2015). Sperm whales have strong preference for waters deeper than 1,000 meters and are rarely found in waters less than 300 meters deep. Because the species are highly mobile, they likely utilize the entire coastlines off Apra Harbor and within the vicinity of G-DODS.

Blue whales (*Balaenoptera musculus*) are known to occur along the coastline to the 984-ft (300-meter) isobath and are likely to utilize the entire coastlines off Apra Harbor and within the vicinity of G-DODS. Acoustic equipment has recorded the presence of blue whales in the western Pacific waters around Guam; however, it is not known if they were in or near NBG (DON, 2018).

Fin whales (*Balaenoptera physalus*) occur in waters generally near the 656-foot isobath. Acoustic equipment has recorded the presence of fin whales in the western Pacific waters around Guam, and they are likely to utilize the waters offshore Apra Harbor and within the vicinity of the G-DODS (DON, 2018).

Sei whales (*Balaenoptera borealis*) occur offshore and prefer deep waters and areas along continental shelf edges (from 10,000- to 15,000-foot depth; Hain et al., 1985). Sei whales were sighted during the 2007 Mariana Islands Sea Turtle and Cetacean Survey. All confirmed sightings of sei whales were south of Saipan (approximately 15 degrees North). Acoustic equipment has recorded the presence of sei whales in the western Pacific waters around Guam; however, it is not known if they were near NBG (DON, 2018). It is likely that sei whales utilize the offshore waters of Guam and vicinity of the G-DODS.

No marine mammals were observed in the surveyed areas during the 2020 scientific dive survey (i.e., sensor array direct and indirect impact areas, cable route, and cable shore landing).

Sea Turtles

Of the six sea turtle species that are found in U.S. waters or that nest on U.S. beaches, all are designated as either threatened or endangered under the ESA. Sea turtles are highly migratory and utilize the waters of more than one country in their lifetimes. The USFWS and NOAA Fisheries share federal jurisdiction for sea turtles with the USFWS having lead responsibility on the nesting beaches and NOAA

Fisheries, the marine environment. Population trends of green turtles vary among regions and nesting populations. In 2016, NOAA Fisheries and the USFWS issued a final rule to identify 11 populations as distinct population segments (DPS). The Central West Pacific DPS was classified as an "endangered" population due to their depleted status and continuing vulnerability (NOAA-NMFS & USFWS, 2016).

Green turtles are the most abundant and common sea turtle in Guam waters (Guam DAWR, 2015; Martin et al., 2016). The seagrass beds and macroalgae of Agat Bay, Sasa Bay, and Apra Harbor provide important foraging and resting areas for green turtles (Guam DAWR 2006, 2015; Brindock 2015; Martin et al. 2016, in DON, 2018). Inner Apra Harbor has limited habitat for green turtles and with few recoded sightings (DoN, 2018). In 2019, three surface observations of green sea turtles occurred within the project area and during approximately 40 hours of observation time. During the 2020 marine surveys of the project area, vessel crew observed a 20- to 25-inch green turtle at the surface west of the UEMMS array site, along with a small hawksbill turtle. Thus, green sea turtles have a regular but low level occurrence within the project area.

The Central West Pacific DPS uses the nearshore waters of the Orote Peninsula and Outer Apra Harbor waters, and nest on three beaches within NBG Main Base: Spanish Steps, Dadi Beach, and Kilo Wharf. (DON, 2018). Considered one of the primary nesting locations on Guam, the main period of green turtle nesting and non-nesting emergences (also known as nesting attempts or false crawls) have been documented at the Spanish Steps from March-July, with some nesting activity observed from December through February (DON, 2018). Survey data showed 14 nesting events for other beaches, including Dadi Beach, Gab Beach, Family Beach. No sea turtle nests nor non-nesting emergences were documented within the project area, including the coast at Polaris Point, which had previously contained large reef flats but have since been filled in (DON, 2018). Today, Polaris Point is comprised of remnant sheet pile walls that are decaying, and the rock that was used as fill material forms the current rocky shoreline. Therefore, it is highly unlikely that the coastline at Polaris Point in the Proposed Action's shoreline landing area would support nesting activity for green sea turtles.

Compared to green sea turtle, hawksbill turtle occurs in low numbers in Guam waters and does not occur in large numbers anywhere within the Marianas (NMFS and USFWS, 2007; Martin et al., 2016, as cited in DON, 2018) except possibly around Rota. Hawksbill turtles have been seen within all areas of Apra Harbor, which may provide important foraging and resting areas for this species (Kolinski, 2001; Smith et al., 2009; Brindock, 2015; Guam DAWR, 2015; Jones et al., 2015, in DON 2018). Two sightings of hawksbill sea turtles occurred along Orote Peninsula: one in November 2003 and the other in October 2004 (Smith & Marx, 2006). No hawksbill turtles were observed in the 2019 and 2020 biological surveys of the project area (NAVFAC Marianas, 2019, 2020 in NAVFAC Pacific, 2021).

As with green sea turtles, hawksbill sea turtle natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas (NOAA & USFWS 2007b). However, nesting by hawksbill turtles have not been observed on NBG since 1995 on a small beach within the Sumay inlet (Commander Naval Forces Marianas 2001; DON 2009; Wenninger 2015, as cited in DON 2018). There is no nesting habitat for hawksbill sea turtles in the project area. Therefore, hawksbill sea turtles may have a rare and infrequent occurrence within the project area. During the 2020 marine surveys of the project area, a small (less than 20-inch) hawksbill turtle surfaced west of the UEMMS array site.

Coral

Corals are invertebrates that are related to anemones, jellyfish, and hydras. They are made of invertebrate polyps and can generally be categorized as either hard or soft. Hard corals have calcium carbonate skeletons, grow in colonies, and are reef-building animals that live in symbiosis with phytoplankton called zooxanthellae. Soft corals are flexible, have calcareous particles in their body walls for structural support, can be found in both tropical and cold ocean waters, do not grow in colonies or build reefs, and do not always contain zooxanthellae. (Note: Non-coral benthic invertebrates are discussed in the following section, Marine Vegetation and Other Invertebrates.)

Substantial healthy coral communities fall within the UEMMS footprint, with high percent coral cover occurring in a majority of the grid cells analyzed. Several species—including *Porites rus*, *P. horizontalata*, *Pavona cactus,* and *Pectinia Paeonia*—provide substantial three-dimensional relief and fish habitat. In addition, there are large numbers of healthy colonies of several species of massive *Porites*, major reef-building species in the region. Aside from the visible fragmentation of some of the more fragile species, most coral colonies at the UEMMS site appeared healthy, with no signs of coral disease or bleaching.

The 2020 marine survey methods included photogrammetric orthomosaics surveys for percent cover, condition, and demographics, as well as in situ Line Point-Intercept (LPI) surveys for species richness (HDR & CSA 2020). The survey and image analysis found that the overall dominant biotic cover comprises hard substrate, with coral, algae (macro & cyanobacteria), other fauna (sponge, sessile invertebrates, etc.), and sand or silt substrate cover varying by location (i.e., direct vs. indirect impact area). Table 3-9 summarizes the percent cover values for major biotic cover groups. Mean coral cover was 32.0% within the direct impact area, with mean coral cover in the eastern direct impact area nearly twice as high as in the western direct impact area (38.0% and 20.9%, respectively). In the adjacent indirect areas, there was an average coral cover of 26.7%, with percent coral cover ranging from a low of 13.2% near the southwest end and up to 49.1% near the northeast end of the array.

The two most abundant coral species at the UEMMS site were *Porites rus* and *Porites horizontalata*, which also often co-occur with *Porites monticulosa* and several other possibly undescribed *Porites* species (*Porites aff. horizontalata* and *Porites* sp.) with similar appearance and growth forms. Due to difficulty in visually delineating and separating these species in video and photographic images because of their continuous physical intermixing across the site, similar appearances, and the multiple growth forms, they were all classified as *Porites rus* "complex." Corals within the *P. rus* "complex," primarily *P. rus*, P*. horizontalata*, and *P. aff*. *horizontalata*, were dominant in abundance at the UEMMS site and surrounding area with an average percent substrate cover of 27.4% for the entire direct impacts area. Based on orthomosaic image analysis, the total number of coral colonies within the direct impacts area grid cells was approximately 7,534 colonies. Of these colonies, 1,166 were non-*P. rus* "complex."

The Polaris Point shore landing survey area crossed the steep slope to the shore, and comprised a predominantly disturbed sand and coral rubble substrate (75.3%). Coral abundance was low within this steeply sloping area, with 145 colonies generating an average of 2.5% of the surveyed cover. *P. rus* was the most abundant coral species observed followed by *Porites* sp. massive.

Table 3-9 Summary of Percent Cover Values for Major Groups

Site	*Average Percent Cover*			
	Algae	*Coral*	*Other fauna*	*Substrate**
Array Direct Impacts Site	18.7	32.0	7.1	42.0
Array Indirect Impacts Site	20.2	26.7	10.0	43.1
Shore Landing Area	18.6	2.5	3.6	75.3

*Coral rubble, exposed rock, sand and silt, anthropogenic debris
Source: HDR & CSA, 2020

Along the subsea cable route, impacts to coral habitat are not expected; therefore, grid cells were not established or surveyed for detailed coral assessments, including the collection of percent cover, coral abundance, and density data. At its seaward end on the east side of the sensor array footprint, the cable route extended through a coral community with high abundance of the corals *P. rus* and *P. horizontalata*. Only a single rock outcrop was noted along the entirety of the deeper section of the cable route. This flat-topped rock feature was about 10 feet in height and observed along the south edge of the route approximately 1,000 feet from the eastern end of the UEMMS array footprint. The outcrop had a steep northern face and was lightly colonized by a few small colonies of the corals *P. speciosa* and *Leptoseris sp*. and an unidentified soft coral whip. The wide crest of the feature was predominately silt-covered with occasional sponges and corals distributed intermittently.

A relatively low diversity of coral community composed of approximately 28 species was previously described during previous surveys of the UEMMS site area (HDR & CSA, 2017). The 2020 survey results identified 33 species at the UEMMS array survey area, 19 along the cable route, and 8 at the cable shore landing survey area (see Table 3-10 for listing). However, several of the more common coral species are difficult to identify with consistency and could not be reliably and repeatedly identified to species during the in-situ survey and orthomosaic analysis (Table 3; HDR & CSA, 2020). Corals within the *P. rus* "complex," including *P. rus*, *P. horizontalata*, and *P. aff. horizontalata*, were dominant in abundance at the UEMMS site, with an estimated 6,368 colonies identified in a review of orthomosaic imagery from the direct impacts area grid cells.

Table 3-10 Coral Taxa Observed During UEMMS Marine Surveys and Image Analysis

Coral Species/Taxa	*UEMMS Array Area*	*Cable Route*	*Shore Landing Area*
Acropora granulosa	x		
Astreopora cucullate			x
Astreopora gracilis	x	x	
Astreopora myriophthalma	x		
Ctenactis sp.	x		
Cyphastrea serailia			
Cyphastrea sp.			
Diploastrea heliopora			
Dipsastraea matthaii	x		
Dipsastraea danae	x		
Euphyllia glabrescens			
Fungia moluccensis	x		
Fungiidae	x		
Galaxea astreata	x	x	

Coral Species/Taxa	*UEMMS Array Area*	*Cable Route*	*Shore Landing Area*
Galaxea fascicularis	x	x	
Goniastrea edwardsi			
Goniastrea pectinata			
Herpolitha limax	x	x	
Herpolitha weberi	x	x	
Hydnophora exesa			
Leptastrea purpurea	x	x	x
Lobophyllia corymbosa	x	x	
Lobophyllia hataii			
Lobophyllia hemprichii	x	x	x
Montipora sp.	x	x	x
Montipora verilli sensu R&M 1982	x		
Pachyseris speciosa	x	x	
Pavona cactus	x		
Pavona chiriquensis	x		
Pavona sp. (P. varians complex)	x		
Pectinia Paeonia	x	x	x
Platygyra pini			
Pocillopora acuta	x		
Pocillopora damicornis			x
Porites aff. Horizontalata	x	x	
Porites cylindrica	x	x	
Porites horizontalata	x	x	
Porites lichen sensu R&M 1982	x		
Porites lobata	x		
Porites lutea	x	x	
Porites murrayensis	x		
Porites rus complex	x	x	x
Porites sp. Massive	x	x	x
Stylocoeniella armata	x	x	x
Stylocoeniella guentheri		x	
Total Coral Taxa Observed	**33**	**19**	**9**

Source: HDR & CSA, 2020

The massive corals of the genus *Porites* may include the species *Porites australiensis*, *Porites lichen*, *Porites lobata*, *Porites lutea*, and *Porites murrayensis* (as well as several species that may be undescribed). This group of massive complex-forming species often require a detailed inspection of individual calyces and the collection of macro-photos or specimens for close inspection to confirm identification to species (HDR & CSA, 2020). Therefore, most were classified into the category "*Porites sp. massive*" to avoid inaccurate identifications. Several colonies of *Pavona* were also observed at the UEMMS site that were similar to *Pavona varians* but distinctly not that species, and also different from each other. These were classified as *Pavona sp*. (*P. varians* complex).

Fish

Fish are vital ecological and economic components of the marine ecosystem. To protect this resource, NMFS works with the regional fishery management councils to identify the essential habitat for every

life stage of each federally managed species using the best available scientific information. Essential fish habitat has been described for approximately 1,000 managed species to date. Essential fish habitat includes all types of aquatic habitat including wetlands, coral reefs, seagrasses, and rivers; all locations where fish spawn, breed, feed, or grow to maturity. (Note: Sharks and rays are discussed in a separate section below.)

Fishing. Fishing from NBG Main Base has impacted marine resources and created safety risks and conflicts among recreational use. NBG Fishing Instruction (NBG Instruction 5090.2A Saltwater Fishing [undated]) applies to NBG Maine Base shores and nearshore waters and sets policy that is consistent with other policies and management plans, conserves natural resources, and ensures safety for recreational users. Unauthorized fishing techniques include: (1) spearfishing, (2) nets other than cast nets, (3) harvest or collection of mollusks (e.g., octopuses, squid, clams, snails), crustaceans (e.g., lobster, crabs), or echinoderms (e.g., cucumbers, urchins), (4) explosives, (5) poisons, (6) intoxicating substances, (7) electrical devices, (8) snagging of fish by any method, (9) fish weirs or other trapping methods (10) collection of coral, and (11) any fishing technique not listed as a permitted fishing technique. Permitted fishing techniques include: (1) hook and line, and (2) cast nets from shore for seasonal juveniles.

Apra Harbor. Results from monitoring efforts on Outer Apra Harbor (Shils, et al., 2017) recorded up to 73 species at a single monitoring site. The most species-rich families of fishes were wrasses (*Labridae*, including 33 wrasses and 15 parrotfishes), damselfishes (*Pomacentridae*, 24 species), surgeonfishes (*Acanthuridae*, 22 species), butterflyfishes (*Chaetodontidae*, 20 species), gobies (*Gobiidae*, 15 species), and squirrelfishes or soldierfishes (*Holocentridae*, 11 species). Large important fisheries species such as groupers (*Epinephelinae*), snappers (*Lutjanidae*), and emperors (*Lethrinidae*) were not commonly observed. Smaller fisheries species, such as parrotfishes and surgeonfishes (*Acanthuridae*), varied in abundance between monitoring sites. However, while performing in-water turtle tagging surveys (2015 and 2016), the surveyor typically observed locally targeted fish species such as bluespine unicornfish (*Naso unicornis*) and bluefin trevally (*Caranx melampygus*) along Gab reef and humphead wrasse (*Chelinus undulates*) and giant sweetlips (*Plectorhinchus albovittatus*) along fringing reefs fronting Dadi and Spanish Steps beaches (Hapdei, 2017).

Schils et al. (2017) focused on a group of indicator species, butterflyfish that have an obligate relationship with coral, in Apra Harbor to assess the coral community and to track indicator reef species' use of habitat within the harbor. Seven of the 20 species of butterflyfish observed are obligate coral-feeding species. *Heniochus lunnulatus* and *H*. *chrysostomus* were most abundant at NBG Main Base sites. Schils et al. (2017) suggest the two most common obligate coral-feeding species are indicator species that could be used to monitor coral reef health on these sites.

Project Area. Fishes and other motile vertebrates were also recorded in 2020 marine surveys at the direct and indirect impact UEMMS array areas and the Polaris Point shore landing site. No stationary counts were collected along the proposed cable route due to very limited visibility. Fishes were simply recorded for presences during a swim along the cable route.

Fish species richness from focused *in situ* surveys recorded a total of 69 species identifications within 19 families (Table 3-11). Five identifications could only be made to the family taxon, due partially to the survey method's limitations for capturing cryptic species and due to the limited visibility at most sites. It is anticipated that small, cryptic recruits and the *Gobiidae* and *Blenniiddae* families, which are difficult to identify to species level, were likely underrepresented in the survey data. Prior general observations of

the bottom habitat indicate that Apra Harbor is rich with many goby and blenny species that live in borrows potentially with symbiotic species, such as shrimp in soft sediment habitats not extraneously examined in these surveys (NAVFAC, 2020 in NAVFAC Pacific, 2021).

Table 3-11 Fish Species Richness Observed in Stationary Plots at UEMMS Project Areas

Acanthuridae	**Carangidae**	**Holocentridae**	**Pomacentridae**
Acanthurus blochii	*Caranx melampygus*	*Neoniphon opercularis*	*Amblyglyphidodon*
Acanthurus nigricauda	*Scomberoides lysan*	*Neoniphon samara*	*curacao*
Acanthurus olivaceus		*Sargocentron spiniferum*	*Chrysiptera traceyi*
Acanthurus sp.	**Chaetodontidae**		*Pomacentrys*
Ctenochaetus striatus	*Chaetodon auriga*	**Labridae**	*amboinensis*
Naso annulatus	*Chaetodon ephippium*	*Cheilinus fasciatus*	*Pomacentrus pavo*
Naso lituratus	*Chaetodon lunulatus*	*Cheilinus trilobatus*	*Pomacentrus sp.*
Zebrasoma veliferum	*Chaetodon ulietensis*	*Cheilinus undulatus*	
	Forcipiger longirostris	*Hemigymnus melapterus*	**Scaridae**
Apogonidae	*Heniochus monoceros*	*Labroides dimidiatus*	*Cetoscarus ocellatus*
Apogon sp.		*Oxycheilinus diagrammis*	*Chlorurus spilurus*
Cheilodipterus macrodon	**Epinephelidae**	*Stethojulis bandanensis*	*Hipposcarus longiceps*
Cheilodipterus	*Epinephelus merra*		*Scarus ghobban*
quinquelineatus	*Epinephelus*	**Lethrinidae**	*Scarus globiceps*
Taeniamia fucata	*polyphekadion*	*Lethrinus harak*	*Scarus schlegeli*
		Lethrinus olivaceus	
Balistidae	**Gobiidae**		**Serranidae**
Balistoides viridescens	*Amblybogius phaelena*	**Lutjanidae**	*Plectropomus sp.*
Rhinecanthus aculeatus	*Amblygobius nocturnus*	*Lutjanus gibbus*	
Sufflamen bursa	*Bryaninops amplus*		**Tetraodontidae**
Sufflamen chrysopterum	*Cryptocentrus*	**Mullidae**	*Arothron*
	strigilliceps	*Parupeneus barberinus*	*nigropunctatus*
Blenniidae	*Ctenogobiops feroculus*		
Meiocanthus atrodorsalis	*Fusigobius signipinnis*	**Nemipteridae**	**Zanclidae**
Pteroscrites sp.	*Exyrias belissimus*	*Pentapodus caninus*	*Zanclus cornutus*
	Eviota lachdeberi		
	Eviota prasites	**Pinguipedidae**	
	Eviota sp.	*Parapercis clathrate*	
	Oxyurichthys papauensis		

Note: Ordered alphabetically by family; names follow Allen *et al.,* 2015 in NAVFAC Pacific, 2021.

Of the 69 species observed during the 2020 survey, species from the *Pomacentridae* family made up the largest percent of observations (38%) with *Pomacentrus ambonensis* and *Amblyglyphidodon curacao* being the most common and present at all project sites. Species from the *Apogonidae* and *Gobidae* families were the next most frequently counted species in all project sites at 20% and 13% respectively for all counts. Table 3-12 summarizes the fish species diversity and abundance at the different survey locations. Visibility was poor along the cable route and fish families and species were only recorded as present; no estimates of abundance (i.e., total counts of individuals) were attempted.

Table 3-12 Fish species diversity and abundance per survey location

Action Area	*Number of Surveys*	*Number of Families*	*Number of Species*	*Total Counts*
UEMMS Array Site	20	16	45	926
Cable Route*	2	10	15	N/A
Shore Landing Transition Site	2	8	18	201

* Qualitative observations
Source: HDR & CSA, 2020

Trophic composition of the array site fish assemblage was numerically dominated by planktivores but also included general carnivores and herbivores. Herbivores present were mostly mobile individuals such as parrotfishes and surgeonfishes. The most common roving herbivores at the array site were *Hipposcarus longiceps*, *Acanthurus nigricauda*, and *Acanthurus blochii*. Larger piscivores were not common in census samples but sightings of *Plectropomus sp*., *Caranx melampygus* and *Scomberoides lysan* were observed outside the survey areas.

Sharks and Rays

The scalloped hammerhead shark (*Sphyrna lewini*) is distributed globally in warm temperate and tropical waters and are highly mobile and partly migratory (Miller et al., 2014, in NAVFAC Pacific, 2021). They inhabit bays and estuaries and occur from surface waters down to depths of 1,700 feet, with occasional dives up to 3,200 feet (Miller et al., 2014). Sharks lack pelagic larvae, and young are born live during summer breeding season between May and September (Duncan et al., 2006 in NAVFAC Pacific, 2021).

Sharks on Guam are within the Indo-West Pacific DPS, which was listed as threatened in 2014. The earliest confirmed record of a scalloped hammerhead shark on Guam was in 1968, but confirmed sightings are rare today (Kami, 1971; NMFS, 2014; Adams, 2018, as cited in DON, 2018). Anecdotal observations of adult scalloped hammerhead sharks have been noted at multiple locations around Guam, including Outer Apra Harbor, Sasa Bay, the southernmost part of Inner Apra Harbor, the outer coastline of the Orote Peninsula near the Orote Airfield (NOAA-NMFS, 2015c; Adams, 2018 in NAVFAC Pacific, 2021). However, no confirmed scientific evidence of scalloped hammerhead sharks has been documented in Apra Harbor, and no anecdotal sightings have been documented in Apra Harbor since 2004 (NOAA-NMFS, 2015c in NAVFAC Pacific, 2021).

Based only on anecdotal observations of solitary scalloped hammerhead sharks, Sasa Bay is suggested as a potential nursery area (NMFS, 2015), although there is no scientific evidence to confirm this supposition (NMFS, 2015; Resko, 2018 in NAVFAC Pacific, 2021) and there is no designated critical habitat for scalloped hammerhead sharks in Apra Harbor. Furthermore, the high level of human activity and the lack of quality habitat in Inner Apra Harbor may limit their presence in the area (DON, 2019 in NAVFAC Pacific, 2021). No scalloped hammerhead sharks were observed during the 2019 and 2020 biological surveys of the project area (NAVFAC Marianas 2019, 2020 in NAVFAC Pacific, 2021) and large numbers of scalloped hammerhead sharks are unlikely to occur in the Project Area.

The primary threats to the Indo-West Pacific DPS of scalloped hammerhead sharks include overutilization by industrial/commercial and artisanal fisheries, overutilization by illegal, unregulated, unreported fisheries. Habitat degradation, inadequacy of current regulatory mechanisms, and impacts

to schooling behavior are moderate risks (Miller et al., 2014). Both CNMI and Guam banned the possession, sale, offer for sale, trade, and distribution of shark fins. Guam also explicitly prohibits the take, purchase, barter, transport, export, and import of shark fins.

The oceanic whitetip shark (*Carcharhinus longimanus*) is a surface-dwelling, pelagic species, and inhabits water depths greater than 184 m (Young et al., 2018). Though frequently encountered in pelagic longline and seine fisheries, they are very uncommon in nearshore waters. The only life stage observed close to shore are pregnant females, but there are no observations from inshore waters (Young et al., 2016, as cited in DON, 2018). Based on the known habitat use and life history, occurrence of oceanic whitetip sharks in JRM-administered submerged lands is possible but unlikely and has reasonable potential to occur within Apra Harbor and the waters surrounding G-DODS (including route from Apra Harbor to G-DODS; DON, 2018).

Reef manta ray (*Manta alfredi*) feed upon multi-species spawning areas in Guam (Hartup, Marshell, Stevens, Kottermair & Carlson, 2013; Hartup, 2017), one of which is located in Outer Apra Harbor. Gray reef shark (*Carcharhinus amblyrhynchos*) and blacktip sharks (*Carcharhinus limbatus*) have also been observed at this site (Hartup, 2017).

3.4.2.4 Marine Vegetation and Non-Coral Benthic Invertebrates

Marine vegetation includes plants occurring in marine or estuarine waters. These may include mangroves, algae, and various grasses. Estuaries, sea grass beds, and mangrove forests occur in Apra Harbor, but not within the project area. Animals that live on the sea floor are called benthos. Most of these animals lack a backbone and are called invertebrates. Typical benthic invertebrates include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, crabs, and many more. (Note: Corals are discussed separately in the previous section.)

Within the UEMMS array (i.e., direct impacts) area, the 2020 biological surveys identified and analyzed percent cover of macroalgae, cyanobacteria and non-coral invertebrate species. Macroalgae contributed significantly to percent cover of biota within the array area with cover averaging 14.7% across the site with species *Caulerpa racemosa*, *Caulerpa serrulata*, *Caulerpa verticillata*, *Dictyota* sp., and *Lobophora* sp. contributing the most. Crustose coralline algae was not observed in any abundance within the surveyed areas. At least one blue-green algae or cyanobacteria observed was *Symploca hydnoides* that averaged 4.5% cover and was mostly seen in areas of broken coral rubble and disturbed sediment bottom.

Observations identified several large elephant ear sponges (*Ianthella basta*) that add a significant three-dimensional component to the benthic community, along with several other sponge species (*Melophlus sarasinorum*, *Stylissa massa*, *Aplysinella rhax*, *Cliona* sp., *Haliclona turquoisia*, *Haliclona* spp., *Iotrochota ditrochota*, and *Xestospongia* aff. *Carbonaria*) all present in lower abundance. Average sponge cover across the UEMMS array area was 4.2%. Observed mobile invertebrates included the holothurid species *Bohadschia argus*, the sea star *Echinaster luzonicus*, and the brittle star *Ophiomastix caryophyllata*. The sessile non-coral invertebrates benthic percent cover mean of 4.4% included the coral boring bivalve *Lithophaga* sp. (observed in colonies of *Porites* sp. massive), the tunicates *Phallusia julinea*, *Polycarpa* sp., *Rhopalaea circula*, and *Rhopalaea* sp., and an unidentified Sabellid feather duster worm.

At the Polaris Point shore landing site, macroalgae was the most abundant biota (12%) and included *C. racemosa*, *C. serrulata*, *C. verticillata*, *Dictyota* sp., and *Padina* sp. The blue green alga *S. hydnoides* had a slightly more significant presence at 6.7%. *Porifera* were in low abundance with the species *A. rhax*,

Ceratopsion sp., *Cliona* sp., *Liosina granularis*, *Stylinos* cf. *ruetzleri*, and X. aff. *carbonaria* noted. Sponge percent cover had an average of 2.5% with an unidentified sponge species that comprised nearly all of the sponge cover. Motile invertebrates included the holthuroid *Holothuria atra* and the nudibranch *Risbecia* sp. Common sessile invertebrates were the boring bivalve *Lithophaga* sp. and the *tunicate* P. *julinea* making up just 1.2% of cover.

Due to the length of the cable route, percent cover was not able to be generated with divers reporting general findings and observations. The benthic habitat transitioned from reef described in the previous sections to fine sediments at about 66-ft depth, with large numbers of small polychaete worm, shrimp, and goby burrows appearing at about 72- to 80-ft depths. The 10-ft outcrop was colonized by the sponges *C. eurypa* and *I. ditrochota*, and large amounts of the green algae *C. verticillata* was heavily covered with silt.

Table 3-13 summarizes the percent cover of non-coral biota at the surveyed areas, by major group.

Table 3-13 UEMMS non-coral biotic percent cover values for major groups

	Percent Cover			
Site	***Macroalgae***	***Cyano-bacteria***	***Sponges***	***Sessile Invertebrates***
UEMMS Array Direct Impact Area	13.2	4.9	4.1	3.0
UEMMS Array Indirect Impact Area	16.1	4.1	4.3	5.8
Shore Landing Area	12.0	6.7	2.5	1.2

Exotic or invasive species noted within the survey footprint included the elephant ear sponge *Ianthella basta*, which was observed throughout the UEMMS survey area and is common throughout deeper regions of Apra Harbor. No seagrass or invasive species other than *I. basta* were observed throughout the surveyed areas.

3.4.2.5 Essential Fish Habitat

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). Magnuson-Stevens Fishery Conservation and Management Act50 CFR 600.10 provides further definition for interpreting EFH. The project area is located within the boundaries of the Mariana Archipelago Fishery Ecosystem Plan (FEP) (WPRFMC, 2009). This place-based FEP uses an ecosystem-based approach with “geographically defined ecosystem plans containing identical fishery regulations.” The FEP identifies and categorizes Management Unit Species (MUS) based on the relevant managed fisheries and incorporates all of the management provisions of the former Fishery Management Plans, with updates.

The *Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region* (WPRFMC, 2009) manages those resources and habitats associated with the pelagic ecosystem, specifically the Pelagic MUS (PMUS). The Pelagic FEP encompasses all areas of pelagic fishing operations in the Exclusive Economic Zone (EEZ) or on the high seas, for any domestic vessels that: 1) fish for, possess, or transship Pacific PMUS within the EEZ waters of the Western Pacific Region; or 2) land Pacific PMUS within the states, territories, commonwealths, or unincorporated U.S. island possessions of the Western Pacific Region.

EFH was designated as the marine water column from the surface to a depth of 1,000 meters from shoreline to the outer boundary of the EEZ (i.e., 230 miles), and on the seafloor from the shoreline out

to a depth of 400 meters around each of the Mariana Islands. As such, the water column, seafloor, and all surrounding waters and submerged lands within the Mariana Archipelago are designated as EFH and support various life stages for the MUS identified under the Mariana and Pelagic FEPs. The MUS and life stages found specifically within the Mariana Archipelago include eggs, larvae, juveniles, and adults for Bottomfish MUS (BMUS) and PMUS. No Habitat Areas of Particular Concern (HAPC) occur for these MUS within Guam, and likewise the Project Area. Furthermore, NMFS considers EFH to comprise specific types of habitat, such as coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, mangrove, lagoon, estuarine, surge zone, deep-slope terraces, and pelagic/open ocean.

Waters and substrate within Apra Harbor are designated as EFH for managed fishery species listed in Table 3-14 below. According to the EFH designations in the Mariana FEP, Apra Harbor is absent of EFH for precious corals, deep-water shrimp, and seamount ground fish.

EFH in the project area includes hard substrate (coral rubble and coral pavement), algae (macro and cyanobacteria), and sessile organisms (sponges, tunicates, etc.) that provide services and functions not limited to but including shelter, water filtration, and food sources (Wilson, 2011 in NAVFAC Pacific, 2021).

Table 3-14 EFH Designated within Project Area

MUS	*Species Complex*	*Designated EFH*
BMUS	• Shallow-water (0-330 ft) • Deep-water (330-1,320 ft) Complexes	• Adults and juveniles: Water column and all bottom habitat from the shoreline to 1,320 ft encompassing steep drop-offs and high-relief habitat • Eggs and larvae: Water column extending from the shoreline to the outer limit of the EEZ to a depth of 1,320 ft
PMUS	• Temperate/Tropical Species • Sharks • Squid Complexes	• Juveniles & Adults: water column from the surface to 3,300 ft; from shoreline to the outer limit of the EEZ • Eggs & Larvae: water column from the surface to 660 ft; from shoreline to outer limit of the EEZ

There are no HAPCs within the project area. The closest HAPC to the project area is Jade Shoals, approximately one mile north of the project area.

3.4.2.6 Threatened and Endangered Species

Terrestrial Species

There are no threatened or endangered terrestrial species known to occur in the ROI.

Marine Species

Table 3-15 lists the marine ESA-listed species that may be encountered during the Proposed Action. Based on historical records and results from biological surveys of Apra Harbor (HDR & CSA, 2020), only three species (green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata)*, and scalloped hammerhead shark (*Sphyrna lewini*)), have reasonable potential to occur where most of the Proposed Action would occur. These three species are discussed in detail in Section 3.4.2.3 above. No ESA-listed coral species (e.g., *Acropora globiceps*) were observed within the project area. During the excavated material disposal trips to the G-DODS, the three ESA-protected species listed above may be encountered, and the risk of a vessel collision with ESA-listed whales and dolphins is considered a

possible impact (see Section 3.4.3.2). If a crane barge is needed from outside Guam, vessels would likely travel from Honolulu, Hawaii through critical habitat for the Main Hawaiian Islands (MHI) Insular False Killer Whale (IFKW) DPS. All other actions would occur within Apra Harbor, where no critical habitats occur.

Table 3-15 Threatened and Endangered Marine Species Known to Occur or Potentially Occurring in the ROI

Scientific Name	*Common Name*	*Status*
MARINE MAMMALS		
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	
Balaenoptera borealis	Sei whale	
Physeter microcephalus	Sperm whale	
Pseudorca crassidens	Main Hawaiian Islands Insular False Killer Whales DPS	
SEA TURTLES		
Chelonia mydas	Green sea turtle, Central West Pacific DPS	Endangered
Eretmochelys imbricata	Hawksbill sea turtle	
Dermochelys coriacea	Leatherback sea turtle	
Caretta	Loggerhead sea turtle, North Pacific DPS	
Lepidochelys olivacea	Olive ridley sea turtle	Threatened
FISHES		
Sphyrna lewini	Scalloped hammerhead shark, Indo-West Pacific DPS	Threatened
Manta birostris	Giant manta ray	
Carcharhinus longimanus	Oceanic whitetip shark	
CORALS		
Acropora globiceps	—	Threatened

Source: NAVFAC Pacific, 2021

Critical Habitat

Under the ESA, critical habitat is defined as specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection. Critical habitat may also include areas that are not currently occupied by the species but would be needed for its recovery. No critical habitat has been designated within Apra Harbor.

The Proposed Action may require a vessel and/or a crane barge to be brought from outside Guam and possibly the MHI. Should open-ocean vessel/barge movements occur from the MHI to Guam, the transit route would most likely be in and out of Honolulu, Hawaii, and through waters designated as MHI IFKW DPS critical habitat, which includes water from the 45-m depth contour to the 3,200-m depth contour around the MHI from Niihau east to the Big Island of Hawaii. The critical habitat comprises a single,

essential feature (i.e., island-associated marine habitat for MHI IFKW) with four characteristics that support this feature:

- adequate space for movement and use within shelf and slope habitat
- prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
- waters free of pollutants of a type and amount harmful to MHI IFKWs
- sound levels that would not significantly impair false killer whales' use or occupancy

3.4.3 Environmental Consequences

This analysis focuses on wildlife or vegetation types that are important to the function of the ecosystem or are protected under federal or state law or statute.

3.4.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no impacts to biological resources would occur with the No Action Alternative.

3.4.3.2 Concrete Anchor Disc Alternative (Preferred Alternative) Potential Impacts

The study area for analysis of effects to biological resources associated with the Preferred Alternative includes:

- Approximately 0.18 acres (7,900 sq ft) of the Outer Apra Harbor seafloor in the navigational channel to Inner Apra Harbor (installation of sensor array)
- Approximately 0.07 acres (3,080 sq ft) of the Outer Apra Harbor seafloor between the sensor array and the cable duct (path of the subsea cable bundle)
- Approximately 225 cubic yards of sea floor and boulder riprap revetment of Polaris Point (shore landing of cable bundle)
- G-DODS (disposal of excavated material)
- Approximately 144 sq ft around the cable bundle transition vault
- Approximately 4,000-linear foot fiber optic cable path from the cable transition point to the cable termination point on Polaris Point (installation of cable bundle within existing conduits)
- Orote Airfield CDF and Field 5 CDF sites (alternative sites for upland disposal of excavated material)
- Approximately one acre on Polaris Point (construction staging area)

Most construction period impacts would be temporary and reversible. These expected impacts are described in detail in the following sections. During the operational period, the system would require minimal maintenance. The sensor array is designed to passively acquire data and would not emit electromagnetic radiation during operation. The data would be transmitted via subsea and below-grade cables and conduits to existing facilities for analysis. Because the UEMMS is a passive system with no mechanical parts, repairs are anticipated to be minimal and would be conducted on an as-needed basis. If new technologies or requirements arise during its service life, upgrades to the system may occur. The installation and operation of the sensor array would not increase ship traffic to or from Apra Harbor by either homeported or transient vessels.

Terrestrial Vegetation

Minor and temporary impacts to terrestrial vegetation would occur from land-based construction activities (shoreside cable landing, installation of transition vault adjacent, cable path from cable transition point to cable termination point on Polaris Point, construction area on Polaris Point, Orote Airfield CDF, and Field 5 CDF). Project construction activities would occur in locations that have been previously disturbed and do not include limestone forest.

The Preferred Alternative would have less than significant impacts on terrestrial vegetation. No impacts would occur to any federal- or Guam-listed endangered plant because there are no protected terrestrial vegetation species known to occur in the ROI.

Terrestrial Wildlife

Minor and temporary impacts to terrestrial wildlife would occur from land-based construction activities (shoreside cable landing, installation of transition vault adjacent at Polaris Point, cable path between the cable transition and termination points on Polaris Point, construction area on Polaris Point, USSA and MEC/MPPEH management sites, and Orote Airfield CDF and Field 5 CDF). Minimal areas of vegetation may be cleared during construction, and noise and human activity would increase during construction. Because construction activities are expected to occur during normal daytime work hours, additional lighting is not anticipated. The Preferred Alternative would not have a significant impact on terrestrial wildlife because there is no native terrestrial wildlife in the project area. No impacts would occur to any federal- or Guam-listed threatened or endangered animal, birds protected under the MBTA, and Guam-designated SOGCNs. No foraging, nesting, or roosting sites for protected animals were identified in the project area.

Ponded water, which could attract migrating birds, is not anticipated to occur in the CDFs. If the CDF becomes an attractive site for migrating birds, construction contractors would discourage use of the sites by migratory birds through various means, such as deploying decoys and using noise makers. Because UEMMS terrestrial operations would consist of data transmission and acquisition that occur below grade or within existing structures, operational period impacts would be less than significant.

Marine Wildlife

Mammals

The Preferred Alternative is unlikely to result in significant adverse effects to marine mammals, as they are not known to be common in Apra Harbor. Planned BMPs would further minimize risks to these animals that have a low probability of being present in the project area. In particular, during the proposed in-water activities, vessel operators would reduce vessel speeds to 10 knots or less if in the proximity of a marine mammal and alter course to remain at least 50 yards from marine mammals. During the operational period, the UEMMS would passively record data, which would be transmitted via the subsea cables to onshore data acquisition equipment for processing.

Sea Turtles

As all sea turtles found in U.S. waters or that nest on U.S. beaches are protected species under the ESA, they are discussed below in the section entitled, Threatened and Endangered Species.

Coral

The Preferred Alternative would result in the physical removal of corals and increased suspended sediments that would adversely impacts corals in the ROI during the construction period. Although unlikely to occur, the following environmental stressors on coral in the ROI may result from Preferred Alternative during the construction period: wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and UXO. The implementation of avoidance, minimization, and offset actions would result in less than significant impacts to coral communities in the ROI. During the operational period, project-related activities (e.g., maintenance and repair) would be minimal and infrequent due to the passive nature of UEMMS operations, resulting in less than significant impacts to coral. Analysis of project effects on coral communities and the DON's proposed mitigation actions are described below.

Physical removal. The Preferred Alternative would result in physical removal of 7,680 coral communities (7,535 in the sensor array footprint and 145 in the cable shore landing footprint) (see Table 12 in NAVFAC Pacific, 2021 [Appendix C] for detailed coral counts and size frequencies). Approximately 19 percent of the 7,680 colonies are 0- to 10-centimeter (0 to 4-inch) size class. About 40 percent of coral colonies fell into the 10- to 20-centimeter (4- to 8-inch) size class and about 32 percent of the colonies are in the 20- to 40-centimeter (8- to 16-inch) size class. See Table 3-16 for summary. The smallest corals (0 to 10-centimeter) contribute the least to EFH structure and complexity, as most are not reproductive and contribute less to sustainment or propagation of reef-building biota. Small colonies are difficult to remove and relocate because of their small size and relative delicacy.

Table 3-16 Coral Colonies to be Physically Removed (estimated)

Area	*Counts*	*Size Frequency*					
	Total	*<10 cm*	*10-20 cm*	*20-40 cm*	*40-80 cm*	*80-160 cm*	*>160 cm*
Direct Impact	7,535	1,408	2,988	2,386	674	73	8
Shore Landing	145	44	48	40	13	--	--
Total	**7,680**	**1,452**	**3,036**	**2,426**	**687**	**73**	**8**
% of Total	**100**	**19**	**40**	**32**	**9**	**1**	**0.1**

Source: Summarized from NAVFAC Pacific, 2021, Tables 12 and 13

The total coral cover to be physically removed by the Preferred Alternative was calculated by applying conservative ratios to the corals' two-dimensional surface area measurements to account for mounding, branching, and foliose morphologies and determined to be approximately 58,400 sq ft (see NAVFAC Pacific, 2021 in Appendix C for detailed methodology). After factoring in minimization measures (i.e., coral translocation), about 18,710 sq ft are considered a loss in the analysis.

Avoidance, Minimization, Offset. The Navy proposes to avoid, minimize, and offset adverse impacts to the affected coral communities from physical removal through the following actions.

- Avoidance – The Navy surveyed about 8,000 sq ft of additional area adjacent to the primary project footprint to identify sensitive habitats for avoiding these areas during temporary constructions actions (anchoring, spud barge, etc.). Navy engineers identified a cable route in deeper water habitats that are predominately devoid of EFH with cables designed to be deployed in such a manner that would circumnavigate sensitive areas. The cables would be installed using diver-guided deployment to avoid sensitive habitats after divers deploy an initial "cable guide path" on the seafloor.

- Minimization - Navy engineers made design changes to the depth of excavation and allowed for partial exposure of the MT sensors by several meters above the sea floor. This design change decreased the required excavation by more than three and a half times less area than initially designed, to about 7,800 sq ft, thus minimizing the direct impacts to the area. The amount of excavated material also decreased from 5,600 CY to 1,200 CY. This redesign also included the relocation of the CTD sensor with the sensor array instead of impacting a separate location on an adjacent coral reef mound. The subsea cable attachment to the benthos was also redesigned to minimize the footprint affected by the cable anchors.

  Of the 7,680 corals estimated at the array site and shore line landing, about 1,380 colonies are not candidates for translocation due to their small size or growth form that cannot be safely transported (i.e., encrusting). The Navy would minimize loss of the remaining 6,300 corals by moving as many as possible (along with large sponges and mobile invertebrates that can be collected) to a coral pinnacle in Outer Apra Harbor called Mound 9, which is located to the southwest of Western Shoals (see NAVFAC Pacific, 2021 in Appendix C for detailed description of translocation activities and map of Mound 9). Due to their large size and the difficulty with moving the colonies extensive distances, select larger corals may be moved to areas adjacent to the UEMMS array area instead of to Mound 9. At the Polaris Point shore landing site, about 103 coral would be translocated to similar habitat to the east and west of the construction area. The Navy would periodically remove algae competing with corals and reattach living coral.

- Offset – To offset expected temporary losses of EFH (including coral cover and benthic habitats), The Navy proposes to perform habitat restoration and conversion at Mound 9, described below. Habitat restoration would complement and synergize with the coral translocation proposed under minimization. Restoration would make the site more suitable for EFH as a coral reef habitat for the coral transplants, as well as for additional marine species that could recruit there. The Navy conducted multiple Habitat Equivalency Analyses (HEA) using software that calculates the amount of compensatory restoration required to provide services that are equivalent to the interim loss of natural resource services following the impacts of the project (Pioch et al., 2017 and Kohler et al., 2006 in NAVFAC Pacific, 2021). The HEA analysis identified approximately **35,240 sq ft of replacement habitat** needed to provide equivalent ecological services lost due to the Preferred Alternative (including about **24,590 sq ft to offset the loss of coral cover** and **10,650 sq ft to offset adverse temporary and permanent loss of benthic habitats contributing to EFH**). See NAVFAC Pacific, 2021 in Appendix C for details of the HEA analysis. (Note: Impacts to benthic habitats and EFH are discussed later in this section.)

  The offset mitigation actions generally include:

  - removing anthropogenic debris scattered within the Mound 9 restoration area prior to stabilization
  - stabilizing approximately 13,300 sq ft of the substrate at Mound 9 to reduce the rubble mobility on top of the mound and create a consistent, stable surface to which marine fauna may attach and thrive
  - placing locally-sourced, limestone boulders on the newly-stabilized area on top of Mound 9 to increase rugosity and habitat complexity
  - attaching transplanted corals to the limestone boulders as well as the stabilized substrate

- monitoring (i.e., quantify and assess the resource conditions) fish and benthic community at the Mound 9 restoration site at pre-determined intervals over two years after translocation
- managing macroalgae and competing invertebrate populations that threaten to overgrow transplanted corals
- managing corallivore species populations (e.g., crown-of-thorns starfish, *Drupella* sp. snails, etc.) at the restoration site

Mound 9 (i.e., the site of the proposed coral translocation and habitat enhancement minimization and offset actions) is a submerged coral seamount located southwest of Western Shoal in Outer Apra Harbor, offshore from the San Luis Ponds and within less than one nautical mile from the primary project action area. The uppermost surface of the seamount is thought to have been dredged after World War II, leaving a large flat central area that crests at a water depth of approximately 46 feet. The central upper surface of this large flat-topped mound, an area of approximately 1.0 to 1.5 acres, is primarily comprised of rock rubble and sand-covered bottom, devoid of consolidated hard substrate, with only occasional small coral colonies (less than four-inch diameter) present in the rubble areas. The unconsolidated material and anthropogenic debris present limited the recruitment and stabilization of natural reef forming organisms.

Habitat restoration at Mound 9 would complement and synergize with the coral translocation and make the site more suitable for EFH as a coral reef habitat for the coral transplants, as well as for additional marine species that could recruit there. By restoring the site at Mound 9, the Navy would translocate habitat from an invertebrate community in a high-traffic vessel channel to an improved, natural site where coral occurred in the past. Finally, management unit species of fish would likewise benefit from the restored environment by improving it as a site for prey to recruit and seek refuge.

Suspended sediments. Construction activities such as excavation for the sensor array footprint would result in temporarily increasing suspended sediments in the water column. Exposure of corals to elevated suspended sediments leads to effects that are complex, dynamic, and interdependent, as the effects may occur individually or via a multitude of interconnecting pathways. The following direct and indirect effects to benthic habitats—including coral—may include (but are not limited to):

- covering/smothering of benthic fauna (direct)
- increased turbidity (direct)
- increased sedimentation (direct)
- changes in light quality and quantity (indirect)
- chemical changes (indirect)
    - oxygen depletion
    - nutrient release
    - contaminant pollution
    - pore-water dilution

The coral reef ecosystem that occurs in or near the project area may be temporarily adversely affected by exposure to suspended sediments. Non-motile species such as coral would either tolerate or succumb to an increase in suspended sediment. The extent of each impact varies for each receptor species based on their tolerance levels, location relative to the proposed activities, and current behavioral patterns. Furthermore, the impact severity is contingent on the intensity, duration, and frequency of exposure to elevated suspended sediments (Erftemeijer et al., 2012).

At all life stages, corals may be impacted by elevated levels of suspended sediment concentration in the marine environment. However, each coral species maintains different tolerance and sensitivity levels, with some coral species having no observable effects while others experiencing widespread mortality. For example, coral species such as *P. rus*, with a flattened colony morphology (which allows more sediments to stay accumulated) and relatively low mucus production (mucus production being one of the ways in which corals actively shed accumulated sediments) are expected to experience greater adverse effects from increased sedimentation than vertically oriented morphology such as *P. cylindrica* (HDR & CSA, 2014 in NAVFAC Pacific, 2021).

Of all possible sedimentation effects to coral, light reduction may have the most significant implications for survival. Turbidity is defined as the optical property of a suspension that scatters and absorbs light and indicates levels of mud, clarity, and transparency (Jones et al., 2016). Elevated levels of suspended sediments contribute to high turbidity levels and reduce the quantity and quality (i.e., spectral composition) of light in marine environments, which subsequently results in decreased photosynthetic production by zooxanthellae (i.e., photo-physical stress) and starvation, reduced growth, lower calcification rates, and reduced regeneration from tissue damage (Erftemeijer et al., 2012). If light conditions are extremely low to negligible, corals may enter low or no oxygen states. Long-term turbidity impacts to the coral community structure may include decreased productivity, growth, and species diversity.

Anchoring the dredge barge would not affect marine substrate that could support sensitive benthic organisms such as coral because the anchors for the mooring system would be located by divers at select locations void of protected resources. All anchors (e.g., for vessels and silt curtains) would be set on hard or soft sand bottom devoid of corals. Selection of anchor locations would take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides.

Avoidance and Minimization. The Navy proposes to avoid, minimize, and offset construction period adverse impacts of increased suspended sediments to the affected coral communities through the following actions.

- Avoidance – No in-water construction would occur during the spawning period for both hard (scleractinian) and soft (octocorallia) corals.
- Minimization – The Navy would prepare and implement a rigorous water quality monitoring plan to continuously monitor and adaptively manage the turbidity levels resulting from the Proposed Action. The contractor would monitor turbidity levels at the Project Area to ensure that employed BMPs effectively control turbidity and protect marine resources (see Appendix C for specific monitoring requirements).

  The contractor shall remove all silt and debris depositing in drainage facilities, roadways and other areas and protect all storm drains and deck openings to prevent the discharge of foreign materials to the harbor. In addition to preparing a turbidity management plan, the contractor would prepare a contingency plan if measures fail. Operations/work would be curtailed in the event of high wind or adverse weather conditions.

Exposure to waste and discharge. The Preferred Alternative would not generate wastes that would enter the water. However, in the unlikely event that project-related wastes and debris accidentally enter the water, exposure to waste and discharge may adversely affect corals in or near the project area

through direct physical contact (e.g., plastic bags that wrap around coral) or exposure to toxic substances (e.g., petroleum or other chemicals).

The project's BMPs include measures to prevent or minimize the potential for the introduction of wastes and toxicants into the marine environment. No debris shall be allowed to enter the water. To further reduce the potential for action-related waste and discharges impacting corals adversely, all waste would be controlled and disposed into trash dumpsters or roll-off bins in the project base yard or storage area. The contractor shall capture all pollutants and dispose of them at an approved disposal facility. Prior to commencing daily activities, all equipment and vehicles would be maintained and checked to reduce any risk of leaks or discharge. Hydraulic equipment would be maintained properly to prevent leaks in accordance with the Navy Preventative Maintenance System.

In addition, a contingency plan to control and contain accidental, toxic spills would be developed for the proposed action and include protective measures for all construction vehicles and heavy machinery. Petroleum spill-containment devices (e.g., absorbent pads, containment booms) would be located on-site, in sufficient quantity, and available and accessible for immediate deployment at all times. Thus, project-specific BMPs would prevent the wastes and toxicants from entering the marine environment. However, if a chemical is discharged or spilled accidentally during the proposed repairs, the realistic worst case would be a small quantity or volume (<25 liters). In the unlikely event of a spill or discharge, the effects would be minimal, of small amounts and cleaned quickly. Based on the BMPs in place and maintenance requirements and programs, the exposure of coral communities to wastes and discharges from the Preferred Alternative would be minimal and controllable.

Exposure to aquatic invasive species. Aquatic invasive species (AIS) present a significant threat to the marine environments worldwide by dramatically altering other species' survival and ecosystem functions. Exposure to AIS may adversely affect coral communities in or near the project area. The key vectors for AIS exposure include biofouling:

- on vessel hulls and other external niches (e.g., propulsion units, steering gear, and thruster tunnels)
- of vessel internal niches (e.g., anchor cable lockers, bilge spaces)
- on equipment immersed routinely in water

Because the Navy would comply with its regulations and management plans that prohibit AIS from being introduced in bodies of water adjacent to Navy installations (i.e. Environmental Readiness Program Manual and INRMP) and would implement appropriate BMPs, potential impacts from exposure to AIS would be unlikely, temporary, and minimal.

Exposure to chemical contaminants. Exposure to contaminants either re-suspended from beneath the sediment surface during dredging or from oil or fuel released during equipment operation could have negative impacts on corals in and around the project area. Excavation and excavated material disposal can cause chemical impairment of the water column and coral communities by releasing and suspending surface and subsurface sediment contaminants. Dredging contaminated areas could mobilize and expose deeper contaminated sediments. Ship scour could cause surficial sediment resuspension, but deeper scouring probably occurs only periodically over small areas during the largest ship movements. However, based on the Navy regulations and management plans (i.e. Environmental Readiness Program Manual and INRMP) and implemented BMPs, as well as the short duration of the proposed construction activities, potential impacts to coral communities from chemical contamination would be temporary and minimal.

Unexploded Ordnance. If ordnance is detonated in the marine environment, nearby marine resources may be exposed to direct physical impact from shrapnel and effects of a pressure wave. The size and type of the munition, the depth of detonation, and the oceanic conditions also determine the radius and effects of a blast. Organisms close to a blast may be directly affected by the blast. Farther away, organisms may be affected by the pressure wave in the form of a sound pressure wave and movement of the water due to cavitation. Most corals and invertebrates do not have air or gas spaces in their bodies, so they may experience fewer traumas from pressure waves than vertebrates such as fish, turtles, and marine mammals. Coral and other invertebrates can be much closer to a blast than many vertebrates and suffer relatively minor effects.

Prior to coral translocation, UXO Qualified Divers would undertake visual surveys and anomaly avoidance (if needed), both of which limit the chances of encountering and disturbing munitions and explosives of concern or material potentially presenting an explosive hazard (MPPEH). If any MEC and/or MPPEH items are discovered during in-water activities, all work would be stopped immediately. Based on the implemented precautions and BMPs, the probability of coral exposure to direct physical impact, a pressure wave, or underwater sound effects from exploding ordnance is very low and unlikely.

Fish

The Preferred Alternative would result in less than significant, temporary construction period impacts on fish occurring in the ROI from the following environmental stressors: increased suspended sediments and elevated underwater noise levels. The following environmental stressors on fish populations in the ROI are possible but unlikely to occur: wastes and discharges and aquatic invasive species. Project BMPs would avoid or minimize adverse impacts to fish from these stressors. During the operational period, the UEMMS would be a passive system, with infrequent maintenance and repair (less than once a year); therefore, no operational period impacts to fish are expected. Analysis of project effects on fish communities and the Navy's proposed mitigation actions are described below.

Suspended sediments. Increased suspended sediments in the marine environment are known to negatively affect fish, although the responses vary considerably between species, life stages, sediment concentrations, and exposure time (Hess et al., 2017). Different species displayed a wide range of tolerance levels to increased suspended sediments, ranging from no effect to temporary behavioral changes to physiological stress and mortality (Wenger et al., 2017). Scientific evidence demonstrated that increased suspended sediments resulted in visual impairment and inhibition of chemical cues, which adversely affects foraging, predator defense, and habitat selection of several fish species (Hess et al., 2017). In some larval fish, development was disrupted and/or delayed following exposure to increased suspended sediments, possibly due to reductions in oxygen uptake efficiency. For species that respond in this way to increased suspended sediments, the long-term, impacts could include significant alterations of population recruitment rates and species distribution.

In the marine environment, the most commonly observed response from fish to elevated suspended sediments is avoidance (Wenger *et al*. 2017). Various studies documented several different species avoiding turbid waters, acclimating to changes or returning to habitats after the sediment levels returned to baseline conditions. Some fish species returned to areas that recovered to pre-disturbance conditions after dredging ceased, depending on food and habitat availability.

Apra Harbor is a relatively low-energy system with multiple sediment inputs separated from a single outlet to the sea by deep water and relatively long distances. These features promote sedimentation and limit the transport of sediment away from the dredging site. Potential effects from suspended

sediments from dredging operations on fish populations would be temporary, lasting only as long as dredging equipment is operating. Implemented BMPs (e.g., silt curtains) would reduce effects of increased suspended sediments on fish to minimum levels. Therefore, based low expected dispersion of sediment in the environment due to natural factors and the implemented BMPs, any adverse effects to fish from increased suspended sediments are expected to be temporary, minimal, and manageable.

Exposure to elevated underwater noise levels. Each fish species has a different hearing sensitivity range, and the majority of fish detect sounds below 100 Hz and up to 500–1,500 Hz. For this risk assessment, a conservative approach assumes that all fish have hearing within the 0–200 Hz frequency range and thus are able to detect the marine dredging sounds.

High-intensity sounds are able to fatigue, damage or kill auditory receptor cells in fish, resulting in temporary threshold shifts (TTS) or permanent threshold shifts (PTS). The level and duration of noise exposure that causes PTS and TTS in fish vary widely and may be affected by factors such as repetition rate of sound, pressure level, frequency, duration, health of the organisms. By definition, hearing recovers after TTS. Unlike other vertebrates, fish are able to regenerate sensory hair cells throughout their lives (including those damaged through sound exposure) (Popper & Hastings, 2009), although the extent (i.e., how many dB of hearing loss) and duration of the TTS may continue from minutes to days after the end of exposure. In spite of the sensory hair cell replacement, sustained injuries from PTS and TTS may render fish vulnerable to mortality indirectly, such as through increased predation, increased susceptibility to disease, and reduced fitness to feed, reproduce or communicate.

In addition, hearing sensitivity in fish also depends on the presence or absence of a swim bladder (and its type), which increases the individual's ability to detect sound over a broad frequency range and great distances, as well as increases its susceptibility to sound pressure and barotrauma injury.

Behavioral responses from exposure to elevated sound levels are variable and may include (but are not limited to):

- leaving the area of the noise source/avoidance/displacement
- startle/alarm responses
- spatial changes in schooling behavior/swimming patterns
- changes in depth/vertical distribution

These behavioral effects are temporary, with duration of effect less than or equal to the duration of exposure. The effects vary between species and individuals and are dependent on the properties of received sound. Available evidence suggested that behavioral changes for some fish species may be no more than a nuisance factor, and that within a few seconds, fish are likely to continue their previous activity.

There is no direct evidence of mortality or potential mortal injury to fish from continuous sounds (such as those produced by dredging operations). For auditory tissue effects or TTS caused by continuous sound, the only evidence available is from data on goldfish (*Carassius auratus*), a species that has specializations for enhanced sensitivity to sound pressure. The data indicate that after 48 hours of exposure to white noise at 170 dB re 1 µPa sound pressure level measured in root-mean-square (SPL_{RMS}), there was some recoverable loss of sensory hair cells in the ear (Popper et al., 2014). TTS recovery was observed seven days later, and full replacement of the sensory cells took eight days. Another study exposed goldfish to 158 dB re 1 µPa SPL_{RMS} and measured TTS, with full recovery after

three days. Without approved regulation or policy, these results provided reasonable, precautionary threshold values upon which to assess potential effects to fish from dredging noise.

The Preferred Alternative would produce elevated noise levels both in-air and underwater from:

- excavation for the sensor array installation
- underwater instrument array installation by divers using a handheld hydraulic breaker
- installation of guide stakes for cable (steel pipes would be driven in with vibratory hammer and PVC and/or fiberglass pipe would be jetted into substrate)
- installation of earth anchors with a barge or vessel by water jetting or by only the weight of a vibratory hammer
- excavation of seafloor and boulder revetment using a clamshell bucket

None of these actions are likely to generate underwater noise levels with the potential to cause adverse impacts to fish.

Sounds from dredges can be variable, depending on the phase of operation, and the type of dredge used, but typically occur at low frequencies (<500 hertz [Hz]; Reine et al., 2014). Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. Mechanical bucket dredges produce a repetitive sequence of sounds: noise from lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge.

Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson et al., 2001), the estimated sound levels of the proposed action in the outer Apra Harbor are not expected to exceed sound pressure level root mean square (SPL_{RMS}) of 124 dB re 1 micro Pascal (µPa) from the dredge bucket impact sound. The surrounding substrate is soft silt-covered rubble and sandy seabed that would generate much less sound than hard substrates when dredged. In addition, the bottom of the UEMMS excavation site does not contain environmental habitats or conditions that could result in fish being trapped and unable to move away from the noise source.

Implemented BMPs (Section 2.5) require that all work stops when an ESA-listed marine species is observed within 50 yards of the work (i.e., Shut-down Zone), and would resume only after the animal has departed voluntarily or until 30 minutes have passed since the previous sightings, thereby ensuring that no direct, physical impacts (permanent threshold shift: PTS onset) would occur to fish in the project area.

Exposure to elevated noise levels may adversely affect fish in the ROI. However, the acoustic effects would be temporary and minimal, and predicted sound levels from dredging would not exceed thresholds likely to cause TTS, PTS, or mortality. Fish may respond behaviorally to dredging noise by leaving or avoiding the area temporarily. Based on the expected underwater sound levels, the lack of sensitive benthic habitats or restricted environments for fish, and the BMPs implemented, potential acoustic effects from exposure to elevated noise levels from dredging operations on the fish populations would be temporary and recoverable, lasting only as long as dredging equipment is operating.

Exposure to waste and discharge. Exposure to waste and discharge may adversely affect fish that travel through the project area. Project wastes may include plastic trash that may be ingested by fish. Spills and discharges could contain petroleum and/or other chemicals and expose fish habitats in the project area to toxic substances in the water. The project's BMPs include measures to prevent or minimize the potential for the introduction of wastes and toxicants into the marine environment. No debris shall be

allowed to enter the water. To further reduce the potential for action-related waste and discharges impacting marine species adversely, all waste would be controlled and disposed into trash dumpsters or roll-off bins in the project base yard or storage area. The contractor shall capture all pollutants and dispose of them at an approved disposal facility. Prior to commencing daily activities, all equipment and vehicles would be maintained and checked to reduce any risk of leaks or discharge. Hydraulic equipment would be maintained properly to prevent leaks in accordance with the Navy Preventative Maintenance System. Based on the BMPs in place and maintenance requirements and programs, the exposure to wastes and discharges from the proposed action would be temporary, minimal, and controllable.

Exposure to aquatic invasive species. Introduction of AIS to the project area from construction of the Preferred Alternative may adversely affect fish in or near the project area if it becomes established in the area and alters the marine community by destroying native habitats, growing over coral reef, and promoting high levels of algal growth, which may adversely affect behavior and survival of reef fish populations. According to its policy guidance for environmental readiness (DON, 2014), all Navy installations shall ensure that aquatic invasive species are not introduced into near shore environments or bodies of water on or adjacent to the installation. Measures to prevent introductions of aquatic nuisance species through ballast water or hull fouling defined in environmental compliance policies and procedures applicable to shipboard operations would be implemented in the Preferred Alternative. Based on the Navy regulations and management plans (i.e. Environmental Readiness Program Manual and INRMP) and implemented BMPs, potential impacts from exposure to AIS would be unlikely, temporary, and minimal.

Marine Vegetation and Non-Coral Benthic Invertebrates

Physical removal. The installation of sensors for the UEMMS array with supporting cables routing to the Polaris Point shore landing site would require the removal of marine vegetation and non-coral benthic invertebrates through dredging and construction activities. None of the macroalgae or non-coral benthic fauna present are considered protected by federal or territorial statute.

The benthic community at the shore landing site would be preserved through the temporary relocation of habitat outside of the construction area and is not considered in further EFH analysis. The placement of concrete anchor discs to secure the cable bundles along the cable route and excavation of the UEMMS array site would result in the loss of approximately 9,930 sq ft of the benthic community.

The Navy found that it is reasonable to conclude that the benthic community and ecosystem functions and services would appear within a short time in areas providing structure after construction activities (NAVFAC Pacific, 2021). Avoidance, minimization, and offset actions described above for coral communities are also relevant to the project's physical removal of benthic communities (i.e., marine vegetation and non-coral benthic invertebrates). This includes creation of about 10,650 sq ft of replacement habitat at Mound 9 to provide ecological services that offset the temporary and permanent loss of benthic community resulting from the Preferred Alternative.

Therefore, the project would have less than significant impacts on marine vegetation and non-coral benthic invertebrates during the construction or operational period.

Wastes and discharges. As discussed under Corals, the Preferred Alternative would not generate wastes that would enter the water, but project-related wastes and debris may accidentally enter the water and adversely affect the benthic community in or near the project area through direct physical contact or exposure to toxic substances. However, project BMPs would prevent or minimize the potential for the

introduction of wastes and toxicants into the marine environment (see Section 2.5). Based on the BMPs in place and maintenance requirements and programs, the exposure to wastes and discharges from the Preferred Alternative would be minimal and controllable.

Chemical contaminants. Exposure to contaminants either re-suspended from beneath the sediment surface during dredging or from oil or fuel released during equipment operation could have negative impacts on the benthic community in and around the project area. However, based on the Navy regulations and management plans (i.e. Environmental Readiness Program Manual and INRMP) and implemented BMPs, as well as the short duration of the proposed construction activities, potential impacts to the benthic community from chemical contamination would be temporary and minimal.

Hypoxia. Coastal hypoxia occurs when the natural and/or anthropogenic dissolved oxygen (DO) levels are depleted in coastal waters to a certain level (e.g., <30% saturation or <2 mg/L; Zhang et al., 2010 in NAVFAC Pacific, 2021). Increasing discharges of nutrients and organic matter may disrupt the balance of oxygen production (photosynthesis), consumption (respiration, chemical reactions), and atmospheric exchange (for given salinity and temp levels). When DO is depleted in the lower part of water column, benthic organisms exhibit stressed behaviors, mortality, and ultimately, changes in the greater community structure. The Preferred Alternative includes in-water activities that may deplete DO levels in the marine environment and cause adverse impacts to the benthic community. However, based on the expected volume of excavated material, proposed BMPs, and short construction duration, potential impacts from hypoxic conditions would be temporary and minimal.

Unexploded ordnance. Based on the implemented precautions and BMPs, the probability of exposure to direct physical impact, a pressure wave, or underwater sound effects on the benthic community from exploding ordnance is very low and unlikely.

Essential Fish Habitat

The Preferred Alternative has the potential to affect EFH through physical removal, increased suspended sediments, elevated underwater noise levels, wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and UXO. Table 3-17 provides an environmental risk assessment summary of the Preferred Alternative's potential impacts on EFH when mitigation actions (including avoidance, minimization, and offset actions) are implemented.

Table 3-17 EFH Environmental Risk Assessment Summary

Environmental Stressor	*Probability*	*Severity*	*Risk Level*	*Avoidance/ Minimization/ Mitigation*	*Risk Assessment for EFH*
Removal of Marine Invertebrate Community	Near Certainty	Catastrophic	Extremely High	• Coral translocation • Habitat conversion	• Permanent loss of benthic community • Temporal loss of ecological function & habitat structure
Increased suspended sediments	Near Certainty	Moderate	Moderate	• Stop work during coral spawning • Erosion control practices • Silt containment devices/curtains • Inclement weather contingency	Temporary indirect impacts

Environmental Stressor	*Probability*	*Severity*	*Risk Level*	*Avoidance/ Minimization/ Mitigation*	*Risk Assessment for EFH*
Elevated underwater noise levels	Near Certainty	Negligible	Moderate	Full-length silt curtain (physical sound barrier)	
Wastes and discharges	Not Likely	Negligible	Low	• Safe equipment use & management • Silt containment devices/curtains • Oil spill contingency plans	
Aquatic invasive species					
Chemical contaminants					
Hypoxia					
Unexploded Ordnance					

Source: NAVFAC Pacific, 2021

The Navy conducted EFH consultation with NMFS and determined that the Preferred Alternative would adversely affect EFH for BMUS and PMUS within Apra Harbor (see Appendix C for EFH consultation correspondence). The Navy determined that the Preferred Alternative would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for BMUS and PMUS within Apra Harbor. The indirect adverse effects to EFH from project-related degradation of water quality would be minimized through implementation of appropriate silt-containment BMPs. Unavoidable loss of ecosystem function and services that supports MUS would be minimized and offset through coral transplantation and habitat restoration at Mound 9. Due to the containment of impacts to Apra Harbor, the quantity and quality of the EFH within the harbor, the size and scale of the impacts, implementation of temporary and permanent avoidance and minimization measures built into the project and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion), the Navy determined that the anticipated impacts do not have the potential to cause substantial adverse effects to EFH.

During the operational period, the Preferred Alternative would have less than significant impacts on EFH in Apra Harbor. Operation of the UEMMS would not involve additional structural changes to the benthic habitat, increased sediment resuspension, elevated noise levels, additional waste, discharge, or chemical contaminants, exposure to aquatic invasive species, hypoxia, or UXO.

By letter dated July 21, 2021, NMFS agreed with the Navy's EFH determination that the Proposed Action would adversely affect EFH and result in unavoidable loss (see Appendix C) and agreed that the Navy's proposed mitigation that includes avoidance (BMPs), minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. In its July 2021 letter, NMFS also proposed conservation measures to ensure that adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated. A summary of these conservation measures and the Navy's corresponding response follow (see Appendix C for full text of the Navy's response letter, dated August 18, 2021).

Conservation Recommendation 1: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over

time (i.e., out years) at Mound 9. The Navy should consider coordinating this monitoring plan with actions listed in the 2019 JRM INRMP and consider including Mound 9 surveys in the next INRMP update.

Discussion: The Navy will develop a two-year monitoring and maintenance plan consistent with the five-year adjacent monitoring for the Lima, Mike, and November Wharves translocation project at Mound 9. The Navy agrees that the monitoring plan for all Mound 9 projects should consider aligning with the 2019 JRM INRMP, and will consider including funding to support long-term monitoring events at Mound 9 within the next update to the JRM INRMP.

Conservation Recommendation 2: The Navy should ensure that in-water construction and mitigation activities avoid any unnecessary contact with marine organisms by divers and/or materials, and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Discussion: The Navy agrees with this Conservation Recommendation and will ensure that the appropriate BMPs are implemented during coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, and cable deployment and anchoring activities to avoid unnecessary contact with marine organisms. To the best of their ability, all divers will avoid exposing corals directly or indirectly to toxicopathological agents.

Conservation Recommendation 3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event.

Discussion: The Navy agrees with this Conservation Recommendation and will ensure that subject monitoring reports will be provided to NMFS upon completion of the coral translocation and after both subsequent monitoring events (at 12 and 24 months). The Navy agrees to coordinate with NMFS if the rate of survival does not meet the 70% survivorship target after the final monitoring period.

Threatened and Endangered Species

Under the ESA, the effects of the action refer to the direct and indirect effects of an action on the species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action and that would be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR § 402.02). Section 7(a)(2) states that each Federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or destroy/adversely modify designated critical habitat, as is responsible for making one of the following effects determinations: No Effect; May Affect, but Not Likely to Adversely Affect; or Likely to Adversely Affect.

The Navy initiated informal consultation with NMFS under ESA Section 7 (see Appendix C for consultation correspondence, which includes a biological assessment of the Proposed Action's potential impacts on ESA-listed species). In its assessment, the Navy considered potential impacts resulting from the Proposed Action on ESA-listed species that may occur within the Action Area. The Navy also considered project designs and BMP measures that would be implemented to avoid and/or minimize such anticipated impacts to the greatest extent practicable. Based on the anticipated low occurrence of ESA-listed species within the project area, the Navy determined that Proposed Action has the potential to affect, but is not likely to adversely affect ESA-listed species, as such adverse effects have been determined either insignificant or discountable. The following sections summarize relevant findings of

the Navy's assessment. By its letter dated October 6, 2021, NMFS concurred with the Navy's determination that the Proposed Action is not likely to adversely affect ESA-listed species (see Appendix C).

Terrestrial Species

The upland project areas (i.e., habitats on Polaris Point, Orote Airfield CDF, and Field 5 CDF) are not suitable areas to support threatened and endangered species on Naval Base Guam.

Temporary impacts on threatened and endangered terrestrial species at NBG could occur from noise and habitat disturbances associated with construction activities. However, threatened and endangered terrestrial species on NBG are already habituated to high levels of noise associated with harbor and landside military operations, training, and support activities. Increases in noise levels from construction activities to the ambient noise environment would be negligible and temporary. Construction would occur on previously disturbed and cleared or developed areas/forested areas. No permanent loss of existing sensitive terrestrial vegetation or habitat would occur under the Preferred Alternative. Therefore, habitat removal would be negligible and would not negatively impact habitat use by any threatened or endangered species. Construction activities would result in short-term impacts from disturbance to terrestrial wildlife, including threatened and endangered species, but would not further threaten the existence of any protected species or critical/sensitive habitats. Additionally, installation personnel would continue to manage habitats according to the INRMP, which is designed to protect and benefit threatened and endangered species.

Marine Species

Based on historical records and results from biological surveys of Apra Harbor (HDR & CSA, 2020), only three species, the green sea turtle (*Chelonia mydas*); hawksbill sea turtle (*Eretmochelys imbricata*); and the scalloped hammerhead shark (*Sphyrna lewini*), have reasonable potential to occur where most of the Proposed Action would occur. No ESA-listed coral species were observed within the project area. During the excavated material disposal trips to G-DODS, all of the ESA-listed species above may be encountered, and the risk of a vessel collision with ESA-listed whales and dolphins are considered a possible impact. If a crane barge is needed from outside Guam, vessels would likely travel from Honolulu, Hawaii, and through critical habitat for the Main Hawaiian Islands Insular False Killer Whale DPS. All other actions would occur within Apra Harbor, where no critical habitats occur. Thus, with the exception of the disposals at the G-DODS and a barge transport, the assessment of impacts to ESA-protected species focuses on the potential impacts to the three species: green sea turtle (Central West Pacific DPS); hawksbill sea turtle; and the scalloped hammerhead shark, Indo-West Pacific DPS.

The Preferred Alternative involves in-water work requiring use of heavy machinery and equipment (both staged on land and atop a floating barge), divers using hydraulic hand tools, transit of a barge pulled by a tug from Apra Harbor to G-DODS, and a potential barge movement from outside Guam. All such activities have the potential to affect ESA-listed species in the marine environment of Apra Harbor, between Apra Harbor and G-DODS. Most effects of the action are considered to have minimal impacts and risks (see Table 3-18), particularly due to low likelihood of ESA-listed species occurrence and the proposed BMPs (Section 2.5). Potential effects from the proposed action may result from exposure to the following environmental stressors: elevated noise levels; elevated suspended sediments; disturbance from human activity and equipment operation, including direct physical contact; vessel collisions; wastes and discharges; and entanglement.

Table 3-18 ESA-Listed Species Environmental Risk Assessment Summary

Environmental Stressor	*Probability*	*Severity*	*Risk Level*	*Mitigation*	*Risk Assessment for ESA-listed Species*
Elevated underwater noise levels	Near Certainty	Negligible	Moderate	• Marine fauna observers • Shut-down zone	Insignificant
Increased suspended sediments	Near Certainty	Negligible	Moderate	• Erosion control practices • Silt containment devices/curtains • Inclement weather contingency	Insignificant
Disturbance from human activity and equipment operation, including direct physical contact	Low	Negligible	Low	• Marine fauna observers • Shut-down zone • Safe equipment use & management • Safe vessel use & management	Discountable
Direct physical contact	Not Likely	Negligible	Low	• Marine fauna observers • Shut-down zone • Safe equipment use & management • Safe vessel use & management • Debris containment • Oil spill contingency plans	Discountable
Vessel collisions					
Wastes and discharges					
Entanglement					

No listed species is known to breed or reproduce in the project area, and thus the Proposed Action would have discountable effects on the reproductive success of these animals. Green sea turtles have a regular but low-level occurrence within the project area, and thus, the Proposed Action may affect this species, which is evaluated in the following sections. Hawksbill sea turtles and scalloped hammerhead sharks are expected to have a rare and infrequent occurrence, and the following impact and risk assessment applies a precautionary approach to include these species.

Sperm whales, baleen whales (i.e., blue, fin, and sei), giant manta rays, and oceanic whitetip sharks are not expected to occur within Apra Harbor, but rather may be encountered during the ocean disposal operations and open-ocean vessel and barge movements (if needed). If a vessel or barge is transported from the MHI, the vessels would transit through the MHI IFKW DPS critical habitat. Thus, potential adverse effects to these listed species is only evaluated for these activities.

Further, the annual peak coral spawning event in Guam waters occurs 7 to 10 days after the full moon in July (Richmond and Hunter, 1990 in NAVFAC Pacific, 2021). Despite evidence that does not identify *A. globiceps* within the project area, all in-water work would cease during this time period to maximize the reproductive success of *A. globiceps* (see Section 2.5.2). Therefore, the Navy determined that potential impacts from the Proposed Action to this species are expected to be discountable and did not assess effects further.

The following sections summarize potential impacts to ESA-protected species from the expected environmental stressors. Detailed discussion on each stressor and its expected impacts on ESA species is found in Section 3.1 of Appendix C EFH/ESA Assessment (NAVFAC Pacific, 2021).

Exposure to elevated noise levels

The proposed UEMMS in-water activities that would produce elevated noise levels include:

- excavation for the sensor array installation (i.e., excavation of seafloor and boulder revetment using a clamshell bucket dredge)
- underwater instrument array installation by divers using a handheld hydraulic breaker
- installation of guide stakes for cable (steel pipes would be driven in with vibratory hammer and PVC and/or fiberglass pipe that would be jetted into substrate)
- installation of cable anchors with a barge or vessel using a water jetting process or by the weight of a vibratory hammer

None of these actions have the potential to generate sound levels loud enough to cause permanent injury or harm to the marine fauna species likely to be in the project area. However, of these activities, only marine dredging is likely to generate noise levels with the potential to cause adverse impacts to ESA-listed marine species. Implemented BMPs would require that all work stops when an ESA-listed marine species is observed within 50 yards of the work (i.e., Shut-down Zone), and would resume only after the animal has departed voluntarily or until 30 minutes have passed since the previous sightings and thus adverse acoustic impacts are discountable and not likely to adversely affect ESA-listed sea turtles. Because the hearing sensitivity is likely to be poor (and cannot likely detect sound pressure), acoustic impacts from elevated underwater sound levels produced by dredging activities would be discountable to scalloped hammerhead sharks.

Elevated Suspended Sediments

The Proposed Action involves dredging (i.e., excavating the seafloor and boulder revetment using a clamshell bucket) and using underwater mechanical tools to install various items, both of which have the potential to temporarily elevate ambient suspended sediment and turbidity levels by dislodging, re-suspending, and dispersing sediment in the water column. The suspension of solids throughout the water column would increase the ambient total suspended solids (TSS) and turbidity levels of Apra Harbor within and immediately adjacent to the project area. It is reasonable to expect that ESA-listed marine species in the project area are likely habituated to high levels of ambient TSS and turbidity in the harbor due to the existing ship traffic through the area.

Project construction-generated elevated turbidity levels would be contained to the greatest extent practicable using turbidity curtains to encircle each discrete work area. Such elevated turbidity levels would be temporary and are expected to naturally settle as work progresses throughout the work area and restore to ambient, pre-construction conditions upon completion, with no persistent or permanent effect.

Green and hawksbill sea turtles breathe air, and their respiratory processes should not be affected by the elevated turbidity. The in-water excavation period degradation of water quality may affect individual animals temporarily by creating an unwelcoming environment, and causing avoidance of the area in favor of clearer waters. Also, elevated turbidity levels reduce light penetration throughout the water column and limit underwater visibility, possibly interfering with an individual sea turtle's ability to

forage. However, the project area does not overlap with important resting, nesting, or foraging habitats for green or hawksbill sea turtles, and thus the potential for adverse effects from increased suspended sediments is expected to be low.

Disturbance from human activity and equipment operation

The Preferred Alternative would result in increased human activity and equipment operation within and adjacent to the marine environment throughout the duration of project construction. Increased project construction-related activity in Apra Harbor would increase human presence, ambient noise levels, and the potential for interaction with ESA-listed species. However, Apra Harbor is a site of regular human and mechanical activity onshore and in the water, and animals that enter and remain in Apra Harbor can be expected to be habituated to some degree to human activity.

Despite their likely habituation to ambient activity levels, increased human activity has the potential to disturb normal behavior of ESA-listed species (other than coral) in Apra Harbor and in the shipping lane to G-DODS. Expected reactions range from benign investigation of or attraction to the activity, avoidance of the area or, the extreme, panicked fleeing with potential self-injury during flight.

Sea turtles are known to be present in Apra Harbor (although occurrence is expected to be low), and these animals tend to be curious and may approach the construction activities. However, it is expected they would also avoid human activity throughout the duration of heightened nearshore and in-water activity. BMPs would be implemented to ensure intentional interactions with ESA-listed species are avoided and that unintentional interactions are minimized to the greatest extent practicable.

Direct physical contact

The Preferred Alternative involves the use of heavy machinery, barge and accessory vessels, and handheld machinery. All project construction phases occurring in-water have the potential to directly physically impact ESA-listed marine species. While BMP measures would be in place to restrict intentional interactions with ESA-listed marine species, individual animals in the area could be subject to direct physical impact by heavy machinery, equipment, or vessels operated in the marine environment.

Physical impact or strike by project components in the water could result in a range of injuries depending upon the force and angle of the strike, the part of the body impacted, and the ability for the animal to get away without further injury. Adverse effects to the animal may include bruising, laceration, broken bones/carapace, amputation, or immediate death. From in-water excavation operations, an animal could be pinned to the seafloor, causing drowning or immediate death. Clamshell dredges are considered to be the least likely of the common dredge methods to cause direct physical impact to ESA-listed species because they are relatively stationary and impact a very small area with each grab.

Direct physical impact of ESA-listed marine species would be avoided to the greatest extent practicable through implemented BMP measures. Observers would actively survey marine waters for presence of listed species within potential hazard zones and have the authorization to stop in-water work when ESA-listed species are observed within 50 yards of the activity, and may only begin/resume after the animals have voluntarily departed the area.

Collision with vessels

Accessory vessels and a floating barge would be used in Apra Harbor for the proposed action. A tugboat would tow the barge to the excavation site and the excavated material scow to the offshore disposal site

at G-DODS. Smaller accessory vessels would be used to monitor for marine fauna, transport the construction crew, and install temporary, in-water BMP measures (e.g., silt curtains) or similar activities. When surfacing to breathe or rest, marine fauna are at risk of being struck by movement of project vessels.

Vessel collisions could result in a range of injury depending upon the size of the vessel, the speed and direction of the vessel if in motion, the part of the vessel that strikes the animal (i.e., hull vs. propeller), and the part of the body impacted. Adverse effects may include bruising, laceration, broken bones/carapace, amputation, or injury-induced or immediate death. Depending on these factors, collision with a small vessel has the potential to cause serious injury or death. Vessels in motion, especially propeller strikes, would cause substantially greater injury than collision with the hull or with a stationary vessel.

ESA-listed marine species are infrequently sighted in Apra Harbor and nearshore waters of Guam, and potential impacts from vessel collisions to these species are expected to be discountable. These species would generally avoid vessels in motion due to the physical disturbance and sound generated. Potential for collision is greatest when transitioning from a stationary to a mobile state where listed species may not be able to evade the oncoming vessel. Best management practices would avoid or minimize the risk of vessel collisions with protected species (e.g., vessel operators would halt or alter course to remain at least 50 yards from ESA-listed marine species and reduce vessel speeds to no more than 10 knots if in the proximity of a marine mammal and no more than 5 knots when in areas of known or suspected turtle activity).

In addition to the green and hawksbill sea turtles and scalloped hammerhead sharks, vessel collisions may involve other ESA-listed species (Table 3-15): MHI IFKW DPS, blue whale, fin whale, sei whale, and sperm whales; olive ridley turtle, loggerhead turtle, and leatherback turtles; oceanic whitetip shark; and the giant manta ray. Any of these species may be encountered when vessels are in transit to the G-DODS location. However, considering the wide and unrestricted ocean around the G-DODS area, the slow operating speed of the vessels, and compliance with the BMPs, the potential for a vessel strike to adversely affect a large whale during the Proposed Action is low and discountable. Furthermore, when the G-DODS was designated in 2010, consultation under ESA Section 7 was conducted for designation and use of the site. NMFS and USFWS concluded that use of the site for disposal of dredged material meeting the criteria for ocean disposal (including vessel trips transporting the material) would not jeopardize the continued existence of any federally-listed species.

It is unknown at this time if the Proposed Action would require barges and other support vessels from outside Guam, and consequently have an open-ocean transit from and to its origin. Given the slow operating speed of the barge and support vessels (unless in an emergency), the likelihood that a vessel strike would significantly impact an ESA-listed species while the vessel is in transit to Guam is expected to be low and discountable.

As with the potential for direct physical impact, BMP measures would be implemented to minimize the potential for vessel collision with ESA-listed species.

Exposure to wastes and discharges

Exposure to leaking chemicals or previously-contained, terrigenous contaminants, depending on the toxicity and concentration, could result in effects ranging from general avoidance to death of listed species. Project wastes may include plastic trash and bags that may entangle or be ingested by a marine

species, which is a major, anthropogenic threat to the recovery of ESA-listed species that results in both lethal and non-lethal effects (NMFS & USFWS, 1998 in NAVFAC Pacific, 2021). Marine debris is one of the main causes of stranding and mortality, particularly from discarded fishing gear and plastic bags that can cause restricted mobility, drowning, starvation, smothering, and wounding, thus leading to infections, amputation of limbs and death. Debris may include plastic bags, rubber, balloons, plastic fragments, and confectionery wrappers, all of which may be confused with prey species and ingested by marine fauna, which can block digestive systems and cause internal injuries and starvation. A long-term concern for plastic debris is that it could be a source of toxic chemicals that could compromise immunity and cause infertility in animals, even at very low levels. Stranding data and necropsies provide evidence that turtle mortalities result from poisoning or obstruction of the esophagus after ingesting garbage, plastic, or tar (NMFS & USFWS, 1998).

The proposed action involves use of heavy machinery and equipment nearshore and in-water for excavation activity. Heavy machinery and equipment can leak fuel, petroleum lubricants, and other hydrocarbon-based pollutants into marine waters, which would expose ESA-listed species to toxic substances. Some spills could occur when small containers of chemicals are used in open areas and there is a risk of entering the sea if spilled. If released in large quantities, the toxic substances may cause avoidance of the affected area, serious injury, or, in severe cases, death. However, if a chemical is discharged or spilled accidentally during the project, the realistic worst case would be the release of a small quantity or volume (i.e., <25 liters).

No construction debris would be allowed to enter the water. To reduce the potential for action-related waste and discharges to adversely impact marine species, all waste would be controlled and disposed into trash dumpsters or roll-off bins in the project base yard or staging area. Wastewater from demolition work would not be discharged into the sanitary sewer system, the storm drainage system, or the harbor. The contractor would capture all pollutants and dispose of them off-site at an approved disposal facility. Prior to commencing daily activities, all equipment and vehicles would be maintained and checked to reduce any risk of leaks or discharge. Hydraulic equipment would be maintained properly to prevent leaks. Should exposure of wastes and discharges to listed species occur, the effects would be minimal and should not reach the level of take.

Entanglement

Marine fauna could be entangled by two different elements of the proposed action: 1) trash and debris and 2) equipment, including silt curtains or barge anchor chains. Materials could be encountered by and have the potential to entangle marine fauna at the surface, in the water column, and along the seafloor. Potential impacts depend on how a marine animal encounters and reacts to the items that pose an entanglement risk, which depend on risk factors such as animal size, sensory capabilities, and foraging methods. Most entanglements are attributable to encounters with fishing gear or other materials that float or are suspended at the surface. Smaller entangled animals are inherently less likely to be detected than larger ones, but larger animals may subsequently swim off while still entangled, towing lines or fishing gear behind them.

If severely entangled, sea turtles and marine mammals cannot forage underwater nor breathe at the surface. Serious injury may result in a lost limb and/or increased vulnerability to predation. Animals that becomes entangled in nets, lines, ropes, or other foreign objects under water may suffer temporary hindrance to movement before it frees itself or they may remain entangled. Entangled individuals may suffer minor injuries but recover fully or may die as a result of the entanglement.

For elasmobranchs, entanglement most commonly occurs from ghost fishing gear and anthropogenic debris, and results in starvation, suffocation, immobilization, and death (Parton et al., 2019 in NAVFAC Pacific, 2021). If these individual impacts increase to greater levels within shark and ray populations, entanglement may have negative implications on reproductive success and survival rates.

Entanglement from equipment and gear typically used in dredging and construction is not commonly observed and unlikely to occur. Project debris and trash would be controlled so that they do not enter harbor waters. The equipment would be managed closely, such that only lines, chains, silt curtains, and flexible elements would be deployed in the water when necessary. The barge could be a site of potential entanglement risk, as it would be anchored in the water near the sensor array location. However, the barge anchor lines and all in-water equipment would be inspected and managed regularly and kept taut when deployed. Furthermore, the silt curtain around the project site is expected to be a barrier to turtles and mammals approaching the area where equipment and lines would be used.

Unexploded Ordnance

If ordnance is detonated in the marine environment, nearby marine resources are exposed to direct physical impact from shrapnel and effects of a pressure wave. As water is incompressible, fragments are slowed and would travel a limited distance from the source. The size and type of the munition, the depth of detonation, and oceanic conditions determine the radius and effects of a blast. Marine fauna close to a blast may be directly affected by the blast. Farther away, organisms are affected by the pressure wave (in the form of a sound pressure wave and movement of the water due to cavitation). Organisms without air or gas spaces in their bodies fare better than organisms that have those spaces because pressure is equalized inside and outside of their bodies. Most corals and invertebrates do not have air or gas spaces in their bodies, so they experience fewer traumas from pressure waves than vertebrates such as fish, turtles, and marine mammals.

The likelihood of contact from in-water excavation and fragments is extremely low since the Navy would work with observers and stop in-water activities when ESA-listed species are within 50 yards of the Action Area. If any MEC and/or MPPEEH items are discovered during in-water activities, all work would be stopped immediately. The Navy would also surround the construction area with a turbidity curtain or other isolation methods, which would prevent or discourage ESA-listed animals from entering the Action Area where they could be contacted. Sea turtles and scalloped hammerhead sharks may react to visual and noise disturbances with startle responses, flight, and/or avoidance. While these responses may display a negative response, they are often common responses to normal human activity that happens in the project area and are not expected to reduce their fitness or prevent them from foraging or resting activities.

Summary of Determination

Based on its biological assessment, the Navy determined the following with respect to ESA:

- **Potential acoustic effects from exposure to elevated noise levels from proposed in-water activities may affect but is not likely to adversely affect green sea turtles, hawksbill sea turtles, and scalloped hammerhead sharks.** Based on the regular but small occurrence of green sea turtles in the Action Area, as well as the rare and infrequent occurrence of hawksbill sea turtles and scalloped hammerhead sharks, the estimated sound levels, and the implemented BMPs, potential acoustic effects from exposure to elevated noise levels from proposed activities would be insignificant to ESA-listed species.

- **Exposure to elevated suspended sediments may affect but is not likely to adversely affect ESA-listed marine species, which are likely habituated to the ambient high turbidity of the harbor marine environment.** Project-related turbidity is not expected to be readily detectable above background levels, as implemented BMPs would limit turbidity from proposed in-water activities. Construction activities for the Preferred Alternative would be temporary and restricted to daylight hours for approximately 10 months, thus having a short-term duration for potential impact. Therefore, exposure to elevated suspended sediments from the Preferred Alternative would be contained within the project area, and the effects of which would be insignificant to ESA-listed marine species.
- **Disturbance from human activities and equipment operation may affect but is not likely to adversely affect green sea turtles, hawksbill sea turtles, and scalloped hammerhead sharks.** Through implementation of project-specific BMP measures, any impacts to ESA-listed species resulting from increased human activity in the nearshore and marine environment would be indirect and minimal, and the potential risk for impact completely eliminated upon completion of the proposed action. Because direct impact would be avoided to the greatest extent practicable, such effects are expected to be discountable. Should the increased human activity result in a change in behavior, it is anticipated that such effects would be insignificant.
- **Direct physical contact from the proposed action may affect but is not likely to adversely affect ESA-listed marine species.** Based on the low occurrence of listed species within Apra Harbor and implementation of BMPs to avoid interaction and minimize potential for direct physical impacts, it is anticipated that such effects would be discountable.
- **Collisions with vessels may affect, but is not likely to adversely affect ESA-listed marine species, including scalloped hammerhead sharks, green sea turtles and hawksbill sea turtles, MHI IFKW DPS, blue whale, fin whale, sei whale, and sperm whales; olive ridley turtle, loggerhead turtle, and leatherback turtles; oceanic whitetip shark; and the giant manta ray.** Based on the low number of project vessels anticipated to be in the water, the low occurrence of ESA-listed species in the project area, and the implemented BMPs (such as slow vessel speeds), the risk of collision with vessels associated with the proposed action is discountable.
- **Exposure from an accidental release of wastes and discharges from the Proposed Action may affect, but is not likely to adversely affect ESA-listed species.** Based on the low level occurrence of ESA-listed species and implemented BMPs (e.g., equipment maintenance, contingency plans, fueling restrictions), the potential for adverse effects from exposure to accidental release of waste and discharges is low and discountable.
- **Entanglement from the Proposed Action may affect, but is not likely to adversely affect ESA-listed species.** Based on the factors stated above and the low occurrence of ESA-listed species in the project area and BMPs that would be implemented, potential entanglement risk to these species is low and discountable.
- **Encountering unexploded ordnance during proposed in-water activities may affect, but is not likely to adversely affect green sea turtles, hawksbill turtles or scalloped hammerhead sharks within the project area.** Based on the implemented precautions and BMPs, the probability of exposure to direct physical impact, a pressure wave or underwater sound effects from exploding ordnance to ESA-listed species is discountable.

Critical Habitat

There is no designated critical habitat within the project area. However, there is a possibility that a vessel and/or crane barge may be brought to Guam from the MHI. The transit route would likely be through MHI IFKW DPS critical habitat, which includes water from the 45-meter depth contour to the 3,200-meter depth contour from the island of Niihau east to Hawaii Island. Underwater noise has the potential to adversely affect the critical habitat characteristic for sound, and scientific evidence indicates that permanent or chronic noises source can degrade the conservation value of the underwater habitat. However, not all types of underwater noise result in adverse modification of critical habitat. For the limited inter-island barge/vessel movements to transport equipment to and from Apra Harbor, the Proposed Action would result in increased underwater sound levels that would be low frequency, transient in nature, and not significantly impair false killer whales' use or occupancy of the habitat. Therefore, the Proposed Action is not likely to adversely affect any essential feature or characteristic of the MHI IFKW DPS critical habitat in any meaningful way, and the effects are discountable. By its letter dated October 6, 2021, NMFS concluded that the Proposed Action's effects to essential features of critical habitat are discountable or insignificant and concurred with the Navy's determination that the Proposed Action is not likely to adversely affect MHI IFKW (see Appendix C).

Therefore, based on the discussion in the foregoing sections, implementation of the Preferred Alternative would not result in significant impacts to biological resources.

3.4.3.3 Concrete Block Mat Alternative Potential Impacts

The study area for the analysis of effects to biological resources associated with the Concrete Block Mat Alternative is the same for as the Concrete Anchor Disc Alternative, with the following exception:

- Approximately 24,800 sq ft of the Outer Apra Harbor seafloor between the sensor array and the northwest point of Polaris Point (path of the subsea cable bundle) would be affected. This is approximately 21,400 sq ft more seafloor coverage than for the Preferred Alternative due to the use of 8-foot-wide concrete block mats to secure the subsea cable bundle to the seafloor instead of much smaller footprint concrete anchor discs (i.e., 4-ft diameter).

As with the Preferred Alternative, during the operational period, the system would require minimal maintenance in the Concrete Block Mat Alternative throughout its known service life. If new technologies or requirements arise during its service life, upgrades to the system may occur. The installation and operation of the sensor array would not increase ship traffic to or from Apra Harbor by either homeported or transient vessels and operational period impacts to biological resources would be less than significant.

Terrestrial Vegetation

Under the Concrete Block Mat Alternative, the terrestrial project area, construction activities and methods, and operational period activities would be the same as in the Preferred Alternative. Because this alternative would involve the same terrestrial project area and construction and operational period activities, it is expected to have the same less than significant construction and operational period impacts on terrestrial vegetation—including protected species—as the Preferred Alternative.

Terrestrial Wildlife

As noted above, under the Concrete Block Mat Alternative, the terrestrial project area, construction activities and methods, and operational period activities would be the same as in the Preferred Alternative. Because of this the Concrete Block Mat Alternative is expected to result in the same less than significant construction and operational period impacts on terrestrial wildlife, including protected species. Under this alternative, BMPs would also be employed, if needed, to avoid attracting migrating birds to the CDFs due to ponded water.

Marine Wildlife

Mammals

As in the Preferred Alternative, the Concrete Block Mat Alternative is unlikely to result in significant adverse effects to marine mammals, as they are not known to be common in Apra Harbor. Planned BMPs (e.g., reduced vessel speeds and remaining at least 50 yards from marine mammals during in-water work) would further minimize risks to these animals that have a low probability of being present in the project area.

Sea Turtles

Sea turtles are discussed below in the section entitled Threatened and Endangered Species.

Coral

The Concrete Block Mat Alternative would result in the physical removal of corals and increased suspended sediments that would adversely impacts corals in the ROI during the construction period. Though also unlikely, this alternative may also result in the same construction period environmental stressors to coral communities as the Preferred Alternative: wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and UXO. This alternative would have the same impacts to coral (by all stressors) within the sensor array direct and indirect impact areas and at the cable shore landing at Polaris Point. However, along the subsea cable route, it would be more difficult to avoid any corals present on the route (as they would be in the Preferred Alternative) due to the larger footprint and shape of the concrete block mats. The implementation of avoidance, minimization, and offset actions would result in less than significant impacts to coral communities in the ROI. During the operational period, project-related activities (e.g., maintenance and repair) would be minimal and infrequent due to the passive nature of UEMMS operations, resulting in less than significant impacts to coral. Analysis of this alternative's effects on coral communities and the Navy's proposed mitigation actions are described below.

Physical removal. In this alternative, the same corals would be removed from the sensor array footprint and shore landing area as in the Preferred Alternative. However, additional corals along the subsea cable route would also be injured or lost due to the placement of the concrete block mats over the cable. Due to the size and limited flexibility of the concrete block mats, there would be less ability than in the Preferred Alternative to adjust the ultimate routing to avoid corals or other sensitive benthic organisms along the route. Approximately 3,100 linear feet of the subsea cable would be secured by concrete block mats (i.e., excludes sensor array footprint and transition to shore). Given the area of the mats and length of the route, approximately 24,830 sq ft of benthic habitat communities would be covered by mats and therefore be a loss of habitat.

In order to evaluate the impacts of the Concrete Block Mat Alternative, coral cover along the subsea cable route was estimated based on the presence of coral reef sustaining sections (about 28.6 percent of the route) and number of corals estimated per square meter (one coral per square meter). Based on these estimates, the analysis assumes that about 7,100 sq ft (660 square meters) of the cable route has coral cover while the remaining 17,730 sq ft consists of other habitat types. Using the estimated coral density of one coral per square meter, 660 coral colonies would be lost in this alternative, primarily consisting of *Porites rus* complex corals. Due to the remoteness and difficulty to locate and translocate individual corals along the cable route, no coral translocation along the cable route would be attempted.

The total surface area of coral estimated to be directly impacted in this alternative (using the same methodology as for the Preferred Alternative) is approximately 58,660 sq ft—about 260 sq ft more than in the Preferred Alternative. After factoring in minimization measures (i.e., coral translocation), about 18,960 sq ft are considered a loss in the HEA analysis—about 250 sq ft more than in the Preferred Alternative.

Under this alternative, avoidance, minimization, and offset actions similar to those of the Preferred Alternative would be undertaken to reduce adverse impacts to coral. The differences would be:

- Minimization – Smaller footprint concrete anchor discs would not be used to secure the subsea cables to the seafloor. Other minimization actions are the same as in the Preferred Alternative (e.g., coral translocation)
- Offset – About **24,910 sq ft of replacement habitat** at Mound 9 would be required to **offset the loss of coral cover** due to this alternative—**about 330 sq ft more** replacement habitat than needed in the Preferred Alternative. The offset mitigation activities would be the same in this alternative as in the Preferred Alternative (e.g., removing debris, stabilizing substrate, monitoring, managing macroalgae and invertebrates that threaten transplanted corals, etc.)

Suspended sediments. This alternative would have the same adverse effects to coral from suspended sediments caused by dredging operations at the sensor array site as in the Preferred Alternative. In addition, as the concrete block mats are placed over the cable bundle, they are likely to resuspend sediments on the seafloor at greater levels than the Preferred Alternative because they would disturb a much larger area of the seafloor when deployed (approximately 21,400 sq ft more than in the Preferred Alternative). As the installation operation changes location and moves along the cable route, these resuspended sediments are likely to settle out of the water column shortly after disturbance due to limited wave and current actions as seen in sediment modeling of Apra Harbor. As the majority of the cable route does not pass through coral reef habitat, the low levels suspended sediments caused by the concrete block mat placement substantial numbers of coral communities are not likely to be exposed to increased sedimentation from the concrete block mat placement. Furthermore, the same avoidance and minimization actions would be employed in this alternative as in the Preferred Alternative (e.g., no in-water work during hard and soft coral spawning periods, turbidity curtains around dredging areas). Therefore, along with planned BMPs and the temporary nature of the expected elevated suspended sediments, any adverse effects to corals from increased suspended sediments in this alternative are expected to be temporary, minimal, and manageable.

Exposure to waste and discharge. As in the Preferred Alternative, this alternative would not generate wastes that would enter the water. The same BMPs would be employed as in the Preferred Alternative (see Section 2.5), and would prevent or minimize the potential for the introduction of wastes and toxicants into the marine environment. As in the Preferred Alternative, based on the BMPs in place and

maintenance requirements and programs, the exposure of coral communities to wastes and discharges from the Concrete Block Mat Alternative would be minimal and controllable.

Exposure to aquatic invasive species. The Concrete Block Mat Alternative would have the same risk of exposure to AIS as the Preferred Alternative. Implementation of BMPs and compliance with regulations and the Navy's maintenance requirements and programs would limit the exposure of coral communities to wastes and discharges from this alternative to minimal and controllable levels.

Exposure to chemical contaminants. This alternative would have the same risk of exposure to contaminants from re-suspended sediments or from oil or fuel released during equipment operation as the Preferred Alternative. As in the Preferred Alternative, implemented BMPs, as well as the short duration of the proposed construction activities, potential impacts to coral communities from chemical contamination would be temporary and minimal in the Concrete Block Mat Alternative.

Unexploded Ordnance. This alternative would have similar risks from UXO as the Preferred Alternative, except that a much larger area of the seafloor surface would be disturbed (i.e., covered by concrete block mats along the subsea cable route), which would increase the risk from UXO. If needed, pre-construction MEC/MPPEH surveys would be conducted to identify magnetic anomalies along the cable route so the UXO item could be removed prior to mat placement. As in the Preferred Alternative, based on implemented precautions and BMPs, the probability of coral exposure to direct physical impact, a pressure wave, or underwater sound effects from exploding ordnance is very low and unlikely.

Fish

As in the Preferred Alternative, the Concrete Block Mat Alternative would result in less than significant, temporary construction period impacts on fish occurring in the ROI from the following environmental stressors: increased suspended sediments and elevated underwater noise levels. Exposure to wastes and discharges and aquatic invasive species are also possible impacts on fish populations in Apra Harbor but are unlikely to occur in this alternative.

Suspended sediments. In addition to resuspended sediments from the proposed dredging activities (i.e., same as the Preferred Alternative), the Concrete Block Mat Alternative would also result in temporary episodes of resuspended sediments along the subsea cable route from the placement of the concrete block mats over the cable bundle and onto the seafloor. These suspended sediments would be localized to the immediate area of concrete block mat placement and are expected to settle quickly out of the water column. The temporary resuspension of sediments would follow the installation of the concrete block mats moves along the cable route. Fish in the area are likely to avoid the mat installation activities, including any areas of suspended sediments. Therefore, along with planned BMPs and the temporary nature of the expected elevated suspended sediments, any adverse effects to fish from increased suspended sediments in this alternative are expected to be temporary, minimal, and manageable.

Exposure to elevated underwater noise levels. Under this alternative, the highest underwater noise level is likely to result from the clamshell bucket striking the seafloor (same as in Preferred Alternative). The same temporary and recoverable acoustic effects to fish populations are expected in this alternative as in the Preferred Alternative, based on the expected underwater sound levels, the lack of sensitive benthic habitats or restricted environments for fish, and the planned BMPs.

Exposure to waste and discharge. Impacts of exposure to waste and discharge on fish that travel through the project area are likely to be the same as in the Preferred Alternative: temporary, minimal, and controllable due to planned BMPs, and maintenance requirements and programs.

Exposure to aquatic invasive species. Potential impacts on fish in the ROI from exposure to AIS are expected to be the same as in the Preferred Alternative: unlikely, temporary, and minimal due to Navy regulations and management plans (i.e. Environmental Readiness Program Manual and INRMP) and the employment of BMPs.

Marine Vegetation and Non-Coral Benthic Invertebrates

Physical removal. As in the Preferred Alternative, the Concrete Block Mat Alternative would require the removal of marine vegetation and non-coral benthic invertebrates through dredging and construction activities in the sensor array footprint, subsea cable route, and Polaris Point shore landing area. This alternative would impact approximately 21,400 sq ft more of the seafloor than the Preferred Alternative, and consequently have greater impacts on marine vegetation and non-coral benthic invertebrates than the Preferred Alternative. Based on estimates of coral cover and other habitats along the subsea cable route that would be affected by the concrete block mats, about 17,730 sq ft consists of non-coral benthic habitat. Impacts at the sensor array and Polaris Point shore landing sites would be the same as in the Preferred Alternative.

A HEA was conducted for this alternative to estimate the EFH ecological services lost from this alternative for both coral (described earlier) and benthic habitats. The HEA identified about 29,670 sq ft of replacement habitat needed to offset the benthic habitat services lost in this alternative, or about **19,000 sq ft more than in the Preferred Alternative**. As in the Preferred Alternative, this offset would be provided at Mound 9.

The majority of the subsea cable route traverses areas generally low in biotic cover, and avoidance, minimization, and offset actions would be implemented to mitigate this alternative's adverse impacts due to physical removal of benthic biotic resources. Therefore, the Concrete Block Mat Alternative would have less than significant impacts on marine vegetation and non-coral benthic invertebrates during the construction or operational period.

Wastes and discharges. As in the Preferred Alternative, the Concrete Block Mat Alternative would not generate wastes that enter the water. The same BMPs would be employed as in the Preferred Alternative (see Section 2.5), and would prevent or minimize the potential for the introduction of wastes and toxicants into the marine environment. As in the Preferred Alternative, based on the BMPs in place and maintenance requirements and programs, the exposure of macroalgae and non-coral benthic invertebrates to wastes and discharges from the Concrete Block Mat Alternative would be minimal and controllable.

Chemical contaminants. This alternative would have the same risk of exposure to contaminants from re-suspended sediments or from oil or fuel released during equipment operation as the Preferred Alternative. As in the Preferred Alternative, implemented BMPs, as well as the short duration of the proposed construction activities, potential impacts to macroalgae and non-coral invertebrate communities from chemical contamination would be temporary and minimal in the Concrete Block Mat Alternative.

Hypoxia. As in the Preferred Alternative, based on the expected volume of excavated material, proposed BMPs, and short construction duration, potential impacts of the Concrete Block Mat Alternative from hypoxic conditions would be temporary and minimal.

Unexploded ordnance. Based on the implemented precautions and BMPs, the probability of exposure to direct physical impact, a pressure wave, or underwater sound effects on the benthic community from exploding ordnance in this alternative is very low and unlikely.

Essential Fish Habitat

As with the Preferred Alternative, the Concrete Block Mat Alternative and its resulting impacts would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for BMUS and PMUS within Apra Harbor. The physical removal of benthic biotic resources, increased suspended sediments, elevated underwater noise levels, wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and UXO associated with this alternative have the potential to affect EFH. The environmental risk assessment summary in Table 3-17 also applies to the potential impacts of the Concrete Block Mat Alternative on EFH when mitigation actions (including avoidance, minimization, and offset actions) are implemented. This alternative would result in about 17,730 sq ft more habitat physically removed or affected than in the Preferred Alternative, as well as temporarily higher levels of suspended sediments along the subsea cable route. The mitigation actions described in the coral and marine vegetation/non-coral benthic habitat sections would be implemented in this alternative, including offset for the temporary and permanent losses of ecological services in the form of habitat restoration at Mound 9.

As in the Preferred Alternative, the indirect adverse effects to EFH from project-related degradation of water quality would be minimized through implementation of appropriate silt-containment BMPs. Unavoidable loss of ecosystem function and services that supports MUS would be minimized through coral transplantation. Due to the containment of impacts to Apra Harbor, the quantity and quality of the EFH within the harbor, the size and scale of the impacts, implementation of temporary and permanent avoidance and minimization measures built into the project and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion), the anticipated impacts do not have the potential to cause substantial adverse effects to EFH. As in the Preferred Alternative, the Concrete Block Mat Alternative would have less than significant impacts to EFH during the operational period because operation of the UEMMS would not involve additional structural changes to the benthic habitat, increased sediment resuspension, elevated noise levels, additional waste, discharge, or chemical contaminants, exposure to aquatic invasive species, hypoxia, or UXO.

Threatened and Endangered Species

As in the Preferred Alternative, the Concrete Block Mat Alternative has the potential to affect, but is not likely to adversely affect ESA-listed species, as adverse effects would be either insignificant or discountable. This alternative would have the same environmental risks to protected species as the Preferred Alternative from the following stressors: elevated underwater noise levels, disturbance from human activity and equipment operation, direct physical contact, vessel collisions, wastes and discharges, and entanglement—all of which would pose insignificant or discountable risks (see Table 3-18 for summary). This alternative would result in temporarily higher levels of suspended sediments along the subsea cable route when about 194 concrete block mats (covering about 24,800 sq ft) are placed on the seafloor to secure the cable bundle, compared with the placement of 29 concrete anchor discs (covering about 365 sq ft) under the Preferred Alternative. However, the work area would move

along the cable route and turbidity levels are likely to return to background levels after each mat is deployed. Therefore, with the low levels of ESA-protected species expected to be in the work areas and BMPs such as work stoppage if protected species are within 50 yards of the work area, the risks from increased suspended sediments would be insignificant.

Critical Habitat

The Concrete Block Mat Alternative would have the same discountable effects to critical habitat as the Preferred Alternative. This alternative would involve the same in-water construction equipment and potentially require the movement of a vessel and/or crane barge from the MHI though MHI IFKW DPS critical habitat but would not significantly impair false killer whales' use or occupancy of the habitat.

Therefore, implementation of the Concrete Block Mat Alternative would not result in significant impacts to biological resources.

3.5 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors in the human environment. This section focuses on construction noise from the Proposed Action. During the operational period, the UEMMS would function passively through the collection and transportation of data via sensor cables. Noise in relation to biological resources and wildlife species is discussed in Section 3.4 Biological Resources. The Proposed Action would not affect aircraft operations or aviation training during the construction or operational periods; therefore, aircraft noise is not addressed.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels
- Frequency – the number of cycles per second the air vibrates, in Hz
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output and are given special attention in this EA.

3.5.1 Basics of Sound and A-Weighted Sound Level

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually

on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit in order to identify that the measurement has been made with this filtering process (dBA). In this document, the dB unit refers to A-weighted sound levels. Table 3-19 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table 3-19 Subjective Responses to Changes in A-Weighted Decibels

Change	*Change in Perceived Loudness*
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Figure 3-3 (Cowan, 1994) provides a chart of A-weighted sound levels from typical noise sources. Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Noise levels from aircraft operations that exceed background noise levels at an airfield typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contributions drop to lower levels, often becoming indistinguishable from the background noise.

3.5.2 Noise Metrics

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The noise metrics used in this EA are described in summary format below and in a more detailed manner in Appendix D. While the Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL) noise metrics are the most commonly used tools for analyzing noise generated at an airfield, the DoD has been developing additional metrics (and analysis techniques). These supplemental metrics and analysis tools provide more detailed noise exposure information for the decision process and improve the discussion regarding noise exposure. Airfield noise was not determined to be an issue for the Proposed Action.

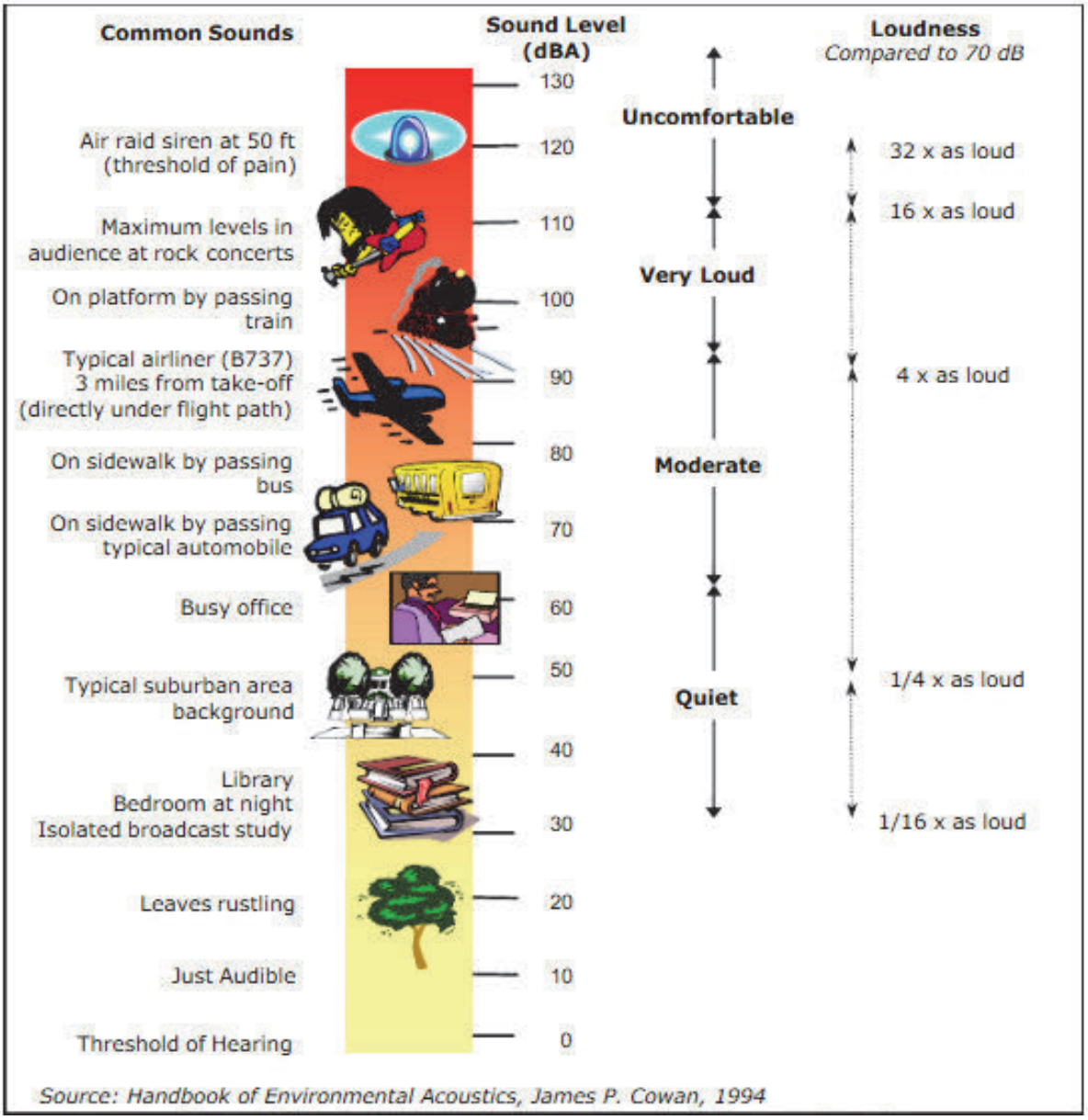

Figure 3-3 A-Weighted Sound Levels from Typical Sources

3.5.2.1 Day-Night Average Sound Level

The DNL metric is the energy-averaged sound level measured over a 24-hour period, with a 10-dB penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). DNL values are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The DNL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. DNL is the standard noise metric used by the US Department of Housing and Urban Development, Federal Aviation Administration, USEPA, and DoD. Studies of community annoyance in response to numerous types of environmental noise show that DNL

correlates well with impact assessments; there is a consistent relationship between DNL and the level of annoyance (refer to Appendix D, Noise). Most people are exposed to sound levels of 50 to 55 DNL or higher on a daily basis.

Research has indicated that about 87 percent of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise, 1980). Therefore, the 65 dB DNL noise contour is used to help determine compatibility of military aircraft operations with local land use, particularly for land use associated with airfields.

3.5.2.2 Community Noise Equivalent Level

CNEL is a noise metric adopted as a standard by the state of California. The CNEL metric is similar to the DNL metric and is also an energy-averaged sound level measurement. DNL and CNEL provide average noise levels taking into consideration and applying penalties for annoyance from intrusive events that occur during evening and nighttime hours. Both DNL and CNEL are measures of cumulative noise exposure over a 24-hour period, with adjustments to reflect the added intrusiveness of noise during certain times of the day. However, while DNL considers one adjustment period, CNEL reflects two adjustment periods. DNL includes a single adjustment period for night, in which each aircraft noise event at night (defined as 10 p.m. to 7 a.m.) is counted 10 times. CNEL adds a second adjustment period where each aircraft noise event in the evening (defined as 7 p.m. to 10 p.m.) is counted three times. The nighttime adjustment is equivalent to increasing the noise levels during that time interval by 10 decibels (dB). Similarly, the evening adjustment increases the noise levels by approximately 5 dB.

3.5.2.3 Equivalent Sound Level

A cumulative noise metric useful in describing noise is the Equivalent Sound Level (Leq). Leq is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy. The same calculation for a daily average time period such as DNL or CNEL but without the penalties is a 24 hour equivalent sound level, abbreviated Leq(24). Other typical time periods for Leq are 1 hour and 8 hours.

3.5.2.4 Sound Exposure Level

The Sound Exposure Level (SEL) metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds, such as aircraft overflights, and is the recommended metric for sleep disturbance analysis (DoD Noise Working Group, 2009).

3.5.2.5 Maximum Sound Level

The highest A-weighted sound level measured during a single event where the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or Lmax. During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the

aircraft recedes into the distance. Lmax defines the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second (American National Standards Institute, 1988). For sound from aircraft overflights, the SEL is usually greater than the Lmax because an individual overflight takes seconds and the Lmax occurs instantaneously. In this EA, Lmax is used in the analysis of aircraft comparison and speech interference.

3.5.2.6 Number of Events Above a Threshold Level

The "Number of Events Above a Threshold Level" metric provides the total number of noise events that exceed a selected noise level threshold during a specified period of time (DoD Noise Working Group, 2009). Combined with the selected noise metric, Lmax or SEL, the Number of Events Above metric is symbolized as NAXXmetric (NA = number of events above, XX = dB level, metric = Lmax or SEL). For example, the Lmax and SEL Number of Events Above metrics are symbolized as NA75Lmax and NA75SEL, respectively, with 75 dB as the example dB level. In this EA, an Lmax threshold is selected to analyze speech interference and an SEL threshold is selected for analysis of sleep disturbance.

3.5.3 Noise Effects

An extensive amount of research has been conducted regarding noise effects including annoyance, speech interference, sleep disturbance, noise-induced hearing impairment, nonauditory health effects, performance effects, noise effects on children, effects on domestic animals and wildlife, property values, structures, terrain, and archaeological sites. These effects are summarized below.

3.5.3.1 Annoyance

As previously noted, the primary effect of aircraft noise on exposed communities is long-term annoyance, defined by USEPA as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response and there is a consistent relationship between DNL/CNEL and the level of community annoyance (Federal Interagency Committee on Noise, 1992).

3.5.3.2 Potential Hearing Loss

People living in high noise environments for an extended period of time (40 years) can be at risk for hearing loss called Noise Induced Permanent Threshold Shift (NIPTS). The NIPTS defines a permanent change in hearing level, or threshold, caused by exposure to noise (United States Environmental Protection Agency, 1982). According to USEPA (1974), changes in hearing level of less than 5 dB are generally not considered noticeable. There is no known evidence that an NIPTS of less than 5 dB is perceptible or has any practical significance for the individual affected. Furthermore, the variability in audiometric testing is generally assumed to be plus or minus 5 dB. The preponderance of available information on hearing loss risk is from the workplace with continuous exposure throughout the day for many years.

Based on a report by Ludlow and Sixsmith (1999), there were no major differences in audiometric test results between military personnel, who as children, had lived in or near installations where fast jet operations were based, and a similar group who had no such exposure as children. Hence, for the purposes of this EA, the limited data are considered applicable to the general population, including children, and are used to provide a conservative estimate of the risk of potential hearing loss.

DoD policy directive requires that hearing loss risk be estimated for the at-risk population, defined as the population exposed to DNL greater than or equal to 80 dB (Department of Defense, 2009). To assess the potential for NIPTS, the Navy generally uses the 80 dB DNL noise contour (or in California 80 dB CNEL) as a threshold to identify the exposed population who may be at the most risk of possible hearing loss from aircraft noise (USEPA, 1982; DoD Noise Working Group, 2009). However, it should be recognized that characterizing noise exposure in terms of DNL and CNEL overestimates hearing loss risk but suffices when nighttime operations are 5 percent or less than the total operations. When nighttime operations are greater than 5 percent, Leq(24) is recommended for calculating potential hearing loss since hearing loss is a physical phenomenon due to the sound level and independent of annoyance. Thus, the additional penalties applied by CNEL for evening and nighttime operations do not accurately portray the NIPTS. This EA calculates potential hearing loss using Leq(24) to get the accuracy necessary for the larger amount of nighttime and evening operations.

3.5.3.3 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. Speech interference can cause disruption of routine activities, such as enjoyment of radio or television programs, telephone use, or family conversation, giving rise to frustration or irritation. In extreme cases, speech interference may cause fatigue and vocal strain to individuals who try to communicate over the noise. In this EA, speech interference is measured by the number of daily indoor events (from 7 a.m. to 10 p.m.) that exceed 50 dB Lmax at selected locations. This metric also accounts for noise level reduction provided by buildings with windows open or closed.

3.5.3.4 Classroom Criteria and Noise Effects on Children

Research suggests that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of school children. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DoD Noise Working Group, 2009).

Analyses for school-aged children are similar to speech interference by using the indoor number of events exceeding 50 dB Lmax, but also has the added restriction of using an outdoor equivalent noise level of 60 dB Leq(9hr). This represents a level that a person with normal hearing can clearly hear a speaker (teacher) speaking at a level of 50 dB indoors in a classroom setting.

3.5.3.5 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. In this EA, sleep disturbance uses the SEL noise metric and calculates the probability of awakening from single aircraft overflights. These are based upon the particular type of aircraft, flight profile, power setting, speed, and altitude relative to the receptor. The results are then presented as a percent probability of people awakening (United States Environmental Protection Agency, 1974).

3.5.3.6 Workplace Noise

In 1972, the National Institute for Occupational Safety and Health (NIOSH) published a criteria document with a recommended exposure limit of 85 dBA as an 8-hour time-weighted average. This exposure limit

was reevaluated in 1998 when NIOSH made recommendations that went beyond conserving hearing by focusing on the prevention of occupational hearing loss. Following the reevaluation using a new risk assessment technique, NIOSH published another criteria document in 1998, which reaffirmed the 85 dB recommended exposure limit (National Institute for Occupational Health and Safety, 1998).

3.5.4 Nonauditory Health Effects

Studies have been conducted to examine the nonauditory health effects of aircraft noise exposure, focusing primarily on stress response, blood pressure, birth weight, mortality rates, and cardiovascular health. Exposure to noise levels higher than those normally produced by aircraft in the community can elevate blood pressure and also stress hormone levels. However, the response to such loud noise is typically short in duration: after the noise goes away, the physiological effects reverse and levels return to normal. In the case of repeated exposure to aircraft noise, the connection is not as clear. The results of most cited studies are inconclusive, and it cannot be conclusively stated that a causal link exists between aircraft noise exposure and the various type of nonauditory health effects that were studied (DoD Noise Working Group, 2009).

3.5.4.1 Noise Effects on Children

A review of the scientific literature indicated that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DoD Noise Working Group, 2009).

3.5.4.2 Noise Effects on the Elderly

Based upon a study by the Harvard School of Public Health, older people exposed to aircraft noise, especially at higher levels, may experience an increased risk of hospitalization for cardiovascular disease (BMJ, 2013). This study concluded a statistically significant association between exposure to aircraft noise and risk of hospitalization for cardiovascular diseases among older people living near airports.

3.5.5 Noise Modeling

Computer modeling provides a tool to assess potential noise impacts. DNL/CNEL noise contours are generated by a computer model that draws from a library of actual aircraft noise measurements. Noise contours produced by the model allow a comparison of existing conditions and proposed changes or alternative actions, even when the aircraft studied are not currently operating from the installation. For these reasons, on-site noise monitoring is seldom used at military air installations, especially when the aircraft mix and operational tempo are not uniform.

3.5.6 Regulatory Setting

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 A-weighted decibels (dBA) over an 8-hour period. The highest allowable sound level to which

workers can be constantly exposed is 115 dBA and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

The joint instruction, Chief of Naval Operations Instruction (OPNAVINST) 11010.36C and Marine Corps Order 11010.16, *Air Installations Compatible Use Zones (AICUZ) Program,* provides guidance administering the AICUZ program which recommends land uses that are compatible with aircraft noise levels. OPNAVINST 3550.1A and Marine Corps Order 3550.11 provide guidance for a similar program, Range Air Installation Compatible Use Zone. This program includes range safety and noise analyses, and provides land use recommendations which will be compatible with Range Compatibility Zones and noise levels associated with military range operations. Per OPNAVINST 11010.36C, NOISEMAP is to be used for developing noise contours and is the best noise modeling science available today for fixed-wing aircraft until the new Advanced Acoustic Model is approved for use.

3.5.7 Affected Environment

Many components may generate noise and warrant analysis as contributors to the total noise impact. The federal government supports conditions free from noise that threaten human health and welfare and the environment. Response to noise varies, depending on the type and characteristics of the noise, distance between the noise source and whoever hears it (the receptor), receptor sensitivity, and time of day. A noise sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Sensitive receptors may also include noise-sensitive cultural practices, some domestic animals, or certain wildlife species. The sensitive receptors nearest the project area are low density military family housing residences at Lockwood Terrace and McCool Elementary/Middle School, which are both located approximately 5,900 feet southwest of the in-water project site. The nearest off-base noise sensitive receptors are civilian residences located approximately 6,500 feet southeast of the Polaris Point shore landing area. See Figure 3-4 for locations of the nearest noise sensitive receptors. Potentially noise-sensitive wildlife species are discussed in Section 3.4 Biological Resources.

3.5.7.1 Installation Noise Environment

Ambient noise levels at the Polaris Point project area are generally low due to its remote location with low activity levels. The predominant noise sources consist of ship and harbor operations at the Navy's Apra Harbor wharves, commercial and recreational vessels transiting the harbor, wind, and vehicle traffic on local streets. Other components such as construction, landscape maintenance, helicopter training, and recreational use of nearby areas produce noise, but such noise generally represents a transitory and negligible contribution to the average noise level environment.

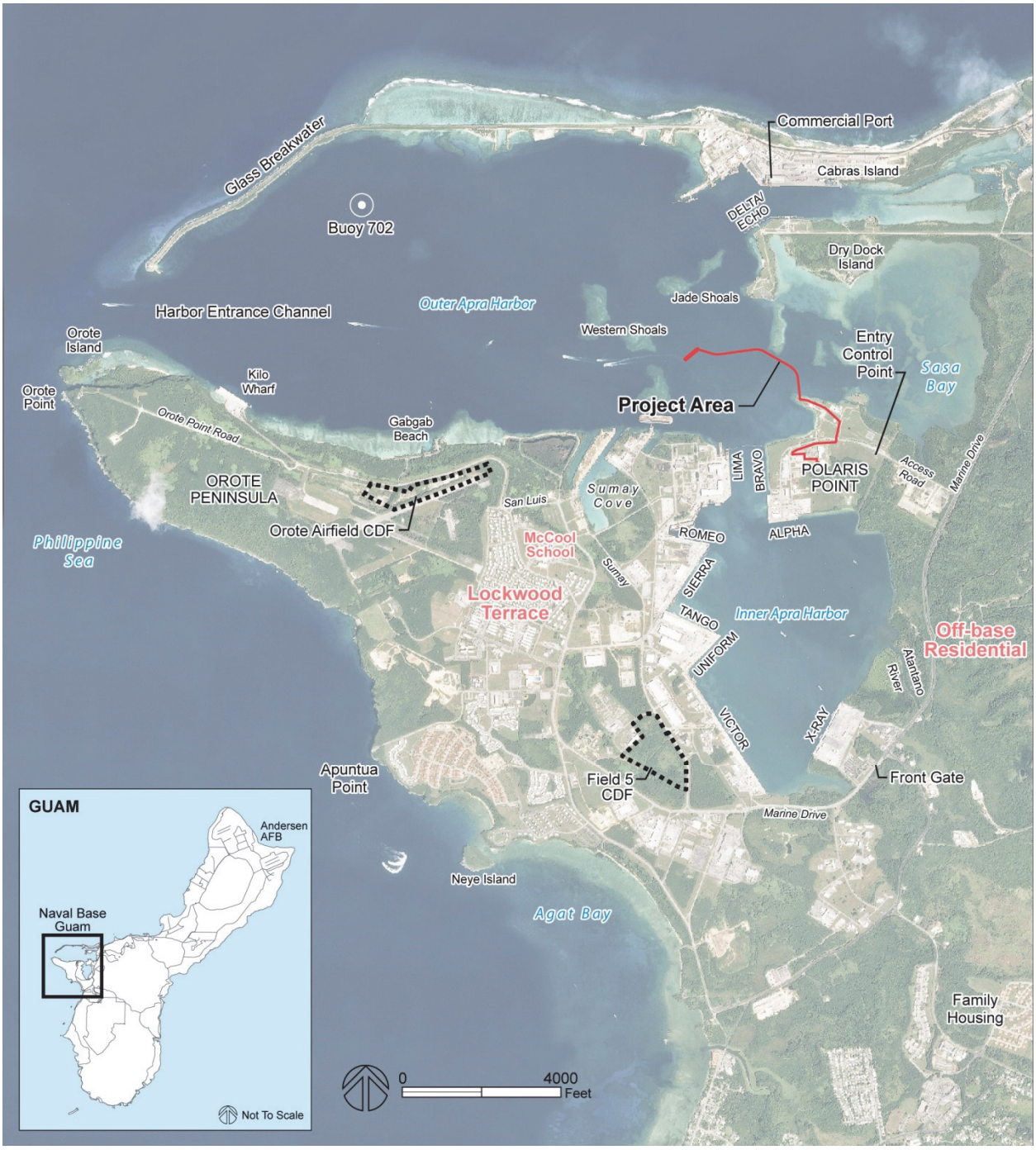

Figure 3-4 Noise Sensitive Receptors

3.5.8 Environmental Consequences

Analysis of potential noise impacts includes estimating likely noise levels from the Proposed Action and determining potential effects to sensitive receptor sites.

3.5.8.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline noise levels. Therefore, no impacts to the noise environment would occur with the No Action Alternative.

3.5.8.2 Concrete Anchor Disc Alternative (Preferred Alternative) Potential Impacts

The study area for noise for the Preferred Alternative includes noise sensitive receptors within NBG and outside the installation that are closest to the project area (i.e., Lockwood Terrace military family housing, McCool Elementary/Middle School, and low-density civilian residences southeast of Polaris Point). (See Figure 3-4 for locations of noise sensitive receptors.)

Construction Period

Construction of the Preferred Alternative would generate noise primarily associated with the use of dredging and excavation equipment, and construction vessels and vehicles. Construction would not increase aviation training or aircraft operations at NBG and no changes in existing noise contours are expected.

A planning level assessment of construction noise impacts was conducted for the Preferred Alternative to provide an order-of-magnitude estimate of potential impacts on noise sensitive receptors within NBG and in the surrounding civilian community. The noise calculations are detailed in Appendix D. The dominant noise sources during in-water construction are likely to be cranes/excavation equipment used to excavate the sensor array site and tugboats used to transport the dredge barge and excavated material scow. Dominant noise sources for the land-based construction equipment that are likely to be a backhoe and skid steer. The seafloor excavation work is estimated to require about 20 weeks. Tugboat operation would occur intermittently throughout the excavation period. Excavation of the shoreline landing duct and cable transition vault is estimated to require about five weeks. The backhoe and skid steer would operate intermittently during that period. All construction activities are expected to occur Monday through Saturday during normal daytime work hours.

Typical noise emission levels of the likely construction equipment (or their closest proxies) are reported in U.S. Department of Transportation Federal Transit Administration construction noise level guidance (Quagliata et al., 2018). For each doubling of distance from the source, there is a 6 dB decrease in sound level. Calculations of the sound levels at the noise sensitive receptors nearest to the in-water construction area indicate that the combined noise of the excavator and tugboat operated simultaneously would be attenuated to about 49 dB at McCool Elementary/Middle School and Lockwood Terrace family housing area. As seen in Figure 3-3, this is generally perceived as “quiet” and similar to background noise in a typical suburban area. Typical sound level reductions of buildings are estimated at 24 dB in warm climates with closed windows (USEPA, 1978). Using the USEPA typical sound level reductions of buildings (i.e., 24 dB), the combined sound from the tugboat and excavator would be reduced to about 25 dB within the nearest Lockwood Terrace dwelling and McCool School, similar to a library or bedroom at night.

At the nearest off-base residential area, the combined sound from the simultaneous operation of the excavator and skid steer is estimated at about 41 dB during the construction period. Applying the typical sound level reduction of 24 dB, sound levels from the land-based construction activities would be reduced to about 17 dB within the residential units, or barely audible.

Operational Period

Operation of the UEMMS would not involve noise generation detectible at noise sensitive receptors, as it would passively acquire electromagnetic field readings below the seafloor, and transmit and analyze data in subsea HDPE conduits, via below-grade conduits, and in interiors of buildings. Repair, maintenance, and decommissioning activities would—at most—involve similar activities as in construction (i.e., use of vessels and excavation equipment), which would have similar insignificant noise impacts to the closest noise sensitive receptors.

Therefore, implementation of the Preferred Alternative would not result in significant impacts to the noise environment.

3.5.8.3 Concrete Block Mat Alternative Potential Impacts

The study area for the Concrete Block Mat Alternative is the same as the Preferred Alternative.

This alternative would involve generally the same construction equipment, vessels, and vehicles as the Preferred Alternative, and the closest noise sensitive receptors would be exposed to similarly low levels of noise from project construction. However, the barge crane would be in use for a longer duration (additional 20 work days) than in the Preferred Alternative to install the concrete block mats along the entire 3,150-foot route, resulting in a longer duration of increased noise levels than in the Preferred Alternative.

As in the Preferred Alternative, this alternative would not involve noise generation detectible at noise sensitive receptors during operation of the UEMMS. Potential noise impacts from repair, maintenance, and decommissioning activities would be the same or lower than construction period impacts.

Neither construction or operations under this alternative would increase aviation training or aircraft operations on at NBG and no changes in existing noise contours are expected.

Therefore, implementation of this action alternative would not result in significant impacts to the noise environment.

3.6 Transportation

This discussion of transportation includes all of the air, land, and sea routes with the means of moving passengers and goods. A transportation system can consist of any or all of the following: roadways, bus routes, railways, subways, bikeways, trails, waterways, airports, and taxis, and can be looked at on a local or regional scale.

Traffic is commonly measured through average daily traffic and design capacity. These two measures are used to assign a roadway with a corresponding level of service (LOS). The LOS designation is a professional industry standard used to describe the operating conditions of a roadway segment or intersection. The LOS is defined on a scale of A to F that describes the range of operating conditions on a particular type of roadway facility. LOS A through LOS B indicates free flow travel. LOS C indicates stable traffic flow. LOS D indicates the beginning of traffic congestion. LOS E indicates the nearing of traffic breakdown conditions. LOS F indicates stop-and-go traffic conditions and represents unacceptable congestion and delay. Additional vehicle trips associated with the Proposed Action within NBG or on public roadways would be minimal during the construction period (i.e., movement of construction vehicles and equipment and the daily commuting of a small number of contractor personnel). There

would be negligible new vehicle volumes related to UEMMS operations (i.e., infrequent maintenance or repair activities). Therefore, the analysis of transportation impacts focuses on marine transportation.

3.6.1 Regulatory Setting

In 2007, the U.S. Department of Transportation through the Federal Highway Administration (FHWA) entered into a stewardship agreement with the Government of Guam that establishes the framework for the utilization of federal funds for the Guam roads program. The Agreement requires that the Government of Guam develop an overall transportation program, consisting of policies and procedures, compliant with FHWA requirements. The *2030 Guam Transportation Plan* (GovGuam, 2008) provides a comprehensive, long-term strategy to improve transportation infrastructure and operations throughout Guam. It addresses Guam's anticipated multimodal transportation needs, including roadway, bicycle, pedestrian, and transit facilities, including those associated with the planned DoD military buildup.

3.6.2 Affected Environment

The transportation system on Guam consists of a federal-aid highway system, village streets, a limited fixed-route and demand-responsive transit service, privately-operated tourist services, an airport, and civilian and military sea ports and their connections to major civilian and military destinations.

3.6.2.1 Roadways

Off Base Roadways

Route 1, also known as Marine Corps Drive, is a major arterial roadway and extends approximately 22 miles from Andersen AFB in Yigo on the northeastern corner of the island down to Naval Base Guam in Santa Rita located on the central western area of the island. It is the main commercial corridor connecting residential areas to major employment centers (GovGuam, 2008).

On Base Roadways

Naval Base Guam Main Gate is accessed by Marine Corps Drive (Route 1). Marine Corps Drive is a north-south four-lane arterial roadway that serves as a primary route on the base. The Traffic Impact Study, BEQ Residential Complex, Naval Base, Guam (Duenas Bordallo & Associates, Inc., 2008) analyzed the LOS for several intersections along Marine Corps Drive (Route 1) within NBG and found them all to be operating at an acceptable LOS in both the a.m. and p.m. peak hours.

On base, Marine Corps Drive, Sumay Drive, San Luis Road, and Orote Point Road connect Inner Apra Harbor wharves where excavated material dewatering would occur and the CDFs that may be used for excavated material disposal. A two-lane access road connects Polaris Point to Marine Corps Drive at a point north of the NBG Front Gate (see Figures 1-1 and 2-1 for roadway locations). Traffic volumes on the Polaris Point access road and on internal roads to the project site are typically low.

3.6.2.2 Marine Transportation

Marine transportation refers to marine vessels and facilities used to support commercial, military, and recreational uses. The primary military, commercial, and recreational port facilities on Guam are located in Apra Harbor, the main berthing facility on the island. Apra Harbor provides deep water and protected loading and off-loading facilities. Apra Harbor consists of a commercial harbor, a naval complex, and a repair facility. The port handles both containerized and conventional cargo from the U.S. and other countries.

Apra Harbor is located on the western side of Guam. It is a natural harbor protected by Orote Peninsula on the south and Cabras Island and Glass Breakwater on the north. Glass Breakwater provides wind and wave protection from the Philippine Sea. The average height of the breakwater is approximately 15 feet above mean sea level.

Apra Harbor comprises both an outer harbor area (Outer Apra Harbor) and an inner harbor area (Inner Apra Harbor). Navy waterfront facilities are located in both the outer harbor and the inner harbor. Waterfront facilities for the U.S. Coast Guard (USCG) are located in the inner harbor, while commercial and recreational facilities are located in the outer harbor. Most of Outer Apra Harbor and the entire Inner Apra Harbor are under the jurisdiction of the Navy. Use of these waters is restricted because they are adjacent to Naval Base Guam facilities.

Inner Apra Harbor is located to the southeast of Outer Apra Harbor; it is separated from Outer Apra Harbor by the Guam Shipyard and Polaris Point. Outer Apra Harbor is the west-facing entrance into Apra Harbor from the Philippine Sea. The primary navigation channel is 1,500-feet wide and has a natural depth of more than 100 feet. Although Outer Apra Harbor has many areas where depths exceed 100 feet, it also contains several shoal and reef areas, primarily in the eastern portion of the harbor close to the entrance to Inner Apra Harbor. While these shallow areas pose only a limited threat to normal operations, they represent a major hazard to navigation during periods of high winds. Outer Apra Harbor extends westerly from the harbor entrance toward Drydock Point. To avoid the shoal areas, the channel into the Harbor extends southeasterly to the entrance at Inner Apra Harbor and then due south; this channel was dredged in the 1940s. Outer Apra Harbor contains several mooring buoys and anchorages used by both military and commercial vessels.

Vessels entering Inner Apra Harbor are limited to a maximum draft of 32 feet. The primary channel from Outer Apra Harbor to Inner Apra Harbor is marked at the entrance with two lighted buoys. The centerline of this channel is defined for navigation by two entrance range lights.

Apra Harbor can accommodate the largest of Navy ships, including aircraft carriers. Guam Shipyard provides repair and maintenance facilities for these ships. The primary facility located in Outer Apra Harbor is Kilo Wharf, a munitions wharf. It is located on the south side of Outer Apra Harbor approximately 3,600 feet east of the outer harbor entrance. This wharf is 800 feet long. As a result of dredging, depths alongside Kilo Wharf are 45 to 50 feet. Kilo Wharf is the only deep water port in the western Pacific where a loaded munitions ship can berth at a pier to obtain repair and maintenance services. Apra Harbor currently supports an average of two Carrier Strike Group port visits per year for an average of seven days per year, though actual port visits and duration are subject to change based upon Fleet operational requirements. Nuclear powered aircraft carriers berth at Kilo Wharf because it is the only wharf that meets their draft requirements. Kilo Wharf currently lacks full “hotel” utilities necessary to support the ship (MSDDC, 2006).

The existing facilities located in Inner Apra Harbor include the following:

- Alpha and Bravo Wharves are 32 feet deep and located at the site of the former Navy Ship Repair Facility on the west side of the entrance to Inner Apra Harbor. These wharves are used for submarine berthing.
- Romeo and Sierra Wharves provide berthing services to Navy ships. Sierra Wharf was extensively damaged in the 1993 earthquake so only the southwest half of the wharf is now usable. The water depth at these wharves is 35 feet.

- Tango Wharf is 35 feet deep; however, the wharf has been damaged and is currently not used.
- Uniform Wharf, which was damaged in the 1993 earthquake and is still unusable.
- Victor Wharf is used as the primary wharf for visiting combatant ships, MSC, foreign navy vessels, and the USCG. The wharf provides about 700 linear feet of berthing space with a depth of 32 feet.
- X-Ray Wharf is NBG's primary supply wharf, providing berthing for Navy supply ships that visit or are forward deployed to Guam. It provides about 1,480 linear feet of berthing with a depth of 35 feet, and consists of two berths. The north berth was recently improved to accommodate T-AKE vessels.

3.6.3 Environmental Consequences

Impacts to ocean traffic and transportation are analyzed by considering the possible changes to existing traffic conditions and the capacity of existing infrastructure from proposed increases in construction vessels.

3.6.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to transportation. Therefore, no impacts would occur with the No Action Alternative.

3.6.3.2 Concrete Anchor Disc Alternative Potential Impacts

The study area for the Preferred Alternative comprises the roadway segments from the intersection of Marine Corps Drive (Route 1) to the Polaris Point project area (access roads) and on-base roadways between Inner Apra Harbor wharves where excavated material dewatering would occur and the CDFs (e.g., Marine Corps Drive, Sumay Drive, San Luis Road, and Orote Point Road). The study area for transportation includes portions of Outer Apra Harbor near the Inner Apra Harbor entrance channel in which in-water construction and operational activities would occur (i.e., portions of the navigation channel and the subsea cable route to shore, and waters subject to project-related standoff or controls). It also includes the ocean transport route from the dredging site in Outer Apra Harbor to G-DODS, if used for excavated material disposal.

Construction Period

During the construction period, there may be temporary, minor impacts to traffic volumes on roadways immediately surrounding the project area as well as roadways leading to and from the Polaris Point project area and between Inner Apra Harbor wharves and the CDFs as construction vehicles, equipment, and workers access the Polaris Point project area. A relatively small contractor crew would commute daily to and from the project area (conservatively estimated at 20 vehicles per day). Construction vehicles and equipment would infrequently be transferred to and from the project site generally during off-peak traffic hours to minimize disruption to traffic on public roadways. MEC/MPPEH screening of the excavated material at the designated USSA and later disposal at either Orote Airfield or Field 5 CDF would require approximately 120 truck round trips from the Inner Apra Harbor MEC/MPPEH Management Area off-loading site over a four- to five-month period. The contractor will also develop, obtain approval for, and comply with a traffic control plan that mitigates project-related impacts to vehicle traffic patterns. Land transport of dewatered excavated material from Inner Apra Harbor wharves to the CDF sites would likely occur during non-peak hours, on an as-needed basis.

In-water construction activities would be coordinated with the Navy's Contracting Officer to accommodate movements of Naval vessels when necessary. The contractor would conduct the work in

such a manner as to minimize or avoid obstructing navigation through the entrance channel. When so ordered, the contractor would relocate all vessels, boats, and moveable equipment a minimum of 1,000 yards from the navigational channel until the Navy issues an order that the vessels and equipment may be moved back. Private or commercial vessels would continue to have ample area to navigate around the in-water construction area. USCG-approved aids to navigation and notices to mariners would be implemented and issued, as required, which would minimize impacts to mariners in the area. Disposing of the excavated material at G-DODS is estimated to require two round trips by tugboat from the project site.

Operational Period

Operation of the UEMMS would not generate additional water-based vessel traffic. The UEMMS would passively collect electromagnetic field signatures from NBG homeported vessels and transmit the data for analysis in subsea and land-based cables terminating in an existing building in the interior of Polaris Point. As described in Section 2.3.2, The UEMMS infrastructure would be located on or below the seafloor, with the exception of the CTD sensor (if installed). The CTD sensor would be installed outside the navigational channel at a depth that would not interfere with general vessel traffic in the area. No additional personnel associated with UEMMS data collection or analysis are expected to be assigned to NBG during the operational period, and substantial increases in vehicle trips are not anticipated. Training, testing, maintenance, and repair of the UEMMS would be infrequent events during the operational period. Increases in vehicle and vessel volumes associated with these activities would be temporary and minimal. At the conclusion of its service life, the UEMMS infrastructure would likely be abandoned in place, and would not increase vessel or vehicle trips accessing NBG.

Therefore, implementation of the Preferred Alternative would not result in significant impacts to transportation.

3.6.3.3 Concrete Block Mat Alternative Potential Impacts

The study area for this alternative is the same as for the Preferred Alternative. This alternative would be of similar scope as the Preferred Alternative, with the exception of the materials and process required to secure the subsea cable bundle to the seafloor (in this case, weighted down by concrete block mats).

Construction Period

Although this alternative would require more workers and a longer construction duration to transport and install the concrete block mats than in the Preferred Alternative, the difference would be negligible (i.e., likely fewer than 10 additional personnel and about three weeks additional duration) resulting in a minor increase in vehicular traffic volume and duration above those of the Preferred Alternative. Vehicle trips or vessel trips transporting excavated material would be identical to the Preferred Alternative because this alternative would involve the same dredging footprint and volume.

The same BMPs and mitigation measures to avoid or minimize impacts to harbor transportation would be employed during the in-water work under this alternative (e.g., avoidance of navigation obstructions, relocating work boats, barges, and moveable equipment to allow Navy vessels through the entrance channel, compliance with USCG aids to navigation and notice to mariners requirements).

Operational Period

Because operation, training, testing, maintenance, and repair of the UEMMS would be the same as under the Preferred Alternative, this alternative would have minimal operational period impacts to land- or water-based transportation.

Therefore, the Concrete Block Mat Alternative is anticipated to have similar insignificant impacts to transportation as the Preferred Alternative (i.e., slightly higher construction period vehicle traffic volume and duration).

3.7 Hazardous Materials and Wastes

This resource area includes hazardous materials, hazardous waste, toxic substances, and contaminated sites. However, only munitions and explosives of concern (MEC) are analyzed in detail, as there are no known hazardous materials or waste contamination sites at the terrestrial project areas. The subsea cable route would pass through areas identified for sediment remediation for PCBs (AECOM Technical Services Inc., 2018). However, securing the cable bundle to the seafloor would involve minimal, short-term sediment disturbance not likely to affect the natural recovery processes recommended for the sediment remediation area.

3.7.1 Regulatory Setting

Hazardous materials are defined by 49 CFR section 171.8 as "hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table, and materials that meet the defining criteria for hazard classes and divisions in 49 CFR part 173." Transportation of hazardous materials is regulated by the U.S. Department of Transportation regulations.

Hazardous wastes are defined by the Resource Conservation and Recovery Act, as amended by the Hazardous and Solid Waste Amendments, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." Certain types of hazardous wastes are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These are called universal wastes and their associated regulatory requirements are specified in 40 CFR part 273. Four types of waste are currently covered under the universal wastes regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps, such as fluorescent light bulbs.

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing material, PCBs, and lead-based paint. USEPA is given authority to regulate special hazard substances by the Toxic Substances Control Act. Asbestos is also regulated by USEPA under the Clean Air Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

The DoD established the Defense Environmental Restoration Program (DERP) to facilitate thorough investigation and cleanup of contaminated sites on military installations (active installations, installations subject to Base Realignment and Closure, and formerly used defense sites). The Installation

Restoration Program and the Military Munitions Response Program are components of the DERP. The Installation Restoration Program requires each DoD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The Military Munitions Response Program addresses nonoperational rangelands that are suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituent contamination. The Environmental Restoration Program is the Navy's initiative to address DERP.

3.7.2 Affected Environment

The Navy has implemented a strict Hazardous Material Control and Management Program and a Hazardous Waste Minimization Program for all activities. These programs are governed Navy-wide by applicable Office of the Chief of Naval Operations (OPNAV) instructions and at the installation by specific instructions issued by the Base Commander. The Navy continuously monitors its operations to find ways to minimize the use of hazardous materials and to reduce the generation of hazardous wastes.

Munitions and Explosives of Concern (MEC)

Naval Base Guam has been classified into areas of high likelihood or low likelihood of encountering MEC/MPPEH. The terrestrial area at Polaris Point (including the areas proposed for use in the Preferred Alternative) is considered to have a high likelihood of encountering MEC/MPPEH. The in-water construction footprint of the Preferred Alternative is located in an area of high likelihood of encountering MEC/MPPEH.

3.7.3 Environmental Consequences

As noted earlier, the analysis contained in this section focuses on potential for encountering MEC during project construction and operation.

3.7.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change associated with hazardous materials and wastes. Therefore, no impacts would occur with the No Action Alternative.

3.7.3.2 Concrete Anchor Disc Alternative (Preferred Alternative) Potential Impacts

The study area encompasses the proposed construction and ground (including seafloor) disturbance areas related to the Preferred Alternative.

During construction, approximately 1,200 CY of substrate would be excavated to install the sensors at the appropriate depth. The transition of the cable bundle conduit onto shore would require excavating about 225 CY of subbase material at the north tip of Polaris Point. This total includes about 125 CY of shoreline revetment material to be removed and replaced after installation of the cable bundle conduit. From the cable transition point to the termination point, the sensor cables would be entirely installed in existing below-grade conduits and would require minimal additional excavation on land.

There are no known hazardous materials or waste contamination sites at the terrestrial project areas. It is not anticipated that the Preferred Alternative would encounter hazardous materials during construction. If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, that portion of work would immediately be stopped and the Contracting Officer notified. During ground disturbing activities on land, the Construction contractor would comply

with the appropriate Explosive Safety Submission (ESS) Annex and conduct the necessary MEC/MPPEH screening and, as necessary, clearance. During ground disturbing activities in-water at the sensor array, the Construction contractor would comply with the appropriate in-water ESS.

During the operational period, activities related to measuring and transmitting magnetic signatures and electric fields from DON ships would generally be passive and would not disturb or create hazardous materials or waste. Maintenance and repair activities, when needed, would comply with applicable federal and local requirements governing the use, transport, storage, and disposal of hazardous and regulated materials and waste, and relevant protocols for MEC survey and clearing.

Therefore, implementation of the Preferred Alternative would not result in significant impacts involving hazardous materials and wastes.

3.7.3.3 Concrete Block Mat Alternative Potential Impacts

The study area encompasses the proposed construction and ground disturbance areas related to the Concrete Block Mat Alternative. The study area for this alternative is identical to that of the Preferred Alternative, with the exception of the width of the area affected by the subsea sensor array cable bundle. In this alternative, the area affected by the concrete block mats securing the sensor cable bundle to the seafloor would be approximately eight feet wide along the length of the cable bundle (about 3,100 linear feet).

As in the Preferred Alternative, there are no known hazardous materials or waste contamination sites at the terrestrial project areas for the Concrete Block Mat Alternative and no hazardous materials are expected to be encountered during construction. During ground disturbing activities on land, the Construction contractor would comply with the appropriate ESS Annex and conduct the necessary MEC/MPPEH screening and, as necessary, clearance. During ground disturbing activities in-water at the sensor array, the Construction contractor would comply with the appropriate in-water ESS.

As in the Preferred Alternative, the Concrete Block Mat Alternative would excavate the same footprint and volume of substrate to install the sensor array. The subsea cable route would be identical to the Preferred Alternative, but the cable bundle would be secured by the concrete block mats. These mats would not require penetrating the substrate, but the act of placing the mats on the seafloor may disturb surface sediments. However, the concrete blocks would contribute to contaminant burial by physically blocking resuspension of sediments with higher concentrations of chemicals of concern.

Therefore, implementation of this action alternative would not result in significant impacts with hazardous materials and wastes.

3.8 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative, and impact avoidance and minimization measures are presented in Tables 3-20 and 3-21, respectively.

Table 3-20 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Concrete Anchor Disc Alternative (Preferred Alternative)*	*Concrete Block Mat Alternative*
Air Quality	No impact	Less than significant temporary construction period impacts due to equipment, vessel, and vehicle exhaust and minor ground disturbance. Less than significant operational period impacts as UEMMS operations are passive and are not expected to induce additional vehicle trips to and from the project area.	Less than significant temporary construction period impacts similar to the Preferred Alternative due to equipment, vessel, and vehicle exhaust and minor ground disturbance. Slightly higher construction period pollutant emissions due to a longer construction duration. Same insignificant operational period impacts as the Preferred Alternative.
Water Resources	No impact	Less than significant temporary construction period impacts on marine waters due to in-water work (e.g., excavation and backfilling of the seafloor to install UEMMS equipment) and shoreside ground disturbance (i.e., to install the terrestrial transmission cable) in a below-grade transition vault. Construction period BMPs would avoid or minimize water quality impacts from both the in-water and shoreside construction activities. No operational period water quality impacts are expected because of the passive nature of the UEMMS operation.	Less than significant temporary construction period impacts, similar to the Preferred Alternative. This alternative would result in more resuspended sediments during construction along the cable bundle route as the concrete block mats are placed on the seafloor. Same operational period impacts as the Preferred Alternative.
Cultural Resources	No impact	Less than significant construction and operational period impacts. No historic properties affected.	Same insignificant impacts as the Preferred Alternative.
Biological Resources	No impact	Less than significant construction and operational period impacts with implementation of BMPs and mitigation measures, including	Greater, but insignificant, construction and operational period impacts than the Preferred Alternative due to greater loss of

Table 3-20 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Concrete Anchor Disc Alternative (Preferred Alternative)*	*Concrete Block Mat Alternative*
		avoidance, minimization, and offset measures.	benthic habitat along the subsea cable bundle route from the concrete block mats.
Noise	No impact	Less than significant construction period impacts from tugboats and subsea and terrestrial excavating equipment. Less than significant operational period impacts.	Similar insignificant construction period impacts as the Preferred Alternative; construction equipment and vessels would be operated for a longer duration than in the Preferred Alternative, resulting in a longer duration of increased noise levels. Same insignificant operational period impacts as the Preferred Alternative.
Transportation	No impact	Less than significant temporary construction period impacts on roadways immediately surrounding the shoreside project area and on roadways leading to and from Polaris Point and between Inner Apra Harbor wharves and the CDFs. Less than significant marine transportation impacts. Less than significant operational period impacts.	Similar insignificant impacts as the Preferred Alternative; however, this alternative would require several more personnel and a longer construction duration, which would increase traffic on affected roadways from additional personal vehicles commuting to the work site. Same less than significant operational period impacts as in the Preferred Alternative.
Hazardous Materials and Wastes	No impact	Less than significant construction and operational period impacts. BMPs would be employed in the event MEC is encountered during construction.	Same insignificant construction and operational period impacts as the Preferred Alternative.

Table 3-21 Impact Avoidance And Minimization Measures

Measure	*Anticipated Benefit / Evaluating Effectiveness*	*Implementing and Monitoring*	*Responsibility*	*Estimated Completion Date*
Concrete Anchor Disc Alternative (Preferred Alternative)				
Designation of marine protected species observer during offshore construction activities	Benefits to ESA-protected marine species	Construction contractor	Construction contractor	2022
Silt containment (e.g., silt curtains, fence, and barriers)	Avoidance or reduction of construction-related water quality impacts	Construction contractor	Construction contractor	2022
Biofouling management plan for all vessels entering Guam waters; daily pre-work equipment inspections	Prevent AIS and pollutants from entering Guam waters	Construction contractor	Construction contractor	2023
No in-water work during the primary Guam coral spawning events for hard (scleractinian corals)	Avoidance of adverse impacts to coral reproduction	Construction contractor	Construction contractor	2022
Coral translocation	Minimization of adverse impacts to coral and EFH;	Navy and contractor; monitoring (quantifying and assessing resource conditions) at pre-determined intervals over two years following the translocation	Contractor	2024
Conformance with SWPPP	Benefits to water quality, marine biological resources	Construction contractor	Construction contractor	
Conformance with applicable federal and territorial regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution	Minimization of adverse effects to water, air, noise quality during construction. Benefits to terrestrial and marine biological resources, and noise sensitive land uses.	BMPs listed in Section 2.5	NBG, construction contractor	2023
Compliance with Section 106 consultation commitments for inadvertent discoveries of historic properties	Protection and/or documentation of inadvertent discoveries of historic properties	SOPs within the INRMP for NBG and provisions of 36 CFR 800.13 Post-Review Discoveries	NBG	n/a
Concrete Block Mat Alternative				
Same as for Preferred Alternative				

4 Cumulative Impacts

This section (1) defines cumulative impacts, (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts, (3) analyzes the incremental interaction the proposed action may have with other actions, and (4) evaluates cumulative impacts potentially resulting from these interactions.

4.1 Definition of Cumulative Impacts

The approach taken in the analysis of cumulative impacts follows the objectives of the National Environmental Policy Act, CEQ regulations and guidance. According to 40 CFR section 1508.1(g), "agencies shall consider effects from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives."

To determine the scope of environmental impact analyses, agencies shall consider cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact analysis document.

In addition, CEQ and USEPA have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ 2005) and Consideration of Cumulative Impacts in EPA Review of NEPA Documents (USEPA 1999). CEQ guidance entitled *Considering Cumulative Impacts Under NEPA* (1997) states that cumulative impact analyses should

"…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions.

- Does a relationship exist such that affected resource areas of the proposed action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the proposed action and another action could be expected to interact, would the proposed action affect or be affected by impacts of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the proposed action is considered alone?

4.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area will include those areas previously identified in Chapter 3 for the respective resource areas. The time frame for cumulative impacts centers on the timing of the proposed action.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the proposed action, the analysis employs the measure of "reasonably foreseeable" to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions include notices of intent for EISs and EAs, management plans, land use plans, and other planning related studies.

4.3 Past, Present, and Reasonably Foreseeable Actions

This section focuses on past, present, and reasonably foreseeable future projects at and near the Proposed Action locale. In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable action. Specifically, using the first fundamental question included in Section 4.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action (included in this EA) might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ, 2005), these actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making. Projects included in this cumulative impacts analysis are listed in Table 4-1 and briefly described in the following subsections.

Table 4-1 Cumulative Action Evaluation

Action	*Level of NEPA Analysis Completed*	*Description*	*Resource Areas with Potential for Cumulative Impacts*
Past Actions			
Ammunition Wharf, Outer Apra Harbor	Final Environmental Impact Statement (FEIS)/Record of Decision (ROD)	Construction of original Kilo Wharf, requiring dredging and filling of submerged lands.	Marine biological resources
Alpha and Bravo Wharf Improvements	EA/FONSI	Extension of Bravo Wharf in Inner Apra Harbor and construction dredging to meet requirements of new class of submarines. Also included utility upgrades at Alpha and Bravo Wharves.	Marine biological resources
Apra Harbor Wharf Improvements (Uniform & Tango, MILCON P-204)	FEIS/ROD	Reconstruction of and structural upgrades to the wharf complex that was badly damaged from a 1989 earthquake. Provision and replacement of shoreside utilities and infrastructure to accommodate Amphibious	Marine biological resources

Action	*Level of NEPA Analysis Completed*	*Description*	*Resource Areas with Potential for Cumulative Impacts*
		Readiness Group and Joint High Speed Vessels transient ships at Tango Wharf.	
Inner Apra Harbor Maintenance Dredging	EA/FONSI	Dredging of sediment from sea floor fronting Alpha, Bravo, Delta, Echo, Victor, X-Ray, Romeo, Sierra, Tango, and Uniform Wharves in Inner Apra Harbor to restore the original navigational depths at each wharf.	Marine biological resources
Kilo Wharf Extension	FEIS/ROD	Extension of Kilo Wharf in Outer Apra Harbor to accommodate new multi-purpose support ships (i.e., the T-AKE).	Marine biological resources
Ocean Dredged Material Disposal Site Offshore of Guam	FEIS/ROD	Permanent ocean site in the Philippine Sea for disposing of dredged material originating from Guam, including naval facilities at Apra Harbor. Disposal limited to 1,000,000 CY per calendar year.	Marine biological resources
Polaris Point Beach Restoration	Record of Categorical Exclusion (CATEX)	Repair eroded areas of the Polaris Point coastline south the project area that were damaged by Typhoon Paka by filling the eroded areas with rock and sand in order to make the area safe for recreation.	Water resources, marine biological resources
Polaris Point Seawall Repair	CATEX	Backfill and installation of riprap to repair eroded seawall along north shoreline of Polaris Point near Building 4446.	Water resources, marine biological resources
X-Ray Wharf Improvements – North Berth (MILCON P-518)	EA/FONSI	Construct new earth-filled, sheet pile wharf contiguous to existing X-Ray Wharf bulkhead, improve utilities, and dredge portions of Inner Apra Harbor and harbor fronting X-Ray Wharf to accommodate T-AKE ships.	Marine biological resources
Present and Reasonably Foreseeable Future Actions			
Clipper Cove (FY 2023)	to be determined (TBD)	Repair/modernize existing boat ramps and sheet pile repair located at Clipper Cove in Sumay on NBG.	Marine biological resources
Cruise Ship Dredging/Port of Guam (Hotel Pier), FY 2020	TBD – in progress	Reinforce the old wharf and build a security fence, install lighting, construct other surface work, and upgrade an access road to the wharf. The project will expand wharf capacity to alleviate congestion at the cargo terminal.	Marine biological resources
Feasibility Study Apra Harbor Sediment Site 41	TBD – in progress	Remediate sediments in four locations of Apra Harbor. Remedial alternatives include focused dredging, monitored natural recovery, and enhanced natural recovery.	Marine biological resources, water quality, noise
Finger Pier Dredging	EA	Maintenance dredging of finger piers located to the northwest of Lima Wharf. Maintenance dredging would be performed to restore the depth of the piers to construction design.	Air quality, marine biological resources, water quality, noise
Glass Breakwater Repairs (FY 2023)	CATEX	Repair damaged sections of Glass Breakwater at Outer Apra Harbor, NBG. Work includes	Marine biological resources

Action	*Level of NEPA Analysis Completed*	*Description*	*Resource Areas with Potential for Cumulative Impacts*
		temporary removal of slope protection, strengthening of toe foundation, addition of heavy concrete wave dissipaters, rebuilding of damaged core, geotextile fabric filter, riprap bedding, and replacing armor rock on 1,500 feet of repaired slope.	
Lima, Mike, November Wharf Repair and Modernization	EA/FONSI	Re-face wharf and repair wharf deck, fixtures, and electrical utilities.	Air quality, water resources, marine biological resources, noise
Mariana Islands Training and Testing	FEIS/Overseas Environmental Impact Statement/ROD	Conduct training and testing activities at established at-sea and land based training areas in Guam and the Commonwealth of the Northern Mariana Islands, operating areas, and special use airspace, including an ocean transit corridor. The action includes underwater training activities in Inner and Outer Apra Harbor that may involve the use of small explosive charges (e.g., 10 pounds net explosive weight, 20 to 40 times per year [Navy, 2015]). These activities would occur about 1.5 miles to the northwest of the project area in Outer Apra Harbor and in Inner Apra Harbor.	Water resources and marine biological resources
Marine Corps Relocation from Okinawa	FEIS/Supplemental Environmental Impact Statement/ ROD	Establish operational U.S. Marine Corps (USMC) presence in Guam consisting of approximately 5,000 USMC personnel and 1,300 dependents. Upgrade existing Inner Apra Harbor general purpose wharves and utilities; create embarkation area and amphibious vehicle/small boat laydown area (Inner Apra Harbor). Uniform and Tango Wharf improvements (P-204) have been completed.	Air quality, water resources, marine biological resources, noise
MILCON P-661 Navy-Commercial Tie-In Hardening	EA ongoing	Replace existing Navy/commercial petroleum, oil, and lubricant pipeline tie-in, with a new, hardened tie-in facility within the pipeline easement causeway in the vicinity of Apra Harbor, Guam. (project implementation likely post-2022)	Air quality, noise
MILCON P-676 Polaris Point Pier	TBD	Construction of waterfront ship repair and berthing facilities to support U.S. Navy Virginia-Class submarines. Project will also provide complete hotel services including berthing space, mooring, power, and utilities.	Air quality, water resources, marine biological resources, noise
Oscar, Papa, Quebec, and Romeo Wharves Maintenance Dredging	TBD – in progress	Maintenance dredging Oscar, Papa, Quebec, and Romeo wharves in Inner Apra Harbor, NBG. Dredging would be performed to	Water resources, marine biological resources

Action	*Level of NEPA Analysis Completed*	*Description*	*Resource Areas with Potential for Cumulative Impacts*
		restore the depth of the Oscar, Papa, Quebec, and Romeo wharves to -35 feet MLLW.	
Port Authority of Guam (PAG) Modernization Program	EA/FONSI	New equipment, systems, and buildings; terminal modernization; new yard capacity (Outer Apra Harbor); structural refurbishment of existing docks; dredging to increase berth depths (Wharves F4 – F6 in Outer Apra Harbor); land reclamation for construction of new berth (F7); 900 feet of additional berthing space; dredging of Outer Apra Harbor. Projects are within PAG-controlled areas of Cabras Island over 1 mile north of the UEMMS sensor array.	Air quality, water resources, marine biological resources, noise
Repair Finger Pier	TBD – in progress	Comprehensive rehabilitation, repair, and modernization of the Finger Pier northwest of Lima Wharf, including structural repair and provision of water, electricity, and fueling utilities.	Air quality, water resources, marine biological resources, noise
Repair Oscar, Papa, and Quebec Wharves	TBD – in progress	Restore wharves to fully functional condition as ship repair and berthing wharves meeting DoD and Navy requirements.	Air quality, water resources, marine biological resources, noise
Repair Quebec Quay Wall and Construct Boat Lift	TBD – in progress	Repair and modernize Quebec Quay Wall and construct a small craft boat ramp and boat lift capable of removing Special Warfare and Coastal Riverine Group vessels from the water for operations, maintenance, and typhoon protection .	Air quality, water resources, marine biological resources, noise
X-Ray Wharf Improvements – South Berth (MILCON P-519)	EA/FONSI	Second component of new earth-filled, sheet pile wharf contiguous to existing X-Ray Wharf bulkhead, including utility improvements and dredging of Inner Apra Harbor fronting X-Ray Wharf to accommodate T-AKE ships.	Air quality, noise, marine biological resources

4.4 Cumulative Impact Analysis

The following analysis of cumulative impacts is organized by resource area in the same order presented in Chapter 3. Only the resource areas that have the potential to have cumulative impacts resulting from the incremental effects of the Preferred Alternative or Concrete Block Mat Alternative are addressed. The Proposed Action is not anticipated to have incremental impacts in the following resource areas that would overlap temporally or spatially in a way that would be cumulatively significant with those of the past, present, and reasonably foreseeable actions identified in Section 4.3: cultural resources, transportation, and hazardous materials and waste. Therefore, these environmental resource areas are not analyzed in detail in this section. Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available and a qualitative analysis was undertaken. In addition, where an analysis of potential

environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA where possible. The analytical methodology presented in Chapter 3, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

The analyses show that, when considered with relevant past, present, and reasonably foreseeable projects, the incremental effects of the Preferred Alternative and the Concrete Block Mat Alternative would not contribute to cumulative impacts on pertinent resource areas. Because it would not contribute any incremental effects, the No Action Alternative would not result in cumulative impacts on the relevant resource areas during the construction or operational periods.

4.4.1 Air Quality

4.4.1.1 Description of Geographic Study Area

The ROI for air quality includes the SO_2 nonattainment area shown in Figure 3-1.

4.4.1.2 Relevant Past, Present, and Future Actions

Past projects have been completed and associated construction period air quality emissions would have dispersed. X-Ray Wharf south berth improvements (MILCON P-519), PAG modernization program, Marine Corps relocation, MILCON P-661 Navy-commercial tie-in hardening, MILCON P-676 Polaris Point Pier, Finger Pier dredging and repair, Repair Oscar, Papa, and Quebec Wharves, Repair Quebec Quay Wall and Construct Boat Lift, and Lima-Mike-November wharf repair and modernization projects may interact with the Proposed Action's air quality impacts if their construction occurs concurrently with that of the Proposed Action.

4.4.1.3 Cumulative Impact Analysis

Cumulative air quality impacts from past, present, and future actions within the ROI would be less than significant because, as described in Section 3.1, the Proposed Action's SO_2 emissions would be well under the de minimis level of 100 tpy and are not considered significant. Furthermore, the Proposed Action installation is anticipated to begin in 2022 with a 10-month duration, and would be operational in 2024. Construction of the projects listed in Section 4.4.1.2 as having the potential for cumulative air quality impacts would have temporary and localized pollutant emissions. They are unlikely to overlap with the Proposed Action's construction period and/or would be located in areas where the introduction of de minimis levels of temporary emissions expected from construction-related equipment or vehicles would not meaningfully interact with those of the Proposed Action.

During the operational period, the Proposed Action would have negligible air quality impacts, as the UEMMS is a passive system that would not involve activities that emit air pollutants. It is not expected to induce additional vehicle trips to the terrestrial project area. Repair or maintenance of the underwater components—which would involve three to five days of in-water work with the same type of vessels and equipment as the Proposed Action—is likely to occur only once every 5 to 10 years. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would not result in significant air quality impacts within the ROI.

4.4.2 Water Resources

4.4.2.1 Description of Geographic Study Area

The ROI for water resources includes the Outer Apra Harbor water column in the vicinity of the UEMMS sensor array, subsea cable route, and Polaris Point shore landing site (see Figure 1-1).

4.4.2.2 Relevant Past, Present, and Future Actions

Previous actions such as construction and extension of Kilo Wharf, Alpha and Bravo wharf improvements, Polaris Point beach restoration and seawall repair projects have had temporary construction period water quality impacts in their respective Outer Apra Harbor project areas. These projects were completed several years ago and marine water quality has presumably returned to background levels. Ongoing Mariana Islands training and testing activities in Outer and Inner Apra Harbor have a limited potential area of impact (i.e., small zones immediately adjacent to the explosive charge), are generally widely dispersed in space and time, and were determined to result in changes to water quality below applicable standards, regulations, and guidelines (DON, 2015). Relevant Marine Corps relocation projects and the other construction projects identified in Table 4-1 may interact with the Proposed Action's water quality impacts if implemented during its construction period.

4.4.2.3 Cumulative Impact Analysis

Cumulative water resources impacts from past, present, and future actions within the ROI would be less than significant because water quality effects of past actions would not overlap temporally and/or spatially with the Proposed Action's expected temporary construction period water quality impacts. In addition, the Proposed Action's temporary construction period water quality impacts would be avoided or minimized through the use of BMPs. As discussed in Section 3.2.3.2, in the long-term, because the proposed sensor array and associated cable infrastructure would function passively (i.e., either buried beneath the seafloor or revetment armoring material, or contained within HDPE cables and conduit), it would have little to no potential to degrade existing surface water quality or change physical or chemical characteristics of marine waters.

Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would not result in significant impacts to water resources within the ROI.

4.4.3 Biological Resources

4.4.3.1 Description of Geographic Study Area

The ROI for biological resources includes Outer Apra Harbor in the vicinity of the UEMMS sensor array, subsea cable route; the Polaris Point shore landing site; G-DODs; the terrestrial cable route; cable transition point and termination point buildings at Polaris Point; Orote Airfield CDF; and Field 5 CDF (see Figure 1-1).

4.4.3.2 Relevant Past, Present, and Future Actions

Previous actions in Outer Apra Harbor or Inner Apra Harbor have had temporary or long-term effects on marine biological resources in the ROI, including construction and extension of Kilo Wharf, Alpha and Bravo Wharf improvements, Uniform and Tango Wharf improvements, Inner Apra Harbor maintenance dredging, Sumay Cove repair and modernization, Polaris Point beach restoration and seawall repair projects, X-Ray Wharf north berth improvements, and Mariana Islands training and testing projects in

Outer Apra Harbor. Temporary impacts to marine biological resources included those related to in-water construction noise and activities that either caused fish and motile species to avoid the immediate area, increased sedimentation or introduction of pollutants into the water column, and indirect impacts to marine vegetation and sessile species such as coral. Long-term effects include removal of coral and marine habitats through dredging or demolition of substrate. In all projects, BMPs and avoidance and minimization measures were implemented to reduce or avoid adverse impacts to marine biological resources. For projects that resulted in significant adverse impacts to marine biological resources, mitigation measures were implemented to offset the ecological services lost due to the action.

The present and reasonably foreseeable actions that might interact with the Proposed Action's effects on marine biological resources if implemented during its construction period are listed in Table 4-1.

4.4.3.3 Cumulative Impact Analysis

Cumulative biological resource impacts from past, present, and future actions within the ROI would be less than significant because adverse effects from past and present actions were temporary, discountable, or recoverable, or have been offset by mitigation measures. The Proposed Action would include BMPs and mitigation measures described in Section 2.5 and 3.4.3.2, respectively, to reduce its impacts to less than significant levels. The present and reasonably foreseeable projects that might interact with the Proposed Action's marine biological effects are geographically distant (e.g., Mariana Islands training and testing site, X-Ray Wharf, PAG projects on Cabras Island, Lima/Mike/November Wharf repair and modernization, Finger Piers, Glass Breakwater, Clipper Cove, Port of Guam wharf, Oscar/Papa/Quebec/Romeo wharves) would occur after the Proposed Action, or have completed its mitigation actions (e.g., Polaris Point Pier). Furthermore, appropriate levels of compensatory mitigation would be implemented to offset ecological services lost due to these actions.

Most of the terrestrial components of the ROI (Polaris Point facilities and cable route, CDFs) would be located within existing, established facilities (e.g., Polaris Point cable transition and termination point buildings, existing underground conduits, established and operational CDFs) or on areas that have been previously disturbed and expected impacts to terrestrial wildlife and vegetation are negligible.

Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would not result in significant impacts within the ROI.

4.4.4 Noise

4.4.4.1 Description of Geographic Study Area

The ROI for noise impacts includes the noise sensitive receptors closest to the Proposed Action project site (see Figure 3-4).

4.4.4.2 Relevant Past, Present, and Future Actions

Past, present, and future actions that may interact with the Proposed Action's noise impacts are identified in Table 4-1. Present and future projects may result in cumulative impacts if construction of the Proposed Action occurs concurrently with their construction.

4.4.4.3 Cumulative Impact Analysis

Cumulative noise impacts from past, present, and future actions within the ROI would be less than significant because the noise impacts of the Proposed Action would occur only during the construction

period. As discussed in Section 3.5.8, the Proposed Action's construction period noise impacts are estimated to be insignificant, and barely audible at the noise sensitive receptors at NBG and in the civilian community. Most of the construction of projects with the potential to interact with the Proposed Action's noise impacts (identified in Table 4-1) would not overlap temporally with the Proposed Action. Other projects would be located at distances from the Proposed Action that make them unlikely to generate construction noise that would contribute to cumulative noise impacts. During the operational period, the Proposed Action would operate passively beneath or on the seafloor, underground, or within existing structures and not generate discernable levels of noise that would interact with noise impacts from other actions identified in Table 4-1.

Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would not result in significant noise impacts within the ROI.

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5 Other Considerations Required by NEPA

5.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 Code of Federal Regulations (CFR) section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 5-1 identifies the principal federal and state laws and regulations that are applicable to the Proposed Action, and describes briefly how compliance with these laws and regulations would be accomplished.

Table 5-1 Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	***Status of Compliance***
National Environmental Policy Act (NEPA); CEQ NEPA implementing regulations; Navy procedures for Implementing NEPA	Complies; EA and FONSI prepared
Clean Air Act	Exempt from General Conformity (see Appendix A)
Clean Water Act	Section 401 Water Quality Certification to be obtained; NPDES permit to be obtained, as applicable
Rivers and Harbors Act	Section 10 Rivers and Harbors Act permit to be obtained
Coastal Zone Management Act	CZMA consultation completed (see Appendix E)
National Historic Preservation Act	Section 106 consultation completed (see Appendix B)
Endangered Species Act	Section 7 consultation completed (see Appendix C)
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	EFH consultation completed (see Appendix C)
Marine Mammal Protection Act	Taking of marine mammals under the MMPA is unlikely
Migratory Bird Treaty Act	No significant effects
Comprehensive Environmental Response and Liability Act	not applicable (n/a)
Resource Conservation and Recovery Act	n/a
Executive Order 11988, Floodplain Management	n/a
Executive Order 12114, Environmental Effects Abroad of Major Federal Actions (Department of Navy implementing regulation 32 CFR part 287)	n/a
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	No significant effects
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	No significant effects
Executive Order 13089, Coral Reef Protection	BMPs, avoidance and minimization measures, and mitigation measures would address coral reef protection issues
Guam Air Pollution Control Standards and Regulations (Guam Administrative Rules, Title 22-1)	Fugitive dust control measures to be identified prior to implementation

5.1.1 Coastal Zone Management

The federal Coastal Zone Management Act (CZMA) of 1972 establishes a federal-state partnership to provide for the comprehensive management of coastal resources. Coastal states and territories develop site-specific coastal management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs. The Guam Coastal Zone Management Program lays out the policy to guide the use, protection, and development of land and ocean resources within the state's coastal zone. Under the Act, federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination or a Negative Determination. In other words, any federal agency proposing to conduct or support an activity within or outside the coastal zone that would affect any land or water use or natural resource of the coastal zone is required to do so in a manner consistent with the CZMA or applicable state coastal zone program to the maximum extent practicable. However, federal lands, which are "lands the use of which is by law subject solely to the discretion of…the Federal Government, its officers, or agents," are statutorily excluded from the State's "coastal zone." If, however, the proposed federal activity affects coastal resources or uses beyond the boundaries of the federal property (i.e., has spillover effects), the CZMA Section 307 federal consistency requirement applies. As a federal agency, the DON is required to determine whether its proposed activities would affect the coastal zone. This takes the form of either a Negative Determination or a Consistency Determination.

The Navy conducted a coastal consistency determination assessment for the Proposed Action and determined that it would be consistent with, and would be conducted in a manner consistent with the Guam Coastal Management Program (GCMP) to the maximum extent practicable. The Navy's CZM coastal consistency determination assessment and supporting materials were submitted to the Guam Bureau of Statistics and Plans (BSP) by letter dated October 12, 2021 and Guam BSP provided conditional concurrence by letter dated December 23, 2021. By letter dated February 14, 2022, the Navy responded to Guam BSP's conditional concurrence, clarifying that, although it cannot be made to obtain permits under 5 Guam Code Annotated §63116.2, it would ensure that its activities are consistent to the maximum extent practicable with Guam's coastal resource management provisions and would implement measures or mitigations necessary to ensure the preservation of Guam's vital coastal resources during the project. By letter dated March 3, 2022, Guam BSP changed its conditional concurrence to an objection to the Navy's determination. In a letter dated April 8, 2022, after conducting supplemental coordination with the Navy to resolve concerns regarding adherence to the enforceable policies of the GCMP, Guam BSP withdrew its objection communicated in its March 3, 2022 letter and concluded its supplemental coordination with the Navy. CZM consultation correspondence is included as Appendix E.

5.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Implementation of the Proposed Action would involve human labor; the consumption of fuel, oil, and lubricants for construction vehicles and vessels; materials used in the sensor array and its supporting

infrastructure; and loss of natural resources (i.e., coral and other marine benthic resources). Implementing the Proposed Action would not result in significant irreversible or irretrievable commitment of resources, as the UEMMS equipment involves a low level of raw materials relative to the important function it would serve. Furthermore, a combination of avoidance, minimization, and mitigation measures would offset the initial natural resource losses.

5.3 Unavoidable Adverse Impacts

This EA has determined that the alternatives considered would not result in any significant impacts. Implementing the alternatives would result in the following unavoidable environmental impacts:

- Short-term, temporary harbor navigation, air quality, and noise impacts during the construction period
- Unavoidable loss of approximately 7,680 coral colonies (about 0.43 acres) and approximately 9,930 sq ft of the benthic community due to the installation of the sensor array and subsea cable. The Navy proposes to offset the ecological services provided by habitat restoration and conversion at Mound 9, which NMFS has found to be acceptable mitigation for the unavoidable loss.

5.4 Relationship between Short-Term Use of the Environment and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

In the short-term, effects to the human environment with implementation of the Proposed Action would primarily relate to the construction activity itself. Harbor navigation, air quality, and noise would be impacted in the short-term. In the long-term, Navy ships homeported at NBG would be able to undergo required electromagnetic signature measurements, which would ensure that they meet parameters established to avoid detection and increase mission effectiveness. The construction of the facility and operation would not significantly impact the long-term natural resource productivity of the area because the UEMMS and its supporting data transmission functions would operate passively, either below grade, encased in HPDE conduits, or within existing facilities on land. Because of the planned avoidance, minimization, and mitigation measures, the Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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Appendix A
Air Quality Methodology and Calculations

Appendix A-1
Record of Non-Applicability for Clean Air Act Conformity
Air Quality Methodology and Calculations
Concrete Anchor Disc Alternative (Preferred Alternative)

Record of Non-Applicability for Clean Air Act Conformity

Naval Base Guam
Underwater Electromagnetic Measurement System

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

Proposed Action

Action Proponent: Commanding Officer, Naval Base Guam, Guam

Location: Naval Base Guam Apra Harbor, Guam

Proposed Action Name: Underwater Electromagnetic Measurement System

Proposed Action and Emissions Summary:

The Proposed Action would install an underwater electromagnetic measurement system (UEMMS), which would support compliance of U.S. Navy submarines and surface ships homeported or forward deployed at Naval Base Guam (NBG) with the electric and magnetic signature limits specified in Office of the Chief of Naval Operations Instruction S8950.2H. The UEMMS would consist of a sensor array, subsea and terrestrial data transmission cables, and shore side data acquisition equipment. The proposed action includes translocation of corals to a suitable receptor site prior to installation.

Electromagnetic/magnetometer sensors and a conductivity, depth and temperature sensor would be installed in an array on the seafloor of Outer Apra Harbor northwest of Polaris Point. To transfer data collected by the sensor array, subsea transmission cables would be routed from the array to a new below-grade transition vault located onshore at Polaris Point.

Once on shore, the cables would connect to data acquisition equipment and the data will be transferred to a single fiber optic cable. The fiber optic cable would follow a terrestrial route in existing below grade conduits on Polaris Point, where the system would terminate. The data collected at the sensor array would be collected, processed, and archived.

After installation, the system would require minimal maintenance. The sensor array is designed to acquire data and will not emit electromagnetic radiation during its operation. Because the

UEMMS has no mechanical parts, repairs are anticipated to be minimal and would be conducted on an as-needed basis.

The sensor array has no relation to frequency of ship traffic at NBG. The specifications of the UEMMS at NBG are customizable and operations of the array is not expected to effect on-base or on-island staffing levels because current staff would assume the role of collecting its data.

The proposed action would be implemented over a three year period starting in 2021 with coral translocation and habitat restoration/stabilization prior to installation.

Table 1. Estimated Emissions for Proposed Action

Project Year	Sulfur Dioxide (ton per year)
2021	< 0.01
2022	< 0.01
2023	< 0.01
General Conformity de minimis Threshold (tpy)	*100*

Affected Air Basin: Piti-Cabras, Guam

Date RONA Prepared: August 23, 2021

RONA prepared by: Naval Facilities Engineering Command, Pacific

Proposed Action Exemption

The proposed action is exempt from the Clean Air Act General Conformity Rule because the proposed action's projected emissions are below the applicable de minimis threshold.

Attainment Area Status and Emissions Evaluation Conclusions

The project area at Naval Base Guam Apra Harbor is located within the Guam Piti-Cabras area, which has been designated as nonattainment for sulfur dioxide, unclassified for particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, and unclassifiable/attainment for carbon monoxide, ozone, nitrogen dioxide, lead, and particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

Since the proposed action's projected emissions in Table 1 do not exceed the de minimis threshold, the proposed action is exempt from the Clean Air Act General Conformity Rule.

RONA Approval:

Signature: MOON.EDWARD.E.1272181507 Digitally signed by MOON.EDWARD.E.1272181507 Date: 2021.08.23 10:54:35 +10'00'

Name/Rank: Edward Moon/GS-13

Date: August 23, 2021

Position: Installation Environmental Program Director

Activity Data

Equipment	Fuel	hp	Operating Hours			No. of Trips	Vehicle Miles Traveled (mi)			Onsite Idling (hr)		
			2021	2022	2023		2021	2022	2023	2021	2022	2023
GOVERNMENT FLEET VEHICLES												
Passenger Truck	GASOLINE	-	-	-	-	320	-	2016	-	-	160	-
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION												
Excavator	DIESEL	1200	200	-	-	-	-	-	-	-	-	-
Flat Bed Truck	DIESEL	280	-	-	-	200	4240	-	-	200	-	-
Tugboat & Auxiliary Generator (2)	DIESEL	1341/134	1600	-	-	-	-	-	-	-	-	-
Twin Engine Large Dive Boat	DIESEL	330	280	280	-	-	-	-	-	-	-	-
Twin Engine Medium Dive Boat	DIESEL	250	140	448	448	-	-	-	-	-	-	-
INSTALLATION												
Air Compressors	GASOLINE	50 < hp <= 75	-	407	-	-	-	-	-	-	-	-
Crane	DIESEL	175 < hp <= 300	-	648	-	-	-	-	-	-	-	-
Generator Sets	DIESEL	40 < hp <= 50	-	780	-	-	-	-	-	-	-	-
Other General Industrial Eqp	GASOLINE	50 < hp <= 75	-	40	-	-	-	-	-	-	-	-
Outboard	GASOLINE	175 < hp <= 300	-	220	-	-	-	-	-	-	-	-
Passenger Truck	GASOLINE	-	-	3200	-	160	-	80000	-	-	80	-
Pumps	GASOLINE	100 < hp <= 175	-	116	-	-	-	-	-	-	-	-
Tractors/Loaders/Backhoes	DIESEL	175 < hp <= 300	-	120	-	-	-	-	-	-	-	-
Tugboat & Auxiliary Generator	DIESEL	1341/134	-	658	-	-	-	-	-	-	-	-
Twin Engine Medium Dive Boat	DIESEL	250	-	104	-	-	-	-	-	-	-	-
Tugboat & Auxiliary Generator (Ocean Disposal)	DIESEL	1000	-	8	-	-	-	-	-	-	-	-

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Extended Idle Processes; Soak Time ≥ 720 minutes; assume all idle when only operating hours available (no VMT data);
Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Processes; Maximum Monthly; Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020; Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Emissions

Equipment	Category	SO2 Emission Factor				SO2 Emissions (lb/yr)		
		2021	2022	2023	units	2021	2022	2023
GOVERNMENT FLEET VEHICLES								
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.02	-
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi			
	Passenger Truck - start[1]	-	0.002	-	g/start			
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION								
Excavator	Excavators (1200 < hp <= 2000)[2]	4.03	-	-	g/hr	1.78	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.07	-	-	g/hr	0.14	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.01	-	-	g/mi			
	Single Unit Short-Haul Truck - start[1]	0.003	-	-	g/start			
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.01	-	-	g/kWh	5.98	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	0.66	0.66	-	g/hr	0.82	0.82	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	0.38	0.38	0.38	g/hr	0.23	0.75	0.75
INSTALLATION								
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	0.14	-	g/hr	-	0.13	-
Crane	Cranes (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.54	-
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	0.09	-	g/hr	-	0.15	-
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	0.21	-	g/hr	-	0.02	-
Outboard	Outboard (175 < hp <= 300)[2]	-	0.24	-	g/hr	-	0.12	-
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.53	-
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi			
	Passenger Truck - start[1]	-	0.002	-	g/start			
Pumps	Pumps (100 < hp <= 175)[2]	-	0.35	-	g/hr	-	0.09	-
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	0.20	-	g/hr	-	0.05	-
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	2.46	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.17	-
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	0.02	-
				TOTAL (lb/yr)		8.95	5.87	0.75
				TOTAL (tpy)		0.004	0.003	0.0004

Equipment	Category	CO Emission Factor 2021	CO Emission Factor 2022	CO Emission Factor 2023	units	CO Emissions (lb/yr) 2021	CO Emissions (lb/yr) 2022	CO Emissions (lb/yr) 2023	CO	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	8.05	-	g/hr	-	43.59	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	3.95	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	16.44	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	404.63	-	-	g/hr	178.41	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	13.90	-	-	g/hr	30.45	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	1.87	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	7.77	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	1.61	-	-	g/kWh	1544.29	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	138.70	138.19	-	g/hr	171.24	170.61	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	79.94	79.64	79.34	g/hr	49.35	157.32	156.73	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	441.66	-	g/hr	-	396.30	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	15.93	-	g/hr	-	22.76	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	17.15	-	g/hr	-	29.49	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	554.04	-	g/hr	-	48.86	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	3681.34	-	g/hr	-	1785.52	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	8.05	-	g/hr	-	709.55	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	3.95	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	16.44	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	2305.84	-	g/hr	-	589.69	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	41.38	-	g/hr	-	10.95	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	1.61	-	g/kWh	-	635.09	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	79.64	-	g/hr	-	36.52	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	1.61	-	g/kWh	-	5.76	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		1973.74	4642.00	156.73		
				TOTAL (tpy)		0.99	2.32	0.08		

NOTES:

[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-1

Year	Emissions (tpy) CO	NOx	PM10	PM2.5	SO2	VOC	CO2	CH4	N2O	CO2e
2021	0.99	6.10	0.15	0.15	0.004	0.20	513.90	0.01	0.02	519.60
2022	2.32	3.14	0.09	0.08	0.003	1.06	352.38	0.02	0.008	355.19
2023	0.08	0.36	0.008	0.008	0.0004	0.02	40.90	0.001	0.00	40.93

UEMMS Emissions - Pref Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	PM10 Emission Factor 2021	2022	2023	units	PM10 Emissions (lb/yr) 2021	2022	2023	PM10	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.37	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.08	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	67.52	-	-	g/hr	29.77	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.39	-	-	g/hr	6.37	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.52	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.26	-	-	g/kWh	247.93	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	14.02	13.76	-	g/hr	17.31	16.99	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.57	8.46	8.34	g/hr	5.29	16.71	16.48	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	2.34	-	g/hr	-	2.10	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	3.02	-	g/hr	-	4.32	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	3.34	-	g/hr	-	5.75	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	3.42	-	g/hr	-	0.30	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	7.05	-	g/hr	-	3.42	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	13.42	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.08	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	5.38	-	g/hr	-	1.38	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	8.01	-	g/hr	-	2.12	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.26	-	g/kWh	-	101.96	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	8.46	-	g/hr	-	3.88	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.26	-	g/kWh	-	0.92	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		306.67	173.63	16.48		
				TOTAL (tpy)		0.15	0.09	0.01		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Category	NOx Emission Factor 2021	2022	2023	units	NOx Emissions (lb/yr) 2021	2022	2023	NOx	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.81	-	g/hr	-	2.56	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.24	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.86	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	2825.57	-	-	g/hr	1245.87	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	31.30	-	-	g/hr	52.65	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	4.07	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.92	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	10.28	-	-	g/kWh	9845.80	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	669.85	652.53	-	g/hr	826.99	805.61	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	381.77	371.50	361.55	g/hr	235.66	733.84	714.19	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	39.07	-	g/hr	-	35.06	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	68.53	-	g/hr	-	97.90	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	64.84	-	g/hr	-	111.51	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	54.02	-	g/hr	-	4.76	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	221.85	-	g/hr	-	107.60	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.81	-	g/hr	-	42.62	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.24	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.86	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	216.74	-	g/hr	-	55.43	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	87.36	-	g/hr	-	23.11	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	10.28	-	g/kWh	-	4049.08	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	371.50	-	g/hr	-	170.36	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	10.28	-	g/kWh	-	36.71	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		12206.97	6276.16	714.19		
				TOTAL (tpy)		6.10	3.14	0.36		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Category	SO2 Emission Factor 2021	2022	2023	units	SO2 Emissions (lb/yr) 2021	2022	2023	SO2	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.02	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.002	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	4.03	-	-	g/hr	1.78	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.07	-	-	g/hr	0.14	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.01	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.003	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.01	-	-	g/kWh	5.98	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	0.66	0.66	-	g/hr	0.82	0.82	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	0.38	0.38	0.38	g/hr	0.23	0.75	0.75	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	0.14	-	g/hr	-	0.13	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.54	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	0.09	-	g/hr	-	0.15	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	0.21	-	g/hr	-	0.02	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	0.24	-	g/hr	-	0.12	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.53	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.002	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	0.35	-	g/hr	-	0.09	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	0.20	-	g/hr	-	0.05	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	2.46	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.17	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	0.02	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		8.95	5.87	0.75		
				TOTAL (tpy)		0.004	0.003	0.0004		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-1

Equipment	Category	PM2.5 Emission Factor 2021	2022	2023	units	PM2.5 Emissions (lb/yr) 2021	2022	2023	PM2.5	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.09	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.01	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	65.49	-	-	g/hr	28.88	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.12	-	-	g/hr	4.23	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.30	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.25	-	-	g/kWh	240.49	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	13.60	13.35	-	g/hr	16.79	16.48	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.31	8.21	8.09	g/hr	5.13	16.21	15.98	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	2.15	-	g/hr	-	1.93	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	2.93	-	g/hr	-	4.19	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	3.24	-	g/hr	-	5.57	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	3.15	-	g/hr	-	0.28	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	6.49	-	g/hr	-	3.15	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	2.46	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.01	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	4.95	-	g/hr	-	1.27	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	7.77	-	g/hr	-	2.06	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.25	-	g/kWh	-	98.90	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	8.21	-	g/hr	-	3.76	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.25	-	g/kWh	-	0.90	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		295.52	157.24	15.98		
				TOTAL (tpy)		0.15	0.08	0.01		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Category	CO2 Emission Factor 2021	CO2 Emission Factor 2022	CO2 Emission Factor 2023	CO2 Emission Factor units	CO2 Emissions (lb/yr) 2021	CO2 Emissions (lb/yr) 2022	CO2 Emissions (lb/yr) 2023	CO2	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	3729.82	-	g/hr	-	3607.10	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	443.36	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	227.45	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	559715.32	-	-	g/hr	246793.50	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	8219.75	-	-	g/hr	16101.61	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	1306.98	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	294.92	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	679.47	-	-	g/kWh	650674.68	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	71826.75	71825.50	-	g/hr	88676.96	88675.41	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	41409.43	41409.53	41409.54	g/hr	25561.94	81798.41	81798.43	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	23819.19	-	g/hr	-	21372.63	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	54265.99	-	g/hr	-	77524.55	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	11458.63	-	g/hr	-	19704.43	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	34826.20	-	g/hr	-	3071.16	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	39930.23	-	g/hr	-	19366.94	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	3729.82	-	g/hr	-	79013.29	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	443.36	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	227.45	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	57357.79	-	g/hr	-	14668.54	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	26276.03	-	g/hr	-	6951.48	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	679.47	-	g/kWh	-	267589.96	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	41409.53	-	g/hr	-	18988.92	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	679.47	-	g/kWh	-	2426.22	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	1027808.69	704759.05	81798.43		
					TOTAL (tpy)	513.90	352.38	40.90		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Extended Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Processes;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-1

Equipment	Category	VOC Emission Factor 2021	VOC Emission Factor 2022	VOC Emission Factor 2023	VOC Emission Factor units	VOC Emissions (lb/yr) 2021	VOC Emissions (lb/yr) 2022	VOC Emissions (lb/yr) 2023	VOC	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	1.30	-	g/hr	-	3.54	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.17	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	1.65	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	93.15	-	-	g/hr	41.07	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	6.81	-	-	g/hr	8.64	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.60	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.30	-	-	g/kWh	283.09	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	42.12	42.58	-	g/hr	52.00	52.57	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	19.73	19.73	19.73	g/hr	12.18	38.98	38.97	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	29.80	-	g/hr	-	26.74	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	4.35	-	g/hr	-	6.22	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	4.54	-	g/hr	-	7.81	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	36.28	-	g/hr	-	3.20	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	3694.12	-	g/hr	-	1791.72	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	1.30	-	g/hr	-	31.09	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.17	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	1.65	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	146.68	-	g/hr	-	37.51	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	13.55	-	g/hr	-	3.58	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.30	-	g/kWh	-	116.42	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	19.73	-	g/hr	-	9.05	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.30	-	g/kWh	-	1.06	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	396.98	2129.49	38.97		
					TOTAL (tpy)	0.20	1.06	0.02		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

UEMMS Emissions - Pref Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	N2O Emission Factor 2021	2022	2023	units	N2O Emissions (lb/yr) 2021	2022	2023	N2O	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.00	-	g/hr	-	0.07	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.00	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.05	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	-	-	-		-	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.00	-	-	g/hr	0.00	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.00	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.01	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.04	-	-	g/kWh	37.05	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	-	-	-	-	-	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	-	-	-	-	-	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	-	-	-	-	-	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.00	-	g/hr	-	0.03	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.00	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.05	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	-	-	-	-	-	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.04	-	g/kWh	-	15.24	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.04	-	g/kWh	-	0.14	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	37.05	15.48	0.00		
					TOTAL (tpy)	0.02	0.01	0.00		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network;
Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Eqn 4.3, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Category	CH4 Emission Factor 2021	2022	2023	units	CH4 Emissions (lb/yr) 2021	2022	2023	CH4	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.14	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.004	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.08	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	7.17	-	-	g/hr	3.16	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.56	-	-	g/hr	0.78	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.05	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.03	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.01	-	-	g/kWh	5.38	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	2.85	3.02	-	g/hr	3.52	3.73	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	1.24	1.32	1.38	g/hr	0.77	2.60	2.74	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	1.86	-	g/hr	-	1.67	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	0.39	-	g/hr	-	0.56	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	0.32	-	g/hr	-	0.55	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	2.30	-	g/hr	-	0.20	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	49.00	-	g/hr	-	23.76	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.77	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.004	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.08	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	13.17	-	g/hr	-	3.37	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	0.67	-	g/hr	-	0.18	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	2.21	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	1.32	-	g/hr	-	0.60	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	0.02	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	13.61	40.35	2.74		
					TOTAL (tpy)	0.01	0.02	0.001		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non
Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7 VOC, g/kWh; 4.5.4 ratios of VOC (1.053) and CH4 (0.02) to HC)) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Nonroad	Onroad	Port-Related
Air Compressors (50 < hp <= 75)	Passenger Truck - 25 mph	Harbor Tug (Tier 0)
Cranes (175 < hp <= 300)	Passenger Truck - idle	
Generator Sets (40 < hp <= 50)	Passenger Truck - start	
Other General Industrial Eqp (50 < hp <= 75)	Single Unit Short-Haul Truck - 25 mph	
Outboard (175 < hp <= 300)	Single Unit Short-Haul Truck - idle	
Pumps (100 < hp <= 175)	Single Unit Short-Haul Truck - start	
Tractors/Loaders/Backhoes (175 < hp <= 300)		

Appendix A-1

Equipment	Fuel	hp	Operating Hours			No. of Trips	Vehicle Miles Traveled			Onsite Idling (hr)			
			2021	2022	2023		2021	2022	2023	2021	2022	2023	
GOVERNMENT FLEET VEHICLES													
Passenger Truck	GASOLINE	-	-	-	-	320	-	2016	-	-	160	-	ONROAD
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION													
Excavator	DIESEL	1200	200	-	-	-	-	-	-	-	-	-	NONROAD
Flat Bed Truck	DIESEL	280	-	-	-	200	4240	-	-	200	-	-	ONROAD
Tugboat & Auxiliary Generator (2)	DIESEL	1341/134	1600	-	-	-	-	-	-	-	-	-	PORT
Twin Engine Large Dive Boat	DIESEL	330	280	280	-	-	-	-	-	-	-	-	NONROAD
Twin Engine Medium Dive Boat	DIESEL	250	140	448	448	-	-	-	-	-	-	-	NONROAD
INSTALLATION													
Air Compressors	GASOLINE	50 < hp <= 75	-	407	-	-	-	-	-	-	-	-	NONROAD
Crane	DIESEL	175 < hp <= 300	-	648	-	-	-	-	-	-	-	-	NONROAD
Generator Sets	DIESEL	40 < hp <= 50	-	780	-	-	-	-	-	-	-	-	NONROAD
Other General Industrial Eqp	GASOLINE	50 < hp <= 75	-	40	-	-	-	-	-	-	-	-	NONROAD
Outboard	GASOLINE	175 < hp <= 300	-	220	-	-	-	-	-	-	-	-	NONROAD
Passenger Truck	GASOLINE	-	-	3200	-	160	-	80000	-	-	80	-	ONROAD
Pumps	GASOLINE	100 < hp <= 175	-	116	-	-	-	-	-	-	-	-	NONROAD
Tractors/Loaders/Backhoes	DIESEL	175 < hp <= 300	-	120	-	-	-	-	-	-	-	-	NONROAD
Tugboat & Auxiliary Generator	DIESEL	1341/134	-	658	-	-	-	-	-	-	-	-	PORT
Twin Engine Medium Dive Boat	DIESEL	250	-	104	-	-	-	-	-	-	-	-	NONROAD
Tugboat & Auxiliary Generator (Ocean Disposal)	DIESEL	1000	-	8	-	-	-	-	-	-	-	-	PORT

UEMMS Emissions - Pref Alt Base Ocean Disposal 2021-08-20.xlsx

Appendix A-2
Air Quality Methodology and Calculations
Concrete Block Mat Alternative

Equipment	Category	CO Emission Factor 2021	CO Emission Factor 2022	CO Emission Factor 2023	units	CO Emissions (lb/yr) 2021	CO Emissions (lb/yr) 2022	CO Emissions (lb/yr) 2023	CO	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	8.05	-	g/hr	-	47.67	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	3.95	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	16.44	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	404.63	-	-	g/hr	178.41	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	13.90	-	-	g/hr	30.45	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	1.87	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	7.77	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	1.61	-	-	g/kWh	1544.29	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	138.70	138.19	-	g/hr	171.24	170.61	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	79.94	79.64	79.34	g/hr	49.35	157.32	156.73	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	441.66	-	g/hr	-	470.30	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	15.93	-	g/hr	-	25.57	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	17.15	-	g/hr	-	34.03	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	554.04	-	g/hr	-	48.86	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	3681.34	-	g/hr	-	2029.00	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	8.05	-	g/hr	-	1156.98	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	3.95	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	16.44	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	2305.84	-	g/hr	-	589.69	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	41.38	-	g/hr	-	10.95	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	1.61	-	g/kWh	-	702.65	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	79.64	-	g/hr	-	36.52	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	1.61	-	g/kWh	-	5.76	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		1973.74	5485.91	156.73		
				TOTAL (tpy)		0.99	2.74	0.08		

NOTES:

[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-2

Year	Emissions (tpy) CO	NOx	PM10	PM2.5	SO2	VOC	CO2	CH4	N2O	CO2e
2021	0.99	6.10	0.15	0.15	0.004	0.20	513.90	0.01	0.02	519.60
2022	2.74	3.39	0.10	0.09	0.003	1.21	401.48	0.02	0.009	404.59
2023	0.08	0.36	0.008	0.008	0.0004	0.02	40.90	0.001	0	40.93

UEMMS Emissions - Concrete Block Mat Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	PM10 Emission Factor 2021	2022	2023	units	PM10 Emissions (lb/yr) 2021	2022	2023	PM10	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.40	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.08	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	67.52	-	-	g/hr	29.77	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.39	-	-	g/hr	6.37	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.52	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.26	-	-	g/kWh	247.93	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	14.02	13.76	-	g/hr	17.31	16.99	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.57	8.46	8.34	g/hr	5.29	16.71	16.48	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	2.34	-	g/hr	-	2.49	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	3.02	-	g/hr	-	4.85	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	3.34	-	g/hr	-	6.63	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	3.42	-	g/hr	-	0.30	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	7.05	-	g/hr	-	3.89	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	22.00	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.08	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	5.38	-	g/hr	-	1.38	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	8.01	-	g/hr	-	2.12	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.26	-	g/kWh	-	112.81	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	8.46	-	g/hr	-	3.88	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.26	-	g/kWh	-	0.92	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	306.67	195.37	16.48		
					TOTAL (tpy)	0.15	0.10	0.01		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-2

Equipment	Category	NOx Emission Factor 2021	2022	2023	units	NOx Emissions (lb/yr) 2021	2022	2023	NOx	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.81	-	g/hr	-	2.80	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.24	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.86	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	2825.57	-	-	g/hr	1245.87	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	31.30	-	-	g/hr	52.65	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	4.07	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.92	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	10.28	-	-	g/kWh	9845.80	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	669.85	652.53	-	g/hr	826.99	805.61	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	381.77	371.50	361.55	g/hr	235.66	733.84	714.19	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	39.07	-	g/hr	-	41.60	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	68.53	-	g/hr	-	109.99	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	64.84	-	g/hr	-	128.66	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	54.02	-	g/hr	-	4.76	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	221.85	-	g/hr	-	122.27	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.81	-	g/hr	-	69.51	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.24	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.86	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	216.74	-	g/hr	-	55.43	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	87.36	-	g/hr	-	23.11	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	10.28	-	g/kWh	-	4479.84	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	371.50	-	g/hr	-	170.36	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	10.28	-	g/kWh	-	36.71	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	12206.97	6784.50	714.19		
					TOTAL (tpy)	6.10	3.39	0.36		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

UEMMS Emissions - Concrete Block Mat Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	SO2 Emission Factor 2021	2022	2023	units	SO2 Emissions (lb/yr) 2021	2022	2023	SO2	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.03	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.002	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	4.03	-	-	g/hr	1.78	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.07	-	-	g/hr	0.14	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.01	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.003	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.01	-	-	g/kWh	5.98	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	0.66	0.66	-	g/hr	0.82	0.82	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	0.38	0.38	0.38	g/hr	0.23	0.75	0.75	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	0.14	-	g/hr	-	0.15	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.61	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	0.09	-	g/hr	-	0.17	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	0.21	-	g/hr	-	0.02	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	0.24	-	g/hr	-	0.13	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.86	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.003	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.002	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	0.35	-	g/hr	-	0.09	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	0.20	-	g/hr	-	0.05	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	2.72	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	0.38	-	g/hr	-	0.17	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	0.02	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		8.95	6.59	0.75		
				TOTAL (tpy)		0.004	0.003	0.0004		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-2

Equipment	Category	PM2.5 Emission Factor 2021	2022	2023	units	PM2.5 Emissions (lb/yr) 2021	2022	2023	PM2.5	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.09	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.01	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	65.49	-	-	g/hr	28.88	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.12	-	-	g/hr	4.23	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.30	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.25	-	-	g/kWh	240.49	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	13.60	13.35	-	g/hr	16.79	16.48	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.31	8.21	8.09	g/hr	5.13	16.21	15.98	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	2.15	-	g/hr	-	2.29	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	2.93	-	g/hr	-	4.70	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	3.24	-	g/hr	-	6.43	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	3.15	-	g/hr	-	0.28	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	6.49	-	g/hr	-	3.58	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	4.04	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.01	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.01	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	4.95	-	g/hr	-	1.27	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	7.77	-	g/hr	-	2.06	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.25	-	g/kWh	-	109.42	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	8.21	-	g/hr	-	3.76	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.25	-	g/kWh	-	0.90	-	PORT	Harbor Tug (Tier 0)
				TOTAL (lb/yr)		295.52	171.50	15.98		
				TOTAL (tpy)		0.15	0.09	0.01		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

UEMMS Emissions - Concrete Block Mat Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	CO2 Emission Factor 2021	2022	2023	units	CO2 Emissions (lb/yr) 2021	2022	2023	CO2	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	3729.82	-	g/hr	-	3945.26	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	443.36	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	227.45	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	559715.32	-	-	g/hr	246793.50	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	8219.75	-	-	g/hr	16101.61	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	1306.98	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	294.92	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	679.47	-	-	g/kWh	650674.68	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	71826.75	71825.50	-	g/hr	88676.96	88675.41	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	41409.43	41409.53	41409.54	g/hr	25561.94	81798.41	81798.43	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	23819.19	-	g/hr	-	25363.58	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	54265.99	-	g/hr	-	87095.48	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	11458.63	-	g/hr	-	22735.89	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	34826.20	-	g/hr	-	3071.16	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	39930.23	-	g/hr	-	22007.89	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	3729.82	-	g/hr	-	129183.68	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	443.36	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	227.45	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	57357.79	-	g/hr	-	14668.54	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	26276.03	-	g/hr	-	6951.48	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	679.47	-	g/kWh	-	296056.98	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	41409.53	-	g/hr	-	18988.92	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	679.47	-	g/kWh	-	2426.22	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	1027808.69	802968.90	81798.43		
					TOTAL (tpy)	513.90	401.48	40.90		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Extended Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Processes;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Appendix A-2

Equipment	Category	VOC Emission Factor 2021	2022	2023	units	VOC Emissions (lb/yr) 2021	2022	2023	VOC	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	1.30	-	g/hr	-	3.87	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.17	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	1.65	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	93.15	-	-	g/hr	41.07	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	6.81	-	-	g/hr	8.64	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.60	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.30	-	-	g/kWh	283.09	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	42.12	42.58	-	g/hr	52.00	52.57	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	19.73	19.73	19.73	g/hr	12.18	38.98	38.97	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	29.80	-	g/hr	-	31.73	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	4.35	-	g/hr	-	6.99	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	4.54	-	g/hr	-	9.01	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	36.28	-	g/hr	-	3.20	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	3694.12	-	g/hr	-	2036.05	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	1.30	-	g/hr	-	50.24	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.17	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	1.65	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	146.68	-	g/hr	-	37.51	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	13.55	-	g/hr	-	3.58	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.30	-	g/kWh	-	128.80	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	19.73	-	g/hr	-	9.05	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.30	-	g/kWh	-	1.06	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	396.98	2412.65	38.97		
					TOTAL (tpy)	0.20	1.21	0.02		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

UEMMS Emissions - Concrete Block Mat Alt Base Ocean Disposal 2021-08-20.xlsx

Equipment	Category	N2O Emission Factor 2021	2022	2023	units	N2O Emissions (lb/yr) 2021	2022	2023	N2O	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.00	-	g/hr	-	0.07	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.00	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.05	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	-	-	-	-	-	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.00	-	-	g/hr	0.00	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.00	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.01	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.04	-	-	g/kWh	37.05	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	-	-	-	-	-	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	-	-	-	-	-	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	-	-	-	-	-	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.00	-	g/hr	-	0.04	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.00	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.05	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	-	-	-	-	-	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.04	-	g/kWh	-	16.86	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	-	-	-	-	-	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.04	-	g/kWh	-	0.14	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	37.05	17.11	0.00		
					TOTAL (tpy)	0.02	0.01	0.00		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; All Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Eqn 4.3, g/kWh) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Category	CH4 Emission Factor 2021	2022	2023	units	CH4 Emissions (lb/yr) 2021	2022	2023	CH4	
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	0.15	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.004	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.08	-	g/start				ONROAD	Passenger Truck - start
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	7.17	-	-	g/hr	3.16	-	-	NONROAD	Excavators (1200 < hp <= 2000)
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.56	-	-	g/hr	0.78	-	-	ONROAD	Single Unit Short-Haul Truck - idle
	Single Unit Short-Haul Truck - 25 mph[1]	0.05	-	-	g/mi				ONROAD	Single Unit Short-Haul Truck - 25 mph
	Single Unit Short-Haul Truck - start[1]	0.03	-	-	g/start				ONROAD	Single Unit Short-Haul Truck - start
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.01	-	-	g/kWh	5.38	-	-	PORT	Harbor Tug (Tier 0)
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	2.85	3.02	-	g/hr	3.52	3.73	-	NONROAD	Inboard/Sterndrive (300 < hp <= 600)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	1.24	1.32	1.38	g/hr	0.77	2.60	2.74	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
INSTALLATION										
Air Compressors	Air Compressors (50 < hp <= 75)[2]	-	1.86	-	g/hr	-	1.98	-	NONROAD	Air Compressors (50 < hp <= 75)
Crane	Cranes (175 < hp <= 300)[2]	-	0.39	-	g/hr	-	0.63	-	NONROAD	Cranes (175 < hp <= 300)
Generator Sets	Generator Sets (40 < hp <= 50)[2]	-	0.32	-	g/hr	-	0.63	-	NONROAD	Generator Sets (40 < hp <= 50)
Other General Industrial Eqp	Other General Industrial Eqp (50 < hp <= 75)[2]	-	2.30	-	g/hr	-	0.20	-	NONROAD	Other General Industrial Eqp (50 < hp <= 75)
Outboard	Outboard (175 < hp <= 300)[2]	-	49.00	-	g/hr	-	27.01	-	NONROAD	Outboard (175 < hp <= 300)
Passenger Truck	Passenger Truck - idle[1]	-	0.02	-	g/hr	-	1.23	-	ONROAD	Passenger Truck - idle
	Passenger Truck - 25 mph[1]	-	0.004	-	g/mi				ONROAD	Passenger Truck - 25 mph
	Passenger Truck - start[1]	-	0.08	-	g/start				ONROAD	Passenger Truck - start
Pumps	Pumps (100 < hp <= 175)[2]	-	13.17	-	g/hr	-	3.37	-	NONROAD	Pumps (100 < hp <= 175)
Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes (175 < hp <= 300)[2]	-	0.67	-	g/hr	-	0.18	-	NONROAD	Tractors/Loaders/Backhoes (175 < hp <= 300)
Tugboat & Auxiliary Generator	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	2.45	-	PORT	Harbor Tug (Tier 0)
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	1.32	-	g/hr	-	0.60	-	NONROAD	Inboard/Sterndrive (175 < hp <= 300)
Tugboat & Auxiliary (Ocean Disposal)	Harbor Tug (Tier 0)[3]	-	0.01	-	g/kWh	-	0.02	-	PORT	Harbor Tug (Tier 0)
					TOTAL (lb/yr)	13.61	44.76	2.74		
					TOTAL (tpy)	0.01	0.02	0.001		

NOTES:
[1] Onroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; January, Hour 08:00-08:59, Weekdays; Virgin Islands St. Thomas; Rural Unrestricted Access, Off-Network; Non-Idle Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb);
Running (25 mph) Emissions (lb/yr) = Emission Factor (g/mi) x activity (mi/yr)]/(453.59 g/lb);
Start Emissions (lb/yr) = Emission Factor (g/start) x 2 starts/trips x activity (trips/yr)]/(453.59 g/lb); trips/yr = annual VMT/project total VMT.

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas except Honolulu Hawaii for Other General Industrial Eqp; Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, September 2020;
Emissions (lb/yr) = # equipment x [Emission Factor (Table H.7 VOC, g/kWh; 4.5.4 ratios of VOC (1.053) and CH4 (0.02) to HC)) x # engines x load factor (Table 4-4) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Nonroad	Onroad	Port-Related
Air Compressors (50 < hp <= 75)	Passenger Truck - 25 mph	Harbor Tug (Tier 0)
Cranes (175 < hp <= 300)	Passenger Truck - idle	
Generator Sets (40 < hp <= 50)	Passenger Truck - start	
Other General Industrial Eqp (50 < hp <= 75)	Single Unit Short-Haul Truck - 25 mph	
Outboard (175 < hp <= 300)	Single Unit Short-Haul Truck - idle	
Pumps (100 < hp <= 175)	Single Unit Short-Haul Truck - start	
Tractors/Loaders/Backhoes (175 < hp <= 300)		

Appendix A-2

Equipment	Fuel	hp	Operating Hours			No. of Trips	Vehicle Miles Traveled (mi)			Onsite Idling (hr)			
			2021	2022	2023		2021	2022	2023	2021	2022	2023	
GOVERNMENT FLEET VEHICLES													
Passenger Truck	GASOLINE	-	-	-	-	350	-	2205	-	-	175	-	ONROAD
CORAL TRANSLOCATION AND HABITAT RESTORATION/STABILIZATION													
Excavator	DIESEL	1200	200	-	-	-	-	-	-	-	-	-	NONROAD
Flat Bed Truck	DIESEL	280	-	-	-	200	4240	-	-	200	-	-	ONROAD
Tugboat & Auxiliary Generator (2)	DIESEL	1341/134	1600	-	-	-	-	-	-	-	-	-	PORT
Twin Engine Large Dive Boat	DIESEL	330	280	280	-	-	-	-	-	-	-	-	NONROAD
Twin Engine Medium Dive Boat	DIESEL	250	140	448	448	-	-	-	-	-	-	-	NONROAD
INSTALLATION													
Air Compressors	GASOLINE	50 < hp <= 75	-	483	-	-	-	-	-	-	-	-	NONROAD
Crane	DIESEL	175 < hp <= 300	-	728	-	-	-	-	-	-	-	-	NONROAD
Generator Sets	DIESEL	40 < hp <= 50	-	900	-	-	-	-	-	-	-	-	NONROAD
Other General Industrial Eqp	GASOLINE	50 < hp <= 75	-	40	-	-	-	-	-	-	-	-	NONROAD
Outboard	GASOLINE	175 < hp <= 300	-	250	-	-	-	-	-	-	-	-	NONROAD
Passenger Truck	GASOLINE	-	-	5250	-	175	-	131,250	-	-	88	-	ONROAD
Pumps	GASOLINE	100 < hp <= 175	-	116	-	-	-	-	-	-	-	-	NONROAD
Tractors/Loaders/Backhoes	DIESEL	175 < hp <= 300	-	120	-	-	-	-	-	-	-	-	NONROAD
Tugboat & Auxiliary Generator	DIESEL	1341/134	-	728	-	-	-	-	-	-	-	-	PORT
Twin Engine Medium Dive Boat	DIESEL	250	-	104	-	-	-	-	-	-	-	-	NONROAD
Tugboat & Auxiliary Generator (Ocean Disposal)	DIESEL	1000	-	8	-	-	-	-	-	-	-	-	PORT

UEMMS Emissions - Concrete Block Mat Alt Base Ocean Disposal 2021-08-20.xlsx

Appendix B
National Historic Preservation Act Section 106 Documentation

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0490
June 6, 2019

L.B. Aguon
State Historic Preservation Officer
Department of Parks and Recreation
490 Chalan Palasyo
Agaña Heights, Guam 96910

Dear Ms. Aguon,

Subject: CONSTRUCTION OF UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM AT APRA HARBOR, NAVAL BASE GUAM, MARIANAS ISLANDS

Pursuant to Section 106 of the National Historic Preservation Act (NHPA), Navy Base Guam (NBG) requests your review of the proposed project to construct and operate an Underwater Electromagnetic Measuring System (UEMMS) in Outer Apra Harbor, Guam (Enclosures 1 and 2). In accordance with Section 106 of the NHPA, we have reviewed the proposed project scope and determined that it is an undertaking as defined by 36 CFR 800.16 (y).

PROJECT DESCRIPTION

The proposed project is to establish a UEMMS in Outer Apra Harbor to measure the electromagnetic signatures and electric fields of surface ships and submarines (Enclosure 3). The UEMMS would consist of an array of 20 magnetic and electrical field sensors that would be installed underwater within the navigational channel (leading to Inner Apra Harbor). A cable would connect from the sensor array to an existing onshore facility to gather and store measured data. This project would enable NBG to support the calibration process which ensures that ships and submarines are in compliance with electromagnetic signatures limits to perform their existing mission and ongoing military operations.

The sensors would be installed in a single line arranged perpendicular to, and extending approximately 200 feet on either side of, the navigational channel center line. The sensors are 20 feet long and would be encased inside 10-inch diameter fiberglass tubes spaced about 20 feet apart, and buried approximately four feet deep below the existing ocean floor depth at -48 to -55 feet mean low water (MLW) (Enclosure 4). The excavation footprint for the sensor array will encompass a rectangular area approximately 20 feet wide by 400 feet long and 10-12 feet deep (excavation depth of up to -72 feet MLW). Sensor cables from the array will use a "deep water" route to connect to onshore facilities at Polaris Point with a transition vault to be constructed along the shoreline. The sensor cables would then connect

to data acquisition equipment in the [redacted] with data cables routed subsurface to the [redacted] for data transfer (see Enclosure 3).

AREA OF POTENTIAL EFFECT

The Area of Potential Effect (APE) includes underwater and terrestrial components. The underwater locations include the site of the sensor array within the navigational channel and the routing of the sensor cable from the array to the onshore facilities at Polaris Point. The APE took into consideration multiple variables that have the potential to affect historic properties including the direct effects from construction, as well as visual and auditory effects.

IDENTIFICATION OF HISTORIC PROPERTIES

Archaeology

There are no known archaeological resources identified either underwater or terrestrially. The onshore route of the data cable is within an area that has been determined to have no potential for archaeological resources (SEARCH 2015). Polaris Point is an artificial land segment constructed of dredged fill material from Apra Harbor during the late 1940s (Helgesson 1964). There is no integrity to these sediments and therefore no possibility of Pre-Contact or WWII sites. Hence, there are no concerns in terms of archaeological resources being present in the vicinity of the terrestrial portion of the project area above or below the ground surface (Enclosure 3).

Built Environment

Equipment used for the UEMMS operation would be installed within Buildings [redacted]. Neither of the facilities or the structures along the route of the cabling are eligible for inclusion on the National Register of Historic Places (Mason Architects 2009).

Underwater Archaeology

Although no known ship wrecks are within the area of the sensor array, or the route of the cabling, a magnetic survey of these areas was conducted to determine if any were present. No large magnetic return signals were observed within 200 feet of the navigation range with most detected features being debris (Ocean Surveys 2009). Although anomalies were located within the area of the sensor array, this is also within the navigational channel, which is dredged when necessary (Enclosure 5).

DETERMINATION OF EFFECT

In consideration of the above information, the Navy has made the determination of "No Historic Properties Affected" for the proposed project. In the unlikely event that any historic items are inadvertently discovered during activities associated with this project, the Standard Operating Procedures contained within the Final

Subject: CONSTRUCTION OF UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM AT APRA HARBOR, NAVAL BASE GUAM, MARIANAS ISLANDS

Integrated Cultural Resources Management Plan, Naval Base Guam, Joint Region Marianas (SEARCH 2015) will be followed as well as provisions of 36 CFR 800.13 Post-Review Discoveries.

We request your review and concurrence with our determination of effect within 30 days of receipt of this letter. We value your support of our efforts in continuing to carry out the United States Department of the Navy's responsibility in regards to the management of cultural resources located in its areas of operation.

Should you have any questions regarding this undertaking, please contact Mr. Lon Bulgrin at (671) 339-2093 or by email at lon.bulgrin@fe.navy.mil, or Mr. Jeffrey Fong at (808) 472-1383 or by email at jeffrey.fong@navy.mil.

Sincerely,

Ed Moon

E.E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosures: 1. UEMMS Project Location Map 1 (Aerial Photo)
2. UEMMS Project Location Map 2 (USGS Map)
3. UEMMS Site Plan
4. UEMMS Plan and Profile for Sensor Array
5. Magnetic Survey Results showing anomaly detection

Subject: CONSTRUCTION OF UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM AT APRA HARBOR, NAVAL BASE GUAM, MARIANAS ISLANDS

REFERENCES

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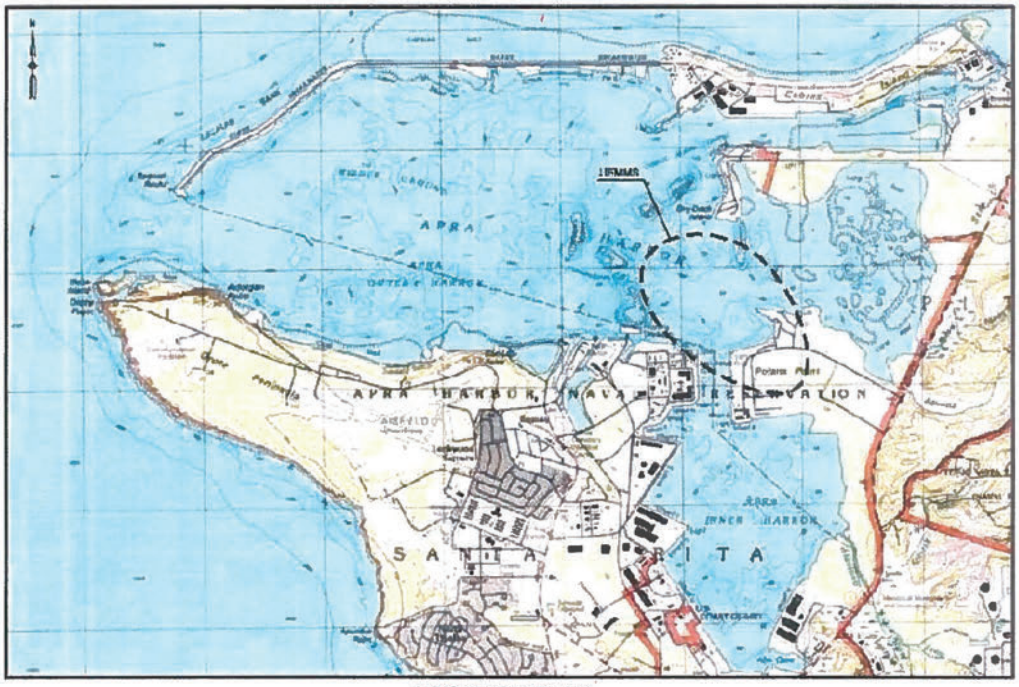
Mason Architects, Inc.
2010 *Cold War Historic Context and Architectural Inventory for Naval Base Guam: Main Base, Piti Power Station, Drydock Island and Polaris Point*. Prepared for Department of the Navy, Naval Facilities Engineering Command, Pacific and Commander Navy Region Marianas. Honolulu, HI.

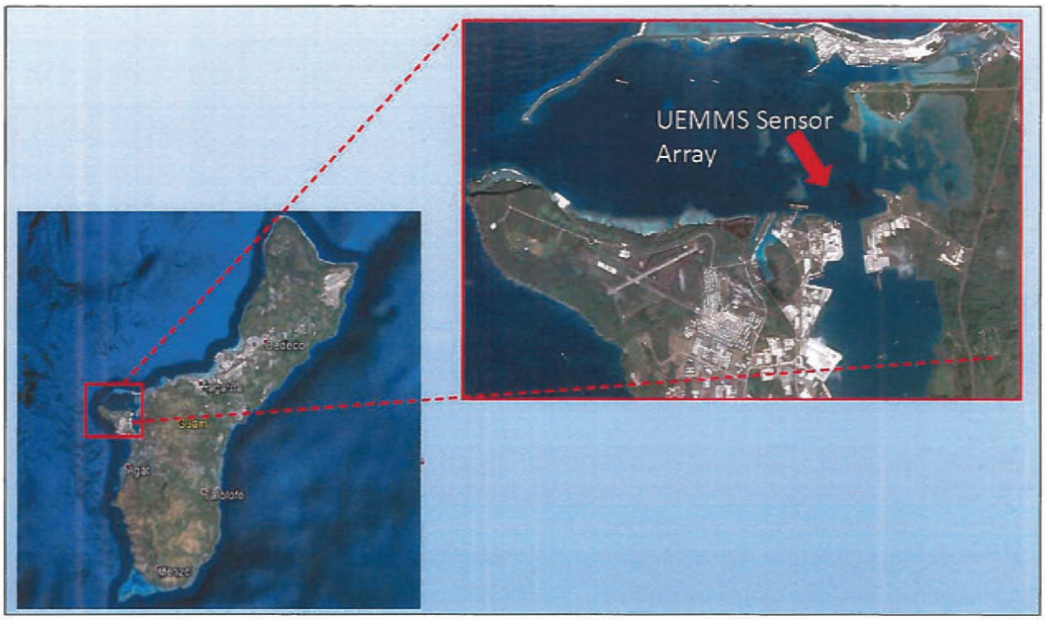
Ocean Surveys, Inc.
2009 *Final Report: Geophysical Survey Proposed Magnetic Measurement Range, Apra Harbor, Guam. OSI Report No. 08ES086*. Prepared for EG&G Technical Services, Inc. and Naval Sea Systems Command. Old Saybrook, CT.

Southeastern Archaeological Research, Inc. (SEARCH)
2015 *Final Integrated Cultural Resources Management Plan Naval Base Guam, Joint Region Marianas*. Prepared for Naval Facilities Engineering Command, Marianas

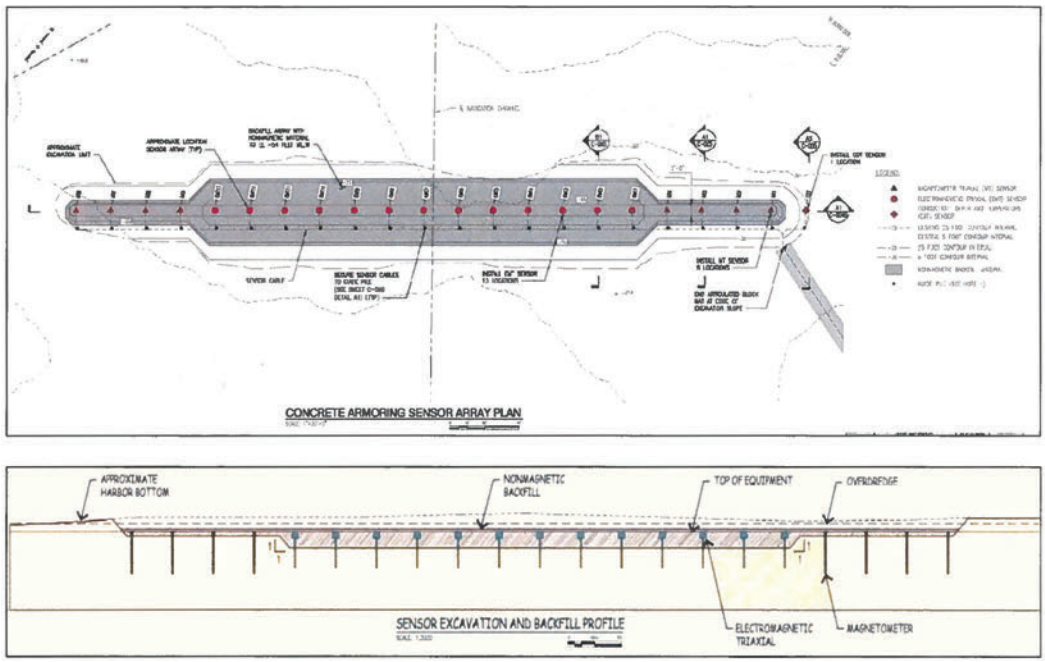


LOCATION PLAN
NOT TO SCALE

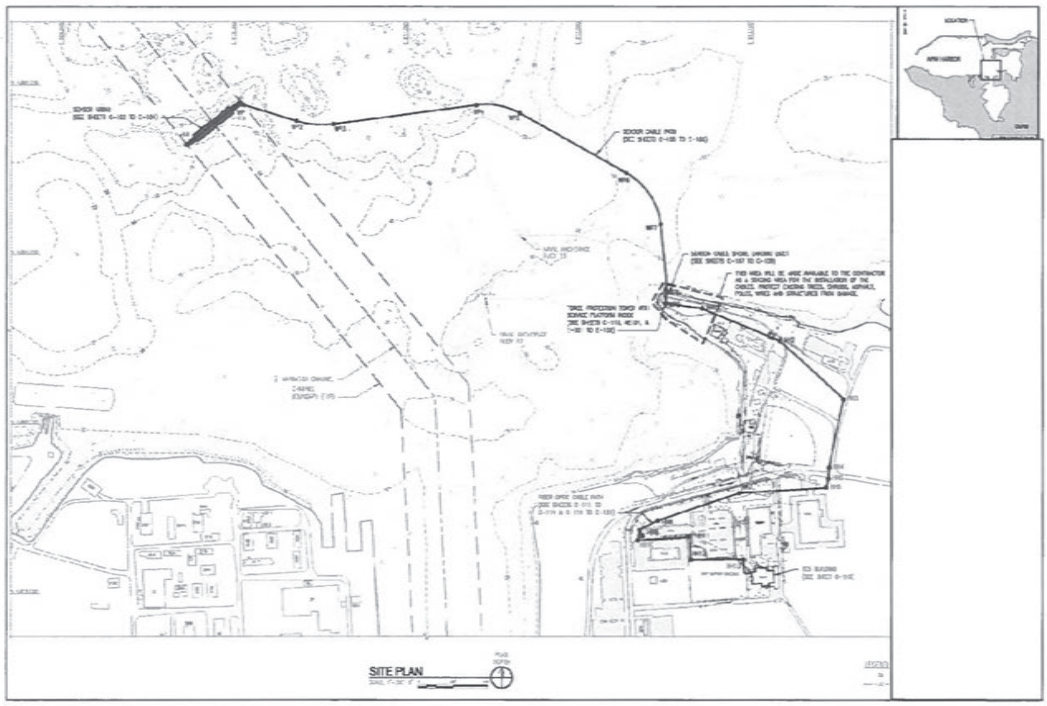
Enclosure 2. UEMMS Project Location Map 2 - USGS Map.



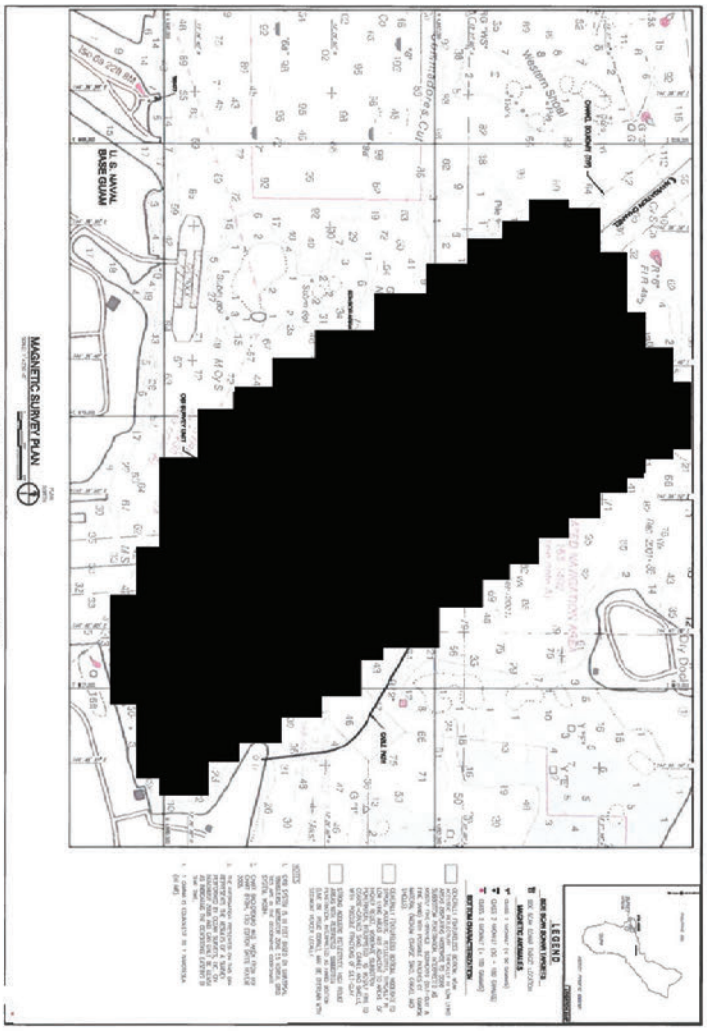
Enclosure 1. UEMMS Project Location Map 1 - Aerial Photo.



Enclosure 4. UEMMS Sensor Array Plan and Profile drawings.



Enclosure 3. UEMMS Site Plan.



Enclosure 5. Magnetic Survey Results showing anomaly detection (Ocean Survey 2009).

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Lourdes A. Leon Guerrero
Governor
Joshua F. Tenorio
Lt. Governor

Richard Y. Ybanez
Acting Director
Victor R. Villagomez
Deputy Director

In reply refer to:
RC2019-0180

July 5, 2019

E.E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer
Department of the Navy
U.S. Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000

Subject: Section 106 Review of:
Construction of Underwater Electromagnetic Measuring System at Apra Harbor, Naval Base Guam, Mariana Islands
5090 Ser EV/0490 June 6, 2019

Dear Mr. Moon:

We have reviewed the subject Section 106 undertaking and concur with the Navy's determination of "No Historic Properties Affected." The Navy proposes to construct and operate an Underwater Electromagnetic Measuring System (UEMMS) in outer and inner Apra Harbor Area of Potential Effect (APE), which includes the site of the sensor array within the navigational channel, and the routing of the sensor cable from the array to the onshore facilities at Polaris Point, to Buildings [redacted] and [redacted]

In the event that historic properties are discovered during activities within outer-inner Apra Harbor and Onshore APE, associated with the subject undertaking, the Standard Operation Procedures of the Final ICRMP, Naval Base Guam, Joint Region Marianas, as well as the 36 CFR Sec.800.13 Post-review discoveries, will be followed.

Should you have any questions or need clarification, please do not hesitate to contact Mr. Jose (Joe) Garrido at 475-6292 or Mr. John Mark Joseph at 475-6339.

Sincerely,

Richard Y. Ybanez
Acting Director

Patrick Q. Lujan
Acting State Historic Preservation Officer

Cc: Lon Bulgrin, CRM, NAVFAC Marianas
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Appendix C
Endangered Species Act and Essential Fish Habitat Consultation Documentation

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/ 0422
June 15, 2021

Mr. Michael Tosatto
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Bldg. 176
Honolulu, HI 96818

Dear Mr. Tosatto,

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Pursuant to section 7(a)(2) of the *Endangered Species Act of 1973* (ESA), as amended (16 USC§ 153 et seq.), the U.S. Navy (Navy) requests informal consultation with the National Marine Fisheries Service regarding the proposed construction of an Underwater Electromagnetic Measuring System (UEMMS) at Outer Apra Harbor, Guam. As described in the enclosed consultation document, the proposed action may affect but is not likely to adversely affect the following ESA-listed species: the threatened green sea turtle (*Chelonia mydas*), the endangered hawksbill sea turtle (*Eretmochelys imbricata*) and the threatened scalloped hammerhead shark (*Sphyrna lewini*). We request your concurrence with our 'not likely to adversely affect' determinations, and hereby request informal consultation under Section 7 of the ESA.

This letter also requests your review and conservation recommendations to fulfill the Navy's requirements to consider the impacts of its actions on Essential Fish Habitat (EFH) as required by the *Magnuson-Stevens Fishery Conservation and Management Act* (16 USC§ 1801 et seq.).

In brief, the Navy proposes to construct and operate a UEMMS to service Navy surface ships and submarines homeported, forward-deployed or visiting Naval Base Guam. The Proposed Action includes both in-water and shore-side infrastructure to passively measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a vessel's susceptibility to certain seaborne-influenced mines. The action will permanently alter seafloor habitat in the Outer Apra Harbor navigation channel through the installation of a passive 22-sensor array with associated power and data cables connecting ashore at Polaris Point. The Project is anticipated to begin operations in 2022 for Navy ships and submarines deployed to the region, and the installation will not operationally increase vessel traffic within the harbor. The in-water actions will be undertaken in daylight hours only and will require approximately 10 months to complete.

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Regarding ESA-listed species:
Potential impacts to ESA-listed species may occur from exposure to the following stressors: disturbance from human activity and equipment operation; elevated underwater noise levels; increased suspended sediments; direct physical contact; vessel collisions; waste and discharge; and entanglement. Based on the best available data, environmental impact analysis, and the implementation of best management practices (BMPs) described in enclosure, the Navy determined that these potential impacts are discountable or insignificant to ESA-listed species. The Navy requests your concurrence with our determination that the proposed Action may affect but is not likely to adversely affect the ESA-listed species above.

Regarding EFH:
The Navy has determined that the proposed Action will adversely affect the quality and quantity of EFH at the sensor array site and cable path, but most of the effects will be managed and minimized with the incorporation of BMPs. Potential adverse effects that are likely to occur to EFH are based on exposure to the following stressors: physical removal; increased suspended sediments; elevated underwater noise levels; waste and discharge; aquatic invasive species; chemical contaminants; and hypoxia. Removal of the marine invertebrate community in the Action Area will be permanent, and the Navy is proposing avoidance, minimization, and offset mitigation measures to compensate for the unavoidable loss of ecosystem functions and services. The remaining effects will primarily be temporary, restricted to the Action Area, and rendered minimal by the implementation of BMPs.

Thank you for your consideration of our request for your review and concurrence. Should you have any questions or concerns, please contact is Kevin Lino at NAVFAC Pacific at (808) 472-1087 or kevin.lino@navy.mil.

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By direction of the Commanding Officer

Enclosure: 1. Endangered Species and Essential Fish Habitat Assessment: Consultation for the Underwater Electromagnetic Measuring System Apra Harbor, U.S. Naval Base Guam

Endangered Species and Essential Fish Habitat Assessment:

Consultation for the Underwater Electromagnetic Measuring System (UEMMS)

Apra Harbor, U.S. Naval Base Guam

Prepared by

Naval Facilities Engineering Command Pacific

and AECOS Inc.

Prepared for:

National Oceanic and Atmospheric Administration

Inouye Regional Center

1845 Wasp Blvd., Building 176

Honolulu, HI 96818

June 2021

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4. Acronym List

ABR	auditory brainstem response
AEP	auditory evoked potentials
AIS	aquatic invasive species
BMP	best management practice
BML	below the mud line
BMUS	Bottomfish Management Unit Species
CCC	Criteria Continuous Concentration
cm	centimeters
CMC	Criteria Maximum Concentration
CPCe	Coral Point Count with Excel extensions
CTD	conductivity, temperature and depth (pressure)
CY	cubic yards
dB	decibel
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EMT	electromagnetic triaxial
ESA	Endangered Species Act of 1973
ERDC	Engineer Research and Development Center
FEP	Fishery Ecosystem Plan
FRP	fiberglass reinforced plastic
ft	feet
[redacted]	[redacted]
G-DODS	Guam Deep Ocean Disposal Site
GPS	Global Positioning System
GWQS	Guam Water Quality Standards
ha	hectares
HAPC	Habitat Areas of Particular Concern
HCD	Habitat Conservation Division
HDPE	high-density polyethylene
HTL	high tide line
Hz	Hertz
IFKW	Insular False Killer Whale
in	inches
INRMP	Integrated Natural Resources Management Plan
kHz	kilohertz
LPI	Line Point-Intercept
m	meter
MEC	munitions and explosions of concern
mi	mile

MHI	main Hawaiian Islands
MLLW	Mean Lower Low Water
MPPEH	material potentially presenting an explosive hazard
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MT	magnetometer triaxial
MUS	management unit species
NBG	Naval Base Guam
NAVFAC	Naval Facilities Engineering Command
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Unit
OPNAVINST	Office of the Chief of Naval Operations Instruction
PCB	polychlorinated biphenyls
PAH	polyaromatic hydrocarbons
PMUS	Pelagic Management Unit Species
PRD	Protected Resources Division
PTS	permanent threshold shift
PTM	Partical Tracking Model
µPa	micro Pascal
SSC	suspended sediment concentration
SPL	sound pressure level
SPL_{RMS}	sound pressure level root mean square
SWPPP	Storm Water Pollution Prevention Plan
[redacted]	[redacted]
TTS	temporary threshold shift
TSS	total suspended solids
US	United States
USACE	US Army Corp of Engineers
USEPA	U.S. Environmental Protection Agency
USFDA	U.S. Food and Drug Administration
UEMMS	underwater electromagnetic measuring ranging system
UXO	unexploded ordnances
WPRFMC	Western Pacific Regional Fishery Management Council

1. Introduction

Naval Base Guam (NBG), a Command of the United States (U.S.) Navy (hereinafter, jointly referred to as the Navy) proposes to construct and operate an underwater electromagnetic measuring ranging system (UEMMS; the "Project" or "Proposed Action") in Outer Apra Harbor, Guam. The UEMMS will passively measure magnetic and electric field signatures of surface ships and submarines. The purpose of and need for the UEMMS are to provide the Navy with the capability in the Pacific area of responsibility (AOR) to ensure homeported and forward-deployed vessels meet the magnetic signature limits specified in Office of the Chief of Naval Operations Instruction (OPNAVINST) S8950.2H.

The purpose of this consultation is: 1) to address the potential effects of the Project on listed endangered or threatened species and designated critical habitat of listed species under the *Endangered Species Act* (ESA); and 2) to evaluate potential impacts to Essential Fish Habitat (EFH) in accordance with the *Magnuson-Stevens Fishery Conservation and Management Act* (MSA). The Project has the potential to affect 14 ESA-listed marine species that may occur in the Project Area (Section 2.3). In addition, as defined in the *Fishery Ecosystem Plan for the Mariana Archipelago* (WPRFMC 2009a) and the *Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region* (WPRFMC 2009b) with amendments, the Proposed Action has the potential to affect the EFH for two Management Unit Species (MUS) that are likely to be present at, near to, or dependent on the Action Area: the Bottomfish MUS (BMUS) and the Pelagic MUS (PMUS; Section 2.4).

Early coordination and pre-consultation with the National Marine Fisheries Service (NMFS) occurred during a series of meetings, and phone conversations, including:

- February 2014 - First, Pre-consultation with NMFS Protected Resources Division (PRD) and Habitat Conservation Division (HCD)
- May 2014 - Action Area reports and data discussed with NMFS PRD and HCD
- September 2015 - NMFS HCD led surveys conducted at the project site area
- November 2015 - Benthic habitat survey presentation to NMFS HCD
- November 2015 - Benthic habitat survey report provided by NMFS HCD
- February 2019 - Second, Pre-consultation with NMFS PRD and HCD
- November 2019 - Inter-agency coordination call with US Army Corp of Engineers (USACE) and NMFS PRD and HCD
- January 2020 - Benthic habitat survey methods call with NMFS HCD
- November 2020 - Benthic habitat survey presentation call with NMFS HCD
- December 2020 - Inter-agency coordination call with USACE and NMFS HCD
- January 2021 – Draft consultation review with NMFS HCD
- May 2021 – Draft consultation update review with NMFS HCD

1.1. Description of the Action Area

NBG covers approximately 1,820 hectares (ha; 4,500 acres) on the west-central coast of Guam. It surrounds Apra Harbor and includes all of Orote Peninsula and north up to Sasa Bay, a mangrove swamp. The UEMMS will be installed in the Outer Apra Harbor navigational channel that leads to Inner Apra Harbor (Figure 1). The sensor array will be connected to onshore facilities at Polaris Point via a cable bundle laid on the sea floor.

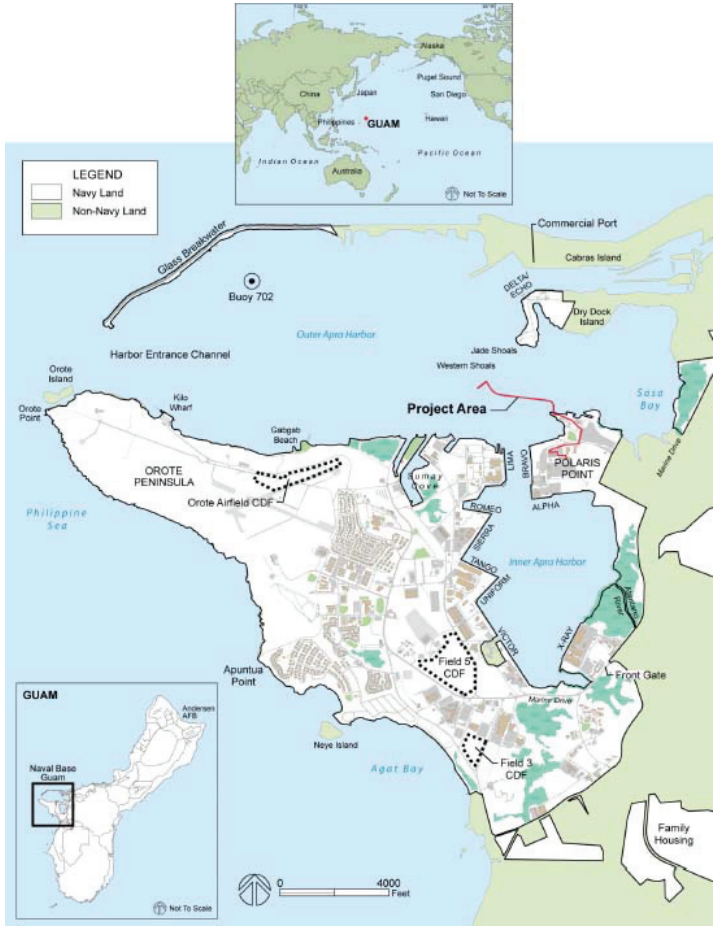


Figure 1. Action Area in Apra Harbor, Guam. Red line depicts the UEMMS array and cable route to shore.

1.2. Description of the Proposed Action

The Navy proposes to construct and operate a UEMMS to service Navy surface ships and submarines homeported, forward-deployed or visiting NBG. The Proposed Action includes both in-water and shore-side infrastructure to passively measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a vessel's susceptibility to certain seaborne-influenced mines. The Project is anticipated to begin operations in 2022 for Navy ships and submarines deployed to the region and the installation will not operationally increase vessel traffic within the harbor.

Electromagnetic triaxial (EMT) sensors, magnetometer triaxial (MT) sensors, and a conductivity, temperature and depth (pressure) (CTD) sensor will be installed in an array on the seafloor of Outer Apra Harbor, approximately [redacted] (m; [redacted] [ft.]) northwest of Polaris Point (Figure 1). To transfer data collected by the sensor array, subsea sensor cables will be routed from the array to a new, below-grade transition vault where the sensor cables will transition into a dry secure junction located onshore at Polaris Point, [redacted]. Once onshore, the cables will connect to the data acquisition equipment located in the [redacted], and the data will be transferred to a single fiber optic cable. The fiber optic cable will follow an existing terrestrial route from the [redacted] to the [redacted] building on Polaris Point, where the system terminates.

The sensor array passively acquires data and will not emit electromagnetic radiation during its operation. Because the UEMMS is a passive system with no mechanical parts, repairs are anticipated to be minimal and would be conducted on an as-needed basis. [redacted]

1.2.1. Passive sensor array: trench excavation and sensor installation

The passive sensor array will be installed in the navigational channel in Outer Apra Harbor perpendicular to and extending approximately 60 m (200 ft.) on either side of the channel centerline. The array will consist of a line of 22 sensors (13 EMT sensors, 8 MT sensors, and 1 CTD sensor). The 13 EMT sensors will be flanked on each side by 4 MT sensors, and the CTD sensor will be installed on the northeast end of the array. The sensors will be spaced approximately 6 m (20 ft.) apart from each other for a total array width of approximately 128 m (420 ft.). The area for the EMT sensors will be at an excavated depth of 16.5 m (54 ft.) below Mean Lower Low Water (MLLW) with 0.3 m (1 ft.) over dredge allowance (17 m [55 ft.] below MLLW). All 22 sensors will have an associated sensor cable guide stake installed perpendicularly 3 m (10 ft.) to the southeast of the sensor positions (Figure 2). The EMT and MT sensors will measure the electric and magnetic field signatures of vessels passing overhead. The CTD sensor will provide real-time measurements of water metrics.

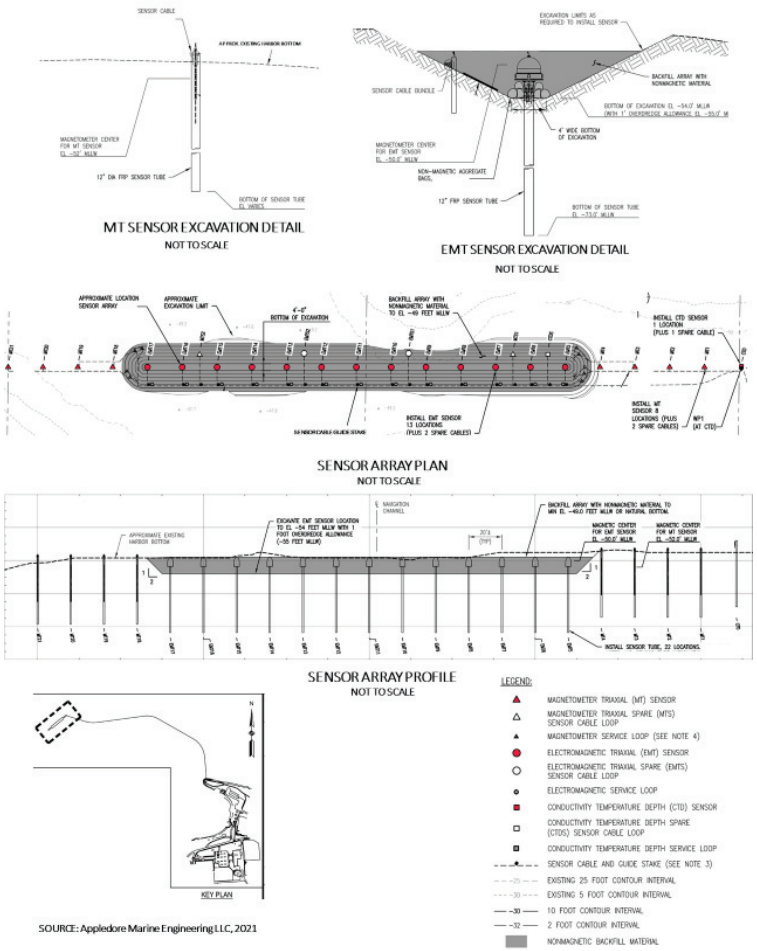


Figure 2. Diagram of underwater instrument array on seafloor.

Figure 3 illustrates the MT and EMT sensor tube assemblies. The EMT sensors will be mounted on top of sensor tubes that will be embedded into the seafloor. The EMT assembly comprises a protective dome, EMT sensor, top mounting assembly, and sensor cable. Each MT sensor will be protected inside a sensor tube embedded in the seafloor. Sensor tubes will be made of fiberglass reinforced plastic (FRP) and will be approximately 6 m (20 ft.) long and 30.5 centimeters (cm; 12 inches [in.]) in diameter. The bottom of the sensor tube will extend 6 m (19.5 ft.) below mudline at approximately 21 m (68 ft.) MLLW. The EMT sensors will be buried approximately 1.2 m (4 ft.) below the existing ocean floor depth at 15.5 m (50 ft.) MLLW and the top of the EMT sensor will be at approximately 15 m (49 ft.) below MLLW. The top of the MT sensors will be exposed approximately 15 cm (6 in.) above the existing sea floor positioned approximately 14-15 m (47-49 ft.) below MLLW. The material covering the sensors will be non-magnetic, backfill aggregate.

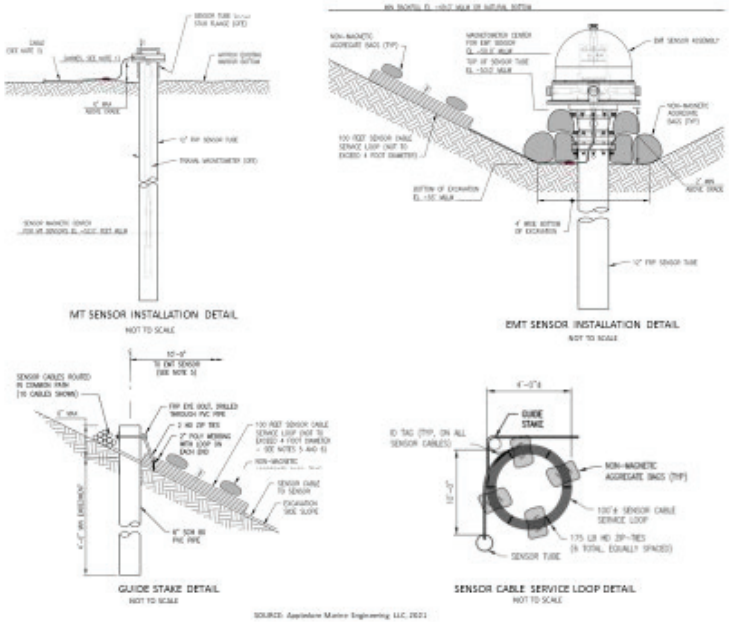


Figure 3. Guide stake, MT and EMT sensor installation detail.

A single CTD sensor will be installed outside the navigation channel and will extend approximately 1.2 m (4 ft.) above the harbor floor (Figure 4). The UEMMS requires accurate, real-time measurements of water conductivity, depth (pressure) and temperature, and the CTD sensor is a high-accuracy recorder designed for moorings or other long-duration, fixed-site deployments. The 0.56 by 0.14 m (22.2 by 5.5 in.) sensor will be attached to the elevated sensor tube, avoiding silt and sedimentation. The CTD unit will require regular maintenance to manually remove fouling flora and fauna from the sensor so that accurate measurements and water flow are achieved.

For each EMT, MT and CTD sensor, a sensor cable guide stake will be installed perpendicularly 3 m (10 ft.) to the southeast of each corresponding position. The guide stakes will be made of FRP and will be 15 cm (6 in) in diameter embedded in the seafloor to a depth of at least 1.2 m (4 ft.). For the CTD and MT guide stakes, approximately 0.6 m (2 ft.) of the stake will remain above the existing sea floor positioned at 15-16 m (49-53 ft.) below MLLW. The guide stake will be completely buried and nothing will be above the backfilled area. The guide stakes will utilize FRP eyebolts, poly webbing and Zip Ties to secure 30 m (100 ft.) of coiled sensor cable service loops between the sensor and guide stake. The coiled cable will not exceed 1.2 m (4 ft.) in diameter and secured to the bottom with non-magnetic aggregate bags. The EMT coiled cable will be additionally covered with non-magnetic backfill in the excavated area. The guide stakes will aid in cable routing, as well as secure coils of service cable, which are used to facilitate repair or replacement of sensors.

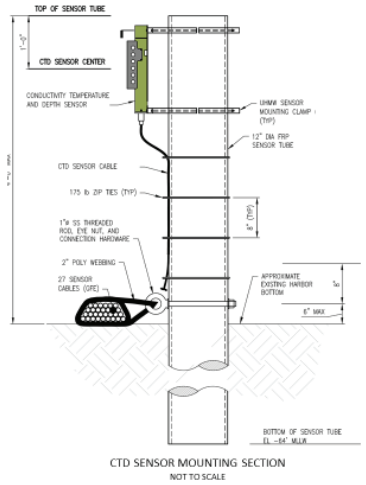


Figure 4. CTD sensor mounting section detail.

A trench must be excavated in the sea floor to achieve the optimal distance between the EMT sensors and the vessels that will be measured above, while maintaining the current navigational depth of the Outer Apra Harbor entrance channel (Figure 2). Approximately 918 cubic meters (m^3; 1,200 cubic yards [CY]) of material are anticipated to be removed. The material will be excavated with a closed-bucket excavator to minimize inadvertent discharges into the water column (Figure 5). The installation contractor will select the mooring or anchor type and locations for the mooring system, ensuring that the seabed will be void of protected resources and sensitive habitats. Any anchors (e.g., for vessels and silt curtains) will be set on hard or soft-sand bottom—void of corals and seagrass. Selection of anchor locations will take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. The "stop and slow" method will be used during dredging to limit suspension of sediments in the water column, and 8-m (25-ft.) length silt curtains will be installed immediately adjacent to the dredge barge. Silt curtains will not contact living macro-organisms, including bottom organisms. Once selected, the contractor will develop a monitoring and assessment program to minimize Project-related impacts on water quality during trenching operations. The excavated material will be stored on scows for later disposal. Best management practices (BMP) to prevent accidental release of spoils or return flow from the scows are listed in Section 1.4.

Figure 5. Photo of previous dredging operation in Apra Harbor (Source: NAVFAC)

Divers will install the sensor tubes followed by guide stakes into the seafloor using a water jetting process known as a handheld hydraulic breaker. Water jetting uses a high-pressure water stream to create a void into which the sensor tube will be pushed by a large steel pipe. It is typically completed by a crane-supported metal pipe with a water hose connection. One end of the water hose is connected to a hydraulic water pump, which is located on the barge. The intake line for the water pump takes in water at one hydraulic pressure and outputs water at a higher hydraulic pressure. This higher-pressure water is pumped into the pipe to the bottom, loosening bottom material and allowing the sensor tube to be pushed into the bottom.

If water jetting cannot successfully embed the sensor tubes due to seafloor characteristics, 0.3 m (12 in.) pilot holes diameter will be drilled into the seafloor, and marine grout applied to secure the tubes. The sensor tube will then be installed within the cored hole and grouted in position with non-shrink grout using a tremie pour method, in which a small amount of grout is placed at the bottom of the hole and a grout hose placed in the grout. The poured grout from the hose will displace water as grout fills the hole. The sensors will then be installed in the tubes, along with their individual cables.

After the sensors are installed, and guide stakes are in place, non-magnetic material will be placed to weigh down sensor cable service loops and to support exposed ends of EMT sensors (Figure 3) at the mudline. As seen in Figure 2, the excavated area will be backfilled using non-magnetic material to at least 30 cm (1 ft.) above the tops of the EMT sensors for protection. The estimated backfill volume will be approximately 826 m^3 (1,080 CY). The backfill material will be locally-sourced and certified as free of contaminants prior to use. The final seafloor elevation at the sensor array will be to minimum -15 m (-49 ft.) below MLLW, restoring existing harbor bottom to original depth.

1.2.2. Disposal of dredged material

For the UEMMS, the estimated excavation volume will be approximately 918 m^3 (1,200 CY), most of which will be deposited at the Guam Deep Ocean Disposal Site (G-DODS; Figure 6). Once each scow is filled, it will be towed during the day to the G-DODS, which was designated by the U.S. Environmental Protection Agency (USEPA) as an exclusive ocean dredged material disposal site in 2010 (Final Rule 40 CFR Part 228; FR Notice 54497). The G-DODS is located approximately 20.6 kilometers (km; 11.1 nautical miles [nm]) offshore of Guam, northwest of the entrance to Apra Harbor (Weston Solutions, Inc. 2010). It is located in 2,680 m (8,790 ft.) of water. This location is outside but immediately adjacent to the established vessel traffic lanes, through which all vessels will travel. The G-DODS regional bathymetry includes a conical seamount to the northwest and is over a gentle slope that descends towards the southeast. The disposal site has a circular footprint (located on the seafloor) centered at 13° 35.500 N and 144° 28.733 E with a 4.80 km (2.98 mile [mi]) radius (Weston Solutions, Inc. 2010).

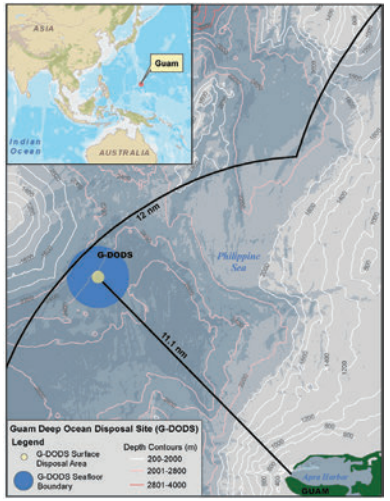


Figure 6. Location of Guam Deep Ocean Disposal Site (Source: www.epa.gov)

All permits or federal projects authorizing use of the G-DODS will include mandatory conditions for ocean disposal at the G-DODS (Weston Solutions, Inc. 2010), which are listed in greater detail in Section 1.4.3. The G-DODS is restricted to the disposal of suitable dredged material only and is designated permanently to receive an annual maximum quantity of dredged material of 764,555 m^3 (1,000,000 CY; NAVFAC Pacific 2010). The USEPA Region IX and USACE Honolulu District encourage advanced planning and coordination by users of the G-DODS to ensure that the annual maximum quantity of dredged material is not exceeded, with consideration of potential variances in proposed dredged material volume determinations for each project and unforeseen circumstance. Decisions to allow ocean disposal will be made on a case-by-case basis through the EPA permitting process, and only clean, non-toxic dredged material (as determined under national sediment testing protocols) will be accepted for ocean disposal (Final Rule 40 CFR Part 228; FR Notice 54497).

Alternatively, if the dredged material cannot be disposed at the G-DODS (i.e., large size, unsuitable materials, capping material, etc.), the material will be disposed at the Naval Base Guam Confined Disposal Facility (CDF), an approved upland site for dredged material. The material will be dewatered first at an existing NBG wharf in Inner Apra Harbor, because any onshore disposal would require dewatering prior to transport to a landfill. Location for the dewatering will be coordinated at the time of the post-award construction conference.

1.2.3. Installation of Cable on Seafloor from Sensor Array to Polaris Point

The CTD, MT, and EMT sensors will have an associated subsea cable, which will be shielded and sheathed copper wires with diameters of 2.16 cm (0.85 in) and 2.64 cm (1.04 in), respectively. The cables will extend from each sensor to a common path marked by guide stakes aligned parallel to and along the southeast side of the array. Up to five additional PVC guide stakes with no more than 0.3 m (1 ft.) of pipe exposed above the seafloor will be installed as the cables approach the array site (3 stakes) and Polaris Point (2 stakes) in order to secure the cable bundles at these areas of significant slope. There will be a total of 27 cables consisting of 10 MT (2 spare cables), 15 EMT (2 spare cables), and 2 CTD (1 spare cable). The cables will be bundled using 5 cm (2-in.) of polypropylene webbing at each sensor, guide stake and as necessary throughout the cable path. The subsea cable bundle will be laid by divers on the seafloor and extend approximately 975 m (3,200 ft.) to the northwest point of Polaris Point (Figure 7). Contractor divers will lay an initial "cable guide path" on the seafloor using line and guide stakes. Once the "guide path" is established, polypropylene webbing will bundle and secure the cables at regular intervals in accordance with the design drawings (Figure 8). The cables will then transition to a shore-side landing duct, consisting of individually-encased, 8-cm (3-in.) diameter, high-density polyethylene (HDPE) conduits. Several HDPE conduits will be bundled together, into a single, 71-cm (28-in.) diameter HDPE cable duct for approximately 38 m (125 ft.). The HDPE conduits and duct will increase the service life of the cables and protect them from high energy waves and debris along the shoreline. A stainless steel anchor band spans the top half of the HDPE duct and will be secured to the seafloor by five pairs of earth anchors, which have an expandable splay (or similar) that rotates and locks into position after being driven into the seafloor. The earth anchors will be installed from a barge or vessel using a topside pneumatically-driven jackhammer to embed the anchors approximately 2.4 m (8 ft.) into the substrate, thereby ensuring a secure attachment. The exposed footprint of each anchor will be approximately 1 in. in diameter.

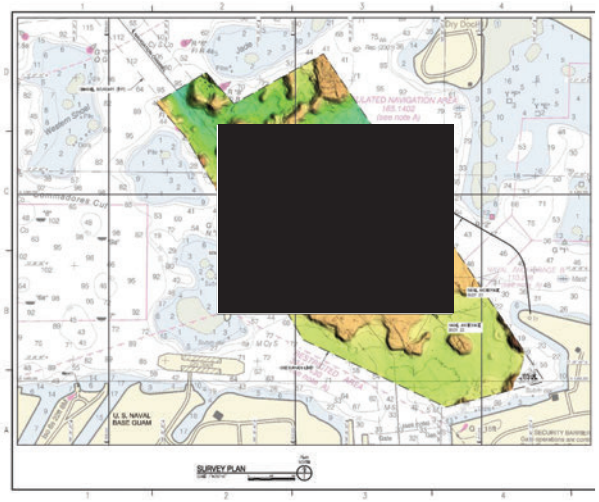


Figure 7. Hydrographic survey results of Action Area in Outer Apra Harbor, Guam. UEMMS array location depicted in dashed black lines, and the subsea cable path to Polaris Point shown in solid black line. Cable route will avoid all coral colonies (Source: NBG 2018).

After the cables have been hand laid in place and routed through the shoreline duct, they will be secured to the seafloor at several anchoring points approximately 30-m (100 ft.) intervals (Figure 8). During the establishment of the "cable guide path", contractor divers will select the locations for 29 reinforced concrete anchor discs to avoid areas with coral cover (Figure 8). The concrete anchor discs will be lowered into place using a crane and barge with contractor divers verifying each anchor placement. The concrete anchor discs are 1.2 m (4 ft.) in diameter by 0.6 m (2 ft.) in height with one hooked bar on the side of the disc that will be used to secure the cable bundles with polypropylene webbing.

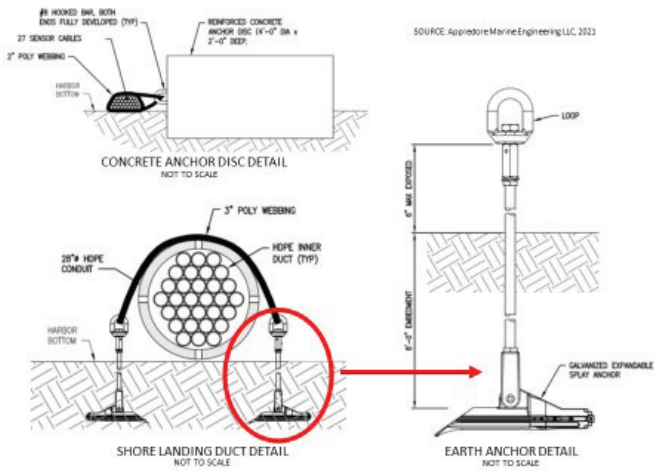


Figure 8. Cross-sectional drawings of: (top) sensor cable bundle secured with concrete anchor discs; (bottom) shore landing duct containing the HDPE conduit and secured with earth anchors; and (right) earth anchor detail (Source: Appledore Marine Engineering 2021).

1.2.4. Egress of cable

As stated above, the seafloor-mounted, cable bundle will transition into a shore-landing, HDPE conduit duct at a point approximately 10.5 m (35 ft.) below MLLW near the northern shoreline of Polaris Point. This conduit duct will be secured by five pairs of steel, earth anchors and poly webbing (Figure 8). As it continues to shallower areas upslope (approximately 4.5 m [15 ft.] below MLLW), the shoreline conduit duct will transition underground.

Because of the high wave energy environment at the transition point, approximately 24 m (80 ft.) of shoreline cable duct will be installed below ground from the -4.5 m (-15 ft.) MLLW depth to the point it enters the transition vault. Figure 9 shows plan and profile views of the cable transition to shore. As shown, the duct will enter a new below-grade, concrete transition vault, where the individual sensor cable will exit the HDPE duct and be routed into the [redacted]

To safely install the shoreline cable duct below-ground on the Polaris Point shore, an oblique trench 17-m wide by 15-m long by 3-m deep (55-ft. wide by 50-ft. long by 10-ft. deep) will be excavated from the transition vault location to a water depth of -4.5 m (-15 ft.) MLLW (Figure 9 for profile), thereby providing the necessary operational slope. The excavation will be conducted by a long-reach, closed-bucket excavator situated on land.

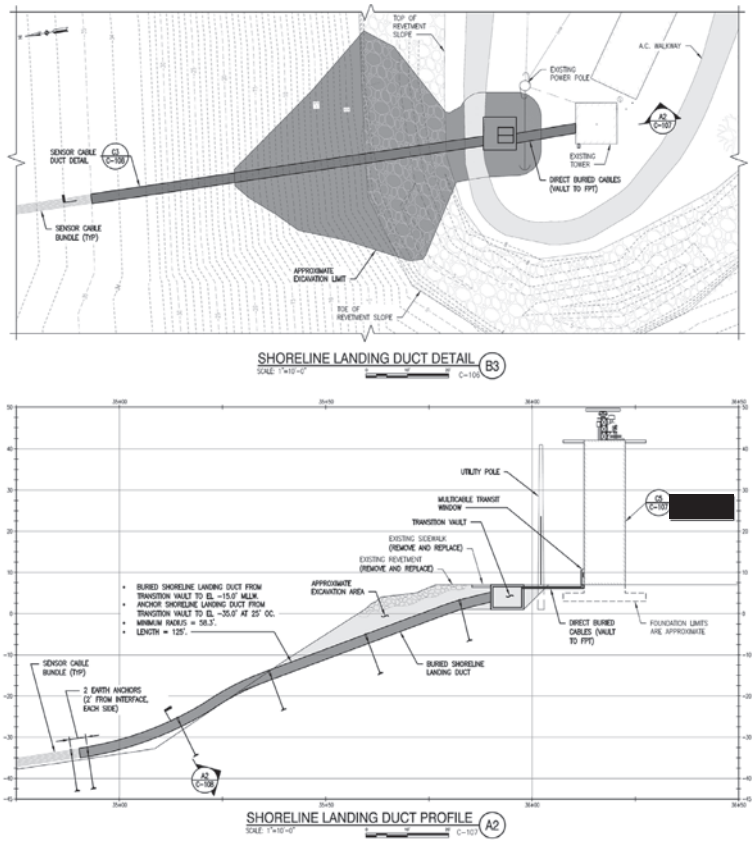


Figure 9. Detailed plan of the shoreline landing for the cable at Polaris Point: (top) aerial view with proposed excavation area shaded in dark gray; and (bottom) side profile showing the cable egress from the water onto shore and buried by replacing the excavated area (Source: Appledore Marine Engineering 2021).

Prior to excavating the cable trench, existing shoreline revetment material will be relocated by the shore-based excavator to the surrounding underwater habitat (Figure 10). Approximately 125 CY (95.6 m^3 or 3,375 ft^3) of revetment riprap will be relocated and later replaced, and approximately 225 CY (172 m^3 or 6,075 ft^3) of subbase material will be excavated and later used as backfill to bury the cable conduit duct. Large, limestone blocks were placed to create the revetment, and during excavation, these blocks will be stored in water (adjacent to the Action Area and devoid of protected resources).

After excavation, the blocks will be re-used as backfill material to restore the revetment to its original configuration to the maximum extent practical. The transition vault will be constructed of cast-in-place concrete. It is anticipated that the dredged material will be stored onshore in a lined dewatering facility that will allow the water from the dredged material to evaporate. Onshore construction will take the cable from the [redacted] to the [redacted] Building.

Figure 10. Photo of the shoreline and riprap near the [redacted] at Polaris Point in Outer Apra Harbor, Guam (Photo credit: Appledore Marine Engineering, LLC 2016)

1.2.5. Silt Containment

Silt Fence

During the cable trench excavation, a full-length silt fence will be installed with posts driven into the ground at 1.8 m (6-ft.) intervals (Figure 11). The curtain fabric will be a pervious sheet with ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected, usable construction life. The silt fence will be inspected after every rainfall, and daily during prolonged rainfall. Any repairs will be made immediately. Sediment deposits should be removed when they reach approximately one-third the fence height. After the upslope area on shore has been stabilized permanently, the silt fence will be removed. Any remaining sediment deposit will be dressed to conform to the existing grade, prepared and seeded.

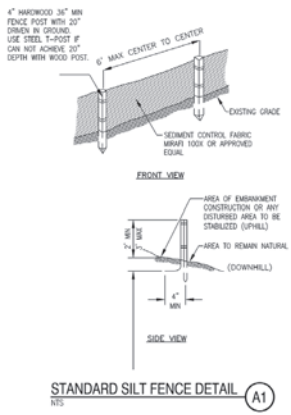


Figure 11. Detailed drawing of the silt fence to be installed around the cable trench excavation area at Polaris Point in Outer Apra Harbor, Guam (Source: Appledore Marine Engineering 2018).

Silt Barrier

A silt barrier will be placed along the shore landing duct, transition vault and any other area as required by the site to prevent onshore sediment from entering the water (Figure 12). The silt barrier will be a 0.3 m (12-in.) diameter silt sock made of heavy duty material and filled with wood chips. Each silt barrier will overlap the subsequent barrier by a minimum of 0.6 m (24 in.), thus ensuring that gaps are not present along the barrier's perimeter. All catch basins and drainage structures will be cleaned of any sediment or debris prior to final completion.

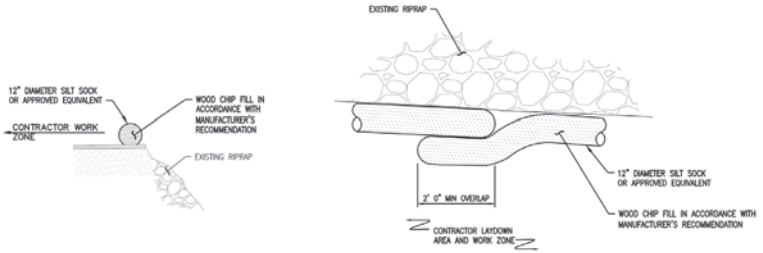


Figure 12. Detailed drawing of the silt barrier to be installed upslope of the shore landing duct at Polaris Point in Outer Apra Harbor, Guam: (left) side profile indicating onshore location and (right) aerial view highlighting overlap between silt barriers (Source: Appledore Marine Engineering 2018).

1.3. Construction Schedule

Construction, which includes performance of any required mitigation activities, is planned to begin November 2021 and will require 10 months (including anticipated weather and standby days) to complete. The in-water work will require approximately five months to complete. Table 1 summarizes the construction schedule.

Table 1. Construction schedule for UEMMS installation, Apra Harbor, Guam

Location	Summary of Actions	Estimated Duration*
Navigational Channel and Outer Apra Harbor (Mounds 9)	• Conduct habitat restoration and site stabilization • Transplant approximately 6,300 coral colonies from Action Area	60 days
Navigational Channel to Inner Apra Harbor	• Excavate 1,200 CY trench • Install, test and validate sensor array • Backfill array with 1,080 CY of non-magnetic material	96 days
G-DODS	Dispose 1,200 CY of dredged material	14 days
Outer Apra Harbor	• Lay cables on seafloor • Secure to bottom with earth anchors	20 days
Polaris Point shore	• Excavate 225 CY seafloor & relocate 125 CY revetment • Install shoreline landing duct and sensor cables • Backfill trench and return revetment	30 days

Note: *Estimated duration for each task was based on a typical time required to complete the work. Multiple construction activities will occur simultaneously. Durations are subject to change based upon several factors (e.g., contractor, funding, weather).

1.4. Best Management Practices

BMPs will be implemented to avoid and minimize impacts to protected species and the marine environment. Throughout the duration of their involvement in the Project, all workers associated with the Project, irrespective of their employment arrangement or affiliation (e.g., employee, contractor) will be fully-briefed on these BMPs and the compliance requirements.

1.4.1. BMPS to Avoid and Minimize Impacts to ESA-Listed Species

A. Constant vigilance will be kept for the presence of ESA-listed marine species to minimize effects from the Project on protected species during in-water activities such as boat operations, operating excavation equipment, diving, and deployment of anchors and mooring lines.

1. The Contractor's Project Manager, site foreman, or site superintendent (herein, Project Manager) will be responsible for ensuring these protocols are adhered to. The Project Manager has stop work authority.
2. Prior to start of construction, Contractor and subcontractor personnel shall attend a Natural Resources Training provided by NBG.
3. The Project Manager will designate at least one marine observer who attended the Natural Resources Training to survey the areas adjacent to the proposed action for ESA-listed marine species during all Project activities.

4. At least one dedicated marine observer will be on-site (stationed on a boat) during all offshore construction phases of the Project (e.g., coral translocation, trench excavation and sensor installation, offshore disposal of dredged material, and cable installation). During the installation of the sensor cable underground at the shore, the marine observer will be stationed onshore or on a boat.
    i. The role of the observer will be to:
        - ensure BMPs are properly installed and maintained;
        - monitor possible impacts on ESA-listed species, including any potential interactions with ESA-listed species;
        - identify any ESA-related concerns;
        - notify the Project Manager if BMPs must be repaired or ESA-listed species enter within the species-specific Project limits;
        - maintain a log of marine species observed within prescribed limits and any interactions that occur.
    ii. During all in-water activities, the observer will use binoculars to visually survey the Action Area each day, beginning 30 minutes prior to the start of work and continuously throughout the workday.
        - The observer will record environmental and Project-related information, including but not limited to date, time, weather, action undertaken, status, and ESA-listed marine species.
        - If no ESA-listed marine species is seen during the survey period, Project activities may commence.
        - If an ESA-listed marine species is seen during the survey period, the marine observer will notify the Project Manager immediately and monitor the animal. If the animal is within 50 m (50 yards [yd.]) of the Action Area, work will cease or not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting. Animal activities will be recorded during this time period.
5. Project-related personnel will not attempt to disturb, touch, ride, feed, or otherwise intentionally interact with any protected species.
6. Project-related personnel will stay more than 50 m (50 yd.) away from sea turtles that haul-out on land.
7. NBG will document and report to NMFS, all interactions with ESA-listed species (monthly), including the disposition of any listed species that are injured or killed (within 24 hours).
    i. Should an ESA-listed species be adversely affected, all work must stop pending re-initiation and completion of consultation between the NBG and NMFS PRD.

B. In-water operations will employ measures to reduce potential collisions with ESA-listed marine species.
    1. Vessel operators will halt or alter course to remain at least 50 m (50 yd.) from ESA-listed marine species.
    2. Vessel operators will reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals, and to 5 knots or less when piloting vessels in

areas of known or suspected turtle activity. Operators will be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity. Ocean disposal transit speeds for a vessel or tugboat towing the scow/barge will be generally at slow speeds (i.e., less than 10 knots) to reduce potential collisions with ESA-listed marine species.
    3. If approached by a ESA-listed marine species, the vessel operator will put the engine in neutral until the animal is at least 15 m (50 ft.) away, and then slowly move way to 50 m (50 yd.) from the animal.
    4. Vessel operators will not encircle or trap ESA-listed marine species between multiple vessels or between vessels and the shore.

C. In-water operations will employ measures to reduce potential direct physical impacts to ESA-listed species
    1. In-water tethers and mooring lines for vessels and marker buoys will be kept to the minimum lengths necessary and will remain deployed only as long as needed to accomplish the task.
    2. Before any equipment or material enters the water, a responsible party (i.e., the Project Manager) will verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the substrate.
    3. All objects lowered to the bottom will be lowered in a controlled manner. This will be achieved by the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
    4. With the exception of the actual dredging apparatus (e.g., clamshell buckets), any heavy equipment will be operated from above and out of the water.
    5. Anchor lines from construction vessels will be deployed with appropriate tension to avoid entanglement with ESA-listed species. Construction related equipment that may pose an entanglement hazard will be removed from the Project site if not actively being used.

1.4.2. BMPs to Avoid and Minimize Impacts on the Marine Environment

The following BMPs are considered a part of the proposed action and would be implemented, as applicable, to avoid and/or minimize adverse impacts, specifically to EFH. Rationale for implementation of each BMP as it related to EFH is also provided.

A. All 6,300 coral colonies will be evaluated for translocation to crest-top edges and upper slope habitats of Mound 9 prior to commencement of the Project. Corals meeting the morphological, health and size criteria for translocation will be relocated to Mound 9, which was selected as transplant sites because it displays a similar species composition as the UEMMS sensor array site (NMFS-PIRO 2015). A translocation plan will be developed and implemented. A monitoring plan with adaptive management will be developed and implemented.

B. Coral transplantation and all in-water activities will cease during the primary Guam coral spawning events each year for hard (scleractinian) corals. The coral spawning period is

estimated to be 21 days total, including 8 days prior to the full moon and 14 days after:

1. 2021 Coral Spawning Season: July 15–Aug 6 (Full moon July 23–24)
2. 2022 Coral Spawning Season: July 5–27 (Full moon July 13–14).

C. All anchors (e.g., for vessels and silt curtains) are set on hard or soft, sandy bottom void of corals and seagrass, and that chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. If practicable, all intertidal work will be conducted at low and/or slack tides.

D. Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. The Navy will attempt to position vessels so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.

E. A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation. The SWPPP will include, at a minimum, the following BMPs:
   1. Silt socks, filter fabric, or an approved equivalent will be used around all topside construction located near waters of the US.
   2. All anchors (e.g., for vessels and silt curtains) are set on hard or soft, sandy bottom void of corals and seagrass, and that chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides.
   3. Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. The Navy will attempt to position vessels so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.
   4. A plan to prevent trash and debris from entering the marine environment during the Project will be included in the SWPPP and implemented throughout construction of the Project.
   5. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the Project.
      i. Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water.
      ii. When applicable, all temporary fuel oil or petroleum storage tanks will be surrounded with a temporary berm of sufficient size and strength to contain the contents of the tanks (plus 10% freeboard for precipitation) in the event of an accidental release.
      iii. Fueling of Project-related vehicles and equipment will take place at least 15 m (50 ft.) away from the water and within a containment area, preferably over an impervious surface. With respect to equipment (e.g., crane on the barge) that cannot be fueled on land, spill prevention booms will be employed to contain potential spills. All fuel spilled will be cleaned immediately.
      iv. Lubricants and excess oil will be disposed of in accordance with applicable federal, territory, and local regulations, laws, ordinances, and permits.
      v. Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.

      vi. All Project-related materials and equipment placed in the water will be free of pollutants.
      vii. Pre-work inspections of heavy equipment for cleanliness and leaks will be conducted daily, with all heavy equipment operations postponed or halted until leaks are repaired and equipment is cleaned.

F. A temporary floating debris boom will be installed around all work located below the high tide line (HTL). The location of the boom will shift as in-water work shifts during Project phasing.

G. Silt containment will be installed at three different sites within the Action Area: a silt curtain immediately adjacent to and around the dredge barge; a silt fence around the cable excavation area at Polaris Point; and silt barriers along the shoreline at Polaris Point. These silt containment devices will isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. If a plume is observed outside of the silt curtains, Project activity will stop and corrective action will be taken immediately. Work will not resume until after the correction is made. The Project Manager will inform NBG if a plume is observed.

H. As practicable, work will be conducted during calm sea states with work stoppages during high surf, winds, and currents. In the event of approaching foul weather (i.e., tropical storms and typhoons), equipment will be either removed from the Project site or adequately secured. Guam utilizes the severe weather alert system levels I-IV (provided below). A Condition Level IV is the lowest alert level and indicates a possible threat of destructive winds within 72 hours and a Condition Level 1 is the highest alert that indicates destructive winds are expected within 12 hours. In order to provide 48 hours leeway preparation, work activities will immediately begin the appropriate removal and/or securement of all in water equipment, vessels and barges once a Condition Level III is triggered. Once post storm activities permit a safe assessment of equipment and conditions of the project sites, as feasible, that will be evaluated for a safe return to work providing reports of any additional adverse storm impacts.

   1. Guam Typhoon Conditions:
      i. Condition Level I: A typhoon is expected to hit the island within 12 hours.
      ii. Condition Level II: A typhoon is expected to hit the island within 24 hours.
      iii. Condition Level III: A typhoon may possibly hit the island within 48 hours.
      iv. Condition Level IV: Guam is always in Condition IV. A typhoon may develop and hit the island within 72 hours.

I. The portions of the equipment that enter the water will be clean and free of pollutants, including aquatic invasive species (AIS). All vessels and equipment (including barges, dry docks, and dredging equipment) will be free from fouling organisms before entering Guam's coastal waters. A biofouling management plan will be developed for all vessels entering Guam waters. The Project Manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.

J. Divers will select the anchor locations (vis-à-vis, the cable route) for the mooring system and ensure that the locations are void of protected resources and circumvent around coral colonies. The Navy will require the contractor to verify that anchors are not being placed on substrate that supports coral growth. Also, the Navy will require the contractor to ensure that anchor chains do not scour the environment where sensitive benthic organisms could occur.

K. During ocean disposal of dredged material to the G-DODS, the following BMPs will be implemented:
   1. Transportation of dredged material to the G-DODS shall only be allowed when weather and sea state conditions will not interfere with safe transportation and will not create risk of spillage, leak or other loss of dredged material in transit to the G-DODS. No disposal vessel trips shall be initiated when the National Weather Service has issued a gale warning for local waters during the time period necessary to complete dumping operations.
   2. Dredged material shall not be leaked or spilled from disposal vessels during transit to the G-DODS.
   3. When dredged material is discharged within the G-DODS, no portion of the vessel from which the materials are to be released (e.g., hopper dredge or towed barge) can be further than 457 m (1,500 ft.) from the center of the surface disposal zone designated in the permit. The center of the G-DODS is also the center of the surface disposal zone for disposal
   4. No more than one disposal vessel may be present within the permissible dumping target area at any time.
   5. The Contractor shall obtain, operate, and maintain a primary disposal tracking system for recording ocean disposal operations data that is disposal-vessel (e.g., scow) based.
   6. An appropriate Global Positioning System (GPS) shall be used to indicate the position of the disposal vessel with a minimum accuracy of 3.5 m (11.5 ft.) during all transportation and disposal operations.
      i. This primary disposal tracking system shall indicate and record automatically both the position and the draft of the disposal vessel at a maximum 1-minute Interval, while outside the G-DODS boundary, and at a maximum of 15-second interval while inside the G-DODS boundary.
      ii. This primary system shall also indicate and record the time and location of each disposal event (e.g., the opening and closing of the hull doors of the disposal vessel).
      iii. Finally, the primary system shall include a real-time display, in the wheelhouse or otherwise for the helmsman, of the position of the disposal vessel relative to the boundaries of the G-DODS.
      iv. If the primary navigation/tracking system fails, all disposal operations must cease until the navigational capabilities are restored. If the primary system fails during transit to the G-DODS, a back-up navigation/tracking system, with all of the capabilities listed in this condition, may be used to complete the trip.
   7. The Contractor shall complete an EPA and USACE approved Scow Certification Checklist Form that documents:
      i. the amount of material dredged and loaded into each barge for disposal
      ii. the location from which the material in each barge was dredged

      iii. the weather report for and sea-state conditions anticipated during the transit period
      iv. the time that each vessel departs for, arrives at, and returns from the G-DODS;
      v. the exact coordinates and time of each disposal
      vi. and the volume of material disposed at the G-DODS during each disposal trip.
   8. An authorized and responsible representative of the Contractor (not a subcontractor) or Navy shall inspect each disposal vessel prior to its departure for the G-DODS. The authorized representative shall certify (along with the disposal vessel captain) whether the specifications on the approved Scow Certification Checklist have been met. The authorized representative shall promptly inform the Navy whether there are any inaccuracies or discrepancies concerning this information, and shall provide a summary for the calendar month in a report to USEPA and USACE by the 15th day of the following month. Space for a representative from USEPA or the USACE will be available on any disposal vessel should a federal regulator desire to observe disposal operations on any specific trip.
   9. The Navy shall report any variances from mandatory or special conditions during disposal operations to the District Engineer and the Regional Administrator within 24 hours. In addition, the Navy shall prepare and submit reports, including a cover letter summarizing problems and corrective action(s) taken, certified accurate by the designated authorized representative, on a frequency that shall be specified in permits, to the District Engineer and the Regional Administrator setting forth the information required by Mandatory Conditions in paragraphs (7) and (8) of this section.
   10. Within 20 days of the completion of ocean disposal operations, the Navy shall prepare and submit to the District Engineer and Regional Administrator a report that includes:
      i. complete records of all dredging, transport and disposal activities, such as navigation logs, disposal coordinates, scow certification checklists, and other information required by permit conditions
      ii. whether any of this dredged material was dredged from outside the areas authorized for ocean disposal or was the dredge deeper than authorized.
      iii. a post-dredging survey that substantiates the total quantity dredged including calculations used to determine the volume difference between the pre- and post-dredging surveys and explain any variation in quantities greater than 15 percent above the estimated quantities. All surveys shall be signed by the Contractor to certify their accuracy.

2. Environmental Baseline Conditions

2.1. General Marine Environment

Apra Harbor, located on the western (leeward) side of Guam, is the largest U.S. deep-water port (depths to 50 m [165 ft.]) in the Western Pacific and the busiest port in Micronesia (Nelson *et al*. 2016, Marx & Smith 2013). Following World War II, the U.S. Navy made extensive port improvements, including dredging a navigation channel to a depth of approximately 14 m (46 ft.). Submerged lands at NBG Main Base were significantly altered during and immediately following World War II (DON 2018). During this period, dredging occurred in both Outer and Inner Harbor to support ship movement and berthing, and large amounts of fill were used to construct port infrastructure, which covered reefs in areas on Inner Apra Harbor (Figure 13). Wetlands southeast of Inner Apra Harbor were also converted for agricultural use from the 1930s through the 1950s (DON 2018). Today, maintenance dredging is performed as necessary in Inner Apra Harbor to maintain navigable depths.

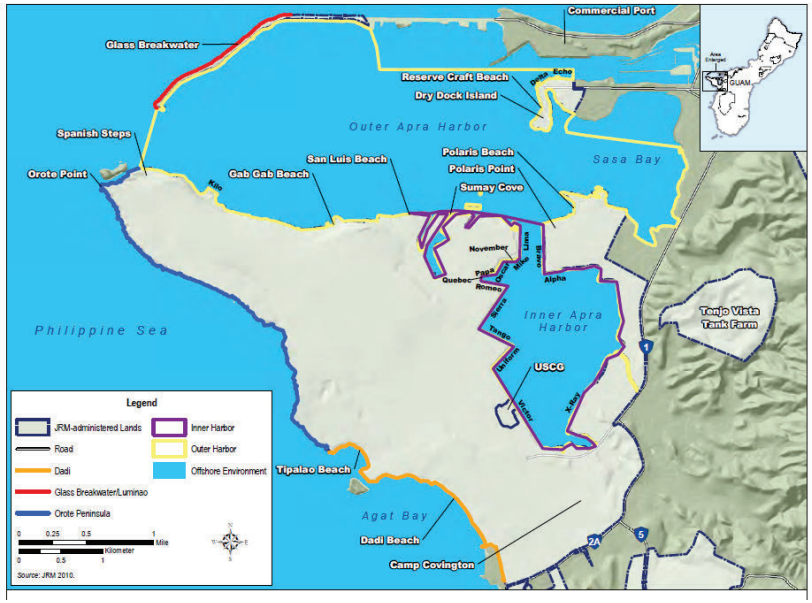


Figure 13. Marine environments of NBG (DON 2018).

Tides are semi-diurnal, currents are generally weak to moderate (Figure 14), and surface seawater temperatures are generally between 26–30°C. Turbidity in Apra Harbor is highly variable; clear oceanic type conditions prevail near the harbor mouth while highly turbid conditions are common in Inner Apra Harbor and Sasa Bay. Bottom sediments range from silty clay to complex coral reefs.

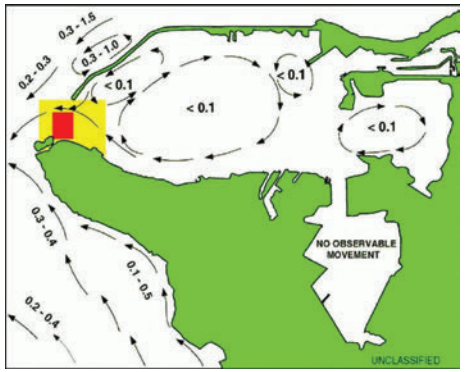


Figure 14. General current circulation of Apra Harbor, Guam: red area indicates where eddies have been reported; yellow area indicates where tides cause current speeds to vary to a degree significantly affecting vessel navigation; speeds are reported in knots (Source: NAVFAC Marianas 2019).

Apra Harbor provides a lagoonal habitat with a rich diversity of coral species. The harbor is protected by the Glass Breakwater and a substantial arc of large, shallow reefs, which underlies the breakwater and brackets the harbor entrance (Nelson *et al.* 2016). Minimal freshwater inputs are limited to a few small streams that discharge into the harbor. Light winds shelters Apra Harbor from the dominant trade winds by the island's mountains, and water visibility is generally reduced by a variable loading of suspended particles (Dollar 2010). Periodic typhoon-driven waves may occur within the harbor. In general, the bathymetry is deeper toward the west, but abrupt bathymetry changes are common, particularly as numerous small and large coral reefs characterize the harbor seabed. Tides in the harbor are mixed, with a mean tidal range of 0.49 m (1.6 ft.) and a mean diurnal range of 0.72 m (2.4 ft.; Nelson *et al*. 2016).

2.1.1. Water and Sediment Quality

The Apra Harbor Watershed is discharged to the ocean from four main rivers, and the quantity, condition, and characteristics of these rivers and associated watersheds can lead to severe drainage and/or surface erosion problems in times of heavy precipitation (DON 2018). Inner Apra Harbor drains into Outer Apra Harbor through the opening at Polaris Point. As a result of weak circulation and substantial sediment transport into the marine environment from the watershed, turbidity throughout the harbor is higher than outside the harbor. However, harbor turbidity is variable, ranging from clear conditions on the western extent near the mouth to highly turbid conditions in Sasa Bay (DON 2018).

Since 2014, long-term water quality monitoring in Apra Harbor has been capturing significant events that occurred on reefs across seasonal cycles, i.e., large rain events and associated plumes, groundwater discharge associated with lunar extremes, and seasonal changes in key parameters that dictate benthic community composition (Schils *et al*. 2017). In Apra Harbor, three long-term water quality monitoring stations (i.e., Orote Point, Middle Shoals, and Anchor Reef) were established to allow for the evaluation of linkages between the water quality and tropical reef assemblages as a result of both natural environmental cycles and human influences (Figure 15). Parameters include temperature, dissolved oxygen, pH, salinity/conductivity, chlorophyll a, and turbidity.

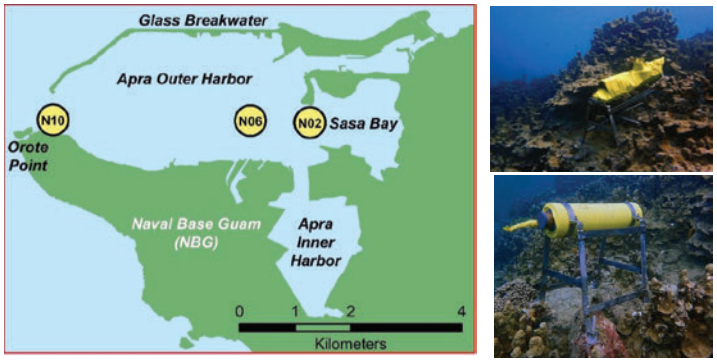


Figure 15. (left) Apra Harbor water quality monitoring sites since 2014; (top right) Sea-Bird water quality sensor and (bottom right) SeaFET pH sensors, both mounted on custom-made stainless steel frame deployed at Middle Shoals (Source: Schils *et al*. 2017).

Initial analysis from the study concluded that episodes of heavy rainfall lowered salinity levels for all three monitoring sites. Surface seawater temperatures on Outer Apra Harbor are typically 79-86°F, and temperature fluctuations are more pronounced at the eastern stations compared to those toward the mouth of the harbor (Schils *et al.* 2017). The region around Middle Shoals was characterized by a higher background level of turbidity with pronounced spikes in the wet season caused by increased freshwater input due to heavy rainfall. Research suggests that natural levels of elevated turbidity in tropical reef environments are less prone to coral bleaching, thus functioning as a climate-change refuge with lowered stress for corals. Similarly, slow-flow habitats like Middle Shoals may serve as a refuge for coralline algae, which could then in turn ensure recruitment of scleractinian corals under elevated water temperature conditions (Schils *et al.* 2017).

Under section 303(d) of the *Clean Water Act* (Title 33, Chapter 26, Subchapter 3), states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The Guam Water Quality Standards (GWQS; EPA 2015) categorize Apra Harbor as impaired for consumption of aquatic life

(polychlorinated biphenyls [PCBs] in fish tissue; EPA 2015). The GWQS categorize Apra Harbor as Marine waters, which include estuarine waters, lagoons and bays (§5012 B.). Marine waters are further divided into three sub-categories: M-1 Excellent, M-2 Good, and M-3 Fair. All of Inner and Outer Apra Harbor is designated as M-2 (Good), which is defined as marine waters that are of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals and other reef-related resources and whole body contact recreation. Other important and intended uses of M-2 waters include mariculture activities, aesthetic enjoyment and related activities. The Piti Channel is characterized as M-3 (Fair) and empties into Outer Apra Harbor, which is defined as being marine waters that are intended for general, commercial and industrial use, while allowing for protection of aquatic life, aesthetic enjoyment and compatible recreation with limited body contact. Specified intended uses of M-3 waters include shipping, boating and berthing, industrial cooling water and marinas. Saltwater acute, saltwater chronic and human health standards are applicable to all toxic pollutants discharged in M-3 waters.

Sediment and biological tissue samples collected from selected locations within the harbor were previously analyzed for heavy metals, PCBs and polyaromatic hydrocarbons (PAHs; Denton *et al.* 1997, 1999, as cited in HDR, 2011). Sponges, soft corals, sea cucumbers and fish collected from within the harbor showed elevated levels of PCBs. Invertebrate tissue samples showed elevated concentrations of arsenic. Relatively high levels of copper and zinc were also recorded in oyster tissues collected from Apra Harbor. None of the fish or shellfish tissue samples, however, exceeded U.S. Food and Drug Administration (USFDA) food standards or guidance limits (GEPA 2000b, as cited in HDR 2011).

In 2017, sediment cores and water column samples were collected from within the project dredge footprint to determine if the dredged material is suitable for ocean disposal (ERA 2018). Metals, PCBs, dioxins, and furans were detected in the sediment, but at levels suitable for ocean disposal. Toxicity Characteristic Leaching Procedure (TCLP) analysis found detections of arsenic and lead, which did not exceed regulatory value. Amphipod survival bioassay results did not meet the acceptability criterion, but juvenile polychaete survival bioassay did meet the acceptability criterion. Mysid shrimp bioassay, juvenile fish bioassay, and bivalve larval development bioassay met LPC requirements for ocean disposal. Metals, PCBs, dioxins, and furans were detected in the water column samples, but the values did not exceed corresponding Criteria Continuous Concentration (CCC) or Criteria Maximum Concentration (CMC) values (ERA 2018).

Although depositional processes predominate in Apra Harbor, the sediment accumulation rates are relatively low. The harbor is a relatively low-energy system, with multiple sediment inputs separated from a single outlet to the sea by deep water and relatively long distances. This geography promotes sedimentation. The low levels of wave and tidal energy, combined with the multi-basinal morphology, promote settling of the mixed carbonate and clastic sediment load. Therefore, in the absence of anthropogenic impact (i.e., discharge of contamination from land-based sources), clean sediment input will eventually cover contaminated sediments in the harbor. The Inner Apra Harbor is significantly more sheltered than the Outer Apra Harbor, has a southward-dominant bottom current, and receives the two largest sediment loadings in the harbor system (i.e., Atantano River and the storm drain outfall at the corner of Sierra and Tango Wharves). Therefore, sedimentation rates in the Inner Apra Harbor are higher than those in the Outer Apra Harbor, with the highest estimated sedimentation rate for the Inner Harbor at 3.2 centimeters per year (cm/yr) and the highest estimated sedimentation rate for the Outer Harbor at 1.3 cm/yr (DON 2016, as cited in AECOM 2018).

2.1.2. Geology

The Mariana Islands are a volcanic island archipelago resulting from subduction of the Pacific plate beneath the Philippine Sea plate. The island of Guam was formed by two separate emergent mountains that fused to form one island. Guam is divided almost evenly into two distinct physiographic provinces by a fault line between Pago Bay on the east central coast and Adelup on the west central coast (Vann *et al.* 2014). The northern province is a karst plateau composed of almost entirely of Miocene to Pleistocene limestone bedrock overlying an Oligocene volcanic basement base layer called the Alutom Formation (Vann *et al.* 2014; Gingerich 2013). The karst terrain of the north is porous and rivers and streams are absent except at its southeastern end, where streams and blind valleys have formed on the limestone that abuts the volcanic rock of the southern highlands.

The Facpi and Alutom Formations, which are volcanic in origin, underlie all rock units on Guam (DON 2019, Tracey *et al.* 1964); this volcanic layer is at the surface or much closer to it in the southern province. The volcanic substrate is much less permeable to water and the southwestern region of Guam is the area of greatest rainfall on Guam (Gingerich 2013), thus the southern province is drained by numerous rivers and streams (Davis *et al.* 2010; HDR 2015a, 2015b; DON 2019). The terrain of the southern province is mostly volcanic upland drained by deeply incised stream valleys formed on heavily weathered Eocene-to-Miocene volcanic rocks (Venn *et al.* 2014). Degradation of vegetation in the upland portions of southern Guam watersheds has resulted in significant erosion that can reduce the water quality and threaten nearshore marine resources (Davis *et al.* 2010; HDR 2015a, 2015b). The most common soil type in the Apra watershed is known as "As Ylig." As Ylig, a clay-rich, somewhat poorly drained soil, is commonly found along the volcanic slopes and in drainage-ways of southern Guam. These soils are composed of highly eroded volcanic rock and alluvium derived from saprolitic tuff and tuff breccia (Young 1988).

Apra Harbor is an open lagoon or bay bounded by the limestone cliffs of Orote Peninsula on the south and by the long barriers of Cabras Island and Luminao Reef on the north. It is a unique formation in the Mariana Islands, because it is the only deep-water port in the entire archipelago. Surface geology near the Project Area in Outer Apra Harbor, is recent beach deposits, coral reef deposits (Merizo Limestone), alluvium and artificial fill. Reef beach deposits, reef limestone, and alluvium cover are composed of poorly consolidated sediments, the origin of which is calcareous sand and gravel and volcanic sand (DON 2019). Sediments in the marine environment mainly consist of coral, coral rubble, mud, and sand.

A 2017 geotechnical investigation was conducted in the Project Area and included six ocean-based, soil borings that ranged from 9-13 m (30-43 ft.) depth below the mud line (BML). Site soils consisted mainly of a surface layer of very loose, silty sands with gravel or soft sandy silts with gravel with standard penetration test (SPTs) values ranging from 0 to 3. Some borings encountered surface layers with higher percentages of gravel, though all are very loose and contained significant amounts of sands and silts. As this layer continues, the proportion of gravel increases in all borings classifying the soils as gravels with sand and silts/lean clays. The soils also become loose to medium dense with SPT values in the range of 7 to 20. At the boring closest to land, this denser layer begins at about 5 m (16 ft.) BML. Below this layer, the gravel continues to densify with SPT values above 20. At one boring location, pieces of very soft, solid coralline limestone were encountered, and rock cores were retrieved for testing at about 7 and 9 m (23 and 30 ft.) BML. Signs of environmental contamination of site soils were not noted during geotechnical investigations (ERA 2018).

2.1.3. Coastal Habitat

The coastline of Outer Apra Harbor is a combination of manmade structures, hardened shoreline, and natural or semi-natural shoreline. Much of the shoreline of Apra Harbor is formed from fill and is built upon former shallow limestone reef flats. The Former Ship Repair Facility and Polaris Point are sites of NBG operations and include wharf or riprap shoreline. Some parts of the southern shore of Apra Harbor, such as along San Luis Shores, are held in place by degraded sheet pile walls.

Sasa Bay is a shallow embayment on east side of Apra Harbor, the northern part of the Bay is separated from the turning basin by a shallow shoal that is a southern extension of Dry Dock Island. Sasa Bay is the site of a marine preserve designated by GovGuam on NBG. Sasa Bay is east of the middle portion of the cable route. The habitat is turbid and warm. The shoreline of Sasa Bay is dominated by mangrove swamp. The largest concentrations of mangrove on Guam are found along the eastern shores of Sasa Bay and Inner Apra Harbor (DON 2019). The mangrove communities of Apra Harbor are the most developed mangrove forests in the Mariana Islands (Burdick *et al*. 2008). Four rivers flow into Apra Harbor (HDR 2015a; DON 2019). The Atantano River empties into Inner Apra Harbor north of X-ray Wharf. The Sasa, Laguas, and Aguada rivers empty into Sasa Bay. All of the rivers flow through the mangrove wetland prior to entering Apra Harbor. The mangrove forest provides important filtering and ecological functions for the Apra Harbor marine community.

Close to where the power cable comes ashore on Polaris Point, replacement of an eroded seawall, piers, and washout sinkholes was completed in 2015 in compliance with the MSA. The project required the hardening of riprap revetment designed to absorb and deflect wave impact and to prevent additional shoreline erosion. The improvements involved the addition of a geo-textile filter fabric and 15.2 cm (6 in) of under layer stone materials to prevent soil from moving through the new embankment and to stabilize the new fill materials. Toe rock (0.91–1.2 m (36–48 in.) diameter) and riprap boulders (0.46–0.61 m (18–24 in.) diameter) were placed on the reshaped slopes, with granular fill materials inserted between them. This design allowed the gaps between rocks to trap and slow the flow of water, thereby lessening its ability to erode soil or structures on the shoreline.

2.1.4. Benthic and Biological Habitat

Unique within the Mariana Islands, Outer Apra Harbor has atypical benthic characteristics, and there are no other harbors that are comparable in scale or structure on Guam or in the Mariana Islands (DON 2018). Outer Apra Harbor contains coral reefs with various types, distributions, and community compositions, all of which are substantially different from Inner Apra Harbor or reefs on the open coast of Guam. These differences are due several factors: substrate availability, depth, and water quality (e.g., sediment input, flushing rates, and circulation). Shallow water coral reef habitats on Outer Apra Harbor occur as fringing reefs, shoals, pinnacles, and as colonized artificial structures along the perimeter of Outer Apra Harbor. The bathymetry of southern Outer Apra Harbor is complex with pinnacles or shoals rising from the bottom, and can be characterized as a matrix of colonized patch reefs surrounded by soft bottom habitats (Figure 16).

Smith, *et al.* (2013) surveyed the turning basin of Outer Apra Harbor (which overlaps with the proposed UEMMS Action Area) to depths of 25 m (82 ft.). At depths below 16 m (53 ft.), the seafloor was uniformly-soft, unconsolidated sediment consisting of fine to medium grained sand with abundant crab and shrimp burrows and mounds in many areas. In the basin overall, corals were sparse (<10%) and occurred as patches up to 100 m^2. The site for the UEMMS sensor array is on an outer finger of a reef plateau with well-developed coral formations (NMFS-PIRO 2015).

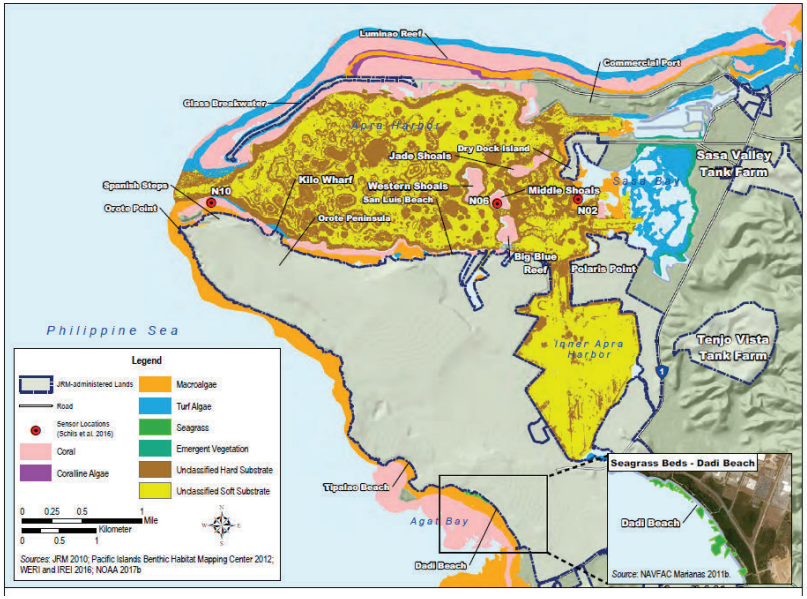


Figure 16. Apra Harbor benthic habitats (DON 2018).

In 2015, scientific divers conducted a survey of the UEMMS Action Area to characterize the benthos, determine coral species and abundance, and assess relative percent cover of coral, macroalgae, sponges, and non-living substrate (HDR & CSA 2020). A detailed analysis of percent cover was conducted for two of six transects detailing that abiotic substrate had the greatest percent coverage, which was substantially greater than coral, cyanobacteria, macroalgae and sponges. Also in 2015, a concurrent scientific dive group from NMFS conducted a survey of the UEMMS Action Area to determine coral species and assess relative percent cover. A variance in the results from both efforts for the density of coral cover in 2018 dialogue resulted in the development of a second HDR and CSA led survey effort to use orthomosaic imagery techniques to further characterize the benthos, coral species abundance, and assess relative percent cover of the modified project footprint (HDR & CSA 2020).

The UEMMS array position falls along the crest of a narrow elongated seafloor ridge-like feature that extends from a much larger previously dredged flat-topped mound to the south. This narrow feature has steep flanks and

a relatively flat upper surface that crests at 14 m (45.9 ft.) depth. For the 2020 surveys, the UEMMS dredge footprint and surrounding habitat was divided into contiguous grid cells with dimensions of approximately 6.1 by 15 m (20 by 49.2 ft.) for individual cells of approximately 91.5 m^2 (984 ft^2) for the collection of photomosaic imagery (Figure 17). Sixteen grid cells were established over the dredge footprint, numbered 1 through 16. An additional 16 non-contiguous indirect area grid cells, numbered 17 to 32, were identified as areas with notable coral cover in the surrounding and adjacent areas to the UEMMS dredge footprint at water depths ranging from 14 to 19 m (45.9– 29.5 ft., Figure 17). With the cable route passing through grid cell 18, it was subsequently classified as part of the UEMMS dredge footprint. Divers and later analysis noted the lack of any large massive *Porites sp.* colonies greater than 1 m diameter, the high abundance of fast-growing *P. rus* and *P. horizontalata* on the feature crest, and the depth matching the heavily dredged larger feature to the immediate south. This suggests that the upper surface of this mound may have been previously dredged to some extent.

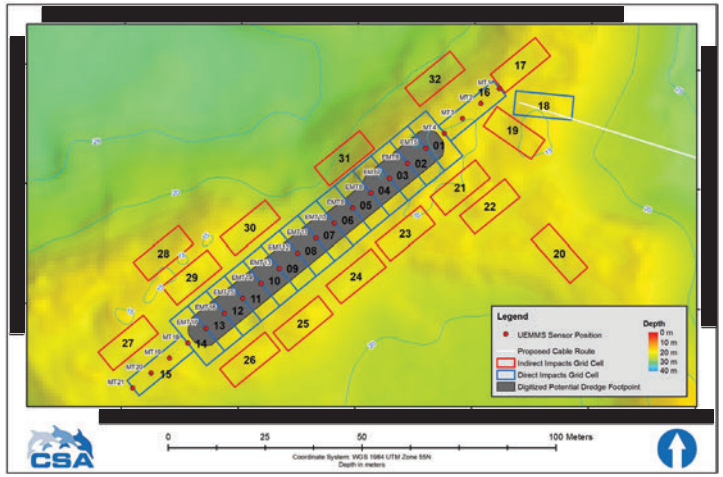


Figure 17. UEMMS site dredge footprint (grid cells 1-16, 18) and indirect areas (grid cells 17, 19-32).

On the slope approaching the Polaris Point shore landing area Grid cells 33 and 34 were established parallel to the cable path centerline. The shore landing area bottom substrate is composed of a combination of fine sediments and rubble material with no appreciable exposed natural hard bottom or reef features. The seafloor from 1.5–9 m (4.9–29.5 ft.) depth is a steep gravel and sediment slope with occasional larger pieces of embedded coral rubble and living corals. The shallow crest is composed of small 2–5 cm (0.07–0.16 ft.) diameter coral rubble, sand, and intermixed large concrete debris, grading into a boulder-armored shoreline.

Mound 9 has a physically disturbed upper surface area of up to approximately 1.5–2 acres, with a majority of the central region composed of loose sediments and coral rubble while healthy coral communities encompass the circumference of the upper edge of the mound. Grids 35 to 39 were established within the rubble bottom areas

on Mound 9, previously identified as potentially suitable as coral relocation sites (Figure 18). Grid cells 36 and 38 were purposely positioned within coral habitat estimated to include species similar to those that would potentially be relocated to the site from the UEMMS dredge area and may serve as possible future reference areas for monitoring. The final, larger grid cell 40, with an overall area of more than 280 m^2 was established on a portion of Mound 9 that has subsequently been utilized for the Lima, Mike, and November (LMN) Wharves coral translocation.

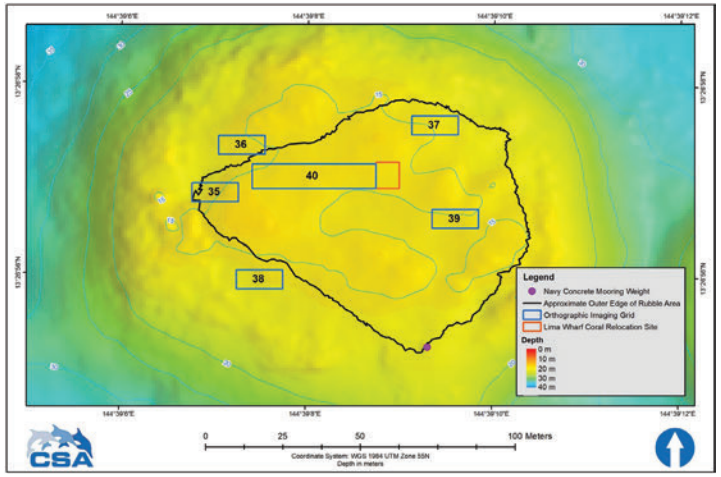


Figure 18. Locations of survey grid cells 35-40 at potential coral relocation areas on Mound 9.

During the 2020 surveys, dive teams surveyed the proposed cable route using pre-plotted waypoints for underwater positioning and diver tracking (Figure 19). Water depths along the cable route ranged from less than 1 m (3.3 ft.) at the Polaris Point terminus to 28 m (92 ft.) several hundred meters to the east of the UEMMS array site. The majority of the cable route is confined to deeper water, fine sediment bottom areas, and only occasionally passing through coral habitat when crossing shallower mound features. The cable route passed through coral cover in grid cell 18 and occasional corals and sponges were noted along the route where it crossed an elevated 14-m (45.9 ft.) depth feature before dropping back into fine sediments to the south. Just to the north of the shore landing area at Polaris Point occasional corals and sponges were again observed in the shallower depths as the route approached the shoreline.

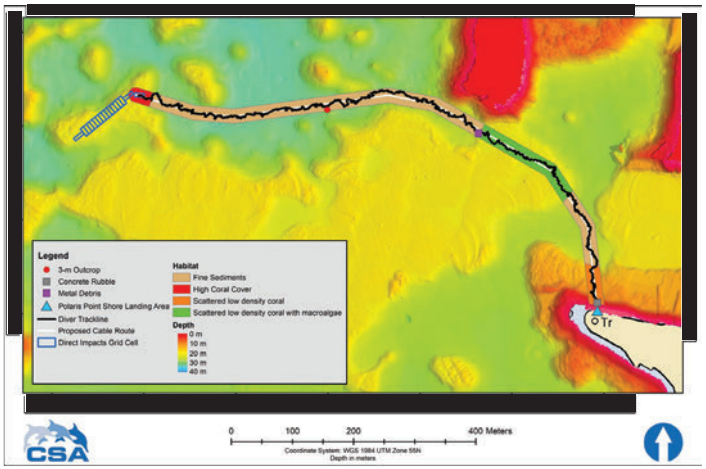


Figure 19. Surveyed cable route from UEMMS site to the Polaris Point shore landing area.

2.1.5. Unexploded Ordnance (Baseline for UEMMS)

Munitions and explosives of concern (MEC), material potentially presenting an explosive hazard (MPPEH) or unexploded ordnance (UXO) may be present in Apra Harbor as a result of World War II-era activities, as well as non-war munitions that were discarded overboard. Evaluation of available historical EOD Incident Reports and associated data resulted in a small amount of MEC/MPPEH responses/finds within Inner and Outer Apra Harbor in-water and terrestrial areas within a 1-mile radius of the Action Area (see Figure 20). No MEC were discovered within the direct project footprint, and MEC activities are not performed currently in the Action Area. However, it is reasonable and conservative to expect a possible likelihood of encountering MEC, MPPEH or UXO in the Action Area.

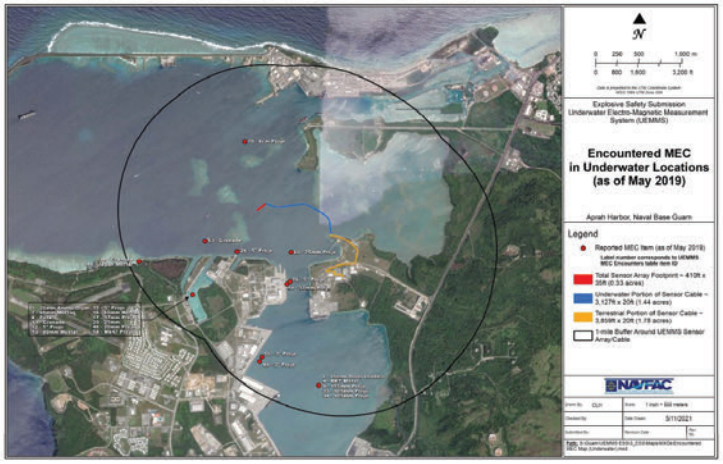


Figure 20. Historical MEC encountered underwater within a 1-mile radius of the UEMMS Action Area.

2.2. Marine Fauna

2.2.1. Corals

In September 2020, the survey methods used for coral analysis were photogrammetric orthomosaics surveys of percent cover, condition and coral demographics and *in situ* Line Point-Intercept (LPI) surveys for species richness (HDR & CSA 2020). According to Coral Point Count with Excel extension (*CPCe*; Kohler *et al.* 2006) still image analysis of the direct impacts array site orthomosaic images, the overall dominant biotic cover is comprised of an average of 35.7% hard substrate, 32.5% coral, 18% algae (macro & cyanobacteria), 7% other fauna (sponge, sessile inverts, etc.) and 6.7% sand or silt substrate (Table 2). Mean coral cover was 38.0% within the eastern direct impact grid cells, nearly twice as high as in the western direct impact grid cells with a mean of 20.9% coral cover. In the adjacent indirect areas, there was an average coral cover of 26.7%, with percent coral cover ranging from a low of 13.2% near the southwest end and up to 49.1% near the northeast end of the array. The two most abundant coral species at the UEMMS site were *Porites rus* and *Porites horizontalata*, which also often co-occur with *Porites monticulosa* and several other possibly undescribed *Porites* species (*Porites aff. horizontalata* and *Porites sp.*) with similar appearance and growth forms. It is especially difficult to visually delineate and separate these species in video and photographic images because of their continuous physical intermixing across the site, similar appearances, and the multiple growth forms of each. Due to this difficulty, they were all classified as *Porites rus* "complex". Corals within the *P. rus* "complex," primarily *P. rus*, *P. horizontalata*, and *P.* aff. *horizontalata*, were dominant in abundance at the UEMMS site and surrounding area with a percent cover of up to 46.2%. Based on orthomosaic image analysis, the total number of coral colonies within the direct impacts area grid cells was approximately 7,534 colonies. Of these colonies, only 1,166 were non-*P. rus* "complex".

The Polaris Point shore landing site grid cells were positioned across the steep slope, which comprised a predominantly disturbed sand and coral rubble substrate (75.3%). Coral abundance was low within these steeply sloping grid cells, with 145 colonies generating an average of 2.5% of the surveyed cover. *P. rus* was the most abundant coral species observed followed by *Porites* sp. massive of the seven species observed. Very few corals were identified along attempted LPI transects due to relatively low coral abundance, so direct *in situ* measurements of coral colonies within and immediately adjacent to the grid cells were made by divers to obtain coral size data for the area combined with later orthomosaic imagery analysis.

While not indicative of the entire Mound 9 coral reef habitat, the 2020 survey effort of Mound 9 focused on identifying and evaluating conditions of potential recovery sites. The provided mean coral cover across all surveys was 5.3% and as expected, the majority (70.8%) of cover is loose sediment (13.5%) or rubble substrate (52.3%). The percent coral cover within the rubble area grids averaged 1.9% and ranged from 0% to up to 3.89%. Percent coral cover increased within grid cells positioned along the border rim margin of coral reef habitat and the rubble area from 6.9% to 17.1%. *Porites* sp. massive and *Astreopora* spp. accounted for most of the coral cover within these two grid cells (HDR & CSA 2020). Despite *P. rus* being the most visually dominant species in the rim margin habitat and side slopes of Mound 9, only a single small colony was observed within the rubble areas. The presence of nine additional coral species at the UEMMS site that were not found in the surveyed area of Mound 9 supports the plan for restoration with translocation being able to increase coral species diversity as well as increase habitat complexity.

Cable impacts to coral habitat are not expected along the cable route; therefore, grid cells were not established or surveyed for detailed coral assessments, including the collection of percent cover, coral abundance and density data. The cable route extended along the length of grid cell 18 located to the east of the UEMMS array footprint. The coral community was typical of the mound crest, with high abundance of the corals *P. rus* and *P. horizontalata.* Only a single rock outcrop was noted along the entirety of the deeper section of the cable route. This rock feature was about 3 m (9.8 ft.) in height and observed along the south edge of the route approximately 310 m (1,017 ft.) from the eastern end of the UEMMS array footprint. The outcrop had a steep northern face and was lightly colonized by a few small colonies of the corals *P. speciosa* and *Leptoseris sp.* and an unidentified soft coral whip. The northwest-facing slope of the 14-m (45.9 ft.) depth flat-topped feature, approximately 550 m (1,804.5 ft.) to the east of the UEMMS array, has silt-covered coral rubble near the base with widely scattered coral colonies, primarily *P. rus* that increased in abundance near the upper slope edge. The wide crest of the feature was predominately silt-covered with occasional sponges and corals distributed intermittently, with visually estimated densities of less than 1 m^{-2}.

Table 2. Summary of percent cover values from UEMMS project sites for major groups from *CPCe* Analysis (Kohler *et al.* 2006). Full detailed data sets HDR & CSA 2020.

Site	Percent Cover			
	Algae	Coral	Other fauna	Substrate
UEMMS Array Site	18.7	32.0	7.1	42.0
Indirect Array Site	20.2	26.7	10.0	43.1
Shore Landing Area	18.6	2.5	3.6	75.3

Mound 9	**17.7**	**5.3**	**6.2**	**70.8**

A relatively low diversity of coral community composed of approximately 28 species was previously described during previous surveys of the UEMMS site area (HDR & CSA 2017). The 2020 survey results identified 33 species but several of the more common coral species are difficult to identify with consistency and could not be reliably and repeatedly identified to species during the in-situ survey and orthomosaic analysis (Table 3; HDR & CSA 2020). Corals within the *P. rus* "complex," including *P. rus*, *P. horizontalata*, and *P*. aff. *horizontalata*, were dominant in abundance at the UEMMS site and surrounding area with an estimated 6,368 colonies identified in a review of orthomosaic imagery from all of the direct impacts area grid cells.

The massive corals of the genus *Porites* may include the species *Porites australiensis*, *Porites lichen*, *Porites lobata*, *Porites lutea*, and *Porites murrayensis* (as well as several species that may be undescribed). This group of massive complex-forming species often require a detailed inspection of individual calyces and the collection of macro-photos or specimens for close inspection to confirm identification to species (HDR & CSA, 2020). Therefore, most were classified into the category '*Porites sp.* massive' to avoid inaccurate identifications. Several colonies of *Pavona* were also observed at the UEMMS site that were similar to *Pavona varians* but distinctly not that species, and also different from each other. These were classified as *Pavona sp.* (*P. varians* complex). The total number of non-*P. rus* "complex" coral colonies falling within the direct impacts area grid cells footprint based on orthomosaic imagery review was approximately 1,166 colonies.

Substantial healthy coral communities fall within the UEMMS footprint, with high percent coral cover occurring in a majority of the grid cells. Several species, including *P. rus*, *P. horizontalata*, *P. cactus* and *P. paeonia*, provide substantial three-dimensional relief and fish habitat. In addition, there are large numbers of healthy colonies of several species of massive *Porites*, major reef-building species in the region. Aside from the visible fragmentation of some of the more fragile species, most coral colonies at the UEMMS site appeared healthy, with no signs of coral disease or bleaching.

Table 3. Summary of coral taxa observed by dive teams during the UEMMS project sites surveys and image analysis, (Source: HDR & CSA 2020)

Coral Species/Taxa	UEMMS Array Area	Cable Route	Shore Landing Area	Mound 9
Acropora granulosa	x			
Astreopora cucullata			x	
Astreopora gracilis	x	x		x
Astreopora myriophthalma	x			x
Ctenactis sp.	x			
Cyphastrea serailia				x
Cyphastrea sp.				x
Diploastrea heliopora				x
Dipsastraea matthaii	x			x
Dipsastraea danae	x			x
Euphyllia glabrescens				x
Fungia moluccensis	x			
Fungiidae	x			
Galaxea astreata	x	x		x
Galaxea fascicularis	x	x		x
Goniastrea edwardsi				x
Goniastrea pectinata				x
Herpolitha limax	x	x		
Herpolitha weberi	x	x		
Hydnophora exesa				x
Leptastrea purpurea	x	x	x	
Lobophyllia corymbosa	x	x		x
Lobophyllia hataii				
Lobophyllia hemprichii	x	x		
Montipora sp.	x	x	x	
Montipora verilli sensu R&M 1982	x			
Pachyseris speciosa	x	x		
Pavona cactus	x			
Pavona chiriquensis	x			
Pavona sp. (P. varians complex)	x			
Pectinia paeonia	x	x	x	
Platygyra pini				x
Pocillopora acuta	x			x
Pocillopora damicornis				x
Porites aff. horizontalata	x	x	x	
Porites cylindrica	x	x		x
Porites horizontalata	x	x		

Coral Species/Taxa	UEMMS Array Area	Cable Route	Shore Landing Area	Mound 9
Porites lichen sensu R&M 1982	x			x
Porites lobata	x			x
Porites lutea	x	x		x
Porites murrayensis	x			
Porites rus	x	x	x	x
Porites sp. massive	x	x	x	x
Stylocoeniella armata	x	x		x
Stylocoeniella guentheri		x		
Total Coral Taxa Observed	**33**	**19**	**8**	**24**

2.2.2. Fish

Fishes and other motile vertebrates were also recorded in surveys of the UEMMS Action Areas during September 2020 (NAVFAC 2020). Fish species composition and relative abundance were assessed using a stationary census method (Bohnsack & Bannerot 1986). Fishes were counted by a solitary diver with fish identification training (ichthyologist) at stationary points consisting of a visually estimated 3-m diameter cylinder extending from the surface to the bottom. At each stationary point, the ichthyologist spent 5 min listing all fish species observed within the cylinder by rotating slowly in one direction and scanning successive, visually selected sectors. Following the initial 5 min, numbers, and size classes for each species on the list were estimated. Identification of taxa that were likely newly settled or small, cryptic species (20 mm or less) were recorded at the lowest practicable taxonomic level.

At the array site, counts were made from grid cells visually selected to be representative of the various habitats, using half of the cell (3 x 7.5 m; 10 × 25 ft.) as the sampling unit. Stationary sampling points were positioned near the center of the half-cells. The selection of cells to sample was also made to include visually representative samples of coral-dominated and rubble dominated substrates. Stationary samples at Mound 9 and the proposed landing area at Polaris Point were selected haphazardly from within the surveyed areas. No stationary counts were collected along the proposed cable route due to very limited visibility. Fishes were simply recorded for presences during a swim along the cable route.

Fish species richness from focused *in situ* surveys recorded a total of 69 species identifications within 19 families (Table 4). Five identifications could only be made to the family taxon, due partially to the survey method's limitations for capturing cryptic species and due to the limited visibility at most sites. It is anticipated that small, cryptic recruits and the Gobiidae and Blenniiddae families, which are difficult to identify to species level, were likely underrepresented in the survey data. Prior general observations of the bottom habitat indicate that Apra Harbor is rich with many goby and blenny species that live in borrows potentially with symbiotic species, such as shrimp in soft sediment habitats not extraneously examined in these surveys (NAVFAC 2020).

Table 4. Fish species richness observed in stationary plots at Apra Harbor, Guam UEMMS Project Areas ordered alphabetically by family. Names follow Allen *et al.* (2015).

Acanthuridae	**Carangidae**	**Holocentridae**	**Pomacentridae**
Acanthurus blochii	*Caranx melampygus*	*Neoniphon opercularis*	*Amblyglyphidodon curacao*
Acanthurus nigricauda	*Scomberoides lysan*	*Neoniphon samara*	*Chrysiptera traceyi*
Acanthurus olivaceus		*Sargocentron spiniferum*	*Pomacentrys amboinensis*
Acanthurus sp.	**Chaetodontidae**		*Pomacentrus pavo*
Ctenochaetus striatus	*Chaetodon auriga*	**Labridae**	*Pomacentrus sp.*
Naso annulatus	*Chaetodon ephippium*	*Cheilinus fasciatus*	
Naso lituratus	*Chaetodon lunulatus*	*Cheilinus trilobatus*	**Scaridae**
Zebrasoma veliferum	*Chaetodon ulietensis*	*Cheilinus undulatus*	*Cetoscarus ocellatus*
	Forcipiger longirostris	*Hemigymnus melapterus*	*Chlorurus spilurus*
Apogonidae	*Heniochus monoceros*	*Labroides dimidiatus*	*Hipposcarus longiceps*
Apogon sp.		*Oxycheilinus diagrammis*	*Scarus ghobban*
Cheilodipterus macrodon	**Epinephelidae**	*Stethojulis bandanensis*	*Scarus globiceps*
Cheilodipterus quinquelineatus	*Epinephelus merra*		*Scarus schlegeli*
Taeniamia fucata	*Epinephelus polyphekadion*	**Lethrinidae**	
		Lethrinus harak	**Serranidae**
Balistidae	**Gobiidae**	*Lethrinus olivaceus*	*Plectropomus sp.*
Balistoides viridescens	*Amblybogius phaelena*		
Rhinecanthus aculeatus	*Amblygobius nocturnus*	**Lutjanidae**	**Tetraodontidae**
Sufflamen bursa	*Bryaninops amplus*	*Lutjanus gibbus*	*Arothron nigropunctatus*
Sufflamen chrysopterum	*Cryptocentrus strigilliceps*		
	Ctenogobiops feroculus	**Mullidae**	**Zanclidae**
Blenniidae	*Fusigobius signipinnis*	*Parupeneus barberinus*	*Zanclus cornutus*
Meiocanthus atrodorsalis	*Exyrias belissimus*		
Pteroscrites sp.	*Eviota lachdeberi*	**Nemipteridae**	
	Eviota prasites	*Pentapodus caninus*	
	Eviota sp.		
	Oxyurichthys papauensis	**Pinguipedidae**	
		Parapercis clathrate	

Of the 69 species observed during the 2020 survey, species from the Pomacentridae family made up the largest percent of observations (38%) with *Pomacentrus ambonensis* and *Amblyglyphidodon curacao* being the most common and present at all project sites. Species from the *Apogonidae* and *Gobidae* families were the next most frequently counted species in all project sites at 20% and 13% respectively for all counts. The species-richness was comparable between the array site and Mound 9 with some variability in species (Table 5). Visibility was poor along the cable route, and fishes were only recorded as present; no estimates of abundance were attempted.

Potential habitat segregation by fish species was examined by broadly classifying substrates in censuses at all sites as either coral-dominated or rubble-dominated. The analysis illustrated that coral-dominated sites had higher numbers of *A. curacao*, newly settled damselfishes, *Meiacanthus atrodorsalis*, *Cheilodipterus*

quinquelineatus, and several dwarfgobies (*Eviota* spp.) than did rubble dominated sites. Rubble sites supported more *Pomacentrus ambonensis*, *Pomacentrus pavo*, and whip gobies (*Bryaninops amplus*).

Trophic composition of the array site fish assemblage was numerically dominated by planktivores but also included general carnivores and herbivores. Herbivores present were mostly mobile individuals such as parrotfishes and surgeonfishes. The most common roving herbivores at the array site were *Hipposcarus longiceps*, *Acanthurus nigricauda*, and *Acanthurus blochii*. A majority of the most abundant herbivorous fishes present at Mound 9 included *Ctenochaetus striatus*, *Naso lituratus*, *Acanthurus olivaceus* and *Cetoscarus ocellatus* and were not recorded at the other locations. The *Chaetodontidae* family comprised the most common sessile invertebrate feeders present. Larger piscivores were not common in census samples but sightings of *Plectropomus* sp., *Caranx melampygus* and *Scomberoides lysan* were observed outside the survey areas.

Table 5. Fish species diversity and abundance per survey location (Source HDR & CSA 2020).

Action Area	Number of Surveys	Number of Families	Number of Species	Total Counts
UEMMS Array Site	20	16	45	926
Mound 9 Coral Translocation Site	6	16	43	327
Cable Route*	2	10	15	N/A
Shore Landing Transition Site	2	8	18	201
Total	**30**	**19**	**69**	**1,454**

* Qualitative observations.

2.2.3. Other Marine Species

Within the UEMMS array area, the 2020 biological surveys identified and analyzed percent cover of macroalgae, cyanobacteria and non-coral invertebrate species, most of which were fairly equally distributed (i.e., 4% ea.) for *Porifera,* cyanobacteria or other sessile invertebrates (See Table 6; HDR & CSA 2020. Macroalgae contributed significantly to percent cover of biota within the array area with cover averaging 14.7% across the site with species *Caulerpa racemosa*, *Caulerpa serrulata*, *Caulerpa verticillata*, *Dictyota* sp., and *Lobophora* sp. contributing the most significance. Crustose coralline algae was not observed in any abundance within the surveyed areas. At least one blue-green algae or cyanobacteria observed was *Symploca hydnoides* that averaged 4.5% cover and was mostly seen in areas of broken coral rubble and disturbed sediment bottom. Observations identified several large elephant ear sponges (*Ianthella basta*) that add a significant three-dimensional component to the benthic community, along with several other sponge species (*Melophlus sarasinorum, Stylissa massa*, *Aplysinella rhax*, *Cliona* sp., *Haliclona turquoisia*, *Haliclona* spp., *Iotrochota ditrochota*, and *Xestospongia* aff. *Carbonaria)* all present in lower abundance. Average sponge cover across the UEMMS array area was 4.2%. Observed mobile invertebrates included the holothurid species *Bohadschia argus*, the sea star, *Echinaster luzonicus*, and the brittle star *Ophiomastix caryophyllata*. The sessile non-coral invertebrates benthic percent cover mean of 4.4% included the coral boring bivalve *Lithophaga* sp. (observed in colonies of *Porites* sp. massive), the tunicates *Phallusia julinea*, *Polycarpa* sp., *Rhopalaea circula*, and *Rhopalaea* sp., and an unidentified Sabellid

feather duster worm.

At the Polaris Point shore landing site, macroalgae was the most abundant biota (12%) and included *C. racemosa*, *C. serrulata, C. verticillata*, *Dictyota* sp., and *Padina* sp. The blue green alga *S. hydnoides* had a slightly more significant presence at 6.7%. *Porifera* were in low abundance with the species *A. rhax*, *Ceratopsion* sp., *Cliona* sp., *Liosina granularis*, *Stylinos* cf. *ruetzleri*, and *X.* aff. *carbonaria* noted. Sponge percent cover had an average of 2.5% with an unidentified sponge species that comprised nearly all of the sponge cover. Motile invertebrates included the holthuroid *Holothuria atra* and the nudibranch *Risbecia* sp. Common sessile invertebrates were the boring bivalve *Lithophaga* sp. and the tunicate *P. julinea* making up just 1.2% of cover.

At Mound 9, macroalgae percent cover averaged 14.0% with several species of the green algae *Halimeda* being observed throughout the rubble areas of the mound, but *Dictyota* sp. and *Padina* sp. were most abundant. The common sponges observed within the Mound 9 grid cells included *C. eurypa*, *Cliona* sp., *Hyrtios atrum*, *I. basta*, *I. ditrochota*, *Liosina* sp., *S.* cf. *ruetzleri*, and *X.* aff. *Carbonaria* generating 3.0% cover. Mobile invertebrates were comparatively rare within the rubble area on Mound 9 with the holothuroid species *S. maculata* the most distinct and *B. argus* also observed. Other sessile non-coral invertebrates included the coral boring bivalve *Lithophaga* sp., and the tunicates *Clavelina moluccensis*, *P. julinea*, *Polycarpa* sp., *R. circula*, *Rhopalaea crassa*, and *Rhopalaea* sp. comprising 2.4% of the benthic cover.

Due to the length of the cable route, percent cover was not able to be generated with divers reporting general findings and observations. The benthic habitat transitioned from reef described in the previous sections to fine sediments at about 20 m (66 ft.) depth, with large numbers of small polychaete worm, shrimp, and goby burrows appearing at about 22 to 24 m depths (72 to 80 ft.). The 3 m (9.8 ft.) outcrop was colonized by the sponges *C. eurypa* and *I. ditrochota*, and large amounts of the green algae *C. verticillata* was heavily covered with silt. Sponges and macroalgae were observed on the northwest-facing slope of the 14-m (45.9 ft.) depth flat-topped feature approximately 550 m (1,804.5 ft.) to the east of the UEMMS array. The slope is colonized by a few sponges (*I. basta*), with silt-covered coral rubble near the base. The wide crest of the feature is silt-covered with occasional sponges (*A. rhax*, *H. turquoisia*, *Haliclona* sp. 1, *I. basta*, and *I. ditrochota)*, having estimated densities of less than 1 m^{-2}. The holothuroid *Synapta maculata* was the only motile invertebrate observed. Sessile invertebrates consist primarily of the two tunicate species *P. julinea* and *R. circula*. Silt-covered macroalgae is the most visually abundant biotic component including *Caulerpa taxifolia*, *C. verticillata*, *Dictyota* sp., *Halimeda macroloba*, and *Halimeda* spp., along with small patches of cyanobacteria.

Table 6. Summary of non-coral biotic percent cover values from UEMMS project sites for major groups from *CPCe* Analysis (Kohler *et al.* 2006). Detailed data are in: HDR & CSA 2020).

Site	Percent Cover			
	Macroalgae	Cyano-bacteria	Sponges	Sessile Inverts
UEMMS Array Site	13.2	4.9	4.1	3.0
Indirect Array Site	16.1	4.1	4.3	5.8
Array Site Average	14.7	4.5	4.2	4.4
Shore Landing Area	12.0	6.7	2.5	1.2
Mound 9	14.0	3.7	3.0	2.4

Vessel crew at the surface observed two sea turtles during dives at the UEMMS area. A small 0.5-0.6 m (1.6-2 ft.) green turtle (*Chelonia mydas*) was noted surfacing near the center of the site and a small (<0.5m; 1.6 ft.) hawksbill turtle (*Eretmochyles imbricata*) surfaced west of the site. Another unidentified turtle was noted at the surface more than 75 m (246 ft.) from the dive vessel at the very western end of Mound 9. Exotic or invasive species noted within the survey footprint included the elephant ear sponge *Ianthella basta*, which was observed throughout the UEMMS survey area and is common throughout deeper regions of Apra Harbor. No seagrass, marine mammals, ESA-listed species, or invasive species other than *I. basta* were observed throughout the Action Area.

2.3. ESA-Listed Species and Critical Habitat

Table 7 lists the marine, ESA-listed species that may be encountered during the Proposed Action. Based on historical records and results from biological surveys of Apra Harbor (HDR & CSA 2020), only three species, the green sea turtle (*Chelonia mydas*)*;* hawksbill sea turtle (*Eretmochelys imbricata)*; and the scalloped hammerhead shark (*Sphyrna lewini*), have reasonable potential to occur where most of the Proposed Action will occur. No ESA-listed coral species were observed within the Action Area (Section 2.2.1). During the dredge disposal trips to the G-DODS, all of the ESA-listed above may be encountered, and the risk of a vessel collision with ESA-listed whales and dolphins are considered a possible impact (Section 3.1.5). Furthermore, if a crane barge is needed from outside Guam, vessels will likely travel from Honolulu, Hawaii, and through critical habitat for the Main Hawaiian Islands (MHI) Insular False Killer Whale (IFKW) Distinct Population Segment (DPS). All other actions will occur within Apra Harbor, where no critical habitats occur. Thus, with the exception of the disposals at the G-DODS and a barge transport, this impacts and risks assessment will primarily focus on the potential impacts to the three species: green sea turtle (Central West Pacific DPS)*;* hawksbill sea turtle; and the scalloped hammerhead shark, Indo-West Pacific DPS.

Table 7. ESA-listed species that may be encountered in Apra Harbor, Guam

Scientific Name	Common Name	Status
MARINE MAMMALS		
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	
Balaenoptera borealis	Sei whale	
Physeter microcephalus	Sperm whale	
Pseudorca crassidens	Main Hawaiian Islands Insular False Killer Whales Distinct Population Segment (DPS)	
SEA TURTLES		
Chelonia mydas	Green sea turtle, Central West Pacific DPS	Endangered
Eretmochelys imbricata	Hawksbill sea turtle	
Dermochelys coriacea	Leatherback sea turtle	
Caretta caretta	Loggerhead sea turtle, North Pacific DPS	
Lepidochelys olivacea	Olive ridley sea turtle	Threatened
FISHES		
Sphyrna lewini	Scalloped hammerhead shark, Indo-West Pacific DPS	Threatened
Manta birostris	Giant manta ray	
Carcharhinus longimanus	Oceanic whitetip shark	
CORALS		
Acropora globiceps	---	Threatened

2.3.1. Green Sea Turtles, Central West Pacific DPS

The green sea turtle is globally distributed along continental coasts and islands in tropical and subtropical waters. In 2016, NMFS reclassified the species into eleven DPS (USFWS & NOAA 2016). The Central West Pacific DPS encompasses green sea turtles in Guam, which are listed as "endangered". Detailed information about the biology, habitat, and conservation status of green sea turtles was described in the *Recovery Plan* (NMFS & USFWS 1998), the *5-year Status Review* (NOAA & USFWS 2007a), the *Green Sea Turtle Status Review* (NOAA-NMFS 2015a), and several publications specific to the Mariana Islands. Threats to the Central West Pacific DPS include nesting habitat degradation, destruction and modification of marine habitat, harvest of turtles and eggs, predation, incidental catch in fisheries, marine debris, temperature increases, sea level rise, and increased frequency and intensity of storm events (USFWS & NOAA 2016).

Green turtles are the most abundant and common sea turtle in Guam waters (Guam DAWR 2015; Martin *et al.* 2016). The seagrass beds and macroalgae of Agat Bay, Sasa Bay, and Apra Harbor provide important foraging and resting areas for green turtles (Guam DAWR 2006, 2015; Brindock 2015; Martin *et al*. 2016, as cited in DON 2018). Inner Apra Harbor has limited habitat for green turtles and with few recoded sightings (DoN 2018). In 2019, three surface observations of green sea turtles occurred within the Action Area and during approximately 40 hours of observation time (NAVFAC 2019). Thus, green sea turtles have a regular but low level occurrence within the Action Area.

The Central West Pacific DPS use the nearshore waters of the Orote Peninsula and Outer Apra Harbor waters,

and nest on three beaches within NBG Main Base: Spanish Steps, Dadi Beach, and Kilo Wharf. (DoN 2018). Considered one of the primary nesting locations on Guam, the main period of green turtle nesting and non-nesting emergences (also known as nesting attempts or false crawls) have been documented at the Spanish Steps from March–July, with some nesting activity observed from December through February (DoN 2018). Survey data showed 14 nesting events for other beaches, including Dadi Beach, Gab Gab Beach, Family Beach. No sea turtle nests nor non-nesting emergences were documented within the Action Area, including the coast at Polaris Point, which had previously contained large reef flats but have since been filled in (DON 2018). Today, Polaris Point is comprised of remnant sheet pile walls that are decaying, and the rock that was used as fill material forms the current rocky shoreline. Therefore, it is highly unlikely that the coastline at Polaris Point in the Action Area would support nesting activity for green sea turtles.

2.3.2. Hawksbill Sea Turtle

Hawksbill sea turtles are distributed globally in tropical and subtropical waters between 30° N and 30° S. Foraging hawksbill sea turtles inhabit the Pacific Region, but are less common and less prevalent than green sea turtle, i.e., hawksbill turtles occur in lower numbers in Guam waters (NOAA & USFWS 2007b; Martin *et al.* 2016, as cited in DON 2018). The *Recovery Plan* (NMFS &USFWS 1998b) and the *5-year Status Review* (NOAA & USFWS 2013) described detailed information about hawksbill sea turtle biology, habitat, conservation status, nesting abundance, and trends, with conclusions that the populations in the Mariana Archipelago and CNMI are declining. The primary threats to hawksbill turtles are habitat degradation and loss from coastal development, water pollution, and global climate change. Throughout the Pacific Islands, hawksbill turtle eggs and meat are harvested for food and other parts, such as the shell, for jewelry and other products.

Hawksbill turtles have been seen within all areas of Apra Harbor, which may provide important foraging and resting areas for this species (Kolinski 2001; Smith *et al.* 2009; Brindock 2015; Guam DAWR 2015; Jones *et al*. 2015, as cited in DON 2018). Two sightings of hawksbill sea turtles occurred along Orote Peninsula: one in November 2003 and the other in October 2004 (Smith & Marx 2006). At least three hawksbill sea turtles were observed during DPV reconnaissance surveys in Apra Harbor (HDR & CSA 2017). In 2019 and 2020, biological surveys of the Action Area did not observe a hawksbill sea turtle (NAVFAC Marianas 2019, 2020).

As with green sea turtles, hawksbill sea turtle natal nesting areas are frequently located in different island groups, and residents at a given island group may originate from multiple natal nesting areas (NOAA & USFWS 2007b). However, nesting by hawksbill turtles have not been observed on NBG since 1995 on a small beach within the Sumay inlet (Commander Naval Forces Marianas 2001; DON 2009; Wenninger 2015, as cited in DON 2018). There is no nesting habitat for hawksbill sea turtles in the Action Area. Therefore, hawksbill sea turtles may have a rare and infrequent occurrence within the Action Area.

2.3.3. Scalloped Hammerhead Shark, Indo-West Pacific DPS

The scalloped hammerhead shark is distributed globally in warm temperate and tropical waters (Miller *et al.* 2014). Sharks on Guam are within the Indo-West Pacific DPS, which was listed as threatened in 2014 (NMFS 2014). The earliest confirmed record of a scalloped hammerhead shark on Guam was in 1968, but confirmed sightings are rare today (Kami 1971; NMFS 2014; Adams 2018, as cited in DON 2018). Anecdotal observations of adult scalloped hammerhead sharks have been noted at multiple locations around Guam, including Outer Apra Harbor, Sasa Bay, the southernmost part of Inner Apra Harbor, the outer coastline of the Orote Peninsula near the Orote Airfield (NOAA-NMFS 2015c; Adams 2018). However, no confirmed scientific evidence of scalloped

hammerhead sharks has been documented in Apra Harbor, and no anecdotal sightings have been documented in Apra Harbor since 2004 (NOAA-NMFS 2015c).

Scalloped hammerhead sharks are highly mobile and partly migratory (Maguire *et al.* 2006 as cited in Miller *et al.* 2014). They inhabit bays and estuaries and occur from surface waters down to depths of 512 m, with occasional dives up to 1,000 m (Miller *et al.* 2014). Sharks lack pelagic larvae, and young are born live during summer breeding season between May and September (Duncan *et al.* 2006). Juvenile scalloped hammerhead sharks may inhabit nursery areas for more than a year, seeking refuges from predation (Duncan & Holland 2006). Areas of higher abundance included greater turbidity, higher sedimentation, and higher nutrient flow (Duncan & Holland 2006). Adult scalloped hammerheads appear regularly in nursery grounds, suggesting that this species may have a capacity for philopatry (i.e., tendency for an animal to return to its birth site, Duncan *et al.* 2006). Based only on anecdotal observations of solitary scalloped hammerhead sharks, Sasa Bay is suggested as a potential nursery area (NMFS 2015), although there is no scientific evidence to confirm this supposition (NMFS 2015; Resko 2018). Also, NMFS has not designated critical habitat for scalloped hammerhead sharks in Apra Harbor. Furthermore, the high level of human activity and the lack of quality habitat in Inner Apra Harbor may limit their presence in the area (DoN 2019). Finally, no scalloped hammerhead sharks were observed during the 2019 and 2020 biological surveys of the Action Area (NAVFAC Marianas 2019, 2020). With the lack of substantiating evidence, large numbers of scalloped hammerhead sharks are unlikely to occur in the Action Area, and the likelihood of encountering a solitary shark is rare.

The primary threats to the Indo-West Pacific DPS of scalloped hammerhead sharks include overutilization by industrial/commercial and artisanal fisheries, overutilization by illegal, unregulated, unreported fisheries. Habitat degradation, inadequacy of current regulatory mechanisms, and impacts to schooling behavior are moderate risks (Miller *et al*. 2014). Both CNMI and Guam banned the possession, sale, offer for sale, trade, and distribution of shark fins. Guam also explicitly prohibits the take, purchase, barter, transport, export, and import of shark fins.

2.4. Essential Fish Habitat Occurring within the Action Area

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). MSA 50 CFR 600.10 provides further definition for interpreting EFH. The entire Action Area is located within the boundaries of the *Fishery Ecosystem Plan for the Mariana Archipelago* (WPRFMC 2009a). This Fishery Ecosystem Plan (FEP) used an ecosystem-based approach with “geographically defined ecosystem plans containing identical fishery regulations”. Also, the FEP identified and categorized MUS based on the relevant managed fisheries, and incorporated the management provisions of the former Fishery Management Plans with updates.

The *Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region* (WPRFMC 2009b) manages those resources and habitats associated with the pelagic ecosystem, specifically the PMUS. The Pelagic FEP encompasses all areas of pelagic fishing operations in the Exclusive Economic Zone (EEZ) or on the high seas, for any domestic vessels that: 1) fish for, possess, or transship Pacific PMUS within the EEZ waters of the Western Pacific Region; or 2) land Pacific PMUS within the states, territories, commonwealths or unincorporated U.S. island possessions of the Western Pacific Region.

EFH was designated as the marine water column from the surface to a depth of 1,000 m from shoreline to the outer boundary of the EEZ (i.e., 5,150 km; 200 nautical miles; 230 miles), and on the seafloor from the shoreline

out to a depth of 400 m around each of the Mariana Islands. As such, the water column, seafloor, and all surrounding waters and submerged lands within the Mariana Archipelago are designated as EFH and support various life stages for the MUS identified under the Mariana and Pelagic FEPs. The MUS and life stages found specifically within the Mariana Archipelago include eggs, larvae, juveniles, and adults for BMUS and PMUS (Table 8). No Habitat Areas of Particular Concern (HAPC) occur for these MUS within Guam, and likewise the Action Area. Furthermore, NMFS considers EFH to comprise specific types of habitat, such as coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, mangrove, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean.

Table 8. EFH designated within Action Area in Inner Apra Harbor, Guam.

MUS	Species Complex	Designated EFH
BMUS	• Shallow-water (0-100 m, 0-330 ft.) • Deep-water (100-400 m, 330-1,320 ft.) Complexes	• Adults and juveniles - water column and all bottom habitat from the shoreline to 400 m (1,320 ft.) encompassing steep drop-offs and high-relief habitat • Eggs and larvae - water column extending from the shoreline to the outer limit of the EEZ to a depth of 400 m (1,320 ft.)
PMUS	• Temperate/Tropical Species • Sharks • Squid Complexes	• Juveniles & Adults: water column from the surface to 1,000 m (3,300 ft.); from shoreline to the outer limit of the EEZ. • Eggs & Larvae: water column from the surface to 200 m (660 ft.); from shoreline to outer limit of the EEZ.

3. Effects of the Proposed Action

3.1. ESA Effects Analysis

Under the ESA, the effects of the action refer to the direct and indirect effects of an action on the species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action and that will be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR § 402.02). Section 7(a)(2) states that each Federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or destroy/adversely modify designated critical habitat, and as such is responsible for making one of the following effects determinations, as described in the ESA Section 7 Consultation Handbook (UFWS & NMFS 1998):

- No Effect: the appropriate conclusion when the action agency determined that its proposed action will not affect a listed species or designated critical habitat
- May Affect, but Not Likely to Adversely Affect: the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat, and the effects on listed species are expected to be discountable, insignificant, or completely beneficial
    - Beneficial effects are contemporaneous positive effects without any adverse effects to the species
    - Insignificant effects relate to the size of the impact and should never reach the scale where take occurs
    - Discountable effects are those extremely unlikely to occur
- Likely to Adversely Affect: the appropriate determination if any adverse effects on listed species or designated critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial; also the appropriate determination if any "take" of listed species will occur.

In analyzing effects to ESA-listed species, the Navy considered the duration and timing of the proposed action, and the frequency, intensity, and severity of disturbance. The proposed Action Area represents a small portion of the geographic range of ESA-listed species. The Proposed Action is expected to begin in November 2021 and will require about 10 months (including anticipated weather and standby days) to complete. The in-water work will require approximately five months to complete.

The Proposed Action involves in-water work requiring the use of heavy machinery and equipment (both staged on land and atop a floating barge), divers using hydraulic hand tools, transit of a barge pulled by a tug from Apra Harbor to G-DODS, and a potential barge movement from outside Guam (Section 1.2). All such activities have the potential to impact ESA-listed species in the marine environment of Apra Harbor and between Apra Harbor and G-DODS. The following sections includes an analysis of the direct and indirect effects of the Proposed Action on ESA-listed species. Most effects of the action are considered to have minimal impacts and risks (Table 9), particularly due to low likelihood of ESA-listed species occurrence and the BMPs implemented into the Project design (Section 3). Potential effects from the proposed action may result from exposure to the following environmental stressors:

- disturbance from human activity and equipment operation, including direct physical contact

- elevated noise levels
- elevated suspended sediments
- vessel collisions
- wastes and discharges
- entanglement.

No listed species is known to breed or reproduce in the Action Area, and thus the Proposed Action will have discountable effects on the reproductive success of these animals. Green sea turtles have a regular but low-level occurrence within the Action Area, and thus, the Proposed Action may affect this species, which will be evaluated in the following sections. Hawksbill sea turtles and scalloped hammerhead sharks are expected to have a rare and infrequent occurrence, and the following impact and risk assessment applies a precautionary approach to include these species.

Sperm whales, baleen whales (i.e., blue, fin, and sei), giant manta rays, and oceanic whitetip sharks are not expected to occur within Apra Harbor, but rather may be encountered during the ocean disposal operations and open-ocean vessel and barge movements (if needed). If a vessel or barge is transported from the MHI, the vessels will transit through the MHI IFKW DPS critical habitat. Thus, potential adverse effects to these listed species will only be evaluated for these activities (Sections 3.1.2 and 3.1.5).

Further, the annual peak coral spawning event in Guam waters occurs 7–10 days after the full moon in July (Richmond and Hunter, 1990). Despite evidence that does not identify *A. globiceps* within the Action Area, all in-water work will cease during this time period to maximize the reproductive success of *A. globiceps* (see Section 3). Therefore, the Navy determined that potential impacts from the Proposed Action to this species are expected to be discountable and will not be assessed further.

Table 9. Environmental risk assessment summary of the potential impacts from the proposed Action on ESA-listed species.

Environmental Stressor	Probability	Severity	Risk Level	Mitigation	Risk Assessment for ESA-listed Species
Elevated underwater noise levels (Section 3.1.2)	Near Certainty	Negligible	Moderate	• Marine fauna observers • Shut-down zone	Insignificant
Increased suspended sediments (Section 3.1.3)	Near Certainty	Negligible	Moderate	• Erosion control practices • Silt containment devices/curtains • Inclement weather contingency	Insignificant
Disturbance from human activity and equipment operation, including direct physical contact (Section 3.1.1)	Low	Negligible	Low	• Marine fauna observers • Shut-down zone • Safe equipment use & management • Safe vessel use & management	Discountable
Direct physical contact (Section 3.1.4) Vessel collisions (Section 3.1.5) Wastes and discharges (Section 3.1.6) Entanglement (Section 3.1.7)	Not Likely	Negligible	Low	• Marine fauna observers • Shut-down zone • Safe equipment use & management • Safe vessel use & management • Debris containment • Oil spill contingency plans	Discountable

3.1.1. Disturbance from Human Activity and Equipment Operation

The Proposed Action will result in increased human activity and equipment operation within and adjacent to the marine environment throughout the duration of the Project. Increased, Project-related activity in Apra Harbor will increase human presence, increase ambient noise levels, and increase potential for interaction with ESA-listed species. However, Apra Harbor is a site of regular human and mechanical activity onshore and in the water, and animals that enter and remain in Apra Harbor can be expected to be habituated to some degree to human activity.

Despite their likely habituation to ambient activity levels, increased human activity has the potential to disturb normal behavior of ESA-listed species (other than coral) in Apra Harbor and in the shipping lane to G-DODS. Expected reactions range from benign investigation of or attraction to the activity, avoidance of the area or, the extreme, panicked fleeing with potential self-injury during flight.

Sea turtles are known to be present in Apra Harbor (although occurrence is expected to be low). However, it is expected they will also avoid human activity throughout the duration of heightened nearshore and in-water activity. Marx and Smith (2013) determined that no impacts to sea turtles are expected to occur, regardless of the chosen location for the UEMMS sensor array, provided the following BMP is implemented: "if any sea turtles are sighted within 150 feet of the construction vessels/equipment, all construction activities should be suspended until the sea turtle voluntarily leaves the area, or disappears and is not sighted for a period of 15 minutes." Furthermore, a recent telemetry study documented flatback sea turtles (*Natator depressus*) before, during, and after a major dredging operation and their breeding season, and the results clearly showed that during the active dredging, flatback turtles increased their use of the dredging areas (Whittock *et al*. 2017). Tagged sea turtles undertook longer and deeper resting dives during dredging, utilizing the newly-created, deeper waters of the dredging areas. Despite their increased use and the presence of active dredge vessels, no events of injury or mortality were recorded. The authors concluded that a possible driver behind the tracked turtles change in movement and dive behavior was predator avoidance, mostly from sharks.

BMPs will be implemented to ensure intentional interactions with ESA-listed species are avoided and that unintentional interactions are minimized to the greatest extent practicable. Biological observers will remain constantly vigilant of the presence of ESA-listed species within a distance that could be impacted, the success and effectiveness of in-water BMP measures and to provide visual observation of the marine waters at all times immediately preceding, during and immediately after in-water construction activities. All personnel are expressly prohibited from attempting to or disturbing, touching, riding, feeding or otherwise -intentionally interacting with ESA-listed species. Additionally, in-water BMP structures (such as a silt curtain) will create a physical barrier between listed species and the active in-water work area to avoid any unintentional interactions.

Determination

The Navy determined that disturbance from human activities and equipment operation may affect but is not likely to adversely affect green sea turtles, hawksbill sea turtles, and scalloped hammerhead sharks. Through implementation of Project-specific BMP measures, any impacts to ESA-listed species resulting from increased human activity in the nearshore and marine environment will be indirect and minimal, and the potential risk for impact completely eliminated upon completion of the Proposed Action, which is expected to have a duration of about 10 months. Because direct impact will be avoided to the greatest extent practicable, such effects are expected to be discountable. Should the increased human activity result in a change in behavior, it is anticipated

that such effects would be insignificant.

3.1.2. Elevated Noise Levels

The proposed UEMMS in-water activities that will produce elevated noise levels include:

- dredging for the sensor array installation (i.e., excavation of seafloor and boulder revetment using a clamshell bucket dredge)
- underwater instrument array installation by divers using a handheld hydraulic breaker
- installation of guide piles for cable (steel pipes will be driven in with vibratory hammer and pvc and/or fiberglass pipe that will be jetted into substrate)
- installation of earth anchors with a barge or vessel using a topside pneumatically-driven jackhammer (Section 1.2.3).

None of these actions have the potential to generate sound levels loud enough to cause permanent injury or harm to the marine fauna species likely to be in the Action Area. However, of these activities, only marine dredging is likely to generate noise levels with the potential to cause adverse effects to ESA-listed, marine species. Sounds from dredges can be variable, depending on the phase of operation and the type of dredge used, but typically occur at low frequencies (<500 Hertz [Hz]; Reine *et al.* 2014). Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. Bucket dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The mechanical dredge noise is generated from lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge.

Underwater acoustic sound levels from bucket dredging were measured at various distances from dredge operations in the Cook Inlet, Alaska (Dickerson *et al.* 2001). The sounds generated a single cycle of bucket deployment and retrieval, which comprised six separate acoustic noise sources/events (Figure 21). The maximum noise spike occurred when the bucket hit the bottom. All other noise levels from this operation (e.g., winch motor, spuds) were insignificant.

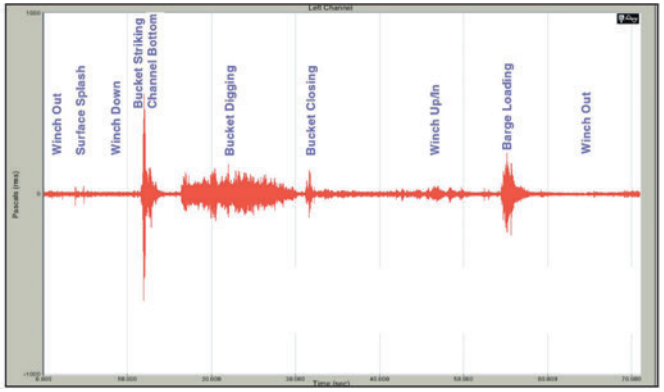


Figure 20. Pressure waveform measured during bucket deployment and retrieval events from dredging operations in coarse sediments in Cook Inlet, Alaska (Dickerson *et al.* 2001).

During the dredge operations, the acoustic events above occurred repeatedly in approximately one-minute periods (Dickerson *et al.* 2001). When peak sound pressure level (SPLs) were compared, the impact sound in coarse sediments had the highest sound intensity level, while the bucket closing (i.e., snap/clank sound) produced the least intense sounds. However, the SPL of an impact sound in soft sediment was substantially lower by a difference of 17 decibel (dB). The peak frequency levels varied, with the highest frequency sound measured from the bucket closing, and the lowest peak frequencies measured during the winch operations.

Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson *et al.* 2001), the estimated sound levels of the proposed action in the outer Apra Harbor are not expected to exceed SPL_{RMS} of 124 dB re 1 micro Pascal (µPa) from the impact sound (Table 10). The surrounding substrate is soft silt-covered rubble and sandy seabed that will generate much less sound than hard substrates when dredged. In addition, the bottom of the UEMMS dredge site does not contain environmental habitats or conditions that could result in fish being trapped (e.g., site-attached species) and unable to move away from the noise source.

Table 10. Peak underwater sound pressure levels root-mean-square (SPL_{RMS}) and peak frequencies measured during bucket deployment and retrieval events from dredging operations in Cook Inlet, Alaska (Dickerson *et al.* 2001).

Dredge Event	Peak SPL_{RMS} (dB re 1 µPa)	Peak Frequency (Hz)
Winch Noise	116.6	34.99
Impact Sound (coarse sediments)	124	162.8
Impact Sound (soft sediments)	107	91.5
Grinding Sound	113.2	40.4
Snap/Clank Sound	99.25	316.3
Dumping Sound (empty barge)	108.6	82.1
Ambient Sound (no dredging)	73.2	57.8

Implemented BMPs (Section 1.4) will require that all work stops when an ESA-listed marine species is observed within 50 yards of the work (i.e., Shut-down Zone), and will resume only after the animal has departed voluntarily or until 30 minutes have passed since the previous sightings, thereby ensuring that no direct, physical impacts (permanent threshold shift: PTS onset) will occur to green or hawksbill sea turtles or the scalloped hammerhead shark.

Furthermore, the complex and relatively shallow marine environment of Apra Harbor will constrain sound transmission to short distances within the harbor. In shallow waters of bays and harbors, sound can be refracted from the bottom or the top, causing either reduced or enhanced transmission (Richardson *et al.* 1995; Urick 1983). Rough surfaces and bottom features may scatter or divert underwater sound energy from a regular path if the medium contains inhomogeneities (i.e., volume scattering). Thus, sound propagation at the Action Area will be modified by physical obstructions (such as barges, piles, and existing structures) and water inlet characteristics (such as the narrowness of the channel to Inner Apra Harbor and the slope of surrounding rock mounds).

Acoustic Effects to Sea Turtles

Sea turtle auditory sensitivity levels and functional morphology are not clearly defined nor well understood in the scientific literature. Morphological investigations demonstrated that sea turtles are poor auditory receptors to airborne sound and have adaptations for underwater sound reception, such as subtympanal fat with density similar to seawater and middle-ear air retention (Piniak *et al.* 2016, Popper *et al.* 2014). Bony encasing around the ear was presumed to allow bone conduction of sound but may in fact prevent the collapse of the air-filled, middle ear during deep dives. While these adaptations facilitate sound pressure level detection, it remained unclear if sea turtles detect sound through either sound pressure levels or particle motion and vibrational stimuli, or both.

Electrophysiological studies measured sea turtle hearing ability and responses to sound stimuli using auditory brainstem responses (ABR) to auditory evoked potential (AEP) techniques. The underwater audiograms for six sub-adult and two juvenile green sea turtles showed hearing sensitivities that were specialized for low-frequency levels from about 100–800 Hertz (Hz; Bartol & Ketten 2006). Similarly, another study produced underwater, AEP audiograms for five juvenile green sea turtles with the same peak, low-frequency hearing sensitivity but with a

wider hearing range overall (Piniak *et al.* 2016). With juveniles, auditory evoked potential responses was between 50 and 1600 Hz, with maximum underwater sensitivity between 200 and 400 Hz (Piniak *et al.* 2016). Hawksbill hatchlings are capable of hearing underwater sounds at frequencies of between 50 and 1,600 Hz (maximum sensitivity at 200 to 400 Hz; Piniak 2012). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994b, as cited in NMFS Office of Protected Resources, 2015).

Information on the importance of acoustic stimuli for sea turtles is lacking, especially to determine impacts from natural and anthropogenic, sound sources (e.g., explosions, sonar or pile driving noise; Popper *et al.* 2014). Sea turtle susceptibility to permanent threshold shifts (PTS) has not been investigated. Temporary threshold shift (TTS) evidence in sea turtles is limited to scattered records and anecdotal accounts. Sea turtle behavioral responses to noise were investigated mostly with seismic sound sources, which is very different from marine dredging noise. Behavioral responses from exposure to elevated sound levels are variable and may include (but are not limited to):

- leaving the area of the noise source/avoidance/displacement
- startle/alarm responses
- spatial changes in schooling behavior/swimming patterns
- changes in depth/vertical distribution.

Incidental observations by boat operators and divers suggested that sea turtles are not highly reactive to underwater sounds. The behavioral effects vary between species and individuals, and are dependent on the properties of received sound. Available evidence suggested that behavioral changes for some sea turtle species may be no more than a nuisance factor, and that within a few seconds, the animals are likely to continue their previous activity. Further, it is important to note that exposure studies are undertaken in controlled environments, and the results must be extrapolated carefully to open-water marine areas with different sound propagation and where animals may swim away freely from the sound source (Nelms *et al.* 2016). Sea turtles may also rely more on visual cues than auditory input and are less sensitive to acoustic disturbances than cetaceans (Hazel *et al.* 2007).

Sound Exposure Guidelines for Fishes and Turtles (Popper *et al.* 2014) evaluated the biological and ecological diversity of sound detection capabilities, as well as the different acoustic characteristics and appropriate metrics for different anthropogenic sounds. Based on the best available scientific data, these guidelines presented a set of numerical thresholds or, if data were insufficient, the relative likelihood of effects occurring. Sounds above the guideline thresholds were considered likely to result in that effect, with higher sound levels likely to produce greater effects, and different guideline levels were provided for different sound sources and different receptor species. For sea turtles exposed to continuous dredging sounds, there are no data on exposure or received levels that enabled guideline numbers to be provided. Rather, acoustic threshold criteria for sea turtles were presented as relative risk (i.e., high, moderate, low) given for animals at three distances from the source defined in relative terms (i.e., near, intermediate, and far; Popper *et al.* 2014). Thus, without specific acoustic thresholds, a risk of acoustic impacts is high if a sea turtle is located near (i.e., tens of meters) to the sound source. However, with implemented BMPs (Section 1.4), in-water Project activities shall not commence or will halt if a sea turtle is observed within 50 yards, and thus adverse acoustic impacts are discountable and not likely to adversely affect ESA-listed sea turtles.

Acoustic Effects to Sharks

Unlike many bony fishes, sharks do not possess swim bladders or other structures that can convert acoustic pressure into a displacement stimulus and are, therefore, thought to be able to respond only to the particle motion component of sound (acceleration, velocity or displacement) and not the pressure component, although this remains to be demonstrated conclusively (Nelson 1967; Gardiner *et al*. 2012, Hart & Collin 2015). Sharks are able to hear sounds up to approximately 1000 Hz and are most sensitive to frequencies below approximately 100 Hz (Nelson 1967; Popper & Fay 1977; Casper & Mann 2006, 2007a, b, 2009; Hart & Collin 2015). As a group, sharks appear to be less sensitive to sounds at all frequencies compared to teleosts fishes, either due to the lack of any pressure-to-displacement transduction mechanism (e.g., swim bladder and Weberian ossicles) or because their gelatinous otoconial masses are less dense than the solid otoliths of bony fishes and, therefore, less sensitive to linear motion and acceleration (Casper & Mann 2007a; Hart & Collin 2015).

Research demonstrated that sharks may be attracted to underwater acoustic sounds, as coastal and oceanic sharks (18 species observed) would often approach underwater speakers broadcasting low-frequency, erratically pulsed sounds from as far away as several hundreds of meters (Myrberg 2001 in Casper *et al.* 2012). Other studies attempted to determine the acoustic characteristics that cause sharks to leave a location, and found that sudden onset, loud (20–30 dB above ambient noise levels) sounds resulted in startling sharks before leaving the area. In most cases involving attraction and repelling, the sharks would habituate to the stimuli after a few trials (Casper *et al.* 2012). However, there is no evidence of acoustic impacts to sharks from dredging operations.

Furthermore, there are no known studies on the auditory sensitivity of scalloped hammerhead sharks, but their hearing sensitivity is likely to be similar to that of other sharks and elasmobranchs, which have poor hearing sensitivities and cannot likely detect sounds pressure (Casper & Mann 2006). Therefore, acoustic impacts from elevated underwater sound levels produced by dredging activities will be discountable to scalloped hammerhead sharks.

Acoustic Effects to Critical Habitat

The Proposed Action may require a vessel and/or a crane barge to be brought from outside Guam and possibly the MHI. Should open-ocean vessel/barge movements occur from the MHI to Guam, the transit route would most likely be in and out of Honolulu, Oahu, and through waters designated as MHI IFKW DPS critical habitat, which includes water from the 45-m depth contour to the 3,200-m depth contour around the MHI from Niihau east to the Big Island of Hawaii. The critical habitat comprises a single, essential feature (i.e., island-associated marine habitat for MHI IFKW) with four characteristics that support this feature:

1. adequate space for movement and use within shelf and slope habitat
2. prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
3. waters free of pollutants of a type and amount harmful to MHI IFKWs
4. sound levels that will not significantly impair false killer whales' use or occupancy.

Underwater noise has the potential to adversely affect the critical habitat characteristic for sound, and scientific evidence indicates that permanent or chronic noises source can degrade the conservation value of the underwater habitat. However, not all types of underwater noise result in adverse modification of critical habitat. For the limited inter-island barge/vessel movements to transport equipment to and from Apra Harbor, the

Proposed Action will result in increased underwater sound levels that will be low frequency, transient in nature, and not significantly impair false killer whales' use or occupancy of the habitat. Therefore, the Proposed Action is not likely to adversely affect any essential feature or characteristic of the MHI IFKW DPS critical habitat in any meaningful way, and the effects are discountable.

Finally, the following BMPs will prevent and mitigate exposure to elevated noise levels:

- The Contractor will assign Marine Observers who attended the Natural Resources Training, provided by NBG.
- The Marine Observers will use binoculars to visually survey the Action Area each day, beginning 30 minutes prior to the start of work and observations will occur continuously throughout the day.
- During the survey period, the Marine Observers will record environmental and Project-related information, including but not limited to date, time, weather, action undertaken, and any ESA-listed marine animals.
- If no ESA-listed marine animal is sighted during the survey period, the Project activities may commence.
- If an ESA-listed marine animal is seen during the survey period, the Marine Observers will notify the Project foreman immediately, and the animal will be monitored continuously. If the animal is within 50 yards of the species-specific Project limits, work will cease or not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting. Animal activities will be recorded during this time period.
- Dredging and all underwater activities using mechanical equipment will commence using a ramp-up/soft-start technique at the start of each work day or following a break of more than 30 minutes or longer. This technique will employ a slow increase in dredging or hammering over a 30-minute period, thereby alerting protected species and allowing an opportunity to vacate the area prior to full-intensity operations.
- During operations, all work shall stop when an ESA-listed marine animal is within 50 yards of the proposed work and shall only begin/resume after the animal has departed the area voluntarily or after 30 minutes passed since the last animal sighting.
- All sightings of ESA-listed marine species will be recorded.
- No construction activities will be conducted after dark.

Determination

The Navy determined that exposure to elevated noise levels from the proposed action may affect but is not likely to adversely affect green sea turtles, hawksbill sea turtles, and scalloped hammerhead sharks. With implemented BMPs, activities will stop if an ESA-listed species is observed within 50 yards and will not commence until the animal left the area voluntarily. Also, noise from activities will be short-term and intermittent. Furthermore, the proposed operations (in-water only) will be temporary and restricted to daylight hours for approximately 10 months. It is likely that an ESA-listed species would be exposed to noise levels that would result in a temporary and recoverable behavioral responses. Based on the regular but small occurrence of green sea turtles in the Action Area, as well as the rare and infrequent occurrence of hawksbill sea turtles and scalloped hammerhead sharks, the estimated sound levels, and the implemented BMPs, potential acoustic effects from exposure to elevated noise levels from proposed activities will be insignificant to ESA-listed species.

3.1.3. Increased Suspended Sediments

The Proposed Action involves dredging (i.e., excavating the seafloor and boulder revetment using a clamshell bucket) and using underwater mechanical tools to install various items, both of which have the potential to elevate ambient suspended sediment and turbidity levels by dislodging, re-suspending, and dispersing sediment in the water column. The suspensions of solids throughout the water column will increase the ambient total suspended solids (TSS) and turbidity levels of Apra Harbor within and immediately adjacent to the Action Area. It is reasonable to expect that ESA-listed marine species in the Action Area are likely habituated to high levels of ambient TSS and turbidity in the harbor.

Particle Tracking Model for Apra Harbor

The NAVFAC Pacific requested assistance from the USACE Engineer Research and Development Center (ERDC) with determining the fate of re-suspended dredged sediment during dredging operations in Apra Harbor. ERDC developed a framework for quantifying turbidity and sedimentation exposure mechanisms for corals in Apra Harbor (Gailani *et al.* 2017). The modelled scenario included dredging operations proposed to widen the channel throughout the entire outer harbor basin plus two berthing alternative sites, all of which would be far greater (spatially and temporally) than the proposed UEMMS dredging (i.e., up to 608,000 CY in the model vs. 1,200 CY for the UEMMS array). However, the results of this modeling effort quantified exposure of the nearby coral reefs to turbidity and sedimentation, and the relative rates provide robust and reasonable comparisons for the UEMMR impact and risk assessment.

The Particle Tracking Model (PTM) is a Lagrangian particle tracker and simulated sediment movement of multiple sediment types in a flow field (Gailani *et al.* 2017). PTM combined accurate and efficient transport computations with effective visualization tools, making it useful for assessment of dredging practices and proposed dredging operations. PTM modeled such processes as settling, deposition, resuspension, and particle-bed interactions to simulate site-specific transport of both fine and coarse sediment. PTM output included time-accurate horizontal and vertical positions of sediment parcels. Various other attributes such as mass, density, and suspension status are also assigned to each of the output parcels. For this application, eight scenarios were defined and modeled based on the dredging sources.

The maximum values within the worst case scenario for total accumulation maps occurred within the dredging footprint (i.e., below 0.1 kg/m^3). Outside of the dredging footprint, values remained between 2 g/cm^2 and 4 g/cm^2 for the different dredging locations modelled. Daily deposition rate values remained below 0.7 g/cm^2/day. When silt curtain effectiveness was increased to 100% and the clamshell loss reduced to 1%, maximum total accumulation decreased to 0.5 g/cm^2 outside of the dredging footprint. In the same case, the maximum values for the suspended sediment concentration were below 0.02 kg/m^3. Deposition rates were likewise reduced to 0.10 g/cm^2/day outside the dredge footprint but within the 200 m line (Gailani *et al.* 2017).

Further, the model results demonstrated that sediment dredged at each site generally remained near the dredge site. It was concluded that lateral transport was nominal because of the small velocities within Apra Harbor (Gailani *et al.* 2017). The model also indicated that sediment tends to deposit shortly after initial suspension. Thus, based on the best available scientific data for a modelled, worst-case dredge scenario in Outer Apra Harbor, it is reasonable to conclude that the sediment transport from the proposed UEMMS dredging would have similar and further-reduced exposure levels for the marine environment, such that sediment accumulation would be confined to the direct area only with minimal transport within the harbor.

Turbidity Measurements from Pearl Harbor Maintenance Dredge

During maintenance dredging of Pearl Harbor's Southeast Loch (SE Loch) in 2018, turbidity levels were measured by an RBRduo3 (https://rbrglobal.com/products/ standard-loggers/rbrvirtuoso-rbrduo) data logger, which recorded turbidity and depth as it was dropped (i.e., cast) through the water column. During each cast, the data logger recorded two turbidity and depth readings every second. Turbidity measurements were taken twice each day: in the middle of the shift and at the end of the shift. Three replications of measurements were taken around the turbidity curtain (with the observer facing the barge): 1) on the left side of the curtain; 2) the right side; and 3) the side of the curtain furthest away from the dredge barge (i.e., center). The unit of measure for turbidity used during the SE Loch dredging was the Nephelometric Turbidity Unit (NTU), which measured scattered white light at 90 degrees from an incident light beam. Particle density is related to the amount of light reflected into the detector from the particles. Water containing 1 mg of finely divided silica per liter has a turbidity of 1 NTU. A turbidity reading below 5 NTU appears clear. In contrast, a reading of 55 NTU will start to look cloudy, and a reading over 500 NTU will appear completely opaque (Fondriest Environmental, Inc. 2014; Perlman 2016). Figure 22 shows reference turbidity levels in samples that are used in the laboratory. As a guide to approximate NTUs to other measures of turbidity, a TSS concentration below 20 mg per liter (mg/L) appeared clear; while levels over 40 mg/L appeared cloudy (Fondriest Environmental, Inc. 2014). It is important to keep in mind that turbidity is dependent on the size and nature of the suspended solids, and thus field measurements are difficult to relate exactly to references that have been formulated for use in a laboratory.

Figure 21. Three turbidity standards and their NTU ratings. Image from https://water.usgs.gov/edu/turbidity.html. Photo by USGS. Laboratory standards are useful references, but will be qualitatively different in character than turbidity cause by naturally occurring sources.

The overall impression from the series of dredging data was that the operations, which were surrounded by a tight silt curtain, introduced much less turbidity into the water column than a significant rain event. Even in the worst case scenario, when sediment was lost from the scow, the rain event introduced more sediment throughout the water column, while sediment from the scow was observed primarily in the lower half of the in the water column and settled toward the bottom (Figure 23).

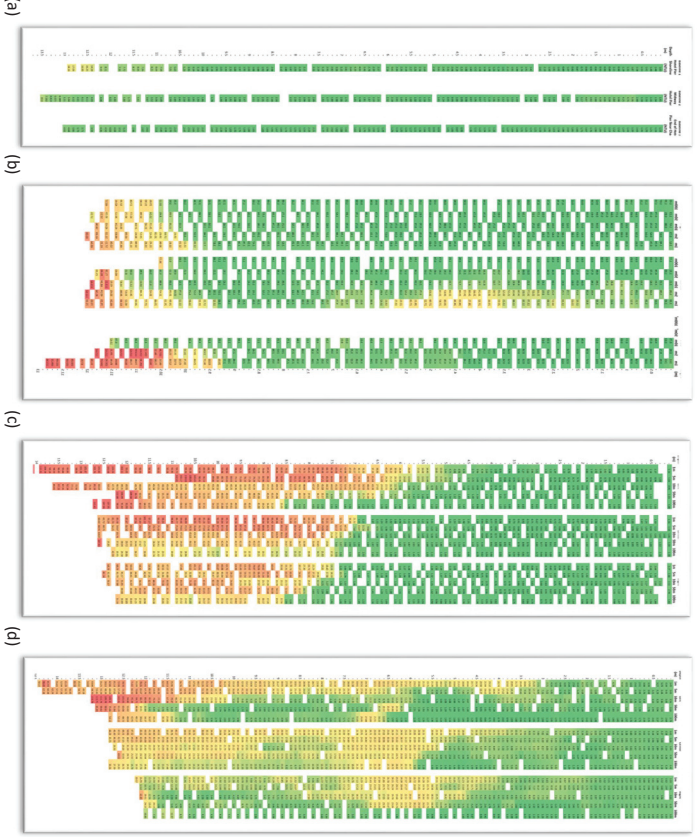


Figure 23. Turbidity measurements from the Pearl Harbor Southeast Loch dredge represented as "heatmaps" (green – low; yellow-middle; red – high) during different events: (a) Baseline pre-dredge; (b) normal operations; (c) rain event; and (d) scow spillage (Source: NAVFAC Pacific 2018).

Evaluating the biological significance of turbidity measurements is difficult because absolute guidance does not exist, and much is determined by the character of the suspended material, the site where dredging occurs, and the differential sensitivity of species present. Water quality parameters guidance from the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management (accessed from https://coast.noaa.gov/estuaries/science-data/) suggested that in nearshore and estuarine habitats, natural turbidity readings are between zero and 10 NTU. Readings that are considered "danger readings" are above 20 NTU. From the SE Loch data, the heat maps suggested that turbidity levels close to or above 20 NTU mostly occurred within a meter or less of the bottom. This could have been caused by the silt curtain interacting with the bottom, especially in shallower parts of the dredge footprint. Also, the dredge operations moved slightly during the shift and some sediment may have been stirred up. Most values in the water column during calm dredging days and in the baseline data were below 5 NTU. During dredging, turbidity was slightly higher if measured closer to the silt curtain (i.e., within 16.5 ft. [5 m]). Turbidity also increased with depth, with the upper 26.4–29.7 ft. (8–9 m) at an almost-uniform and relatively high clarity.

With a turbidity curtain in-pace, dredging will result in *de minimis* discharges into the marine environment incidental to the in-water dredge operation, which will elevate turbidity levels in the marine environment. Such elevated turbidity levels would be temporary and are expected to naturally settle as work progresses throughout the work area and restore to ambient upon completion, with no persistent or permanent effect. In addition, the contractor shall remove all silt and debris depositing in drainage facilities, roadways, and other areas, and protect all storm drains and deck openings to prevent the discharge of foreign materials to the harbor. Finally, the contractor will prepare a turbidity management plan outlining all of the above measures and a contingency plan if measures fail. Operations/work will be curtailed in the event of high wind or adverse weather conditions.

Project-generated, elevated turbidity levels will be contained to the greatest extent practicable using turbidity curtains to encircle each discrete work area. By creating a vertical barrier in the water to contain sediment and to minimize sediment transport from a disturbed underwater area, silt curtains are a common engineering control, and their effectiveness in containing re-suspended sediments is not fully understood, as water may pass below or around curtains if not secured properly at the bottom (Ogilvie *et al.* 2012; Bridges *et al.* 2010). Silt curtains are suited to shallow water environments (<10 m deep) and generally provide protection to ecologically sensitive habitats, e.g., seagrass meadows, corals, mangrove forests, shellfish beds and water intakes (Ogilvie *et al.* 2012).

Green and hawksbill sea turtles breathe air, and their respiratory processes should not be affected by the elevated turbidity. The during-dredging degradation of water quality may affect individual animals temporarily by creating an unwelcoming environment, and causing avoidance of the area in favor of clearer waters. Also, elevated turbidity levels reduce light penetration throughout the water column and limit underwater visibility, possibly interfering with an individual sea turtle's ability to forage. The potential displacement of individuals from the Proposed Action could have both short- and long-term effects, including both temporary and permanent displacement and impacts to energy budgets and prey dynamics within the ecosystem. However, the Action Area does not overlap with important resting, nesting or foraging habitats for green or hawksbill sea turtles, and thus the potential for adverse effects from increased suspended sediments is expected to be low and discountable.

Using generalized linear models to identify ecological drivers of the several shark species, including the scalloped hammerhead shark, a recent study demonstrated that mangrove proximity, depth, and water temperature were

also important (Yates *et al.* 2015). For these shark species, turbid environments were especially important for all species at typical oceanic salinities. A total of 73 immature scalloped hammerhead sharks were included in the analysis, and turbidity, salinity and temperature were present in all best-performing models. While the influence of these abiotic and biotic features varied between species, relationships with turbidity were similar across species, which the authors concluded as the importance of turbidity in the functioning of coastal habitats and communal shark nurseries (Yates *et al.* 2015).

BMP measures will be implemented to avoid and/or minimize potential for listed species to be exposed to elevated turbidity levels, and will be included as a condition of any final authorization. Accordingly, such minimal impact is considered insignificant. The following BMPs from the list in Section 3.1 will be followed to reduce effects of suspended sediments and elevated turbidity on ESA-listed species:

- Turbidity and siltation from Project-related work will be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions. During all in-water or overwater work, silt curtains will completely enclose the work area to the maximum extent practicable.
- If a plume is observed outside of the silt curtains, Project activity will stop and corrective action will be taken immediately. Work shall resume after the correction was made.
- In the event of approaching tropical storms and typhoons, equipment will either be removed from the Project site or adequately secured.

Determination

The Navy determined that exposure to elevated suspended sediments may affect but is not likely to adversely affect ESA-listed marine species, which are likely habituated to the ambient high turbidity of the harbor marine environment. Also, Project-related turbidity is not expected to be readily detectable above background levels, as implemented BMPs will limit turbidity from proposed in-water activities. The effective and proper use of a silt curtain will contain re-suspended sediment and prevent its dispersal beyond the Action Area. The Proposed Action will be temporary and restricted to daylight hours for approximately 10 months, thus having a short-term duration for potential impact. Therefore, exposure to elevated suspended sediments from the proposed actions will be contained within the Action Area, and the effects of which will be insignificant to ESA-listed marine species.

3.1.4. Direct Physical Contact

The Proposed Action involves the use of heavy machinery, barge and accessory vessels, and handheld machinery. All Project phases occurring in-water have the potential to directly physically impact ESA-listed marine species. While BMP measures will be in place to restrict intentional interactions with ESA-listed marine species, individual animals in the area could be unintentionally subjected to direct physical impact by heavy machinery, equipment, or vessels operated in the marine environment.

Physical impact or strike by Project components in the water could result in a range of injuries depending upon the force and angle of the strike, the part of the body impacted, and the ability of the animal to get away without further injury. Injuries may include bruising, laceration, broken bones/carapace, amputation or injury-induced or immediate death. From dredging operations, an animal could be pinned to the seafloor, causing drowning or immediate death. Clamshell dredges produce the least amount of water disturbance compared to other dredgers, and the impacts are localized to relatively small areas. Also, clamshell dredges are considered to be the

least likely of the common dredge methods to cause direct physical impact to ESA-listed species because they are relatively stationary and impact a very small area with each grab.

Direct physical impact of ESA-listed marine species will be avoided to the greatest extent practicable through implemented BMP measures. Observers will actively survey marine waters for presence of listed species within potential hazard zones and have the authorization to stop in-water work when ESA-listed species are observed within 50 yards of the activity, and may only begin/resume after the animals have voluntarily departed the area. Any interactions not resulting in injury or death will be reported to NMFS on a monthly basis, while instances of injury or death will be reported immediately and work will cease and not resume until NMFS resolved the concern (e.g., by reinitiating consultation).

Determination

The Navy determined that direct physical contact from the Proposed Action may affect but is not likely to adversely affect ESA-listed marine species. With implemented marine fauna monitoring and Shut-down Zones of 50 yards, marine fauna will not be close enough to the activities to result in direct, physical contact. All materials will be introduced into the marine environment in a controlled manner that will minimize disturbance and impacts. Also, the proposed in-water activities will be restricted to daylight hours for approximately 10 months, thus having a short-term duration for potential impact. Implemented BMP measures (particularly silt curtains and specific in-water operations) will avoid and/or minimize potential for direct physical impacts with listed species. Based on the low occurrence of listed species within Apra Harbor and implementation of BMPs to avoid interaction and minimize potential for direct physical impacts, it is anticipated that such effects would be discountable.

3.1.5. Vessels Collisions

Accessory vessels and a floating barge will be used in Apra Harbor for the Proposed Action. A tug boat will tow the barge to the dredge site and to the offshore disposal site at G-DODS. Smaller accessory vessels will be used to monitor for marine fauna and to install temporary, in-water BMP measures (e.g., silt curtains) or similar activities. When surfacing to breathe or rest, marine fauna is at risk of being struck by moving any of the Project vessels. Vessel collisions could result in a range of injury depending upon the size of the vessel, the speed and direction of the vessel (if in motion), the part of the vessel that strikes the animal (i.e., hull vs. propeller), and the part of the body impacted. Injuries may include bruising, laceration, broken bones/carapace, amputation or injury-induced or immediate death. Depending on these factors, collision with a small vessel has the potential to cause serious injury or death. Vessels in motion, especially propeller strikes would cause substantially greater injury than collision with the hull or with a stationary vessel.

ESA-listed marine species are sighted infrequently in Apra Harbor and nearshore waters of Guam, and potential impacts from vessel collisions to these species are expected to be discountable. These species will generally avoid vessels in motion, due to the physical disturbance and sound generated. Potential for collision is greatest when transitioning from a stationary to a mobile state where listed species may not be able to evade the oncoming vessel. The likelihood of a lethal vessel/whale collision is influenced by vessel speed: the greater the speed at impact, the greater the risk of mortality (Laist *et al.* 2006; Jensen & Silber 2003). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots.

During the proposed in-water activities, vessel operators will reduce vessel speeds to 10 knots or less if in the proximity of a marine mammal. In addition to the green and hawksbill sea turtles and scalloped hammerhead sharks, vessel collisions may involve other ESA-listed species (Table 7): MHI IFKW DPS, blue whale, fin whale, sei whale, and sperm whales; olive ridley turtle, loggerhead turtle, and leatherback turtles; oceanic whitetip shark; and the giant manta ray. Any of these species may be encountered when vessels are in transit to the G-DODS location. However, considering the wide and unrestricted ocean around the G-DODS area, the slow operating speed of the vessels, and compliance with the BMPs, the potential for a vessel strike to adversely affect a large whale during the Proposed Action is low and discountable.

In addition, it is unknown at this time if the Proposed Action will require barges and other support vessels from outside Guam, and consequently have an open-ocean transit from and to its origin. Given the slow operating speed of the barge and support vessels (unless in an emergency), the likelihood that a vessel strike will impact significantly an ESA-listed species while the vessel is in transit to Guam is expected to be low and discountable.

Sea turtles may not respond readily to auditory cues, relying more heavily on visual cues to realize a threat and so may not be able to avoid collision with an oncoming vessel. For green sea turtles, a regular but low-level occurrence is expected within the Action Area, and thus, there is some likelihood for collisions with vessels. Research suggested that sea turtles may not consistently detect and avoid vessels traveling at speeds over 2 knots (Hazel *et al*. 2007). Marine turtles on the sea surface or in shallow coastal waters avoided approaching vessels by moving away from the vessels track, which was suggested as an avoidance behavior based on visual cues despite the vessel noise being within range of turtle hearing (Hazel *et al*. 2007). While the potential for vessel strikes at various speeds has not been quantified, higher vessel speeds were more likely to cause impacts, particularly in shallow waters where turtles were abundant and in turbid waters. Therefore, the success of avoiding a vessel strike is largely dependent on the speed of the approaching vessel and the prevailing water clarity, rather than vessel type. Vessel operators will be actively vigilant of sea turtles in the vessel's path to avoid and prevent collision, adjust speed and direction, and allow adequate reaction time for sea turtles. When piloting vessels at or within 50 yards from marine mammals and sea turtles, vessel speed will reduce to 10 knots or less, and sea turtles are expected to exhibit avoidance behavior and move away. Thus, potential effects from a vessel collision with a green sea turtle are expected to be discountable.

Vessel collisions may involve elasmobranchs, and have been most commonly documented with larger shark species (e.g., whale sharks and basking sharks) with evidence of blunt trauma and laceration scars (Schoeman *et al.* 2020; Speed *et al.* 2008). The risk of a vessel collision depends on the amount of time that an animal spends at the surface of the water, and their behaviors at the surface of the water. Behaviors such as foraging, resting, socializing with other animals, and taking care of their young may distract an animal from detecting approaching vessels. For most sharks and rays, these behaviors do not occur at the surface of the water, thereby reducing the likelihood of collisions with vessels during these critical behaviors. Telemetry data revealed that juvenile scalloped hammerhead sharks have a daytime preference for deeper water characterized by mud and silt (Duncan *et al.* 2006). Satellite-tagged adult scalloped hammerhead sharks frequently made deep dives (1,000 m) offshore at night, while mostly remaining in waters >100 m deep, and daytime shallower dives were commonly in water depths between 10 and 40 m (NMFS 2020). Therefore, based on their spatial distribution in deeper water depths, the likelihood of scalloped hammerhead sharks at the surface of the water where vessel collisions may occur is low and discountable.

Similar to the potential for direct physical impact, BMP measures will be implemented to minimize the potential for vessel collision with ESA-listed species. BMP measures are included in the Project design to be implemented during vessel operation to avoid and minimize potential for vessel collision with listed species. The following BMPs from the list in Section 3.1 will be followed to avoid collisions:

- When piloting vessels, vessel operators shall alter course or halt in order to remain at least 50 yards from marine mammals and sea turtles.
- When piloting vessels at or within 50 yards from marine mammals and sea turtles, reduce vessel speed to 10 knots or less. In areas of known or suspected sea turtle activity, vessel operators shall be vigilant to watch for sea turtles at or near the surface, and if practicable, reduce vessel speed to 5 knots or less.
- If a marine mammal or sea turtle approaches the vessel, vessel operators will put the engine in neutral until the animal is at least 50 yards away, and then move away slowly.
- Marine mammals and sea turtles shall not be encircled nor trapped between multiple vessels or between vessels and the shore.
- No one on-site or associated with this Project will attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine fauna species.

Determination

The Navy determined that collisions with vessels may affect but is not likely to adversely affect ESA-listed marine species. With implemented marine fauna monitoring, slow vessel speeds, and Shut-down Zones of 50 yards, marine fauna will not be close enough to vessels to result in collisions or strikes. Also, the proposed in-water activities will be restricted to daylight hours for approximately 10 months, thus having a short-term duration for potential impact. Based on the low occurrence of listed species within Apra Harbor and implementation of BMPs to avoid interaction and minimize potential for vessel collisions, it is anticipated that such effects would be discountable.

3.1.6. Wastes and Discharges

Exposure to leaking chemicals or previously-contained, terrigenous contaminants, depending on the toxicity and concentration, could result in effects ranging from general avoidance to death of listed species. Project wastes may include plastic trash and bags that may entangle or be ingested by a marine species, which is a major, anthropogenic threat to the recovery of ESA-listed species that results in both lethal and non-lethal effects (NMFS & FWS 1998). Marine debris is one of the main causes of stranding and mortality, particularly from discarded fishing gear and plastic bags that can cause restricted mobility, drowning, starvation, smothering, and wounding, thus leading to infections, amputation of limbs and death. Debris may include plastic bags, rubber, balloons, plastic fragments, and confectionery wrappers, all of which may be confused with prey species and ingested by marine fauna, which can block digestive systems and cause internal injuries and starvation. A long-term concern for plastic debris is that it could be a source of toxic chemicals that could compromise immunity and cause infertility in animals, even at very low levels. Stranding data and necropsies provided evidence that turtle mortalities resulted from poisoning or obstruction of the esophagus after ingesting garbage, plastic, or tar (NMFS & FWS 1998).

The Proposed Action involves use of heavy machinery and equipment nearshore and in-water for dredge activity. Heavy machinery and equipment can leak fuel, petroleum lubricants, and other hydrocarbon-based pollutants into marine waters, which would expose ESA-listed species to toxic substances. Some spills could occur when small containers of chemicals are used in open areas and there is a risk of entering the sea if spilled. If released

in large quantities, the toxic substances may cause avoidance of the affected area, serious injury, or, in severe cases, death. However, if a chemical is discharged or spilled accidentally during the Project, the realistic worst case would be a small quantity or volume (i.e., <25 L). The intentional release of fuel, petroleum-based products, construction debris or trash will not occur during the Proposed Action.

No debris will be allowed to enter the water during the Proposed Action. To reduce the potential for action-related waste and discharges impacting marine species adversely, all waste will be controlled and disposed into trash dumpsters or roll-off bins in the Project base yard or storage area. Wastewater from demolition work will not be discharged into the sanitary sewer system, the storm drainage system, or the harbor. The contractor will capture all pollutants and dispose of them off-site at an approved disposal facility. Prior to commencing daily activities, all equipment and vehicles will be maintained and checked to reduce any risk of leaks or discharge. Hydraulic equipment will be maintained properly to prevent leaks.

Should exposure of wastes and discharges to listed species occur, the effects would be minimal and insignificant. The development and implementation of BMPs will avoid and minimize exposure of construction wastes and debris to ESA-listed species. Additionally, the relatively low occurrence of ESA-listed species within Apra Harbor will further reduce the likelihood of adverse effects, and such impacts would be considered insignificant within the context of their populations.

The occurrence of exposure to wastes and discharges such as these will be avoided and minimized to the greatest extent practicable through development and implementation of an oil spill contingency plan contained within the SWPPP, which includes measures to prevent (and respond to) inadvertent discharges of construction wastes into the marine environment. Petroleum, spill-containment devices (e.g., absorbent pads, containment booms) will be located on-site in sufficient quantity and available and accessible for immediate deployment at all times. Thus, the Project-specific BMPs will prevent the wastes and toxicants from entering the marine environment and thus any exposure to an ESA-listed species. However, in the unlikely event of a spill or discharge, the effects would be insignificant, because accidental spills or discharge will be of small amounts and cleaned quickly.

The following BMPs will prevent and mitigate exposure to accidental release of wastes and discharges:

- The Contractor will develop a contingency plan to control and contain toxic spills (including petroleum products). Appropriate materials to contain and clean potential spills will be stored and readily available at the work site.
- All Project-related materials and equipment placed in the water shall be free of pollutants.
- Operators shall perform daily pre-work equipment inspections for cleanliness and leaks. Should a leak be detected, all heavy equipment operations shall be postponed or halted and shall not proceed until the leak is repaired and equipment cleaned.
- Fueling of land-based vehicles and equipment shall take place at least 50 ft. away from the water, preferably over an impervious surface. Fueling of vessels shall be done at approved fueling facilities. With respect to equipment (e.g., on the barge crane) that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned immediately.
- Turbidity and siltation from Project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions. During all in-water or over-water work, silt curtains will completely enclose the work area to the maximum extent practicable.

- If a plume is observed outside of the silt curtains, Project activity will stop and corrective action will be taken immediately. Work shall resume after the correction was made.
- All Project-related debris other waste will be contained and will not enter or remain in the marine environment.
- In the event of approaching tropical storms and typhoon, equipment will either be removed from the Project site or adequately secured.

Determination

The Navy determined that exposure from an accidental release of wastes and discharges from the Proposed Action may affect but is not likely to adversely affect ESA-listed species. Based on the low level occurrence of ESA-listed species within the Action Area and implemented BMPs (e.g., equipment maintenance, contingency plans, fueling restrictions), the potential for adverse effects from exposure to accidental release of waste and discharges is low and discountable.

3.1.7. Entanglement

Marine fauna could be entangled by two different elements of the Proposed Action: 1) trash and debris; and 2) equipment, including silt curtains or barge anchor chains, in the Action Area. Materials could be encountered by and have the potential to entangle marine fauna at the surface, in the water column, and along the seafloor. Potential impacts depend on how a marine animal encounters and reacts to the items that pose an entanglement risk, which depend on risk factors such as animal size, sensory capabilities, and foraging methods. Most entanglements are attributable to encounters with fishing gear or other materials that float or are suspended at the surface. Smaller entangled animals are inherently less likely to be detected than larger ones, but larger animals may subsequently swim off while still entangled, towing lines or fishing gear behind them.

If severely entangled, sea turtles cannot forage underwater nor breathe at the surface. Serious injury may result in a lost limb and/or increased vulnerability to predation. Animals that becomes entangled in nets, lines, ropes, or other foreign objects under water may suffer temporary hindrance to movement before it frees itself or they may remain entangled. Entangled individuals may suffer minor injuries but recover fully or may die as a result of the entanglement.

For elasmobranchs, entanglement most commonly occurs from ghost fishing gear and anthropogenic debris, and results in starvation, suffocation, immobilization, and death (Parton *et al.* 2019). If these individual impacts increase to greater levels within shark and ray populations, entanglement may have negative implications on reproductive success and survival rates.

Entanglement from equipment and gear typically used in dredging and construction is not commonly observed and unlikely to occur. Project debris and trash will be controlled so that it does not enter harbor waters. The equipment will be managed closely, such that only lines, chains, silt curtains, and flexible elements will be deployed in the water when necessary. The barge could be a site of potential entanglement risk, as it will be anchored in the water near the sensor array location. However, the barge anchor lines and all in-water equipment will be inspected and managed regularly and kept taut when deployed. Furthermore, the silt curtain around the Project site is expected to be a barrier to turtles and mammals approaching the area where equipment and lines will be used. Based on the factors stated above and the low occurrence of sea turtles in the Action Area, potential entanglement risks to ESA-listed species will be discountable.

The following BMPs (Section 1.4) will be followed to avoid entanglement:

- Comply with monitoring plan to survey the Action Area for ESA-listed marine animals.
- In-water tethers and mooring lines for vessels and marker buoys shall be kept to the minimum lengths necessary and shall remain deployed only as long as needed to properly accomplish the required task.

Determination

The Navy determined that the entanglement from the Proposed Action may affect but is not likely to adversely affect ESA-listed marine species, which are expected to have a rare to low-level of occurrence in the Action Area. The Proposed Action will be restricted to daylight hours for approximately 10 months, thus having a short-term duration for potential impact. The silt curtain will be a barrier to any ESA-listed marine species approaching the dredging operations, where the construction work will occur. Finally, BMPs will be implemented, and the risk of entanglement of an ESA-listed species from the Proposed Action is low and discountable.

3.1.8. Unexploded Ordnances

As a conservative safety measure prior to commencement, all personnel involved in the Action activities will be briefed on the potential hazards of MEC/MPPEH. If any MEC and/or MPPEEH items are discovered during in-water activities, all work will be stopped immediately. The Contractor will contact Explosive Safety Office (ESO) and Explosive Ordnance Disposal Detachment Marianas to evaluate. The Naval Ordnance Safety and Security Activity will be notified by the ESO if any MEC is found during the project.

If ordnance is detonated in the marine environment, nearby marine resources are exposed to direct physical impact from shrapnel and effects of a pressure wave. As water is incompressible, fragments are slowed and will travel a limited distance from the source. The size and type of the munition, the depth of detonation, and oceanic conditions determine the radius and effects of a blast. Marine fauna close to a blast may be directly affected by the blast. Farther away, organisms are affected by the pressure wave (in the form of a sound pressure wave and movement of the water due to cavitation). Organisms without air or gas spaces in their bodies fare better than organisms that have those spaces because pressure is equalized inside and outside of their bodies. Most corals and invertebrates do not have air or gas spaces in their bodies, so they experience fewer traumas from pressure waves than vertebrates such as fish, turtles, and marine mammals.

The likelihood of contact from dredging and fragments is extremely low since the Navy will work with observers and stop in-water activities when ESA-listed species are within 50 yards of the Action Area. The Navy will also surround the Action Area with a turbidity curtain or other isolation methods, which will prevent or discourage ESA-listed animals from entering the Action Area where they could be contacted. Sea turtles and scalloped hammerhead sharks may react to visual and noise disturbances with startle responses, flight, and/or avoidance. While these responses may display a negative response, they are often common responses to normal human activity that happens in the Action Area and are not expected to reduce their fitness or prevent them from foraging or resting activities.

Determination

The Navy determined that encountering a MEC, MPPEH, and/or a UXO during the proposed in-water activities may affect, but is not likely to adversely affect green sea turtles, hawksbill turtles or scalloped hammerhead sharks within the Action Area. However, based on the implemented precautions and BMPs, the probability of

exposure to direct physical impact, a pressure wave or underwater sound effects from exploding ordnance to ESA-listed species is discountable.

3.2. EFH Effects Analysis

The MSA defines procedures for coordination, consultation, and recommendations to promote the protection of EFH in the review of Federal and state actions that may adversely affect EFH. An adverse effect means any impact that reduces quality and/or quantity of EFH and may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

A total of 1,498 m² (16,124.34 ft²) of benthic substrate would be directly and permanently impacted by the Proposed Action. As presented in Section 2.2, field surveys revealed a robust coral community within the proposed UEMMS footprint. Dredging in the Action Area will adversely impact the benthic habitat and biota, including corals and soft-sediment infauna. Based on similar prior activities and known water movement in Outer Apra harbor, it is presumed that marine waters immediately adjacent to and up to an approximately 125-m radius of the in-water work area would be indirectly affected by in-water construction activity.

In analyzing effects to EFH, the Navy considered the duration and timing of the Proposed Action, and the frequency, intensity, and severity of disturbance. The in-water actions (i.e., dredging this area, in-water construction) are expected to continue for approximately 10 months (beginning November 2021). All such activities have the potential to impact EFH in the marine environment of Outer Apra Harbor. All individuals are responsible for identifying potential environmental risks and adjusting or compensating appropriately. Environmental risk decisions must be made at a level of responsibility that corresponds to the degree of risk, taking into consideration the significance of the mission/activity and the timeliness of the required decision. The aim of this environmental risk assessment is to increase mission/activity success while reducing the environmental risk to natural resources and execution to the lowest practical level. As described in Section 3.1, the environmental risk management process evaluated potential effects of the Action and concluded that most effects may have minimal impacts and risks (Table 11), particularly due to temporary nature of the Proposed Action and the BMPs implemented (Section 1.4). The potential effects to EFH from the Proposed Action may result from exposure to the following environmental stressors:

- Physical removal
- Suspended sediments
- Elevated noise levels
- Waste and discharge
- Aquatic invasive species
- Chemical contaminants
- Hypoxia
- Unexploded Ordnance.

Table 11. Environmental risk assessment summary of the potential impacts from the Proposed Action on EFH.

Environmental Stressor	Probability	Severity	Risk Level	Mitigation	Risk Assessment for EFH
Removal of Marine Invertebrate Community (Section 3.2.1)	Near Certainty	Catastrophic	Extremely High	• Coral translocation • Habitat conversion	• Permanent loss of benthic community • Temporal loss of ecological function & habitat structure
Increased suspended sediments (Section 3.2.2)	Near Certainty	Moderate	Moderate	• Stop work during coral spawning • Erosion control practices • Silt containment devices/curtains • Inclement weather contingency	Temporary indirect impacts
Elevated underwater noise levels (Section 3.2.3)	Near Certainty	Negligible	Moderate	Full-length silt curtain (physical sound barrier)	
Wastes and discharges (Section 3.2.4)	Not Likely	Negligible	Low	• Safe equipment use & management • Silt containment devices/curtains • Oil spill contingency plans	
Aquatic invasive species (Section 3.2.5)					
Chemical contaminants (Section 3.2.6)					
Hypoxia (Section 3.2.7)					

3.2.1. Removal of Marine Invertebrate Community

The installation of sensors for the UEMMS array with supporting cables routing to the Polaris Point shore landing site will require the removal of habitat through dredging and constructions activities. This action will result in the loss of the sessile organisms that comprise ecosystem components for some of the life stages of BMUS and PMUS. The benthic organisms will be removed from the direct impacts array site and shore landing site, and their removal will result in the loss of habitat and refuge where early stages of BMUS and PMUS may recruit. The impacted area of the array site is primarily coral reef habitat and may be refuge habitat for juvenile and adult BMUS to rest or forage. The impacted area of the shore landing site is primarily loose and soft sediment with debris and riprap that is potential habitat for juvenile and adult BMUS to rest or forage. Both habitats provide area where prey for later life stages of BMUS may reside.

The 2020 biological survey of the UEMMS Action Areas determined that the array site had an average biotic cover of 35.7% hard substrate, 32.5% coral, 18% algae (macro & cyanobacteria), 7% other fauna (sponge, sessile inverts, etc.) and 6.7% sand and silt substrate (NAVFAC 2020). The average cover of the shore landing site was approximately 75.3% substrate (37.0% coral rubble, 28.7% silt and sand, 9.0% rock and 0.63% debris), 18.6% algae (macro and cyanobacteria), 3.6% other fauna (sponge, sessile inverts, etc.) and 2.5% coral. Dredging of the area for UEMMS sensor array installation will result in the physical removal of approximately 725 m^2 (7,803.8 ft^2) of existing coral reef habitat with 1,200 CY (917.5 m^3 or 32,400 ft^3) of dredge material removed. A conservative estimate of 739 m^2 (7,954.53 ft^2) of surrounding reef habitat will be impacted from additional construction activity and 33.9 m^2 (365 ft^2) of seafloor will be covered from the placement of the concrete anchor discs along the cable route for a combined marine environment area of 1,498 m^2 (16,124.34 ft^2). The action at the UEMMS shore landing area is approximately 169 m^2 (1,819.1 ft^2) and will result in the temporary dredge of 225 CY (172 m^3 or 6,075 ft^3) of material from Polaris Point. The temporary placement of 125 CY (95.6 m^3 or 3,375 ft^3) of riprap in-water but outside of the construction area is expected to retain colonized organisms and habitat that will later be returned to its original location.

Corals

Physical removal of the UEMMS Action Area's coral community will result in a reduction of quantity of habitat that supports MUS and prey species. In the array footprint, photomosaic documentation and analysis counted 7,535 coral colonies (NAVFAC 2020). This assessment is based on actual counts of photomosaic data that was repeated by several researchers (HDR & CSA 2020). Additionally, photomosaic analysis counted 145 coral colonies in the shore landing footprint for a combined total of 7,680 colonies in the UEMMS Action Area. Coral species were divided to their most frequently known and/or observed morphology within the action areas (See Table 12; Veron 2021). Of the 7,680 corals counted within the action areas, 2,128 (28%) were measured using orthomosaic imaging software (*Agisoft*) and those frequencies were then extrapolated across size classes for the provided coral species actual counts (Table 12). Size classes 1 (0-2 cm), 2 (2-<5 cm) and 3 (5-10 cm) were conservatively binned into one class (0-10cm) that comprised all corals less than 10cm. Of all colonies, approximately 1,452 (array and shore landing) are in the smallest size class (0–10 cm). Therefore, of the 7,680 coral colonies, approximately 19% are in the smallest size class (0–10 cm) of the UEMMS Action Area's total coral community (NAVFAC 2020).

Table 12. UEMMS Array Site coral colony counts by species and size frequency chart based on *Agisoft* software measurements from orthomosaic imagery collected in September of 2020 (Source: HDR & CSA 2020).

Species	Counts		Size Frequency					
	Measured	Total	1,2,3	4	5	6	7	8
			< 10cm	10-20cm	20-40cm	40-80cm	80-160cm	>160cm
Acropora granulosa	2	3	0.00	1.00	2.00	0.00	0.00	0.00
Astreopora spp.	38	42	8.84	23.21	8.84	1.10	0.00	0.00
Ctenactis spp.	5	5	0.00	3.00	2.00	0.00	0.00	0.00
Fungia moluccensis	3	3	3.00	0.00	0.00	0.00	0.00	0.00
Fungia sp.	4	4	3.00	1.00	0.00	0.00	0.00	0.00
Galaxea spp.	38	41	32.37	6.47	2.16	0.00	0.00	0.00
Herpolitha limax	89	89	0.00	7.00	67.00	15.00	0.00	0.00
Herpolitha weberi	3	3	2.00	1.00	0.00	0.00	0.00	0.00
Leptastrea purpurea	4	4	4.00	0.00	0.00	0.00	0.00	0.00
Lobophyllia corymbosa	13	13	4.00	3.00	2.00	4.00	0.00	0.00
Lobophyllia hataii	1	1	1.00	0.00	0.00	0.00	0.00	0.00
Lobophyllia hemprichii	41	42	5.12	12.29	13.32	11.27	0.00	0.00
Montipora spp.	1	1	0.00	0.00	0.00	1.00	0.00	0.00
Pachyseris speciosa	73	73	30.00	23.00	17.00	3.00	0.00	0.00
Pavona cactus	470	470	47.00	228.00	134.98	53.02	7.00	0.00
Pavona varians sp. complex	5	5	3.00	1.00	1.00	0.00	0.00	0.00
Pectinia paeonia	77	77	20.02	31.00	17.00	10.01	0.00	0.00
Pocillopora acuta	2	2	2.00	0.00	0.00	0.00	0.00	0.00
Pocillopora damicornis	2	2	0.00	2.00	0.00	0.00	0.00	0.00
Porites cylindrica	64	65	17.26	28.44	17.26	2.03	0.00	0.00
Porites lutea	8	10	0.00	0.00	2.50	7.50	0.00	0.00
Porites rus complex	843	6368	1193.36	2568.21	2025.02	513.90	60.50	7.64
Porites sp. massive	177	183	4.14	48.59	73.40	51.70	5.16	0.00
Stylocoeniella armata	20	28	28.00	0.00	0.00	0.00	0.00	0.00
Total	**1,983**	**7,534**	**1,408.1**	**2,988.2**	**2,385.5**	**673.5**	**72.7**	**7.64**

The smallest corals (i.e., <10 cm) contribute the least amount of EFH structure and complexity. Most are not reproductive and contribute less to the sustainment or propagation of reef-building biota. They also have the greatest rate of natural mortality as they grow (Meesters *et al.* 1996; Bak & Meesters 1998). Small colonies are difficult to remove and relocate because of their small size and relative delicacy. In the UEMMS Action Area, the smallest colonies represented 19% of individual coral colonies across species and their removal is not considered to represent a significant net loss of quality or quantity to EFH. However, based on expert recommendations (HDR & CSA 2020), several *Pocillopora acuta* and *Pocillopora damicornis* colonies and all *Fungia spp*. and *Herpolitha spp*. colonies less than 10 cm may be suitable candidates for translocation. These will therefore be translocated and not be considered as a loss in later analysis. Additionally, three coral species (*Pachyseris speciosa*, *Porites cylindrica* and *Stylocoeniella armata*), two groups (*Galaxea spp*. and *Lobophyllia spp*.) and one species complex (*Pavona varians sp*.) have been determined to potentially be fit for translocation as corals less than 10 cm. Therefore, half of those colonies will be considered as a loss and the other half will be translocated. Corals less than 10 cm from three other coral species (*Leptastrea purpurea*, *Pavona cactus* and *Pectinia paeonia*);

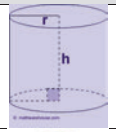
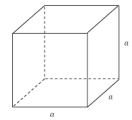
two groups (*Astreopora spp.* and *Porites spp*. massive) and one group complex (*Porites rus*) have been determined to not be fit for translocation when less than 10 cm. Therefore, these colonies will not be included in translocation, but are considered in later analysis as making a contribution to EFH as habitat.

Table 13. UEMMS Shore Landing Site coral colony counts by species, size frequency chart and coral colony area based on in-situ measurements and Agisoft software measurements from orthomosaic imagery collected in September of 2020 (Source: HDR & CSA 2020).

Species	Counts Total	Size Frequency				Area (cm²)			
		1,2,3	4	5	6	1,2,3	4	5	6
		<10cm	10-20cm	20-40cm	40-80cm	< 10cm	10-20cm	20-40cm	40-80cm
Astreopora spp.	**5**	1	2	1	1	157.08	1256.64	2513.27	10053.09
Leptastrea purpurea	**1**	1				78.54	0.00	0.00	0.00
Lobophyllia hemprichii	**1**			1		0.00	0.00	2513.27	0.00
Montipora spp.	**1**			1		0.00	0.00	1256.64	0.00
Pectinia paeonia	**2**	1		1		314.16	0.00	11309.72	0.00
Pocillopora damicornis	**3**	1	2			314.16	5654.86	0.00	0.00
Porites rus complex	**85**	22	33	20	10	3300.00	44550.00	108000.00	216000.00
Porites sp. massive	**46**	17	11	16	2	2670.35	6911.50	40212.35	20106.18
Stylocoeniella armata	**1**	1				78.54	0.00	0.00	0.00
Total	**145**	**44**	**48**	**40**	**13**	**6912.83**	**58373.00**	**165805.26**	**246159.26**

It was established from photomosaic analysis that examining the two-dimensional surface area of corals along the longest colony diameter against the perimeter area for comparison, that the ratio of the total diameter area to perimeter area was about 2:1 for a flat surface area (NAVFAC Marianas 2019; HDR & CSA 2019). Such a ratio suggests that estimating coral cover based on the longest colony diameter, and assuming circular shape ($A = \pi r^2$) will double the actual coral cover result. For this analysis, a circular shape for coral colonies with encrusting or free living morphologies was conservatively assumed based on the maximum diameter in each size class (Table 14). For corals of a typical mounding morphology, an area of half a sphere ($A = 2\pi r^2$) generates more appropriate surface area estimates while using a conservative maximum diameter in each size class. The surface area of more complex corals predominately exhibiting a foliose morphology was estimated using the area of a cube minus the base ($A = 5r^2$). While the morphology of these foliose corals can vary from simply flat and encrusting to complex layers, none were observed to have a vertical growth equal to the base and therefore the Navy conservatively used the maximum diameter in each size class for 'r'. The corals exhibiting a branching morphology provide the greatest difficulty in estimating surface area without the collection and sacrificing of colonies for further analysis. Therefore the Navy has used the area of a cylinder ($A = 2\pi rh + 2\pi r^2$) to best evaluate the surface area of typically branching corals for this analysis, again using the maximum diameter in each size class for both radius and height values in the calculations. Based on these area formulas combined with frequency, the Navy extrapolated that the total area of coral cover in the UEMMS Action Area was 5,426.4 m² (58,409.3 ft²). This area will be the primary focus of avoidance, minimization, and offset mitigation proposed for this Action.

Table 14. UEMMS Array Site coral colony area formulas and assumptions based on most common species morphology.

Morphology	Species	Area Formula		Assumptions
Branching	*Acropora granulosa* *Pectinia paeonia* *Pocillopora acuta* *Pocillopora damicornis* *Porites cylindrica*	$A = 2\pi rh + 2\pi r^2$		$\pi = 3.14$ r & h = maximum for ea. size class
Encrusting	*Leptastrea purpurea* *Montipora spp.* *Stylocoeniella armata*	$A = \pi r^2$		$\pi = 3.14$ r = maximum for ea. size class
Foliose	*Pachyseris speciose* *Pavona cactus* *Porites rus* complex	$A = 5r^2$		r = maximum for ea. size class surface area = 5 sides (not base)
Free Living	*Ctenactis spp.* *Fungia spp.* *Herpolitha limax* *Herpolitha weberi*	$A = \pi r^2$		$\pi = 3.14$ r = maximum for ea. size class
Mounding	*Astreopora spp.* *Galaxea spp.* *Lobophyllia corymbosa* *Lobophyllia hataii* *Lobophyllia hemprichii* *Pavona varians* sp. complex *Porites lutea* *Porites sp. massive*	$A = 2\pi r^2$		$\pi = 3.14$ r = maximum for ea. size class A = ½ that of a sphere

Benthic Biota and Community

The benthic community is comprised of mobile and sessile non-coralline invertebrates that include suspension feeders that utilize the planktonic community and contribute to the biomass and energy transport of the marine ecosystem in the UEMMS Action Area. EFH in the UEMMS Action Area includes hard substrate (coral rubble and coral pavement), algae (macro and cyanobacteria) and sessile organisms (sponges, tunicates, etc.) that provide services and functions not limited to but including shelter, water filtration and food sources (Wilson 2011). Scientific evidence documented that benthic communities recover within 6–8 months (Newell *et al.* 1998), and in tropical reef habitats, the biofouling community settled on newly-immersed structures within two weeks, with the number of invertebrate species that recruited increasing over time: 17 species after two months; 24 species after six months; and 28 species after one year (Bailey-Brock 1989). It is reasonable to conclude that the benthic

community and ecosystem functions and services would appear within a short time in areas providing structure after construction. Within the benthic community, sponges provide shelter and are active suspension feeders that receive food particles and plankton that settle out of the water column, using and temporarily storing these particles, thus serving as a link between the benthic and planktonic systems (Gili & Coma 1998). The impact to refuge, food sources and filtration services associated with the removal of the benthic community will adversely affect the quality of EFH through a reduction of habitat and water quality. For this analysis, the benthic community EFH analysis will include all 60.7% of hard substrate, algae and other fauna cover in the UEMMS array site in order to evaluate the temporary and permanent loss of function and services to the environment. The benthic community at the shore landing site will be preserved through the temporary relocation of habitat outside of the construction area and will not be considered for further EFH analysis. The placement of concrete anchor discs to secure the cable bundles along the cable route will result in the covering of 33.9 m^2 (365 ft^2) of non-coral benthic communities. The percent cover for where the concrete anchor discs will be deployed was not quantified during the 2020 surveys therefore resulting in the conservative total area covered by 29 discs to be considered for further EFH analysis The UEMMS array site encompasses 1,464 m^2 (15,758.4 ft^2) of area with 888.6 m^2 (9,564.8 ft^2) being considered as the benthic community. Combined with the disc-covered area, a total area of 922.5 m^2 (9,929.7 ft^2) will be the focus of the Benthic Community EFH analysis.

Infauna Community

The 2020 surveys indicated that the array site and shore landing site consisted of 6.7% and 28.7% (respectively) soft, sand and silt (HDR & CSA 2020). As described in Section 2.1, this sand and silt seafloor habitat is dominant throughout Apra Harbor (Smith 2013), and not suitable for recruitments of coral or other benthic community EFH. The limited infauna community serves little functions and services as EFH and will be retained after temporary removal at the shore line site. Additionally, it is expected that a similar habitat will develop after the non-magnetic backfill replacement of the dredged area and subsequent natural sediment settlement will occur in the array footprint. The dredging and other construction activities of sand and silt habitats in the UEMMS Action Area will not reduce the quantity or quality of EFH for PMUS and BMUS and therefore, will not be considered further in this analysis.

Mitigation Measures

The Navy used a standard tiered approach to mitigation for this proposed Action. The activity under each tier is detailed in sections below and summarized as follows:

- ***Avoidance*** – Effects from the Action were reduced by implementing avoidance BMPs, such as work restrictions during coral spawning events. Sensitive areas were designated in the indirect impacts area to avoid sensitive habitats during temporary construction activities (i.e., spud barge, anchoring, etc.). In addition, Navy engineers further avoided impacts to corals on the harbor floor by redesigning the cable system, route and deployment method to avoid coral reef habitat.
- ***Minimization*** – Effects from the Action will be minimized by implementing BMPs and natural resource management actions. Navy engineers minimized impacts to EFH on the harbor floor by redesigning the array depth, dredge size and relocated the CTD sensor to reduce the overall project footprint. Additional design changes to the cable attachment method were made to diminish the size of the impacts to the habit. The 100% design requires construction contractors to use full-length silt curtains and temporarily relocate shore line dredge and riprap to reduce the loss of colonizing organism at the Polaris Point site. In addition, the Navy will move coral (suitable for translocation) and other invertebrates from the UEMMS Action Area to a mitigation site in Outer Apra Harbor. The receiving site will be managed so that

the effects of relocation are minimized and that the moved fauna may establish and grow with reduced stress from environmental pressures (such as algal growth). Management steps will include taking actions to reduce potential impacts from human activities of the area.

- ***Offset*** – The Navy will seek to offset unavoidably lost function and services provided by coral and other benthic biota through habitat conversion and ecological uplift at the mitigation site where the corals will be moved for minimization purposes (see above). The mitigation site is currently a degraded marine habitat. However, habitat conditions at the site will be improved to increase the survival of translocated corals and to promote the natural establishment of coral reef communities in and around the mitigation site.

Avoidance

The Navy made the additional effort to conduct surveys in adjacent areas to the primary project footprint, surveying an additional 739 m^2 (7,954.53 ft^2) specifically to identify sensitive habitats for avoiding these areas during temporary constructions actions (anchoring, spud barge, etc.). Navy engineers incorporated NMFS feedback and survey data to develop a cable route that targets deeper water habitats that are predominately devoid of EFH with cables designed to be deployed in such a manner that will circumnavigate sensitive areas. Another redesign element included a deployment method that incorporates diver-guided deployment to avoid sensitive habitats after divers deploy an initial "cable guide path" on the seafloor.

Based on prior pre-consultation with NMFS, the Navy will implement a new BMP to further avoid impacts to sensitive habitats on the harbor floor (Section 1.3): While in water depths where the draft of the vessel provides less than a 2 m (6 ft.) clearance, all vessels should operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should employ a dedicated "lookout" to assist the pilot with avoiding large coral colonies and other benthic organisms that might extend up from the bottom.

Minimization

After soil samples revealed that a dredge area of 2,694.2 m^2 (29,000 ft^2) would be required to install the sensor arrays, Navy engineers made design changes to the depth of dredge and allowed for partial exposure of the MT sensors by several meters above the sea floor. This design change decreased the required dredge by more than three and a half times less area than initially designed, to just 725 m^2 (7,803.8 ft^2), thus minimizing the direct impacts to the area. The amount of dredge material also thus decreased from 4,282 m^3 (5,600 CY) to just 918 m^3 (1,200 CY), a decrease of 3,364 m^3 (4,400 CY) of dredge material that will not be removed from the environment or require disposal. This redesign also included the relocation of the CTD sensor with the sensor array instead of impacting a separate installation location on an adjacent coral reef mound.

Additional Navy engineer redesign of the cable attachment to the benthos resulted in a minimized footprint for each anchoring position that requires securing. Cables will be secured at regular intervals using polypropylene webbing that will bundle and secure to reinforced hooks on concrete anchor discs. While silt curtains will be utilized at both the array dredge site and shore line landing to minimize suspended sediments, the array barge silt curtains will be 8-m (25-ft.) to prevent drag and damage to surrounding coral reef habitats. Full length silt curtains will be used at the shore landing site in order to minimize the movement of suspended sediments during construction.

The temporary relocation of the 125 CY (95.6 m³ or 3,375 ft³) of Polaris Point riprap will utilize construction equipment to move the large revetment to areas outside the construction area retaining the colonized organisms in place. The riprap will benefit from the full-length silt curtains retaining sedimentation within the Polaris Point shore line dredge area until construction is completed and the sediment has been stabilized. The riprap will then be returned to the same area with the colonized organisms intact.

Of the 7,680 corals estimated at the array site and shore line landing, about 1,380 colonies are not candidates for translocation. They were too small and/or had a growth form that cannot be safely transported (i.e., encrusting). The Navy will strive to minimize loss of the remaining 6,300 corals by moving as many as possible to a coral pinnacle in Outer Apra Harbor called Mound 9, which is located to the southwest of Western Shoals (13° 26' 57" North and 144° 39' 09" East; Figure 23). Immediately after WWII, Mound 9 was dredged to a depth of approximately 46 ft. (14 m) and heavily impacted by large vessel anchoring. However, the Mound 9 area has not been used for large vessel anchoring in the past several decades. While a well-developed and complex coral habitat occurs within 3–15 m (10–49 ft.) around the upper perimeter and down the sides of Mound 9, nearly the entire central top surface is devoid of consolidated hard substrate or established coral communities (HDR & CSA 2017, 2020). The 1.5–2 acre area on top of Mound 9 is predominately comprised of rock rubble and sand-covered bottom except for two other coral translocation projects (Figure 24).

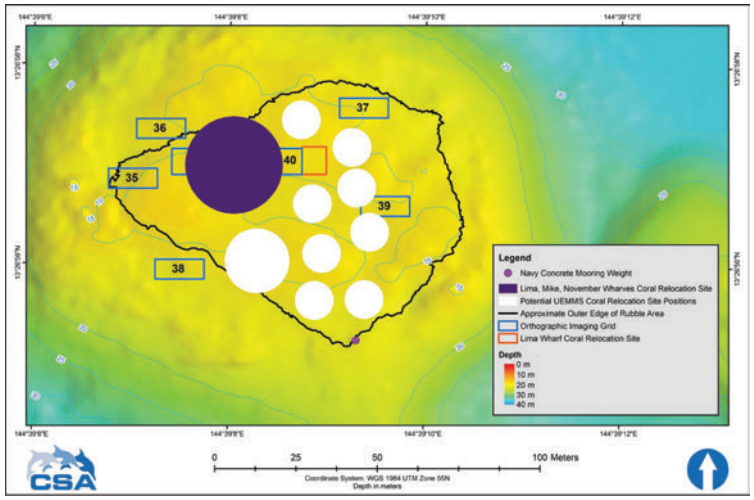


Figure 24. Mound 9 showing Lima Wharf 2017 coral translocation site, Lima, Mike, November wharves coral translocation site, and potential UEMMS coral translocation site positions. (Source: NAVFAC 2020)

All corals species within the UEMMS array site as well as the shore landing footprint will potentially be targeted

for translocation. An estimated 7,534 coral colonies were identified in orthomosaic imagery within the UEMMS array site and 145 colonies were identified at the shore landing site during the 2020 survey. The Navy does not expect that all 7,680 corals will be successfully translocated to Mound 9. Some corals have a growth form or are of a size that is too delicate to move because of fragility or sheer mass. The Navy defined the following criteria for the appropriate candidates for coral translocation:

1. For corals where at least one dimension is not greater than 10 cm:
    a. corals less than 10 cm from 3 coral species (*Leptastrea purpurea, Pavona cactus* and *Pectinia paeonia*); two groups (*Astreopora spp.* and *Porites spp.* massive) and one group complex (*Porites rus*) have been determined to not be fit for translocation will therefore be considered as a loss in later analysis
    b. 3 coral species (*Pachyseris speciosa, Porites cylindrica* and *Stylocoeniella armata*); two groups (*Galaxea spp.* and *Lobophyllia spp.*) and one species complex (*Pavona varians sp.*) have been determined to potentially be fit for translocation as corals less than 10 cm and half of those colonies will therefore be considered as a loss while the other half is translocated
    c. several *Pocillopora acuta and Pocillopora damicornis* colonies and all *Fungia spp.* and *Herpolitha spp.* colonies less than 10 cm are candidates for translocation and will therefore be translocated
2. Colonies in good health (i.e., no signs of bleaching, wounds, disease or parasites).
    a. Throughout the UEMMS Action Area and in all size classes, little to no disease or bleaching was detected
    b. Corals that are undergoing bleaching, are stressed/diseased, have encrusting or boring sponge cover, or are otherwise unhealthy will not be translocated.
3. Morphology that could be removed with minimal damage, in particular:
    a. No flat-encrusting growth forms, such as *L. purpurea*.

Therefore, the Navy expects that 19% of the possible candidate corals (approximately 1,380) will not meet the translocated criteria, including the majority of coral colonies that are less than 10 cm. The Navy will attempt to move 81% of the total estimated coral colonies (i.e., the remaining 6,300 corals) along with large sponges and mobile invertebrates that can be collected in the UEMMS Action Area to Mound 9, Polaris Point or in the area adjacent to the dredge site (Grids 20 and 27). Based on the Navy's recent coral translocation events (e.g., mitigation for the Lima Wharf maintenance dredge and X-ray Wharf repairs; see below), the Navy expects that 70% of translocated coral will survive, with only partial mortality within two years after transplant. In the case of the delicate forms, colony movement may be attempted, but some damage in process is expected and will be tolerated. Thus, the Navy accepts the risk of 30% more corals (i.e., 1,890 of 6,300 total corals) that may be unavoidably lost. From the UEMMS array site 6,069 colonies will be translocated to Mound 9 with 4,248 colonies (70%) expected to survive and 1,821 colonies (30%) conservatively anticipated to not survive. Overall EFH will benefit from the 70% (i.e., 4,410 total corals) that are expected to survive and grow after translocation at all three locations.

Due to their large size and the difficulty associated with moving the colonies extensive distances, select larger corals may be moved to adjacent grid cells in lieu of transport to Mound 9. Approximately twelve large (≥1 m diameter) colonies of *Porites rus* and up to twelve large (near 1 m diameter) *Porites* sp. massive colonies occurring within the direct impacts area may be moved to grid cell 27 at the west end of the UEMMS site or grid cell 20 to the southeast of the site. These two cells each have approximately 20% coral cover with adequate space for placement of large colonies. Utilizing these two grid cells should result in the corals being located outside the area of impacts associated with the dredging work. Additionally, the Fungiidae corals *Ctenactis* spp. (5 colonies),

Herpolitha spp. (92 colonies), *Fungia moluccensis* (3 colonies), and other observed Fungiidae colonies (4 colonies) will be translocated to grid cells 20 or 27 rather than transporting them to Mound 9. Therefore, 128 coral colonies will be translocated a short distance from the primary dredge site to suitable habitat areas in the immediate vicinity with 38 colonies (30%) conservatively not surviving and 90 colonies (70%) expected to survive and grow.

103 corals from the Polaris Point shore landing footprint will be translocated to similar habitat to the east and west of the construction area. The 2020 survey identified existing boulders and concrete debris outside the construction footprint. This similar habitat is approximately 20 to 25 m (65.6 to 82 ft.) laterally beyond the footprint the intended riprap temporary relocation boundaries and may serve as suitable coral reattachment substrate. Divers will first translocate corals, at times with attached boulders or concrete debris, prior to construction in the planned footprint. The additional remaining riprap will be temporarily relocated without impacts to the translocated corals that will remain in the new areas while the riprap without corals will be returned to the original footprint with the remaining colonized organisms intact. Of the 103 corals to be translocated, 72 colonies (70%) are anticipated to survive while 31 colonies are conservatively anticipated to not survive.

At all mitigation sites (Polaris Point, Grid 20 and/or 27 and Polaris Point), translocated corals require additional habitat management to minimize adverse effects from translocation and to ensure coral survival. The Navy will visit the receiving site periodically to remove algae that is competing with corals and to reattach corals that may have become detached but still have living tissue. The Navy expects that coral with partial mortality may recover and grow if given optimal habitat conditions. Algae removal will be prioritized for areas with translocated coral, while other areas in the vicinity of the coral transplants may be cleared of algae overgrowth, if feasible.

In recent years, Mound 9 served as a receiving site for previous coral transplants. As minimization mitigation for Lima Wharf's maintenance dredge, the Navy transplanted 400 corals to Mound 9 in December 2017 (HDR *et al.* 2019). Of the transplanted corals, most coral colonies were cemented to a plastic mesh fabric that was fixed to the harbor floor, covering approximately 64 m^2 (689 ft^2). The success rate of the transplanted corals was not fully quantified, but the recent biological survey obtained a photomosaic of the area and identified 302 corals that were visible on the mesh fabric (Wells *et al.* 2019). An additional 62 free-living coral colonies were relocated to the site but not affixed, all of which were noted to be healthy and alive in 2019. Presumably, wave action transported them off the mesh. Overall, among all corals that were identified (Wells *et al.* 2019):

- 140 (46%) showed no mortality
- 111 (37%) showed partial mortality
- 51 (17%) were classified as completely dead
- Resulting survival rate of about 83%.

Another example of successful Navy coral translocation in Inner Apra Harbor was a 600-day field experiment that relocated 96 healthy coral colonies from X-ray Wharf onto locally-sourced, limestone boulders placed approximately 0.5 mile away (HDR *et al*. 2019). The relocated corals were visually monitored immediately after reattachment and at 30, 90, 240, 410, 450, and 600 days after relocation. The results showed a high coral-colony survival rate, with 98% of relocated colonies retaining at least partial living tissue after 600 days. Additionally, 91% of the relocated corals increased in measured maximum total length during the post-relocation monitoring period. Further, the relocated colonies exhibited reasonably good health and growth, including coral tissue not visibly bleached, more than 75% living tissue, and visible and measurable colony growth (Figure 25). The coral

transfer and reattachment techniques used in this translocation were effective, and all relocated corals remained firmly anchored to the boulders throughout the 600-day experiment. No significant biofouling from macroalgae, sponges or tunicates was observed either on the living coral tissue or on the boulders. Using this translocation effort as the best available scientific evidence, it is reasonable to expect similar results for the proposed Action, based on the similar methods, species, and marine environment.

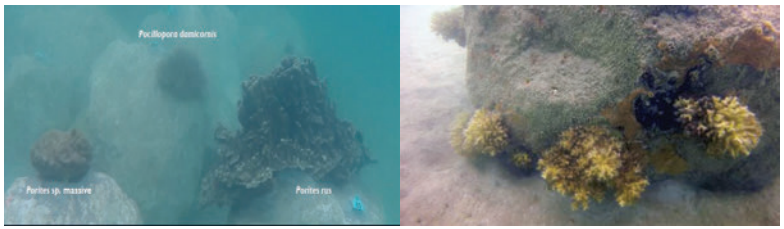


Figure 22. (Left) Corals translocated onto limestone boulders in Inner Apra Harbor in 2015; (Right) recruited coral colonies of *Pocillopora damicornis* growing along lower edges of a boulder at translocation site in 2018 (center colony approximately 15 cm diameter; Source HDR *et al*. 2019).

Offset

The most notable ecosystem functional loss to EFH from this Action is the invertebrate community and habitat complexity at the UEMMS array and shore landing sites, which allows for recruitment, refuge, and prey source habitat for BMUS and PMUS species. Based on the recent biological survey analysis (HDR & CSA 2020), the total area of coral (1,738.3m^2: 18,710.9 ft^2) and benthic community (922.5 m^2: 9,929.7 ft^2) that are functioning collectively as EFH in all of the Action Areas that is expected to be unavoidably lost is estimated to be 2,660.8 m^2 (28,640.61 ft^2). To offset these temporary losses of EFH, the Navy proposes to perform habitat restoration and conversion at Mound 9. Habitat restoration will complement and synergize with the coral translocation proposed under minimization. Restoration will make the site more suitable for EFH as a coral reef habitat for the coral transplants, as well as for additional marine species that could recruit there.

Additionally, the Navy will strive to move other beneficial invertebrates to Mound 9, as feasible. By restoring the site at Mound 9, the Navy will be performing habitat translocation from the invertebrate community on a highly trafficked vessel channel to an improved natural site where coral occurred in the past. BMUS and PMUS will benefit from the restored environment because prey can recruit and seek refuge there.

Focusing on species of the same genera as BMUS species in the Mariana Archipelago FEP, previous research of gut content and stable isotope analysis showed a preference for coral reef associated prey, for example for crabs, shrimp, and polychaetes for *Lutjanus fulvus* or black snapper (Nakamura *et al.* 2008) and juvenile fish and crustaceans for *Lethrinus insulindicus* (Eya *et al.* 2011). According to data for *Aprion virescens* (green jobfish) in the Hawaii Archipelago FEP Amendment (WPR FMC 2016), the stomach contents contained multiple reef fish species, cephalopods, crustaceans, and other sessile reef invertebrates. In addition, these and other BMUS species could inhabit Mount 9 as juveniles and adults.

For the proposed Action, the Navy performed multiple Habitat Equivalency Analysis (HEA) using *Visual_HEA* software that determines the amount of compensatory restoration required to provide services that are equivalent to the interim loss of natural resource services following the impacts of this project (Pioch *et al.* 2017, Kohler *et al.* 2006). The parameters used (see Appendix A) in the HEA analysis produced 2,284.2 m^2 (24,586.9 ft^2) of replacement habitat to offset the loss of coral cover, and 989.49 m^2 (10,650.78 ft^2) of replacement habitat to offset the temporary and permanent loss of benthic community EFH. In total, the HEA analysis indicated a replacement project of 3,273.69 m^2 (35,237.71 ft^2) will provide the service gains equal to the services temporarily lost (see Appendix A).

The Navy understands that the percent cover used for analysis of corals and benthic community is limited in its three-dimensional evaluation of habitat, and attempted to use conservative area formulas as described previously. The largest initial loss of habitat is to small corals (<10 cm) and the encrusting corals that provide only nominal EFH functions and services for BMUS and PMUS species in terms of places for prey fish to recruit and seek refuge. The Navy has therefore taken multiple, conservative measures to compensate for the under-representation of habitat complexity and rugosity in its analysis for offset mitigation:

1. The two-dimensional surface area of corals visible in orthomosaic images was calculated via a conservative method that estimated the surface by using:
    a. the total diameter area versus perimeter area, which based on the LMN survey reports (Wells *et al*. 2019) averaged for each coral was about 2:1. This suggests that estimating coral cover based on the longest colony diameter, and assuming a circular shape doubled the actual coral cover. Therefore, the Navy used the longest colony diameter measurements in its analysis and nearly doubled the estimated coral cover.
    b. a circular shape for all encrusting and free living species was calculated using the maximum diameter from each size class with $\pi = 3.14$.
2. Three dimensional surface area of corals based on the most common morphology was calculated via conservative area formulas:
    a. a hemispherical shape and surface area for all mounding species was calculated using the maximum diameter from each size class with $\pi = 3.14$.
    b. a cube shape and surface area for all foliose species was calculated using the maximum diameter from each size class for five sides (not including base) with $\pi = 3.14$.
    c. a cylindrical shape and surface area for all branching species was calculated using the maximum diameter from each size class with $\pi = 3.14$.
3. All coral colony area was calculated using the maximum size and growth forms:
    a. corals were binned into the most common growth morphology despite multiple corals species having multiple morphologies, often with lesser surface area than was calculated for this analysis.
    b. corals of the smallest size classes 1 (0-2 cm), 2 (2-<5 cm) and 3 (5-10 cm) were binned into one size class (0-10 cm) conservatively increasing the surface areas of these corals.
4. The HEA analysis of coral cover area included all coral species from the UEMMS Action Area:
    a. all corals less than 10 cm and corals of a morphology not able to be translocated represented 19% of all colonies and will be offset for despite lesser impacts on EFH.
    b. the Navy conservatively anticipated an additional 30% loss of corals while attempting translocation and will proactively compensate for this loss.

The coral and biofouling community HEA analysis included a ratio of 1:1 for the pre-injury site (UEMMS Action

Area) versus the recovery site (Mound 9). The Navy conservatively accepted that a turbid active vessel channel with multiple anthropogenic impacts was equivalent to a natural coral reef mound that has also suffered previous adverse impacts but has received restoration efforts and is closer to open ocean influences. Realistically, conditions and quality at Mound 9 are expected to be more optimal for coral survivorship and recruitment, especially after additional habitat restoration is executed and further complemented with regular maintenance and monitoring.

Based on the HEA calculations, the Navy will perform the following offset mitigation at Mound 9 (note that measurements and quantities are approximate due to irregularities of surfaces and variability in natural systems):

- remove anthropogenic debris scattered within the restoration area prior to stabilization.
- stabilize 1,235.89 m^2 (13,303.01ft^2) of the substrate to:
    - reduce the rubble mobility on top of the mound
    - create a consistent, stable surface to which marine fauna may attach and thrive.
- increase rugosity and habitat complexity by placing 615 locally-sourced, limestone boulders on the newly-stabilized area on top of Mound 9 (above).
    - The use of this substrate was based on the successful coral translocation completed for compensatory mitigation of X-ray Wharf repairs in 2015 (Figure 25 and Figure 26; HDR *et al.* 2019). Limestone boulders procured from Smithbridge Quarry in Yigo, Guam, for the coral transplant experiment were roughly cubic with very rounded corners and edges. The surface area ranged from about 1.8–7.2 m^2 (not including the face that is down on the substrate).

Figure 23. Limestone boulders from a quarry on Guam were transported to a coral translocation site by barge and placed underwater at the selected site (Source: HDR *et al.* 2019).

  - The Navy expects to procure limestone boulders from the same source but of a more appropriate size for the proposed habitat restoration. If feasible, the use of boulders with an "elongated cube shape" with an average exposed surface area (does not include bottom surface) of 3.32 m^2 would be used. Therefore, 615 boulders will add approximately 2,041.8 m^2 (21,977.75ft^2) of hard surface area to the top of Mound 9. The actual number of boulders utilized will be dependent upon final boulder sizes and will vary due to limits and imprecision in quarrying techniques.
  - Also, the Navy will optimize boulder placement and stability by working with coastal engineers to determine best methods to withstand current and wave stresses.
- based on their attachment and growth morphologies, attach transplanted corals to boulders as well as the stabilized substrate.
- design the boulder layout and stabilized areas to create sections or regions that will facilitate the Navy or other parties in future monitoring of transplanted corals and cordoning of potential adverse health vectors. One region of the restored area will be allowed to develop without transplants or maintenance to allow the Navy to observe and determine the natural progression of recovery at Mound 9.
- establish a reference baseline site and conduct subsequent monitoring surveys of existing coral community adjacent to the restoration site at Mound 9.
- monitor (i.e., quantify and assess the resource conditions) fish and benthic community at the Mound 9 restoration site at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).
- monitor (i.e., quantify and assess the resource conditions) transplanted coral at Mound 9, Grid 20 and/or 27 and Polaris Point at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).
- after each monitoring event, provide a status report to NMFS on the condition of coral, algae, and fish at the Mound 9 restoration site and conditions of translocated corals at Grid 20 and/or 27 and Polaris Point.
- manage macroalgae and competing invertebrate populations that threaten to overgrow transplanted corals at Mound 9, Grid 20 and/or 27 and Polaris Point (including "weeding" and removing algae, sponges, competing invertebrates, etc. at 3-6 month intervals up to two years after translocation).
- manage corallivore species populations (e.g,. crown-of-thorns starfish, *Drupella* sp. snails, etc.) at the Mound 9 restoration site (as stated in the JRM INRMP).
- designing restoration and translocation plans at Mound 9, to ensure optimal and available habitat to receive future coral transplants from other Navy projects that seek to avoid and minimize adverse effects to corals and EFH.
- avoid coral translocation during coral spawning seasons.

Through the above minimization actions, approximately 3,688.1 m^2 (39,698.4 ft^2) of living coral cover at all three translocation sites will survive being translocated. Once translocation is complete, Grid 20 and/or 27 will have 90 new living coral colonies; Polaris Point will have 72 living colonies; and Mound 9 will be populated with a community of approximately 4,248 new living corals (along with other invertebrates), with all expected to persist and grow when properly managed. Additionally, with the execution of the above offset actions, the Navy expects to stabilize and/or add 3,273.69 m^2 (35,237.71 ft^2) of improved restoration habitat as HEAs offset for the loss of services and functions to EFH (benthic community & corals). The Navy conservatively anticipated 30% of translocated colonies that do not survive will be compensated for in the offset analysis. If all 30% are dead, then

the colonies will still be able to provide 1,890 m^2 (20,343.8 ft^2) of dead coral cover that is not considered as part of the offset. However, the approximate total surface area of the proposed habitat conversion available as EFH will be 5,163.69 m^2 (55,581.49ft^2). This area will conservatively provide 36% more replacement habitat than was calculated by the combined HEAs.

Determination

The Navy determined that the direct physical removal of coral and other marine benthic community within the 1,464 m^2 (15,758.4 ft^2) footprint of the UEMMS Action Area will adversely affect EFH for BMUS and PMUS. Of the coral and benthic community in the Action Area, approximately 5,426.4 m^2 (58,409.3 ft^2) coral area and 922.5 m^2 (9,929.7 ft^2) benthic community are contributing to EFH that warrants avoidance, minimization, and offset measures (Table 15). The Navy will avoid this impact by revising the Action along the cable route (i.e., reducing attachment method, avoiding sensitive areas with diver deployment) and by implementing BMPs (e.g., safe equipment and vessels use). The Navy will also minimize losses by translocating approximately 81% of corals and other invertebrates to a receiving site in Outer Apra Harbor (Mound 9). Additionally, the Navy will offset the unavoidable losses of ecosystem functions and services provided by EFH by performing habitat restoration and conversion at Mound 9, which includes stabilizing the substrate, increasing structural complexity of the site, and managing fast growing species that could out compete transplanted corals for two years. This offset will also increase the likelihood of transplanted coral survival at Mound 9. Finally, the Navy proposes to monitor the receiving site and provide status reports after each monitoring event to NMFS for two years after translocation. The Navy's obligation under this consultation (including any conservation and mitigation measures) is contingent upon the availability of appropriated funds, from which payment for conservation and mitigation measures can be made.

Table 15. Summary of mitigation actions other than BMPs proposed to address the removal of the marine invertebrate community in the UEMMS Action Area

Mitigation Action	Type	Quantity
Additional survey areas mapped	Avoidance	Adjacent habitats will avoid impacts from secondary construction activities
Deep water cable deployment	Avoidance	Cables will route around sensitive habitats
Diver guided cable deployment	Avoidance	Cables will route around sensitive habitats
Decreased dredge footprint and volume	Minimization	• 1,969.2 m^2 (21,196.3 ft^2) less area required to be impacted • 3,364 m^3 (4,400 CY) less dredge material
Inclusion of CTD sensor into array footprint	Minimization	Adjacent habitat will not be impacted
Cable securement will be conducted by divers and hand tools	Minimization	Concrete anchor discs decrease cable anchor footprint
Translocate coral and other benthic invertebrates	Minimization	Target moving approximately 6,300 colonies; about 4,410 projected to survive
Removing algae at mitigation site (after translocation)	Minimization	• Primary focus: area where coral has been transplanted; • Secondary focus other areas near coral transplants

Mitigation Action	Type	Quantity
Reattaching transplanted coral that become dislodged at mitigation site (after translocation)	Minimization	All broken coral >10 cm that has at least 20% living tissue
Remove marine debris on top of Mound 9 that not inhabited by coral	Compensatory mitigation – habitat conversion	Undetermined
Stabilize rubble surface of Mound 9	Compensatory mitigation – habitat conversion	About 1,235.89 m^2 (13,303.01 ft^2) of rubble stabilized for invertebrate attachment and recruitment
Boulder placement at Mound 9	Compensatory mitigation – habitat conversion	615 boulders - about 2,041.8 m^2 (21,977.75 ft^2) of surface area for coral and invertebrate attachment and recruitment

3.2.2. Increased Suspended Sediments

The marine environment endures natural sediment fluctuations with successive suspension and deposition events. Sediment and turbidity levels fluctuate regularly from ocean conditions such as cyclones, storms, tides, floods, winds, waves, and currents, all of which may increase suspended sediment concentration (SSC) in the water column and transport material over great distances (Erftemeijer *et al*. 2012). As the hydrodynamic forces return to baseline levels, sediment will settle and deposit in new locations, sometimes exceeding previous amounts. Smaller particles will disperse in the water column and may clump together before settling again. If the environment is sufficiently turbulent, some particles will remain suspended within the fluid mud layer near the bottom. Other sediment particles will deposit and adhere to the seabed, or, depending on the size of the sediment and water conditions, the suspended sediment can travel far distances from its original location.

Exposure to elevated SSC leads to effects that are complex, dynamic, and interdependent, as the effects may occur individually as a consequence of each other or via a multitude of interconnecting pathways. The following direct and indirect effects to EFH may include (but are not limited to):

- covering/smothering of benthic fauna (direct)
- increased turbidity (direct)
- increased sedimentation (direct)
- changes in light quality and quantity (indirect)
- chemical changes (indirect)
  - oxygen depletion
  - nutrient release
  - contaminant pollution
  - pore-water dilution.

For shallow, benthic organisms (e.g., corals, sponges, seagrass, filter-feeders, etc.), the effects listed above are highly-interconnected, and the influence of each effect are altered spatially and temporally, depending on the in-water activities and the prevailing metocean conditions (e.g., tides, winds, waves, currents, storms). Motile species are expected to avoid the area; while non-motile or slow-moving species would either tolerate or succumb to an increase in suspended sediment. The extent of each impact varies for each receptor species based

on their tolerance levels, location relative to the proposed activities, and current behavioral patterns. Furthermore, the impact severity is contingent on the intensity, duration and frequency of exposure to elevated SSC (Erftemeijer *et al.* 2012). For MUS likely to occur in the area, the associated EFH may be adversely affected by exposure to suspended sediments. As such, the following assessment evaluates potential impacts for coral eggs, larvae, juveniles, and adults.

Impacts to Corals

At all life stages, corals may be impacted by elevated levels of SSC in the marine environment. However, each coral species maintains different tolerance and sensitivity levels, with some coral species having no observable effects while others experienced widespread mortality. In addition, coral reefs occur in habitats with ambient sediment levels that range from <10 to >100 mg/L (Erftemeijer *et al.* 2012), further demonstrating the continuum of tolerance of exposure to suspended sediments.

Exposure to elevated sediments impacts corals directly by covering, smothering or burying corals with sediment and material, thereby preventing corals from capturing food using polyp expansion, mucus entrapment, and/or ciliary movements. Effects will vary based on sediment grain size, as coarse particles lead to scouring and abrasion and fine particles reduce light substantially (Anthony & Larcombe 2000). Some corals ingest sediment, which may be a diverse food resource for bacteria, microalgae, and organic matter, but high levels of sediment may cause corals to stop feeding and reject sediments, causing polyps to retract or cease altogether, and ultimately reduce their feeding rates (Jones *et al*. 2016; Anthony & Larcombe 2000). Reduced feeding leads to inhibition in metabolic rates, growth processes, population recruitment and survival, and species abundance and diversity.

Coral smothering may prevent spawning by physically blocking gamete release or by sinking the eggs and sperm, thus inhibiting their ascent to the surface. These adverse impacts may lead to spawning asynchrony and failed spawning events, significantly reducing coral reproduction rates and survival. In addition, both laboratory and field experiments demonstrated that coral larvae were reluctant to settle in silty environments or on substrate covered by sediments (Jones *et al*. 2015). Other scientific studies covered corals with organically-rich sediments of a few millimeters and resulted in coral lesion formation, local necrosis and partial mortality (Jones *et al.* 2016). In contrast, coral reefs thrived in areas with high levels of turbidity and SSC levels, particularly if strong hydrodynamic conditions (e.g., high tidal currents and wind-generated swells) circulated the sediments regularly. In shallow, coastal reefs (<4 m deep) in Australia, coral reefs were exposed to sediments re-suspended by waves and flourished in high SSC levels of 220 mg/L (Anthony & Larcombe 2000). However, these sediments did not accumulate, and wind-driven longshore currents created strong tidal flushing, which was a key factor in the coral reef tolerance for high sediment exposure.

Of all possible sedimentation effects to coral, light reduction may have the most significant implications for survival. Turbidity is defined as the optical property of a suspension that scatters and absorbs light and indicates levels of mud, clarity, and transparency (Jones *et al*. 2016). Elevated levels of suspended sediments contribute to high turbidity levels and reduce the quantity and quality (i.e., spectral composition) of light in marine environments, which subsequently results in decreased photosynthetic production by zooxanthellae (i.e., photo-physical stress) and starvation, reduced growth, lower calcification rates, and reduced regeneration from tissue damage (Erftemeijer *et al*. 2012). If light conditions are extremely low to negligible, corals may reduce autotrophy completely and enter hypoxic and anoxic states. Long-term impacts to the coral community structure may include decreased productivity, growth and species diversity.

Depending on the species, corals may respond passively or actively to increased suspended sediments levels and have different tolerance and recovery capabilities to this exposure, especially if background turbidity levels are high. The thin shape of branching species has little surface area for sediment accumulation and allows more sediment to slough off. Other species actively inflate or move polyps when surface receptors are triggered or remove sediments through ciliary or tentaclular movements and mucus production. Some coral species are injured and killed from prolonged sediment cover, and coral size and diversity is reduced. Other species are highly resistant to sediment cover and survived burial after days and weeks of smothering (Rice & Hunter, 1992), while other species regenerate successfully after sediment is removed. The range of reef recovery is diverse, with evidence of rapid recovery rates within week to months, long-term recovery over several years and no recovery at all (Erftemeijer *et al*. 2012).

In an effort to assess effects on corals in Apra Harbor from high sedimentation and increased turbidity, a bench-scale laboratory experiment was conducted to evaluate macroscopic (gross morphological) and microscopic (tissue and cellular) responses of selected stony coral species to deposition of fine and coarse sediments dosing rates that ranged from 0.05 to 0.4 g/cm^2/day (50 to 400 mg/cm^2/day) over a 28-day exposure period (HDR & CSA 2017). Coral fragments were acclimatized to laboratory conditions for about 10 weeks before being introduced into the treatment tanks. Gross and microscopic responses to both fine (<1.4-mm diameter) and coarse (between 1 and 20 mm sand, crushed live rock/reef skeleton) sediments were evaluated. Both gross morphologic and microscopic observations indicated that coral health deteriorated in most experimental treatments over the course of the 4-week experiment. In general, specimens exposed to higher concentrations of fine sediments fared worse than fragments of the same species that were exposed to lesser concentrations of fine sediments and coarse sediments. In general, morphological responses differed more clearly with species than with treatments. Overall, *P. rus,* which has a flattened colony morphology (which allows more sediments to stay accumulated) and relatively low mucus production (mucus production being one of the ways in which corals actively shed accumulated sediments), fared the worst of the four species tested. More tissue paling and bleaching, which can be precursors to tissue mortality, were observed in this species than in any other species. By Week 2, 18% of all *P. rus* specimens exhibited >95 percent tissue mortality. Horizontally flattened colony morphology reduces passive sediment shedding allowing more sediment to accumulate compared to specimens with vertically oriented morphology (e.g., *P. cylindrica*; HDR & CSA 2014). Section 3.1.3 contains more information about the Particle Tracking Model for Apra Harbor and the Turbidity Measurements from a Pearl Harbor Maintenance Dredge.

Mitigation Measures

During in-water construction and dredging activities, the Navy will ensure that a rigorous water quality monitoring plan will continuously monitor and adaptively manage the turbidity levels resulting from the Proposed Action. The contractor will monitor turbidity levels at the Project Area to ensure that employed BMPs effectively control turbidity and protect marine resources. Turbidity data will be collected using real time monitoring devices (such as the HACH TSS Portable Handheld Instrument for Turbidity /Suspended Solids), and will be collected at two test stations and two control stations:

- Test station – Turbidity data will be collected at two test stations.
    - One station will be located approximately 300 ft. downstream of current from the silt curtain surrounding construction operations
    - The other station will be located approximately 300 ft. up current from the silt curtain.
    - Turbidity meters will be positioned approximately 3 ft. above the sea floor at both locations.

- Control stations – Turbidity data will be collected at two control stations located approximately 1000 ft. from the work area
  - Both control stations will also consider the heavy boat traffic inside the inner and outer Apra Harbor as significant fluctuations in readings are anticipated due to the heavy boat traffic.
  - Turbidity meters will be positioned approximately 3 ft. above the sea floor at both locations.
- Dynamic Requirements – Locations of the monitoring stations will be moved depending on the nature of the work.
  - Monitoring stations will be placed near phased work for construction or dredging.
  - Control stations will normally remain in the same location for the duration of the work.

Turbidity data collected at the test stations will be compared to data collected at the control stations to determine whether water quality standards are maintained. Following Guam Water Quality Standards, turbidity values at the test station should not exceed 1.0 NTU over ambient conditions measured at the control stations. In the event that turbidity values at the either test station exceed 1.0 NTU above the value at the control stations, shut-down procedures will be implemented.

Turbidity data will be collected in real time, continuously, with a person monitoring the data at an interval of 15 minutes and recording compliance during active construction or dredging. During construction and dredging operations, continuous visual monitoring of the water condition will be conducted around silt curtains, which will be checked for breach of turbid water and turbidity plumes. The silt curtain will contain re-suspended sediment from in-water activities and reduce effects from elevated turbidity levels reaching nearby coral patches. The silt curtains will be inspected daily to ensure correct deployment, and their effectiveness will be monitored daily by the contractor after each task is completed. Before and during the workday, visual inspections of turbidity levels in the water in and around the Action Area will be performed in regular intervals, documented in the daily reports, and pursuant to the Clean Water Act Section 401 requirements. If a plume is observed outside the silt curtains, operations will be stopped, curtains will be mended, and additional control measures (i.e., secondary turbidity curtain) will be deployed as necessary. Operations will resume when turbidity levels do not exceed 1.0 NTU above ambient. The contractor will submit all data collected during turbidity monitoring to the Navy following a weekly reporting schedule and including data such as turbidity levels, activity during data collection (e.g., dredging, etc.), weather, etc.

Furthermore, the Proposed Action was revised to include a BMP that will avoid impacts from increased sedimentation during coral spawning. The stony corals in Guam spawn seven days after the full moons in June, July, and August. Twenty-one days is the minimum period recommended by coral biologists in the Mariana Archipelago (Richmond pers. comm, Houk pers. comm). This period covers the three key phases of the spawning process necessary for successful spawning and settlement:

1. Phase One – Synchronization / Fertilization (Day 1-8): During this phase, the corals respond to chemical and light cues to synchronize the release of gametes. Good water quality is important prior to the release of gametes. Suspended sediment and chemical pollutants may prevent synchronization and decrease fertilization rates (Richmond 1997, Kojis & Quinn, 1984).
2. Phase Two – Larval Development (Day 9-13): After fertilization, coral larvae require approximately five days to develop and prepare for settlement (Harrison & Wallace 1990, Miller & Mundy 2003). This development can be strongly impacted by poor water quality.

3. Phase Three – Settlement and Metamorphosis (Day 13-21): This includes an eight-day period during which corals settle and metamorphose. Poor water quality and heavy sedimentation can negatively affect this process (Miller & Mundy 2003).

Soft coral spawning occurs 4-5 days after the full moon over a three-month period between March and June (Slattery *et al.* 1999). It is difficult to select a single event, as soft corals often split spawn (i.e., they release 50% of their gametes during the first month, then 50% during the second month). Thus, a reasonable estimation is a 21-day spawning period, beginning eight days before the spawning event in May and extending two weeks after the event. Therefore, water quality impairments can significantly impact the success of these yearly spawning events. In an effort to maximize spawning and minimize impacts from the Action, all in-water activities (including pile driving and dredging) will cease during the primary coral spawning events each year for both hard (scleractinian) and soft (octocorallia) corals. The duration of the coral spawning periods is estimated as 21 days total, including 8 days prior to the full moon and 14 days after:

- 2021 Coral Spawning Season
  - Soft corals: May 18–June 8 (Full moon May 26)
  - Hard corals: July 15–Aug 6 (Full moon July 23–24)
- 2022 Coral Spawning Season
  - Soft corals: May 7–29 (Full moon May 15–16)
  - Hard corals: July 5–27 (Full moon July 13-14).

Finally, the contractor shall remove all silt and debris depositing in drainage facilities, roadways and other areas and protect all storm drains and deck openings to prevent the discharge of foreign materials to the harbor. The contractor will prepare a turbidity management plan outlining all of the above measures and a contingency plan if measures fail. Operations/work will be curtailed in the event of high wind or adverse weather conditions.

Potential impacts to fish

Increased suspended sediments in the marine environment are known to negatively affect fish, although the responses vary considerably between species, life stages, sediment concentrations, and exposure time (Hess *et al.* 2017). Different species displayed a wide range of tolerance levels to increased suspended sediments, ranging from no effect to temporary behavioral changes to physiological stress and mortality (Wenger *et al.* 2017). Scientific evidence demonstrated that increased suspended sediments resulted with visual impairment and inhibition of chemical cues, thereby having adverse effects to foraging, predator defense, and habitat selection of several fish species (Hess *et al.* 2015). In some larval fish, development was disrupted and/or delayed following exposure to increased suspended sediments, possibly due to reductions in oxygen uptake efficiency. For species that respond in this way to increased SSC, the long-term impacts could include significant alterations of population recruitment rates and species distribution.

In laboratory experiments, clownfish larvae were exposed to SSC of 45 mg/L, and when compared to control fish, significant effects included alterations in gill morphology and gill microbiomes (Hess *et al.* 2015). Oxygen uptake efficiency depends on gill morphology, and the gills are also the first point of entry for pathogens. Increased suspended sediments directly covered and clogged the gills, changed its morphology, reduced oxygen uptake, increased respiratory stress, and increased bacterial growth. The evidence suggested that these stressors could lead to long-term population effects, such as delayed development and compromised ecosystem health (Hess *et al.* 2015).

Another experimental study found that prolonged exposure to high SSC for six weeks resulted in no change to food intake, growth rates or lethal effects to green grouper fish (Au *et al.* 2004). However, gill structures were damaged, which was evidence of osmoregulatory stress. The authors concluded that sub-lethal stress occurred from the exposure to high levels of suspended sediments, and suggested that fish health would be compromised with prolonged exposure.

In the marine environment, the most commonly observed response from fish to elevated suspended sediments is avoidance (Wenger *et al*. 2017). Various studies documented several different species avoiding turbid waters, acclimating to changes or returning to habitats after the sediment levels returned to baseline conditions. Some fish species returned to areas that recovered to pre-disturbance conditions after dredging ceased, depending of food and habitat availability.

For the UEMMS dredging activities, the contractor will be required to use a silt curtain configuration at the array installation area and at Polaris Point. In addition, the contractor will remove all silt and debris depositing in drainage facilities, roadways, and other areas and protect all storm drains and deck openings to prevent the discharge of foreign materials to Apra Harbor. Finally, the contractor will prepare a turbidity management plan outlining all of the above measures and a contingency plan if measures fail. Operations/work will be curtailed in the event of high wind or adverse weather conditions. The following BMPs (Section 1.4) will be implemented to reduce effects of suspended sediments to EFH:

- Turbidity and siltation from Project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions. During all in-water or over-water work, full water depth, silt curtains will completely enclose the work area to the maximum extent practicable.
- If a plume is observed outside of the silt curtains, Project activity will stop and corrective action will be taken immediately. Work shall resume after the correction was made.
- All Project-related debris other waste will be contained and will not enter or remain in the marine environment.
- In the event of approaching tropical storms and hurricanes, equipment will either be removed from the Project site or adequately secured.

Determination

The Navy determined that suspended sediment from dredging may adversely affect EFH. However, any effects from suspended sediment would be temporary and last only as long as dredging occurs. The harbor is a relatively low-energy system with multiple sediment inputs separated from a single outlet to the sea by deep water and relatively long distances. These features promote sedimentation and limit the transport of sediment away from the dredging site. Furthermore, based on results from the PTM for Apra Harbor and a recent Pearl Harbor maintenance dredge (Section 3.1.3), implemented BMPs (e.g., silt curtains) will reduce effects of increased suspended sediments to EFH to minimum levels. Therefore, based low expected dispersion of sediment in the environment due to natural factors and the implemented BMPs, any adverse effects to EFH from increased suspended sediments are expected to be temporary, minimal, and manageable.

3.2.3. Elevated Noise Levels

The proposed actions will produce elevated noise levels both in-air and underwater from:

- dredging for the sensor array installation
- underwater instrument array installation by divers using a handheld hydraulic breaker
- installation of guide piles for cable (steel pipes will be driven in with vibratory hammer and pvc and/or fiberglass pipe that will be jetted into substrate)
- installation of earth anchors with a barge or vessel using a topside pneumatically-driven jackhammer (Section 1.2.3)
- excavation of seafloor and boulder revetment using a clamshell bucket.

None of these actions are likely to generate underwater noise levels with the potential to cause adverse impacts to fish.

Acoustic Effects to Fish

Like other vertebrates, fish have two inner ears (Popper *et al*. 2014). Otolithic organs comprise the auditory portions of the ears and respond to particle motion of the surrounding fluid. Close to each otolith is a sensory epithelium embedded with numerous sensory receptors (e.g., auditory hair cells). As sound energy generates particle motion in the water and stimulates the otolithic organs, the hair cells are deflected and activated. Additionally, the head and body of bony and cartilaginous fish are covered with hundreds to thousands of hair cell sensors that form the lateral line system, which responds to relative motion between the body and the water around. As this is based on relative motion, responses only occur in very close proximity to the sound source, approximately one or two body lengths away. Several essential behaviors rely on the signals detected through the lateral line: predator avoidance, prey detection, courtship, spawning, orienting to the direction of water flow (rheotaxis), station holding in currents, and spatial imaging (Popper *et al.* 2014).

In addition, hearing sensitivity depends on the presence or absence of a swim bladder, which can radiate sound energy and particle motion to the otolithic organs. A swim bladder increases the individual's ability to detect sound over a broad frequency range and great distances, as well as increase its susceptibility to sound pressure and barotrauma injury. Fish with the lowest possibility of these types of injuries are those without a swim bladder at all, e.g., sharks, skates, rays and other pelagic and deep-sea species.

Furthermore, the type of swim bladder may also influence acoustic sensitivity in fish. Fish respond to fluctuating sound pressure levels by changing their internal, gas volume. Physostomous fish have a direct connection between the swim bladder and the gut, thereby allowing fish to change its gas volume quickly by either gulping or releasing air (Casper *et al.* 2013). Examples include primitive, soft-rayed teleost fish (UCSD 2009), such as sardines, herring, salmons, and sturgeon fishes. In contrast, physoclistous fish must diffuse gas through their blood via a gas gland in order to control the volume of their swim bladder. For these fish, gas diffusion is a slower process. Three categories of fish may be used to assess potential acoustic impacts and effects:
Fish with no swim bladder or other gas chamber – these fish are less susceptible to physical trauma and injury from exposure to noise.

1. Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume (physostomous swim bladders) - these fish are susceptible to physical trauma and injury from exposure to noise; although hearing only involves particle motion, not sound pressure.
2. Fishes in which hearing involves a swim bladder or other gas volume (physoclistous swim bladders) - these fish are susceptible to physical trauma and injury from exposure to noise; and they detect sound pressure as well as particle motion.

Each fish species has a different hearing sensitivity range, and the majority of fish detect sounds below 100 Hz and up to 500–1,500 Hz. For example, the reef soldierfish audiogram demonstrated the best hearing sensitivity for frequencies between 1,000–2,000 Hz (1–2 kilohertz [kHz]), which is higher than marine dredging sounds (Table 10, Section 3.1.2). A smaller number of species can detect sounds over 3 kHz, while very few species can detect sounds over 100 kHz. Potential effects on hearing sensitivity will depend on the hearing frequency range of the receptor fish and the acoustic intensity levels of the sound generated. For this risk assessment, a conservative approach assumes that all fish have hearing within the 0–200 Hz frequency range and thus are able to detect the marine dredging sounds.

High-intensity sounds are able to fatigue, damage or kill auditory receptor cells, resulting in TTS or permanent threshold shifts PTS. Evidence of fish mortality and serious injury resulted from exposure to sound with very high amplitude levels and/or changes in pressure levels (Popper *et al.* 2014). Barotrauma is tissue injury that results from rapid pressure changes from change in depth, explosions, and intense sounds. Rapid pressure changes cause the internal release of gases stored in blood, rapid changes in internal gas volumes in swim bladders that damage surrounding tissues and organs, and rupture of the swim bladder. While barotrauma may lead to immediate or delayed mortality, the cause and effects of barotrauma vary based on the pressure change and physiological conditions of the receiver fish.

The level and duration of noise exposure that causes PTS and TTS in fish vary widely and may be affected by factors such as repetition rate of sound, pressure level, frequency, duration, health of the organisms. By definition, hearing recovers after TTS. The extent (i.e., how many dB of hearing loss) and duration of the TTS may continue from minutes to days after the end of exposure. Unlike other vertebrates, fish are able to regenerate sensory hair cells throughout their lives. Thus, hair cells damaged as a result of exposure to sound may cause a temporary shift in auditory thresholds (i.e., TTS) and can subsequently be replaced (Popper & Hastings, 2009). However, sustained injuries from PTS and TTS may render fish vulnerable to mortality indirectly, such as through increased predation, increased susceptibility to disease, and reduced fitness to feed, reproduce or communicate. Behavioral responses from exposure to elevated sound levels are variable and may include (but are not limited to):

- leaving the area of the noise source/avoidance/displacement
- startle/alarm responses
- spatial changes in schooling behavior/swimming patterns
- changes in depth/vertical distribution.

These behavioral effects are temporary, with duration of effect less than or equal to the duration of exposure. The effects vary between species and individuals and are dependent on the properties of received sound. Available evidence suggested that behavioral changes for some fish species may be no more than a nuisance factor, and that within a few seconds, fish are likely to continue their previous activity.

Acoustic Effects to Fish from Dredging

Underwater noise from dredging operations have lower sound pressure levels than sound produced from pile driving, seismic exploration or in-water construction (Wenger *et al.* 2017). Scientific measurements of underwater sound levels exist for four types of dredging vessels: trailer suction hopper dredger, cutter suction dredger, backhoe dredger and clam/bucket dredger. From this limited dataset, transiting vessels produced the

highest sound levels, and different sediments provided different source levels during extraction, i.e., gravel was louder than fine sands or softer materials. Also, dredging operations in deep, offshore waters are expected to produce louder sound levels that are detectable at greater distances, compared to dredging operations in shallow environments with higher ambient, suspended sediment levels (WODA 2013).

Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson *et al.* 2001), the estimated sound levels of the proposed action in the UML are not expected to exceed SPL_{RMS} of 117 dB re 1 µPa from the winch noise (Table 5), which is considerably below the threshold levels likely to induce mortality/mortal injury, PTS, TTS or masking for fish from a continuous sound (Table 4). By definition, hearing sensitivity recovers after TTS, and hearing loss from TTS is temporary and acceptable. The extent (i.e., how many dB of hearing loss) and the duration of the TTS may continue from minutes to days after the exposure. The surrounding substrate is soft silt-covered rubble and sandy seabed that will generate much less sound than hard substrates when dredged. In addition, the bottom of the UML dredge site does not contain environmental habitats or conditions that could result in fish being trapped (e.g., site-attached species) and unable to move away from the noise source.

Sound Exposure Guidelines for Fishes and Turtles (Popper *et al*. 2014) evaluated the biological and ecological diversity of their sound detection capabilities as well as the different acoustic characteristics and appropriate metrics for different anthropogenic sounds. Based on the best available scientific data, these guidelines presented a set of numerical thresholds or, if data were insufficient, the relative likelihood of effects occurring. Sounds above the guideline thresholds were considered likely to result in that effect, with higher sound levels likely to produce greater effects, and different guideline levels were provided for different sound sources and different receptor species.

Direct evidence of mortality or potential mortal injury to fish does not exist from continuous sounds (such as those produced by dredging operations). For auditory tissue effects or TTS caused by continuous sound, the only evidence available is from data on goldfish (*Carassius auratus*), a species that has specializations for enhanced sensitivity to sound pressure. After 48 hours of exposure to white noise at 170 dB re 1 µPa sound pressure level measured in root-mean-square (SPL_{RMS}), acoustic effects included some recoverable loss of sensory hair cells in the ear (Popper *et al.* 2014). TTS recovery was observed seven days later, and full replacement of the sensory cells took eight days. Another study exposed goldfish to 158 dB re 1 µPa SPL_{RMS} and measured TTS, with full recovery after three days. Without approved regulation or policy, these results provided reasonable, precautionary threshold values upon which potential effects to fish from dredging noise (Table 16) will be assessed in this document.

Table 16. Acoustic exposure guidelines for fish exposed to shipping and continuous sounds based on knowing that fish will respond to sounds, but there are no data on exposure or received levels that enable guideline numbers (Source: Popper *et al*. 2014).

Effect of Action		Threshold Value – No swim bladder	Threshold Value – Physostomous swim bladder	Threshold Value – Physoclistous swim bladder
Mortality & potential mortal injury		(Near*) High**/(Intermediate) Moderate/(Far) Low		
Impairment	PTS	(Near*) High**/(Intermediate) Moderate/(Far) Low		170 dB SPL_{RMS} for 48 hrs.
	TTS	(Near*) High**/(Intermediate) Moderate/(Far) Low		158 dB SPL_{RMS} for 12 hrs.
	Masking	(Near*) High**/(Intermediate) Moderate/(Far) Low		
Behavior				

Notes: *Near – tens of meters; Intermediate – hundreds of meters; Far – thousands of meters.
** The relative risk of an effect taking place is indicated as being High, Moderate, and Low.

Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson *et al*. 2001; Section 3.1.2), the estimated sound levels of the proposed reclamation dredging are not expected to exceed SPL_{RMS} of 117 dB re 1 µPa from the winch noise (Table 10), which is below the threshold levels likely to induce mortality/mortal injury, PTS, TTS or masking for fish from a continuous sound (Table 16). By definition, hearing sensitivity recovers after TTS, and hearing loss from TTS is temporary and acceptable. The extent (i.e., how many dB of hearing loss) and the duration of the TTS may continue from minutes to days after the exposure. The surrounding substrate is soft silt-covered rubble and sandy seabed that will generate much less sound than hard substrates when dredged.

Determination

The Navy determined that exposure to elevated noise levels will adversely affect the quality of EFH, particularly for BMUS and PMUS, because species in these MUS may be more sensitive to sound. However, the acoustic effects will be temporary and minimal, and predicted sound levels from dredging will not exceed thresholds likely to cause TTS, PTS or mortality. Fish may respond behaviorally to dredging noise by leaving or avoiding the area temporarily. Based on the expected underwater sound levels, the lack of sensitive benthic habitats or restricted environments for fish, and the BMPs implemented, potential acoustic effects from exposure to elevated noise levels from dredging operations on the fish populations and will be temporary and recoverable, lasting only as long as dredging equipment is operating.

3.2.4. Waste and Discharge

The Proposed Action will not generate wastes that will enter the water. However, in the unlikely event that Action-related wastes and debris accidentally enter the water, exposure to waste and discharge may adversely affect BMUS and PMUS in the Action Area. Action wastes may include plastic trash and bags that coat or wrap around coral. Large debris items (e.g., ropes and cables) entering the water may also contact corals or other sensitive benthic fauna. Spills and discharges could contain petroleum and/or other chemicals and expose EFH

to toxic substances in the water.

The proposed BMPs include measures to prevent or minimize the potential for the introduction of wastes and toxicants into the marine environment. No debris shall be allowed to enter the water. To further reduce the potential for action-related waste and discharges impacting marine species adversely, all waste will be controlled and disposed into trash dumpsters or roll-off bins in the Project base yard or storage area. The contractor shall capture all pollutants and dispose of them at an approved disposal facility. Prior to commencing daily activities, all equipment and vehicles will be maintained and checked to reduce any risk of leaks or discharge. Hydraulic equipment will be maintained properly to prevent leaks in accordance with the Navy Preventative Maintenance System.

In addition, a contingency plan to control and contain accidental, toxic spills will be developed for the proposed action and include protective measures for all construction vehicles and heavy machinery. Petroleum spill-containment devices (e.g., absorbent pads, containment booms) will be located on-site, in sufficient quantity, and available and accessible for immediate deployment at all times. Thus, Project-specific BMPs will prevent the wastes and toxicants from entering the marine environment. However, if a chemical is discharged or spilled accidentally during the proposed repairs, the realistic worst case would be a small quantity or volume (<25 L). In the unlikely event of a spill or discharge, the effects would be minimal, of small amounts and cleaned quickly.

The following BMPs (Section 1.4) will prevent and/or mitigate exposure to accidental release of wastes and discharges:

- All Project-related materials and equipment placed in the water shall be free of pollutants.
- Operators shall perform daily pre-work equipment inspections for cleanliness and leaks. Should a leak be detected, all heavy equipment operations shall be postponed or halted and shall not proceed until the leak is repaired and equipment cleaned.
- Fueling of land-based vehicles and equipment shall take place at least 50 ft. away from the water, preferably over an impervious surface. Fueling of vessels shall be done at approved fueling facilities. With respect to equipment (e.g., on the barge crane) that cannot be fueled out of the water, spill prevention booms will be employed to contain any potential spills. Any fuel spilled will be cleaned immediately.
- All Project-related debris or other waste will be contained and will not enter or remain in the marine environment.
- In the event of approaching tropical storms and typhoons, equipment will either be removed from the Project site or adequately secured.

Determination

The Navy determined that exposure to wastes and discharges from the proposed action may adversely affect EFH. However, implemented BMPs (e.g., equipment maintenance, contingency plans, fueling restrictions) will prevent and mitigate effects from an accidental release of waste and discharges. Thus, potential effects from exposure to accidental release of waste and discharges would be temporary, minimal, and controllable.

3.2.5. Aquatic Invasive Species

AIS present a significant threat to the marine environments worldwide by dramatically altering other species' survival and ecosystem functions. Exposure to AIS may adversely affect all MUS likely to occur in the Action Area. The key vectors for AIS exposure include biofouling:

- on vessel hulls and other external niches (e.g., propulsion units, steering gear and thruster tunnels)
- of vessel internal niches (e.g., anchor cable lockers, bilge spaces)
- on equipment immersed routinely in water.

Once established, AIS may alter the marine community by destroying native habitats, growing over coral reef, promoting high levels of algal growth, adversely affecting behavior and survival of reef fish populations, decreasing ecosystem functions and services and ultimately causing native species extinctions. Introduced organisms can be difficult or impossible to eradicate unless ample funding is dedicated and coordination with outside agencies and the public are conducted. When eradication is not possible, control operations can continue to provide a level of protection for the MUS and EFH threatened by AIS.

The available data suggest that per-capita transport of biofouling organisms to Guam by commercial and military vessels is relatively high, creating significant opportunities to transfer species (Ruiz & Zabin 2014). All of these vessels have visited other regions. Thus, they may simultaneously be a source of new introductions to Guam and other ports of call, including those in Hawaii and elsewhere in Micronesia. Moreover, native and non-native species present in Guam can colonize vessels and be transferred sequentially to other ports, in a hub-and-spoke model of dispersal (Ruiz & Zabin 2014).

In 2014, the Navy published its *Environmental Readiness Program Manual* (DON 2019), which contained the Navy's policy guidance for environmental readiness, requirements, responsibilities and management of the environmental, natural, and cultural resources for all Navy ships and shore activities. This manual defined an invasive species, with respect to a particular ecosystem, as any non-native (alien) plant, animal, microbe or their seeds, eggs, spores, or other biological material capable of propagation of that species, and whose introduction into a non-native ecosystem is likely to cause harm to the economy, environment, or human health. Accordingly, all Navy installations shall ensure that aquatic invasive species are not introduced into near shore environments or bodies of water on or adjacent to the installation. Measures to prevent introductions of aquatic nuisance species through ballast water or hull fouling are defined in environmental compliance policies and procedures applicable to shipboard operations.

Finally, the JRM INRMP contains objectives and actions that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication. Financial costs increase as species become established and widespread, and thus the Navy intends to prevent introductions as much as possible. Prevention includes ensuring clean gear and vessels during inter-port movements (i.e., biosecurity), and good outreach and education practices.

Determination

The Navy determined that exposure to AIS from the proposed action would adversely EFH for all MUS likely to occur in the Action Area, and the effects could be long-term. However, based on the Navy regulations and management plans (i.e., Environmental Readiness Program Manual and INRMP) and implemented BMPs, potential impacts from exposure to AIS will be unlikely, temporary, and minimal.

3.2.6. Chemical Contaminants

Many heavy metals and persistent organic compounds (e.g., pesticides and polychlorinated biphenyls) tend to adhere to solid particles. When these solid particles are deposited, the heavy metals, persistent organic

compounds, or their degradation products can bioaccumulate in benthic organisms at much higher concentrations than in the surrounding waters (Good 1987; Stein *et al.* 1995). Corals exposed to hydrocarbons have been shown to exhibit loss of zooxanthellae (bleaching), impaired reproduction and tissue damage, decreased reproductive success, tissue retraction, and a reduction in tissue lipid contents, thereby limiting fat reserves necessary for increased mucus production or proliferation of mucus secretory cells and complete mortality (Turner & Renegar 2017; Jackson *et al*. 1989; van Dam *et al*. 2011). Little is known regarding the effects of organochlorine (OC) pesticides (e.g., DDT, dieldrin, chlordane) on reef building corals. Suspected adverse effects caused by OCs range from carcinogenesis, interruption of neurological function, changes in cell metabolism and gene expression, to endocrine disruption and interference with reproduction (van Dam *et al*. 2011; Table 17). Herbicides readily penetrate coral tissue and rapidly reduce the photosynthetic efficiency of the zooxanthellae, and bleaching of adult coral colonies is a common reaction to high concentrations of chronic exposure (van Dam *et al*. 2011). Once introduced in a biotic matrix, trace metals have the potential to affect nutrient cycling, cell growth and regeneration, as well as reproductive cycles and photosynthetic potential (van Dam *et al*. 2011).

Table 17. Main contaminants, sources and concerns in regards to tropical coral reefs (van Dam *et al*. 2011).

Contaminant group	Representatives	Sources	Main concerns to coral
Insecticides	DDT, Dieldrin, Chlorpyrifos, Carbaryl, Permethrin	Agriculture and urban runoff	Survival, reproduction, early life transitions & genetic effects. (Bioaccumulation for persistent OC pesticides)
Herbicides	Diuron Atrazine Hexazinone Glyphosate	Agriculture and urban runoff, antifouling applications, ballast water discharge	Photosynthesis & calcification
Antifouling agents	Irgarol-1051 Zn-pyrithione TBT	Shipping activities & marine structures	Photosynthesis & calcification. Survival, reproduction, early life transitions & genetic effects
Industrial OCs	Dioxins PCBs Furans	Thermal processes (atmospheric deposition) & terrestrial runoff	Bioaccumulation, reproduction in birds & mammals, metabolism & genetic effects
Oil products & PAHs	Often unspecified mixtures	Shipping operations, industrial discharge, oil exploration, mining activities & spills	Bioaccumulation, survival, reproduction, metabolism, growth & genetic effects
Metals	Copper Zinc Mercury Cadmium	Agricultural runoff, various urban and industrial sources, oil explorative activities & antifouling applications	Bioaccumulation, survival, reproduction, growth & behavior

Data from previous investigations, including a remedial investigation (RI), were used to identify the nature and extent of chemicals of potential concern (COPCs) in the harbor sediments, evaluate sediment transport processes, and assess current conditions, including risks to human and ecological receptors within Apra Harbor (AECOM 2018). Surface sediment exceedances of the RI Project screening levels were found for low molecular weight- and high molecular weight-polynuclear aromatic hydrocarbons (PAHs), total NOAA-18 PCB congeners, four pesticides (total benzene hexachloride, total chlordane, total DDT, and dieldrin), and eleven metals (arsenic, chromium, cobalt, copper, lead, manganese, mercury, nickel, tin, vanadium, and zinc). Subsurface sediment exceedances were found for the same COPCs as above, as well as antimony, barium, cadmium, and silver (AECOM 2018).

Exposure to contaminants either re-suspended from beneath the sediment surface during dredging or from oil or fuel released during equipment operation could have negative impacts on EFH. Dredging and dredge disposal can cause chemical impairment of the water column and EFH by releasing and suspending surface and subsurface sediment contaminants. Dredging contaminated areas could mobilize and expose deeper contaminated sediments. Ship scour could cause surficial sediment resuspension, but deeper scouring probably occurs only periodically over small areas during the largest ship movements. It is anticipated that extreme events, such as typhoons, will produce greater amounts of nearshore wind-wave energy that could contribute to mixing of the surface sediments and possible resuspension in the highest energy areas; however, widespread transport is expected to be limited or prevented by the low current velocities found throughout much of the harbor area (AECOM 2018).

However, a turbidity curtain will be used during all in-water activities to contain the sediment within the curtain and reduce sediment from escaping into the marine environment (Sections 3.1.3 and 3.2.2). Thus, it is reasonable to expect that contaminants from within the sediment may be stirred by the Proposed Action's in-water activities, but that the silt curtain will provide an effective containment to prevent adverse effects from contaminants to EFH.

Determination

The Navy determined that exposure to chemicals from the Proposed Action would adversely affect EFH for all MUS likely to occur in the Action Area, and the effects could be long-term. However, based on the Navy regulations, management plans (i.e., Environmental Readiness Program Manual and INRMP), and implemented BMPs, as well as the short duration of the proposed activities, potential impacts from chemical contamination will be temporary and minimal.

3.2.7. Hypoxia

Coastal hypoxia occurs when the natural and/or anthropogenic dissolved oxygen (DO) levels are depleted in coastal waters to a certain level (e.g., <30% saturation or <2 mg/L; Zhang *et al*. 2010). Increasing discharges of nutrients and organic matter may disrupt the balance of oxygen production (photosynthesis), consumption (respiration, chemical reactions), and atmospheric exchange (for given salinity and temp levels). In shallow environments (<50 m), DO concentration may be modified by turbulent mixing, consumption and production. Also, marine environments may be affected by changes in watershed properties through coastal eutrophication, as hypoxia depends on freshwater input, terrestrial nutrients cycles, and microbial processes.

When DO is depleted in the lower part of water column, benthic organisms exhibit stressed behaviors, mortality, and ultimately, changes in the greater community structure. Some hypoxia effects include reduced tolerance to other stressors, behavior changes, limited energy budgets, and reduced growth and activity levels, all of which have the potential to cause death (Steckbauer *et al*. 2011). However, species-specific thresholds for depleted DO are unknown and vary with size and taxa. Thus, no single definition of hypoxia exists for benthic organisms, although larval stages are more sensitive than adults (Zhang *et al*. 2010).

Recovery from hypoxia depends on extent and community changes. Some studies demonstrated that short-term (i.e., hours to days) hypoxia did not decimate animal communities completely; although long-term hypoxia may remove all taxa, leading to bacterial dominance (Steckbauer *et al*. 2011). Recovery may be initiated as soon as DO levels return, and ecosystem functions have been observed to recover fully in time. One study documented functional capacity and recovery of a macrofaunal assemblage after 1-2 years following low-dredging intensity (i.e., <1 hr marine dredging per 100 m^2; Cooper *et al.* 2008). Patterns of biological recolonization following hypoxia documented the following trends (Steckbauer *et al*. 2011):

- Polychaetes pioneered and dominated the recovery process, as they were most tolerant to low oxygen conditions
- Nematodes documented occasionally as pioneers
  Molluscs recorded as second most important colonizers after hypoxia.

The Proposed Action includes in-water activities that may deplete DO levels in the marine environment, and thus cause adverse impacts to EFH. However, based on the volume of expected dredged material, it is highly unlikely that pore water will be released from the accumulated sediment. Thus, it is reasonable to expect that low DO conditions will not result from the Proposed Action's in-water activities, and that no adverse effects from hypoxia will occur to EFH.

Determination

The Navy determined that exposure to hypoxic conditions from the Proposed Action would adversely affect EFH in the Action Area, and the effects could be long-term. However, based on the volume of dredged material, implemented BMPs, and the short duration of the Proposed Action, potential impacts from hypoxic conditions would be temporary and minimal.

3.2.8. Unexploded Ordnance

As a conservative safety measure prior to commencement, all personnel involved in the Action activities will be briefed on the potential hazards of MEC/MPPEH. Furthermore, prior to coral translocation, UXO Qualified Divers will undertake visual surveys and anomaly avoidance (if needed), both of which limits the chances of encountering and disturbing MEC/MPPEH. If any MEC and/or MPPEEH items are discovered during in-water activities, all work will be stopped immediately. The Contractor will contact Explosive Safety Office (ESO) and Explosive Ordnance Disposal Detachment Marianas to evaluate. The Naval Ordnance Safety and Security Activity will be notified by the ESO if any MEC is found during the project.

If ordnance is detonated in the marine environment, nearby marine resources may be exposed to direct physical impact from shrapnel and effects of a pressure wave. As water is incompressible, fragments are slowed and will travel a limited distance from the source. The size and type of the munition, the depth of detonation, and the oceanic conditions also determine the radius and effects of a blast. Organisms close to a blast may be directly

affected by the blast. Farther away, organisms may be affected by the pressure wave in the form of a sound pressure wave and movement of the water due to cavitation. Organisms without air or gas spaces in their bodies fare better than organisms that have those spaces because pressure is equalized inside and outside of their bodies. Most corals and invertebrates do not have air or gas spaces in their bodies, so they may experience fewer traumas from pressure waves than vertebrates such as fish, turtles, and marine mammals. Coral and other invertebrates can be much closer to a blast than many vertebrates and suffer relatively minor effects.

Determination

The Navy determined that encountering a MEC, MPPEH, and/or a UXO during the proposed in-water activities may adversely affect the quality of EFH. However, based on the implemented precautions and BMPs, the probability of EFH exposure to direct physical impact, a pressure wave or underwater sound effects from exploding ordnance is very low and unlikely.

4. Summary of Determinations

4.1. ESA Determination

This assessment considered potential impacts resulting from the Proposed Action on ESA-listed species that may occur within the Action Area. Project designs and BMP measures will be implemented to avoid and/or minimize such anticipated impacts to the greatest extent practicable. Therefore, based on the anticipated low occurrence of ESA-listed species within the Action Area, the Proposed Action has the potential to affect, but is not likely to adversely affect ESA-listed species, as such adverse effects have been determined either insignificant or discountable.

The Navy requests NMFS's concurrence with this determination.

4.2. EFH Determination

The Navy determined that the proposed activities and their resulting impacts would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for BMUS and PMUS within Apra Harbor. The indirect adverse effects to EFH from Project-related degradation of water quality will be minimized through implementation of appropriate silt-containment BMPs. Unavoidable loss of ecosystem function and services that supports MUS would be minimized through implementation of the proposed coral transplantation plan. Due to the containment of impacts to Apra Harbor, the quantity and quality of the EFH within the harbor, the size and scale of the impacts, implementation of temporary and permanent avoidance and minimization measures built into the Project and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion), the Navy determined that the anticipated impacts do not have the potential to cause substantial adverse effects to EFH.

The Navy requests NMFS's concurrence with this determination.

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6. Appendix A

Appendix A

CORAL HEA

For the proposed Action, the Navy performed a Habitat Equivalency Analysis (HEA) using Visual_HEA software that determined the amount of compensatory restoration required to provide services that are equivalent to the interim loss of ecological functions and services following the impacts of this project (Pinoch *et al.* 2017, Kohler *et al.* 2006). A HEA uses a problem-solving, mathematical framework (i.e., algorithm) to measure habitat loss from an impact/injury against the gains of habitat restoration (USCRTF 2016). Created in 2006 by the National Coral Reef Institute at the Nova Southeastern University Oceanographic Center (Florida, USA), Visual_HEA software uses a discounting algorithm to estimate the quantity of habitat compensatory restoration that is required to replace lost ecological functions and services (Pinoch *et al.* 2017). The algorithm sets a value to the future services that a natural resource may provide after impact. This value is then combined with the compensatory mitigation to determine the total area that must be restored to compensate for the damages caused by the impact. For the duration of the compensatory action period, the algorithm provides a quantitative and temporal measure of the habitat's ecological services that are both lost and gained during a set period of time (Pioch *et al.* 2017).

The estimated total area of coral cover of 5,426.4 m^2 (58,409.3 ft^2) for the proposed action includes all 7,680 corals from the direct impacts array site and the shore landing site. Of these colonies, 1,380 corals have been deemed too small or of a morphology that will not be able to be translocated. Therefore, 6,300 corals will be translocated and 65.3 m^2 (702.8 ft^2) of coral area from corals smaller than 10 cm and of an encrusting morphology will be considered a loss. A conservative estimate is that 30% of all colonies to be moved will not survive translocation. Therefore, the Navy proposes to additionally consider 1,673 m^2 (18,008 ft^2) to be a loss, generating a total coral area of 1,738.3 m^2 (18,710.9 ft^2) injured units to be used in this HEA.

For this HEA, the Navy based parameters on assumptions of the ecological functions and services that existed before the impact occurs and lost after the impacts, as well as assumptions about the habitat gains from proposed compensatory mitigation for the habitat (i.e., EFH). For the proposed Action, the HEA parameters used produced 2,284.2 m^2 (24,586.9 ft^2) of replacement habitat to offset the temporary and permanent losses of coral colonies. Below is a detailed description of each parameter used in this HEA.

Claim Year: Assumed construction activities would commence only after the restoration and coral translocation have been completed in late 2021.
Injured Units: The total coral cover in the Action Area that is estimated to be injured is 1,738.3 m^2.
Value Injured/Value Restored: The primary Action Area is in an active harbor channel with various stressors. The recovery site will have less stressors and be in an area with improved conditions. Therefore, for this ratio, a value of 1 was conservatively used.
Discount rate per time unit (%): The discount rate is the amount of discounting to reflect the relative value of present versus future service levels. The Navy used the standard value of 3% according to the Coral Reef Task Force (USCRTF) guidelines (2016) and (Pinoch *et al.* 2017).

Pre-Injury Service Level (%): The Navy conservatively used a 100% level of services provided by the injured area prior to injury, since all coral surveyed (inclusive of the direct impacts and shoreline landing sites) showed little to no signs of bleaching or disease.
Pre-Restoration Service Level (%): Due to the lack of hard consolidated substrate preventing natural coral recruitment (i.e., loose rubble), a value of 25% was used for the level of services provided by the restoration area prior to the restoration process. There is also an unknown amount of anthropogenic debris at the restoration site that will be removed before habitat restoration commences.
Units: Square meters (m^2) was used.
Time Units: Years were the unit used.
Service Loss Displayed Years: The age of the coral colonies at the primary site was not established but colony size indicates that the majority of colonies are within 50 years of age. Therefore, considering the action and estimated time to full recovery, the years 2021 to 2051 were used as the time span of service loss analysis to be displayed.
Service Gain Displayed Years: Similar to "Service Loss Displayed Years", 50 years was used based on coral colony size. Therefore, the years of 2021 to 2051 were used as the time span of service gain analysis to be displayed.
Service Level at the Injury Site Node: The pre-injury service level was set to 100%, but it was anticipated that the Action Area will lose most service level between translocation and construction activities in 2021. Therefore, a service level node of 5% was assigned to 2021 for the remaining functioning area.
Service Level at the Injury Site Node: It was assumed that most habitat in the injury Site will be replaced with non-magnetic fill in the dredged area for EMT sensors. However, areas surrounding the MT sensors will retain hard bottom and regain more function within a year. Therefore, a service level node of 10% was assigned to 2022.
Service Level at the Injury Site Node: It was assumed that most habitat in the injury Site will be replaced with non-magnetic fill in the dredged area for EMT sensors. However, areas surrounding the MT sensors will retain hard bottom and regain more function from natural recruitment within 5 years. Therefore, a service level node of 15% was assigned to 2026.
Service Level at the Injury Site Node: It was assumed that the pre-injury service level will oscillate in service level over time, but it will return to at most 25% service level within 50 years naturally due to the replacement of most habitat with non-magnetic fill in the EMT sensor dredged area. Therefore, a final service level node of 25% was assigned to 2051.
Service Level at the Recovery site Node: The pre-restoration service level at the restoration site was set to 25%, but it is anticipated that 10% of services will be immediately gained upon debris removal, habitat restoration and coral translocation in 2021. Therefore, a service level node of 35% was assigned to 2021.
Service Level at the Recovery Site Node: It is assumed that the restoration area will have stabilized and begun natural recruitment of new coral colonies. Therefore, a service level node of 50% was assigned to 2026.
Service Level at the Recovery Site Node: After 20 years, it was assumed that the restoration will nearly be recovered through natural recruitment of coral and reef community. Therefore, a service level node of 75% was assigned to 2031.
Service Level at the recovery site node: After 25 years, it was assumed that the restoration will reach a service level node of 95% in 2036.
Service Level at the recovery site node: It was assumed that the recovery site service level will oscillate in service level over time, but it will reach 100% service level (as compared to the pre-injury site) within 50 years naturally. Therefore, a final service level node of 100% was assigned to 2051.

Results: The analysis indicated that a compensatory replacement project of 2,284.2 m^2 (24,586.9 ft^2) will provide service gains equal to the services temporarily and permanently lost over time in the injured area.

Table 1: Habitat Equivalency Analysis Software Units used to Facilitate Calculation of Compensatory Restoration of Coral Cover (Pinoch *et al.*, 2017; Kohler *et al.*, 2006)

Claim Year	2021
Number of Injured Area Units	1,738.3 m^2
Value Injured/Value Restored	1
Discount Rate Per Time Unit (%)	3
Pre-Injury Service Level (%)	100
Pre-Restoration Service Level (%)	25
Units	sq m
Time Units	year
Service Loss Displayed Years	2021 - 2051
Service Gain Displayed Years	2021 - 2051
Service Level at the Injury Site Node	2021 5%
Service Level at the Injury Site Node	2022 10%
Service Level at the Injury Site Node	2026 15%
Service Level at the Injury Site Node	2051 25%
Service Level at the Recovery Site Node	2021 35%
Service Level at the Recovery Site Node	2026 50%
Service Level at the Recovery Site Node	2031 75%
Service Level at the Recovery Site Node	2036 95%
Service Level at the Recovery Site Node	2051 100%
HEA Results	
Total Discounted Service Unit Years (DSUYs) Lost:	47384.6
Total DSUYs Gained:	36060.7
DSUYs Gained Per Unit	20.7
Replacement Habitat Size (sq m)	2284.2

Benthic Community EFH HEA

Assumptions:

The project array footprint conservatively includes a buffer area of 739 m^2 (7,954.53 ft^2) around the actual array dredge area of 725 m^2 (7,803.8 ft^2). According to 2020 survey data, the percent cover from CPCe (Kohler et al., 2006) analysis of the total dredge and buffer combined area (1,464 m^2 [15758.4 ft^2]) is comprised of an average of 35.7% hard substrate, 32.5% coral, 18% algae, 7.1% other fauna (sponge, sessile inverts, etc.) and 6.7% sand and silt habitat. Therefore, coral habitat is evaluated separately while sand/silt will not be evaluated due to it serving lesser EFH function and services. Additionally, the area to be covered by the concrete anchoring disks along the cable route was not analyzed for percent cover. Therefore the entire benthic footprint of the 29 discs is 33.9 m^2 (365 ft^2) and all of it will be considered in this

analysis. The area then considered for a full analysis, as Benthic Community EFH comprises 922.5 m² (9,929.7 ft²) of the Action Area.

For this HEA, the Navy based parameters on assumptions of the ecological functions and services that existed before the impact occurs and lost after the impacts, as well as assumptions about the habitat gains from proposed compensatory mitigation for the habitat (i.e., EFH). For the proposed Action, the HEA parameters used produced 989.49 m² (10,649.92 ft²) of replacement habitat to offset the temporary and permanent losses of coral colonies. Below is a detailed description of each parameter used in this HEA.

Claim Year: Assumed construction activities would commence only after the restoration and coral translocation have been completed in late 2021.
Injured Units: The total coral cover in the Action Area that is estimated to be injured is 922.548 m².
Value Injured/Value Restored: The primary Action Area is in an active harbor channel with various stressors. The recovery site will have less stressors and be in an area with improved conditions. Therefore, for this ratio, a value of 1 was conservatively used.
Discount rate per time unit (%): The discount rate is the amount of discounting to reflect the relative value of present versus future service levels. The Navy used the standard value of 3% according to the Coral Reef Task Force (USCRTF) guidelines (2016) and (Pinoch et al., 2017).
Pre-Injury Service Level (%): The Navy conservatively used a 100% level of services provided by the injured area prior to injury.
Pre-Restoration Service Level (%): Due to the lack of hard consolidated substrate (i.e., loose rubble), a value of 25% was used for the level of services provided by the restoration area prior to the restoration process. There is also an unknown amount of anthropogenic debris at the restoration site that will be removed before habitat restoration commences.
Units: Square meters (m²) was used.
Time Units: Years were the unit used.
Service Loss Displayed Years: The age of the existing fauna was not established but research indicates that most non-coralline communities show quick recovery often within 1 year. Therefore, considering the action and estimated time to full recovery, the years 2021 to 2031 were conservatively used as the time span of service loss analysis to be displayed.
Service Gain Displayed Years: Similar to "Service Loss Displayed Years", 10 years was conservatively used based on fauna recovery. Therefore, the years of 2021 to 2031 were used as the time span of service gain analysis to be displayed.
Service Level at the Injury Site Node: The pre-injury service level was set to 100%, but it was anticipated that the Action Area will lose most service level between translocation and construction activities in 2021. Therefore, a service level node of 5% was assigned to 2021 for the remaining functioning area.
Service Level at the Injury Site Node: It was assumed that most habitat in the injury site will be replaced with non-magnetic fill in the dredged area for EMT sensors. However, areas surrounding the MT sensors will retain hard bottom and regain more function within a year. Therefore, a service level node of 10% was assigned to 2022.
Service Level at the Injury Site Node: It was assumed that most habitat in the injury site will be replaced with non-magnetic fill in the dredged area for EMT sensors. However, areas surrounding the MT sensors will retain hard bottom and regain more function from natural recruitment within 5 years. Therefore, a service level node of 15% was assigned to 2026.
Service Level at the Injury Site Node: It was assumed that the pre-injury service level will oscillate in service level over

time, but it will return to at most 25% service level within 10 years naturally due to the replacement of most habitat with non-magnetic fill in the EMT sensor dredged area. Therefore, a final service level node of 25% was assigned to 2031.
Service Level at the Recovery site Node: The pre-restoration service level at the restoration site was set to 25%, but it is anticipated that 10% of services will be immediately gained upon debris removal, habitat restoration and coral translocation in 2021. Therefore, a service level node of 35% was assigned to 2021.
Service Level at the Recovery Site Node: It is assumed that the restoration area will have stabilized and be nearly covered with natural recruitment of new fauna within 1 year. Therefore, a service level node of 70% was assigned to 2022.
Service Level at the Recovery Site Node: After 3 years, it was assumed that the restoration site would nearly be established through natural recruitment of fauna and reef community. Therefore, a service level node of 90% was assigned to 2024.
Service Level at the recovery site node: It was assumed that the recovery site service level will oscillate in service level over time, but it will reach 100% service level (as compared to the pre-injury site) within 5 years naturally. Therefore, a final service level node of 100% was assigned to 2026.
Results: The analysis indicated that a compensatory replacement project of 953.1 m² (10,259.4 ft²) will provide service gains equal to the services temporarily and permanently lost over time in the injured area.

Table 2: Habitat Equivalency Analysis Software Units used to Facilitate Calculation of Compensatory Restoration of Coral Cover (Pinoch *et al.*, 2017; Kohler *et al.*, 2006)

Claim Year	2021
Number of Injured Area Units	922.548 m²
Value Injured/Value Restored	1
Discount Rate Per Time Unit (%)	3
Pre-Injury Service Level (%)	100
Pre-Restoration Service Level (%)	25
Units	sq m
Time Units	year
Service Loss Displayed Years	2021 - 2031
Service Gain Displayed Years	2021 - 2031
Service Level at the Injury Site Node	2021 5%
Service Level at the Injury Site Node	2022 10%
Service Level at the Injury Site Node	2026 15%
Service Level at the Injury Site Node	2031 25%
Service Level at the Recovery Site Node	2021 35%
Service Level at the Recovery Site Node	2022 70%
Service Level at the Recovery Site Node	2024 90%
Service Level at the Recovery Site Node	2026 100%
HEA Results	
Total Discounted Service Unit Years (DSUYs) Lost:	24539.419
Total DSUYs Gained:	22879.231

DSUYs Gained Per Unit	24.8
Replacement Habitat Size (sq m)	989.491

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U.S. DEPARTMENT OF COMMERCE
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Edward Moon
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July 21, 2021

Dear Mr. Moon:

The National Marine Fisheries Service, Pacific Islands Regional Office (NMFS), received the Naval Facilities Engineering Command Pacific's (the Navy) essential fish habitat (EFH) consultation initiation request for the installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam. We have reviewed the EFH Assessment (EFHA) titled "Final Endangered Species and Essential Fish Habitat Assessment: Consultation for the Underwater Electromagnetic Measuring System (UEMMS)" and agree that there will be unavoidable and substantial adverse effects to sensitive and hard-to-replace EFH due to the proposed action including a conservative unavoidable loss estimate of 3,273.7 square meters (m^2) of benthic EFH and 3,270 coral colonies. We also agree that the mitigation plan put forward by the Navy, which includes avoidance through a range of best management practices (BMPs), minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. We have provided three EFH conservation recommendations pursuant to the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; Section 305(b)(2)) as described by 50 C.F.R 600.920. Your implementation of the proposed conservation recommendations and all of the proposed BMPs will ensure that expected and potential adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated.

Project Description
The Navy proposes to construct and operate an UEMMS in Outer Apra Harbor, Guam. The UEMMS will passively measure magnetic and electric field signatures of surface ships and submarines,

hereafter vessels, to ensure vessels meet magnetic signature limits specified in the Office of the Chief of Naval Operations Instruction S8950.2H. The proposed action includes both in-water and shore-side infrastructures to passively measure electromagnetic signatures of vessels and transmit data to facilities on land. The sensor array will be installed on the seafloor of Outer Apra Harbor 915 meters (m) northwest of Polaris Point in 17 m of seawater.

Installation of the senor array will require excavation, backfilling and disposal of material from the array site, water jetting or drilling of holes at the array site, deployment and anchoring of subsea cables, and excavation and backfilling at the egress location at Polaris Point. Extensive proposed mitigation, including coral translocation, is planned, detailed in the minimization and offset sections below. In-water construction activities are expected to take approximately 10 months to complete.

Sensor Array Excavation, Installation, and Backfill

Once coral translocation has occurred (detailed in the minimization section below), an estimated 918 cubic meters (m^3) of material will need to be excavated from the array site before sensor installation can occur. The material will be excavated with a closed-bucket excavator to minimize inadvertent discharges into the water column. Excavated materials will be deposited at the Guam Deep Ocean Disposal Site (G-DODS) 20.6 kilometers (km) offshore of Guam in 2,680 m of seawater. The G-DODS was designated as an exclusive ocean dredged material disposal site in 2010 (Final Rule 40 CFR Part 228; 21 FR Notice 54497).

Once excavation and disposal is completed, the Navy will begin installing the UEMMS sensor array. The sensor array proposed for deployment will consist of a line of 22 sensors (13 Electromagnetic triaxial (EMT) sensors and eight magnetometer triaxial (MT) sensors extending 128 m and spaced six m apart, as well as one conductivity, temperature and depth (CTD) sensor). The CTD sensor will be installed at the northeast end of the array. Each sensor will be mounted to a 30.5-centimeter (cm) diameter fiberglass reinforced plastic sensor tube that will be embedded six m deep into the seafloor at each location. A 15 cm diameter fiberglass reinforced plastic cable guide stake will also be embedded 1.2 m deep into the seafloor three m to the southeast of each sensor tube. Sensor tube and guide stake installations will be performed by divers using a water jetting process known as a handheld hydraulic breaker. A large steel pipe will be used to push the tubes to the appropriate depth as the high-pressure water loosens the bottom material. If water jetting is not feasible due to seafloor characteristics, 30-cm diameter pilot holes will be drilled into the seafloor and marine grout will be used to secure the tubes at the same locations. Additionally, 30 m of sensor cable will be installed between each sensor and guide stake, and secured with eyebolts, poly webbing, and zip ties. After installation, the excavated area, including the coiled cables, will be covered with 826 m^3 of non-magnetic, certified contaminant free backfill material in order to restore the excavated area to the original water depth.

Subsea Cable Installation and Anchoring

To transmit data of electromagnetic signatures collected by the UMMES to facilities on land, 27 subsea cables, 5 additional guide stakes, and 29 concrete anchor discs will need to be installed along the 975 m cable route. The subsea cables are made up of shielded and sheathed copper wires with a diameter of 2.64 cm. One cable will extend from each of the 22 sensors to a common path marked by guide stakes along the southeast side of the array. Five additional cables will also be routed to the array for future use. Three additional guide stakes will be installed adjacent to the array site and two additional guide stakes will be installed at Polaris Point to secure each end of the subsea cable. The cables will be bundled using polypropylene webbing at each sensor and at each guide stake. Divers will lay the cable along the cable route and select a location every 30 m along the pathway for deployment of a 1.2 m diameter concrete anchor disc that will secure the cable to the seafloor. The concrete anchor discs will be deployed by a crane and barge with the assistance of divers to ensure areas with coral cover are avoided.

Subsea Cable Egress and Trenching

To protect the cables from wave and storm damage at Polaris Point, high-density polyethylene (HDPE) conduits will be deployed . The HPDE conduits will be bundled together into a single 71-cm diameter, 38-m long cable duct, anchored 10.5 m below mean low low water (MLLW). The bottom of the duct will be secured in place using a stainless steel anchor band span and earth anchors. The earth anchors will be installed to a depth of 2.4 m by a vessel using a topside pneumatically-driven jackhammer. At 4.5 m below MLLW, the remaining 24 m of duct will transition underground until it reaches a concrete transition vault.

An oblique trench 17 m wide, 15 m long, and 3 m deep will be excavated by a closed-bucket excavator to create the necessary slope for burial of the conduit at the surface. Prior to excavation, 95.6 m^3 of existing shoreline revetment material will be relocated by an excavator to a similar depth adjacent to the site. The Navy estimates that 172 m^3 of subbase materials will be excavated and placed on land. After the conduit has been secured, the subbase material and revetment material will be reused as backfill to bury and protect the cable conduit duct.

Consultation History

Substantial pre-consultation occurred between NMFS and the Navy that began in February 2014. In September 2015, NMFS led a preliminary survey effort to document the resources within the proposed action area in Apra Harbor, Guam. In November 2015, the Navy presented the first set of quantitative survey findings and a report to NMFS documenting the resources in the action area. No additional coordination occurred between 2016 and 2018. In February 2019, pre-consultation continued between NMFS and the Navy. In November 2019, the Navy hosted an interagency meeting with NMFS and the US Army Corps of Engineers (USACE) to discuss concerns and proposed a mitigation strategy be conducted, similar to the approach that had recently been implemented for a project at Lima, Mike, and November wharves in Apra Harbor, Guam. The Navy and NMFS agreed to perform a similar Habitat Equivalency Analysis (HEA) model to quantify the interim loss of ecosystem services and function associated with the adverse effects of this proposed

action, and developed a quantifiable mitigation strategy focusing on EFH area replacement. The Navy worked with NMFS to generate parameters (e.g., expected injury, service levels, discount rate, and years to recover) for inclusion in the HEA model. In January 2020, NMFS and the Navy had a call to discuss final survey methods and the plan to use photogrammetric orthomosaic surveys to document benthic organisms and stationary point counts to document the fish communities at each location. In September 2020, the Navy performed extensive surveys at each of the project areas following the approaches previously agreed upon with NMFS. In November 2020, the Navy presented the updated findings (i.e., effectively replacing the 2015 information) from the benthic and fish surveys to NMFS. In December 2020, the Navy hosted an additional inter-agency coordination call with NMFS and the USACE, clarifying their plan to submit consultation documents in the spring of 2021. In January and May 2021, NMFS reviewed a draft of the consultation documents, including substantive discussions regarding the proposed mitigation and requests for additional information regarding water quality be included within the final EFHA.

Essential Fish Habitat

The marine water column from the surface to a depth of 1,000 m from shoreline to the outer boundary of the Exclusive Economic Zone (200 nautical miles (nm)), and the seafloor from the shoreline out to a depth of 400 m around each of the Mariana Islands, have been designated as EFH. As such, the water column and bottom and all surrounding waters and submerged lands around Guam are designated as EFH and support various life stages for the management unit species (MUS) identified under the Western Pacific Regional Fishery Management Council's, Pelagic and Mariana Archipelago Fishery Ecosystem Plans (hereafter, Mariana FEP). The MUS and life stages found specifically within Apra Harbor include eggs, larvae, juveniles, and adults for Bottomfish and Pelagic MUS. Habitat Areas of Particular Concern (HAPCs) only occur for these MUS within the Marianas. Specific types of habitat considered as EFH include coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, mangrove, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean.

Baseline Condition

Benthic Community

Photogrammetric orthomosaic surveys were performed within the sensor array impact area (17 sites) and adjacent to the impact area (15 sites). Coral cover within the impact area averaged 32.5% while coral cover at the adjacent sites ranged from 13.2% at the southwest to 49.1% at the northeast end of the array. The *Porites rus* coral complex, which is made up of flat, horizontal plates, and cylindrical vertical pillars, was dominant throughout the entire array area. The Navy identified 7,534 coral colonies within the direct impact area of which only 1,166 coral colonies were not part of the *Porites rus* complex. The direct impact area also included 18% macro algae and cyanobacteria cover, 7% other fauna, and 35.7% hard substrate covered in turf algae.

The cable route survey did not include photogrammetric orthomosaic grid cells because preliminary surveys had already identified a route where the scattered and overall low density of coral could be avoided. One rocky feature at 310 m which included *Porites speciosa* and *Leptosiris sp.* and a northwest-facing slope at 550 m with *Porities rus* were observed and prioritized for avoidance during the cable deployment. Coral abundance was 2.5% within the survey grid cells at the Polaris Point egress impact site, totaling 145 colonies, and dominated by *Porites rus* and other massive *Porites sp*.

The proposed mitigation site at Mound 9 was also surveyed at six photogrammetric orthomosaic grid cell sites. Coral cover across all sites was 5.4% while loose sediment and rubble made up 70.8% of the benthos. These numbers support the proposed mitigation to stabilize and recolonize target areas at Mound 9.

Fish

A total of 30 stationary point count surveys were performed in September 2020, which identified 69 species across 19 families. Analysis included a baseline species-richness comparison between the sensor array impact area and the proposed mitigation site at Mound 9, which indicated that different species could be found at each location. The continued inclusion of fish surveys at future time points has the potential to help the Navy illustrate the effectiveness of their mitigation activities at Mound 9 (Opel 2017).

Water Quality

A particle tracking model was developed to evaluate the movement of re-suspended dredge sediment in Apra Harbor in 2017 (Gailani 2017). The model tested eight scenarios for the proposed action at the outer harbor basin including 600 times more material then what is being proposed for UEMMS. The model concluded that lateral transport is nominal for Apra Harbor due to the low water velocities and that sediments will generally stay within the dredge footprint or just adjacent to the site. The Navy also examined the recent turbidity study performed during Pearl Harbor maintenance dredging activities, which concluded that rain events generated far more turbidity at collection sites than they could achieve in a worst-case scenario where turbidity BMPs failed. The Navy is also proposing a range of BMPs to ensure that the turbidly of waters outside silt curtains do not exceed 20 Nephelometric Turbidity Units (NTU), a level that NOAA's Office of Coastal Management has identified as high for nearshore and estuarine habitats. Sedimentation and turbidity caused by dredging, backfilling, and ocean disposal should be minimal and temporary if the proposed BMPs and monitoring efforts are being followed to ensure that the silt curtains are functioning properly.

Ecological Roles

The principal benthic organisms provide ecological services (e.g., water filtration and maintaining balanced nutrient concentrations) and provide physical habitat at both micro- and macro-scales. At a micro scale, the shape of benthic organisms change water movement, which can influence the settlement (McDougall 1943) and behavior of larvae and the availability of planktonic prey

(Williams 1964). Sessile organisms provide refuge from predators, particularly for larvae and small sized species (Russ 1980; Sutherland 1974). Sessile organisms provide new ecological niches increasing species diversity. At a macro-scale, corals are the primary habitat builders in the coral reef ecosystem that benefit juvenile, sub-adult, and adult life stages of the MUS that utilize this designated EFH. The non-coral invertebrate marine successional and filter feeding community also plays an important role in the ecology of these systems (Stella 2011). The morphology, shape, and composite features of benthic organisms can also influence feeding strategies of these MUS.

Adverse Effects

The proposed construction and dredge activities will result in: physical damage from dredging, water jetting and drilling, backfilling, anchor deployment, and diver activities; turbidity and sedimentation from dredging, backfilling, and ocean disposal; the potential for introduction of invasive species and chemical contamination from equipment, vessels, and deployed materials; and potential introduction of toxopathological agents during in-water diving activities.

The project activities will result in a combination of short-term, long-term, and permanent loss of hard bottom. The project activities will result in unavoidable and substantial long-term to permanent adverse effects to sensitive and hard-to-replace EFH, including the loss of corals and non-coral invertebrates (e.g., successional community, filter feeders, etc.), and their ecosystem services and functions. The action will directly affect 7,680 coral colonies, and replace or remove 1,666.9 m^2 of benthic substrate (725 m^2 direct removal from the array site, 739 m^2 from construction activities, 33.9 m^2 from permanent anchors, and 169 m^2 at egress).

Physical Impacts to Benthic and Water Column Communities (physical stressor):

Physical damage to principle benthic organisms from dredging, backfilling, jetting or drilling, anchor deployment, and diver activities is expected to cause breakage or dislocation (i.e., mortality), but can also result in sub-lethal tissue abrasion. Corals, which are primarily responsible for the structural complexity of coral reefs, are particularly vulnerable to physical damage because their slow-growing carbonate skeleton is relatively brittle and their polyps are easily damaged. In general, lobate, encrusting, and other massive colony morphologies tend to withstand breakage better than foliose, table, plating, and branching morphologies; more fragile forms tend to have higher growth rates (Riltzler 2001). Reduction of topographic complexity in the habitats of the coral reef ecosystem reduces biodiversity and productivity (Alvarez-Filip et al. 2009). The Navy has proposed BMPs, minimization (coral translocation), and offset (new habitat creation), that has the potential to replace the ecosystem services that will be unavoidably lost from proposed action.

Sedimentation and Turbidity (pollution stressor):

Suspended sediment can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015). Coral reef organisms are easily smothered by sediment (Golbuu et al. 2003), and rates > 100 milligrams/cm/day can kill exposed coral tissue within a few days (Riegl and Branch 1995),

although corals show considerable interspecific variability. Sedimentation can also reduce photosynthetic rates (Philipp and Fabricius 2003), disrupt polyp gas exchange, inhibit nutrient acquisition (Richmond 1996), cause tissue damage (Rogers, 1990), reduce recruitment success (Gilmour 1999; Hodgson 1990), and increase metabolic costs due to enhanced mucus production (Telesnicki and Goldberg 1995).

Invasive Species (biological stressor):

Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Marine species can be introduced to new biogeographies, typically via transport on vessel hulls, in ballast water, or on marine equipment. Invasive species can rapidly increase in abundance and can dominate their new environment, creating adverse ecological effects to other species of the ecosystem, and their respective functions and services that may be provided (Goldberg and Wilkinson 2004). Invasive species can decrease species diversity, change trophic structure, and diminish physical structure, but adverse effects are highly variable and species-specific. The Navy has put forward BMPs that will minimize the potential introduction of invasive species associated with this action.

Chemical Contamination (pollution stressor):

Chemical pollutants can have a variety of lethal and sublethal effects on habitat-forming marine organisms, including alteration of growth, interference with reproduction, disruption of metabolic processes, and changes in behavior. These adverse effects can cascade through ecosystems, altering species composition and ecosystem functions and services. Some pollutants are environmentally persistent and can take years or even decades to biodegrade, and others can bioaccumulate and biomagnify through the food chain, eventually posing a direct threat to human health. Many contaminants readily attach to sediment particles and are transported into the ocean where they become entrained in the bottom sediment of estuaries, reefs, and potentially deeper ocean ecosystems. Once trapped in sediment pore water, they can continue to flux into the overlying water column, creating a persistent source of contamination long after the initial input has ended, especially in the sediment of many industrialized bays and watersheds (Nalley et al. 2021). Dredging can release containments trapped in layers of accumulated sediment and pore water at concentrated levels, sometimes referred to as "black water". Petroleum contamination can adversely affect coral, with results including mortality, inhibition of reproduction, reduced calcium deposition, alteration of physiological processes, tissue loss, and reduced carbon fixation (Turner and Renegar 2017). The Navy has put forward BMPs and monitoring protocols that should minimize the threat of chemical contamination associated with this action.

Toxicopathological Agents (pollution stressor):

Recent studies have shown that sunscreens and other products containing oxybenzone, butylparaben, octinoxate, and 4-methylbenzylidene camphor can disrupt coral production, cause coral bleaching, and damage coral DNA at very low concentrations (Downs et al. 2016). The

proposed transplanting activities will result in divers working directly with, and in close proximity to, thousands of corals, creating a potential exposure pathway for toxicopathological agents to come into contact with corals or to enter the water column near corals. The Navy has not put forward BMPs that will minimize the risk of toxicopathological agents being introduced into the marine environment.

Navy-proposed BMPs
To avoid and minimize potential adverse effects to EFH, the following BMPs and minimization measures will be implemented:

Physical Impacts to Benthic and Water Column Communities

- All vessel and silt curtain anchors will be set on hard or soft, sandy bottom void of coral and seagrass, and chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel moves due to currents or tides. If practicable, all intertidal work will be conducted at low or slack tides.
- Divers will select the locations for anchors along the cable route and avoid coral colonies and substrate that supports coral growth. Divers will also ensure that anchor chains do not scour the environment where sensitive benthic organisms could occur.
- Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. Vessels will be positioned so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.
- A storm plan has been developed that includes specific conditions (Guam Condition Level III) that will require work to stop, and the removal or securing of equipment 48 hours ahead of any potential storms.
- While in water depths where the draft of the vessel provides less than a 2-m clearance, all vessels will operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should employ a dedicated "lookout" to assist the pilot with avoiding coral colonies and other benthic organisms that might extend up from the bottom.

Increase in Sedimentation and/or Turbidity

- During in-water construction and dredging activities, the Navy will ensure that a rigorous water quality monitoring plan will continuously monitor and adaptively manage the turbidity levels resulting from the proposed action and ensure BMPs are working properly. Turbidity data will be collected using real time monitoring devices at two test stations and two control stations.
- Coral translocation and all in-water activities will cease during the primary Guam coral spawning events each year for hard (scleractinian) corals. The coral spawning period is estimated to be 21 days total, including 8 days prior to the full moon and 14 days after.

- A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation.
- An 8-m length silt curtain will be deployed and monitored immediately adjacent to and around the dredge barge.
- A silt fence and silt barriers will be installed around the cable excavation area and shoreline at Polaris Point.
- If a silt plume is observed within the action area, project activity will stop and corrective action will be taken immediately. Work will not resume until after the correction is completed.
- Transportation of dredged material to the G-DODS shall only be allowed when weather and sea state conditions will not interfere with safe transportation and will not create risk of spillage, leak or other loss of dredged material in transit to the G-DODS.
- Dredged material shall not be leaked or spilled from disposal vessels during transit to the G-DODS.
- Dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit.
- No more than one disposal vessel will be present within the permissible dumping target area at any time.
- Each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Increase in Contaminants

- A plan to prevent trash and debris from entering the marine environment will be developed and include installation of a temporary floating debris boom around all in-water work areas.
- An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the proposed action.
- Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water.
- When applicable, all temporary fuel oil or petroleum storage tanks will be surrounded with a temporary berm of sufficient size and strength to contain the contents of the tanks (plus 10% freeboard for precipitation) in the event of an accidental release.
- Fueling of proposed action-related vehicles and equipment will take place at least 15 m (50 ft.) away from the water and within a containment area, preferably over an impervious surface. With respect to equipment (e.g., crane on the barge) that cannot be fueled on land, spill prevention booms will be employed to contain potential spills. All fuel spilled will be cleaned immediately.
- Lubricants and excess oil will be disposed of in accordance with applicable federal, territory, and local regulations, laws, ordinances, and permits.

- Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
- All proposed action-related materials and equipment placed in the water will be free of pollutants.
- Pre-work inspections of heavy equipment for cleanliness and leaks will be conducted daily, with all heavy equipment operations postponed or halted until leaks are repaired and equipment is cleaned.

Increase in Invasive Species

- The portions of the equipment that enter the water will be clean and free of pollutants, including aquatic invasive species (AIS). All vessels and equipment (including barges, dry docks, and dredging equipment) will be free from fouling organisms before entering Guam's coastal waters (3 nm offshore).
- A biofouling management plan will be developed for all vessels entering Guam coastal waters.
- The Navy will coordinate with and follow the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). The JRM INRMP contains objectives and actions that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication.

Navy-proposed Minimization

The Navy is proposing to translocate 6,300 of the 7,680 coral colonies from the project impact area, whichfall within the preferred size, morphology, and observed health range. The corals considered not appropriate for translocation include:

1. All corals less than 10 cm from: *Leptastrea purpurea*, *Pavona cactus*, *Pectinia paeonia*, *Astreopora spp*., *Porites spp.* massive, and the *Porites rus* complex.
2. Half of the corals less than 10 cm from: *Pachyseris speciosa*, *Porites cylindrical*, *Stylocoeniella armata*, *Galaxea spp*, *Lobophyllia spp*., and *Pavona varians sp*.
3. Select corals less than 10 cm from: *Pocillopora acuta* and *Pocillopora damicornis*.
4. All corals that are undergoing bleaching, are stressed/diseased, have encrusting or boring sponge cover, or are otherwise unhealthy.
5. All flat-encrusting growth forms.

The majority of the translocated corals will be moved to a location in Outer Apra Harbor called Mound 9. The Navy is currently planning to move 24 of the largest coral colonies, 104 other select colonies, and an additional 103 coral colonies from Polaris Point to adjacent sites and not Mound 9. The Navy is planning to monitor (i.e., quantify and assess the resource conditions) corals from each of these locations at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).

NMFS considers this a minimization measure because the corals that survive translocation are not unavoidably lost and do not require direct offset. Based on the previous performance of similar outplanting efforts within Apra Harbor, the Navy expects a minimum of 4,410 coral colonies (70%) to survive the relocation effort and that number could be much higher based on the recent success of translocation efforts at X-Ray wharf (i.e. 4,410 is a conservative estimate). The proposed approach will leave behind 1,380 smaller corals and potentially lose an additional 1,890 corals after translocation, resulting in a conservative unavoidable loss estimate of 3,270 corals.

Navy-proposed Offset

The Navy worked with NMFS through early coordination to generate parameters (e.g. expected injury, service levels, discount rate, and years to recover) for a Habitat Equivalency Analysis (HEA) to quantify the interim loss of ecosystem services and function associated with the adverse effects of this proposed action, and developed a quantifiable mitigation strategy focusing on EFH area replacement. The Navy built in several conservative assumptions into the HEA regarding two-dimensional surface area, three-dimensional surface area, largest morphology, and estimates of coral survivorship. The Navy also included an area loss estimate for the marine successional and filter feeding community within the HEA. Collectively, these conservative choices resulted in a HEA requirement of 3,273.7 m^2 of offset for unavoidable losses to EFH, an area that justifiably exceeds the two-dimensional estimation of physical impacts, which was 1,666.9 m^2.

The Navy has proposed to offset the 3,273.7 m^2 of lost EFH through the generation of new and improved habitat. The Navy plans to remove anthropogenic debris, stabilizing substrate, and deploy limestone boulders at Mound 9. These measures will generate area for coral settlement and regrowth, increase rugosity, and increase benthic complexity in an area where corals have historically flourished (i.e. prior to WWII dredging). The proposed improvements at Mound 9 are also expected to benefit coral reef associated species known to be a food sources for benthic MUS (Nakamura et al. 2008).

To achieve the required offset the Navy plans to stabilize 1,235.9 m^2 of rubble at Mound 9, and place 615 limestone boulders that will provide 2,041.8 m^2 of new surface area. These two measures will generate 3,277 m^2 of offset. The Navy has also calculated that the coral estimated not to survive translocation have the potential to provide an additional 1,890 m^2 of new area above what was required within the HEA, providing an additional conservative buffer to the modeled requirement. The Navy is also proposing to move other invertebrates to Mound 9 as part of the translocation effort when feasible.

The Navy is planning to monitor (i.e., quantify and assess the resource conditions) the fish and benthic community at the Mound 9 restoration site at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter). The offset effectiveness monitoring effort will likely align with the

translocation survivorship monitoring planned as part of the proposed minimization in the section above.

NMFS Concerns
NMFS is concerned that the proposed activity will cause physical damage to EFH resources, including unavoidable loss of corals and non-coral invertebrates (i.e., substantial adverse effects), turbidity and sedimentation leading to degradation of coral condition, introduction of invasive species, introduction of chemical contamination from equipment, and introduction of toxicopathological contaminants during diver activities. NMFS is also concerned that translocation of corals from the *Porites rus* complex, which make up the majority of corals within the action area, may not respond well to translocation efforts due to their size and morphology. These concerns could result in long-term to permanent loss of corals, non-coral invertebrates, and their ecosystem services and function as discussed below.

Construction and dredging activities associated with this action will directly impact an estimated 1,666.9 m^2 of two-dimensional benthic area (2,661 m^2 of modeled EFH when including coral morphology), including more than 7,680 coral colonies. Minimization measures are expected to protect approximately 4,410 of the 6,300 coral colonies proposed for translocation, leaving more than 3,000 corals unavoidably lost. The Navy has put forward a realistic mitigation strategy to offset for lost EFH (e.g., corals and filter feeders), which has the potential to increase overall habitat area over time. The proposed approach hinges on successful coral recruitment at Mound 9 to replace the lost habitat area and demonstrate a return to comparable coral densities, and ecosystem function, to what we would have seen in the action area over the next 30 years (i.e. the selected Visual HEA service recovery period). If the new boulders and stabilized areas fail to resemble a reasonable facsimile of the coral diversities and densities that would have occurred within the action area, effective offset of EFH has failed. The HEA has proven to be an effective tool in developing the theoretical offset, but should be supported by long-term monitoring and adaptive management to ensure that the expected level of recovery occurs.

The mitigation projects proposed as minimization and offset have the potential to adversely affect EFH through vessel (e.g. physical damage and chemical contamination risks) and diver interactions (e.g. physical damage, introduction of toxicopathological agents, and invasive species risks) associated with the surveying, coral transplanting, staging and moving of the limestone boulders at Mound 9.

EFH Determination
NMFS agrees with the Navy's determination that the proposed action will adversely affect EFH and result in unavoidable loss. Furthermore, NMFS determines that even with the avoidance, minimization, and offset measures proposed by the Navy, the proposed action could still have long-term to permanent adverse effects to EFH associated with the implementation of the proposed

mitigation strategies, unexpectedly low survivorship for translocated corals (e.g. *Porites rus complex*), or resulting from delays in coral recovery and/or recruitment at Mound 9.

Conservation Recommendations
NMFS provides the following EFH conservation recommendations in accordance with the EFH provisions of the Magnuson-Stevens Act (50 C.F.R. 600.920) to help the Navy ensure that adverse effects to EFH including corals are avoided, minimized, offset for, or otherwise mitigated.

Conservation Recommendation #1: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2019 JRM INRMP, Marine Habitat Management section. If the 2019 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Mound 9 surveys within the next update to the JRM INRMP.

Conservation Recommendation #2: Coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment, and anchoring activities will all require the staging of materials in the marine environment and/or be supported by divers. The Navy should ensure that these activities avoid any unnecessary contact with marine organisms and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Conservation Recommendation #3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event. Each report should clearly documents the performance of the *Porites rus* complex and include a comparison of performance between morphology types, colony sizes, and translocation location (i.e. those moved to Mound 9, moved adjacent to the array area, or to Polaris Point). If survivorship of translocated corals does not meet the 70% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Please be advised that regulations (Section 305(b)(4)(B)) of the Magnuson-Stevens Act to implement the EFH provisions require that Federal action agencies provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. The final response must include a description of measures to avoid, minimize, and offset the adverse impacts of the activity. If the response is inconsistent with our EFH conservation recommendations, an adequate explanation for not implementing the recommendations must be provided.

Conclusion

Upon review of the consultation documents for the proposed construct and operation of an underwater electromagnetic measuring system in Outer Apra Harbor, Guam, NMFS determines that there will be unavoidable loss and substantial adverse effects to sensitive and hard-to-replace EFH. NMFS expects that many adverse effects to EFH from these project activities can be avoided and/or minimized if all of the proposed BMPs are fully implemented, and coral translocation achieves the targeted success levels. Additionally, NMFS believes that full offset can be realized so long as the Navy follows the EFH conservation recommendations provided by NMFS and reengages using the HEA to confirm that natural settlement and recovery of corals is meeting or exceeding the recovery rates put forth in the model. NMFS provides the EFH conservation recommendations as described above to help the Navy ensure that adverse effects to EFH including coral reef resources are avoided, minimized, offset for, or otherwise mitigated. Please don't hesitate to contact Steve McKagan at 670-234-0004 and/or steven.mckagan@noaa.gov should you have any questions, comments, or require additional technical assistance.

Sincerely,

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division

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18 August 2021

Gerry Davis
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Dear Mr. Davis,

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

In accordance with the Essential Fish Habitat (EFH) provisions of the *Magnuson-Stevens Fishery Conservation and Management Act* (MSA; 6 U.S.C. § 1801 et seq.), the Navy is providing this letter as a response to the National Marine Fisheries Service (NMFS) conservation recommendations letter dated 21 July 2021. The EFH consultation is for proposed installation the underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, U.S. Naval Base Guam. Many of the effects from the project can be avoided and minimized through the implementation of the Best Management Practices (BMPs) that were described in the Navy's EFH assessment that was submitted to NMFS on 21 June 2020. The Navy understands that conservation recommendations from NMFS are intended to enhance, or to be in addition to, BMPs and the Navy provides its responses to the conservation recommendations below.

NMFS Conservation Recommendation #1: To ensure that the proposed offset from the Habitat Equivalency Analysis (HEA) is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2019 JRM INRMP, Marine Habitat Management section. If the 2019 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Mound 9 surveys within the next update to the JRM INRMP.

Navy Response to Conservation Recommendation #1: The Navy understands that while the HEA is currently the best available program that provides an efficient method of predicting likely loss and recovery of coral and calculating the required compensation, subsequent monitoring of coral recruitment and growth will confirm the accuracy of the HEA predictions and the efficacy of the implemented mitigation measures. The Navy's subject matter experts will

develop a two-year monitoring and maintenance plan consistent with the five-year adjacent monitoring for the Lima, Mike, and November Whurves (LMN) translocation project at Mound 9. In response to this conservation recommendation, the Navy plans to evaluate the HEA analysis (or an equivalent and improved model analysis) for the impact area of LMN and Mound 9 after five years of monitoring that can be compared with the UEMMS monitoring data later in 2025.

Furthermore, the Navy agrees with this Conservation Recommendation, that the monitoring plan for all Mound 9 projects should consider aligning with the 2019 JRM INRMP. In addition, subject to available funds, the Navy will consider including funding support for the long-term monitoring events at Mound 9 within the next update to the JRM INRMP. As per the policy set forth in Chief of Naval Operations Instruction (OPNAVINST) 5090.1E, Environmental Readiness Program, all mitigation requirements must be coordinated in advance with natural resources managers representing the Installation Commanding Officers. If appropriate, the responsibility for the compensatory requirement can be realigned to the Natural Resources Conservation program at Naval Base Guam.

NMFS Conservation Recommendation #2: Coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment, and anchoring activities will all require the staging of materials in the marine environment and/or be supported by divers. The Navy should ensure that these activities avoid any unnecessary contact with marine organisms and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Navy Response to Conservation Recommendation #2: The Navy agrees with Conservation Recommendation 2 and will ensure that the appropriate BMPs are implemented during the coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment and anchoring activities, including avoidance of physical contact with organisms not transplanted (especially coral). The Navy will stabilize and secure materials that are staged on the bottom, while also avoiding movement during inclement weather. The Navy will be using experienced coral biologists for the coral transplantation and habitat restoration. The divers are knowledgeable about the risk of disease to corals including the use of reef-safe sunscreen. To the best of their ability, all divers will avoid exposing corals directly or indirectly to toxicopathological agents.

NMFS Conservation Recommendation #3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event. Each report should clearly documents the performance of the *Porites rus* complex and include a comparison of performance between morphology types, colony sizes, and translocation location (i.e. those moved to Mound 9, moved adjacent to the array area, or to Polaris Point). If survivorship of translocated corals does not meet the 70% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Navy Response to Conservation Recommendation #3: The Navy agrees with Conservation Recommendation 3 and will ensure that three monitoring reports documenting the performance of the translocated corals at the three translocation sites, including the *Porites rus* complex, will be provided to NMFS upon completion of coral translocation and after both subsequent monitoring events (12 & 24 months). The Navy agrees to coordinate with NMFS if the rate of survival does not meet the 70% survivorship target after the final monitoring period.

The Navy appreciates NMFS's effort and careful deliberation invested in evaluating the proposed actions and providing these three EFH conservation recommendations. Should you have any questions or concerns, please contact Kevin Lino at NAVFAC Pacific at (808) 472-1087 or kevin.c.lino.civ@us.navy.mil.

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
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October 6, 2021

Kevin Lino
Natural Resources Management Specialist EV24
Naval Facilities Engineering Command, Pacific
258 Makalapa Drive
Pearl Harbor, HI 96860
808-472-1087

RE: Installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam (PIRO-2021-02037; I-PI-21-1966-AG)

Dear Mr. Lino:

This letter responds to the Naval Facilities Engineering Command Pacific (the Navy) June 15, 2021, request to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1536(a)(2)) for the installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam. In the request, you determined that the proposed action is not likely to adversely affect (NLAA) the endangered or threatened species or designated critical habitat under National Marine Fisheries Service's (NMFS) jurisdiction listed below in Table 1. The consultation request included a biological evaluation (BE) that described the proposed project and evaluated the potential effects of the action on ESA-listed species under NMFS' jurisdiction. On August 7, 2021, we requested additional information regarding project equipment noise levels. On August 8, 2021, we requested a more detailed action area map. On August 21, 2021, we requested additional information on the location of *Acropora globiceps* in Apra Harbor. On August 18 and 23, 2021, you responded to our requests for additional information. After a phone conversation pertaining to the action area and species present on August 25, 2021, we concluded that we had sufficient information to initiate informal consultation that same day.

This response to your request was prepared by NMFS pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), implementing regulations at 50 CFR 402, and agency guidance for the preparation of letters of concurrence.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554. A complete record of this consultation is on file at the Pacific Island Regional Office, Honolulu, Hawaii.

Proposed Action

The Navy proposes to construct and operate an UEMMS in Outer Apra Harbor, Guam. The UEMMS will passively measure magnetic and electric field signatures of surface ships and submarines (hereafter vessels) to ensure vessels meet the magnetic signature limits specified in the Office of the Chief of Naval Operations Instruction S8950.2H. The proposed action includes both in-water and shore-side infrastructures to passively measure electromagnetic signatures of vessels and transmit data to facilities on land. The Navy will install the sensor array on the seafloor of Outer Apra Harbor 915 meters (m) northwest of Polaris Point in 17 m of seawater.

Installation of the sensor array will require excavation, backfilling and disposal of material from the array site, water jetting or drilling of holes at the array site, deployment and anchoring of subsea cables, and excavation and backfilling at the egress location at Polaris Point. In-water construction activities are expected to take approximately 10 months to complete.

Coral translocation, habitat restoration and monitoring

Due to the need for coral translocations from the array location, substantial pre-consultation for Essential Fish Habitat (EFH) impacts and mitigations occurred between NMFS Habitat Conservation Division (HCD) and the Navy beginning in February 2014 and continuing through 2021. NMFS HCD concluded EFH consultation in a letter dated July 21, 2021, and determined that full offset of habitat impacts can be realized with full implementation of the EFH conservation recommendations.

In September 2020, the Navy performed extensive surveys at each of the project areas following the approaches previously agreed upon with NMFS HCD. No ESA-listed corals were observed during surveys and listed corals are not proposed for translocation.

To minimize impacts to EFH, translocation of approximately 6,300 coral colonies from the UEMMS project site to a recipient site (Mound 9) will first require habitat enhancement including sediment stabilization and rugosity uplift. These measures are part of compensatory mitigation. Divers will first remove anthropogenic debris from Mound 9. At least 615 locally sourced limestone boulders will be lowered from a barge and placed into clusters using a hydraulic grab. In order to ensure accurate placement, the barge will be positioned with a guide vessel to demarcated areas previously identified by divers and marked with temporary surface marker floats identifying each cluster. If winds occur during implementation, divers will place anchors in sand substrate (avoiding impacts to substrates) to hold the barge in position. Divers will use hand tools to remove corals from the UEMMS project site. Small vessels will be nearby with crates for the coral translocations. Divers will then stabilize translocation sites at Mound 9 using a combination of mesh mats, reinforcement rods and concrete cement. These materials will stabilize loose rubble and affix coral colonies. All dive team members will be experienced coral biologists and boat technicians skilled in conducting coral translocation. Divers and crews will wear gloves and minimize contact with living coral tissue. Biological observers will be present aboard vessels and in-water in order to ensure BMPs are implemented, avoiding impacts to protected species and documenting listed species sightings. As for all work proposed, if a listed marine species is observed within 50 m, work will cease until the animal leaves the area.

Habitat restoration on Mound 9 will generate new areas for coral settlement and regrowth, increase rugosity, and increase benthic complexity in an area where corals historically flourished prior to WWII dredging. The proposed improvements at Mound 9 are also expected to benefit coral reef associated species known to be a food sources for benthic species (Nakamura et al. 2008).

The Navy is planning to use experienced coral divers for the translocation, habitat restoration and monitoring at the array location and Mound 9. Three monitoring events using standardized

protocols will occur at Mound 9: at the time of completed translocation, and at 12 and 24 months thereafter.

Sensor Array Excavation, Installation, and Backfill
Once coral translocation has occurred, an estimated 918 cubic m (m^3) of material will need to be excavated from the array site before sensor installation can occur. The material will be excavated with a closed-bucket excavator to minimize inadvertent discharges into the water column. The BE included BMPs to minimize sediment and turbidity impacts to listed species including the following: during in-water construction and dredging activities, the Navy will ensure rigorous water quality monitoring and will manage turbidity levels to contain them within the sensor array work area; turbidity data will be collected using real time monitoring devices at two test stations and two control stations; all in-water activities will cease during the primary Guam coral spawning events each year for hard (Scleractinian) corals estimated to be 21 days total, including 8 days prior to the full moon and 14 days after; a Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation; an 8-m length silt curtain will be deployed and monitored immediately adjacent to and around the dredge barge; a silt fence and silt barriers will be installed around the cable excavation area and shoreline at Polaris Point; and, if a silt plume is observed within the action area, project activities will cease until corrective action is taken.

Excavated materials will be deposited at the Guam Deep Ocean Disposal Site (G-DODS) 20.6 kilometers (km) offshore of Guam in 2,680 m of seawater. The G-DODS was designated as an exclusive ocean dredged material disposal site in 2010 (Final Rule 40 CFR Part 228; 21 FR Notice 54497). Formal consultation on disposal and vessel transits to and from the G-DODS was conducted with U.S. Fish and Wildlife Service and NMFS in 2009. The BE included BMPs for dredge disposal including the following: transportation of dredged material to the G-DODS shall only be allowed when weather and sea state conditions will not interfere with safe transportation and will not create risk of spillage, leak or other loss of dredged material in transit to the G-DODS; dredged material shall not be leaked or spilled from disposal vessels during transit to the G-DODS; dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit; no more than one disposal vessel will be present within the permissible dumping target area at any time; and, each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Once excavation and disposal is completed, the Navy will begin installing the UEMMS sensor array. The sensor array will consist of a line of 22 sensors (13 Electromagnetic triaxial (EMT) sensors and eight magnetometer triaxial (MT) sensors extending 128 m and spaced six m apart, as well as one conductivity, temperature and depth (CTD sensor). The CTD sensor will be installed at the northeast end of the array. Each sensor will be mounted to a 30.5-centimeter (cm) diameter fiberglass reinforced plastic sensor tube that will be embedded six m deep into the seafloor at each location. A 15 cm diameter fiberglass reinforced plastic cable guide stake will also be embedded 1.2 m deep into the seafloor three m to the southeast of each sensor tube. Sensor tube and guide stake installations will be performed by divers using a water jetting process known as a handheld hydraulic breaker. A large steel pipe will be used to push the tubes to the appropriate depth as the high-pressure water loosens the bottom material. If water jetting is not feasible due to seafloor characteristics, 30-cm diameter pilot holes will be drilled into the seafloor and marine grout will be used to secure the tubes at the same locations. Additionally, 30

m of sensor cable will be installed between each sensor and guide stake, and secured with eyebolts, poly webbing, and zip ties. After installation, the excavated area, including the coiled cables, will be covered with 826 m^3 of non-magnetic, certified contaminant free backfill material in order to restore the excavated area to the original water depth.

Subsea Cable Installation and Anchoring
To transmit data of electromagnetic signatures collected by the UEMMS to facilities on land, 27 subsea cables, 5 additional guide stakes, and 29 concrete anchor discs will need to be installed along the 975 m cable route. The subsea cables are made up of shielded and sheathed copper wires with a diameter of 2.64 cm. One cable will extend from each of the 22 sensors to a common path marked by guide stakes along the southeast side of the array. Five additional cables will also be routed to the array for future use. Three additional guide stakes will be installed adjacent to the array site and two additional guide stakes will be installed at Polaris Point to secure each end of the subsea cable. The cables will be bundled using polypropylene webbing at each sensor and at each guide stake. Divers will lay the cable along the cable route and select a location every 30 m along the pathway for deployment of a 1.2 m diameter concrete anchor disc that will secure the cable to the seafloor. The concrete anchor discs will be deployed by a crane and barge with the assistance of divers to ensure areas with coral cover are avoided.

Subsea Cable Egress and Trenching
To protect the cables from wave and storm damage at Polaris Point, high-density polyethylene (HDPE) conduits will be deployed. The HPDE conduits will be bundled together into a single 71-cm diameter, 38-m long cable duct, anchored 10.5 m below mean low water (MLLW). The bottom of the duct will be secured in place using a stainless steel anchor band span and earth anchors. The earth anchors are only a few inches in diameter and will be installed using a hand tool such as a hammer. At 4.5 m below MLLW, the remaining 24 m of duct will transition underground until it reaches a concrete transition vault.

An oblique trench (17m wide x 15m long x 3m deep) will be excavated by a closed-bucket excavator to create the necessary slope for burial of the conduit at the surface. Prior to excavation, 95.6 m^3 of existing shoreline revetment material will be relocated by an excavator to a similar depth adjacent to the site. The Navy estimates that 172 m^3 of subbase materials will be excavated and placed on land. After the conduit has been secured, the subbase material and revetment material will be reused as backfill to bury and protect the cable conduit duct.

Construction, which includes performance of any required mitigation activities, is planned to begin November 2021 and will require 10 months (including anticipated weather and standby days) to complete. Within the 10 month time frame, the in-water work will require approximately five months to complete.

Best Management Practices (BMPs) are included in the BE (Section 1.4) as part of the proposed action and will be implemented to minimize adverse effects.

Action Area
The action area is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). For this action, the extent of vessel noise covers all areas affected. Thus, we delineate the action area as the following vessel transit paths as well as 251 meters in every direction to account for project-related noise propagating from the vessels to the edge of the behavioral response isopleth:

- From Inner Apra Harbor to the UEMMS site (Figure 1) and Mound 9 (Figure 2) in Outer Apra Harbor
- From the UEMMS site to the dredge disposal site (G-DODS) located 20.4 km offshore of Guam (Figure 3)
- From the Hawaiian Islands to Guam if additional vessels are needed for the construction.

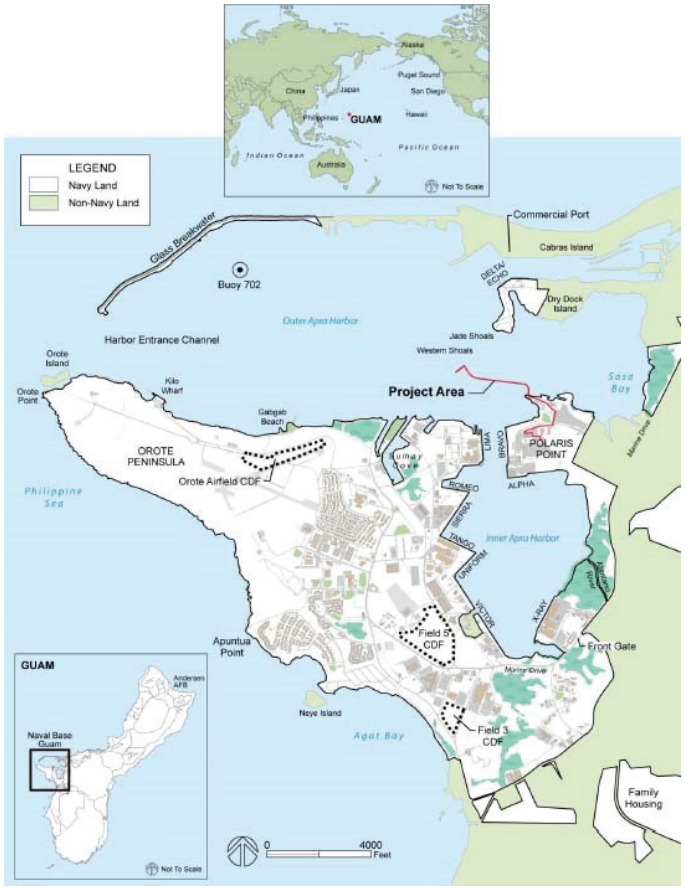

Figure 1. Navy UEMMS action area in Apra Harbor.

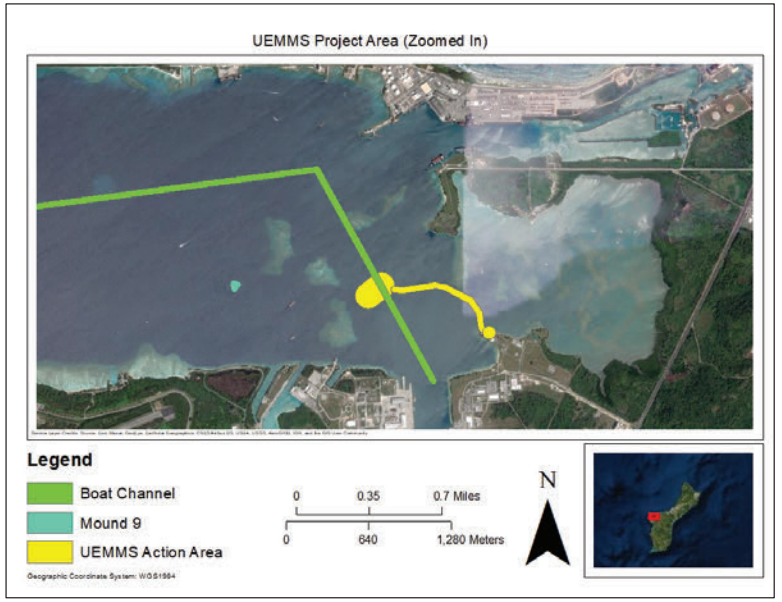

Figure 2. Navy UEMMS Mound 9 coral translocation site relative to the UEMMS site in Apra Harbor.

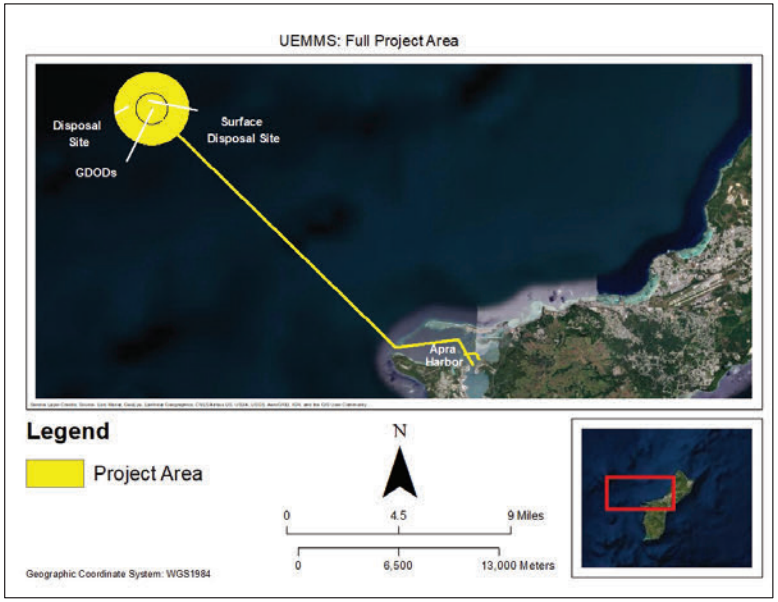

Figure 3. Action area diagram including Navy UEMMS G-DODS dredge disposal area 20.4 km offshore of Guam.

Listed Species

The ESA-listed threatened and endangered species under NMFS' jurisdiction listed in Table 1 are known to occur, or could reasonably be expected to occur, in the action area, and may be affected by the proposed activities. Detailed information about the biology, habitat, and conservation status of the animals listed in Table 1 can be found in their status reviews, recovery plans, federal register notices, and other sources at http://www.nmfs.noaa.gov/pr/species/esa/.

Table 1. Common name, scientific name, ESA status, effective listing date, and Federal Register reference for ESA-listed species considered in this consultation.

Species	Scientific Name	ESA Status	Effective Listing Date	Federal Register Reference
Central South Pacific Green Sea Turtle	*Chelonia mydas*	Endangered	5/06/2016	81 FR 20057
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	7/28/1978	43 FR 32800

Species	Scientific Name	ESA Status	Effective Listing Date	Federal Register Reference
Loggerhead Sea Turtle North Pacific DPS	*Caretta caretta*	Endangered	9/22/2011	76 FR 58868
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened	7/28/1978	43 FR 32800
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	6/02/1970	35 FR 8491
Indo-Pacific Scalloped Hammerhead Shark	*Sphyrna lewini*	Threatened	09/02/2014	79 FR 38213
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened	1/30/2018	83 FR 4153
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter microcephalus*	Endangered	12/02/1970	35 FR 18319
North Pacific Right Whale	*Eubalaena japonica*	Endangered	12/27/2006	71 FR 77694
False Killer Whale Main Hawaiian Island Insular	*Pseudorca crassidens*	Endangered	11/28/2012	77 FR 70915
Giant Manta Ray	*Manta birostris*	Threatened	1/22/2018	83 FR 2916
Corals	*Acropora globiceps*	Threatened	10/10/2014	79 FR 53852

Critical Habitat

Critical habitat for MHI insular false killer whales includes waters from 45 m to 3,200 m in depth surrounding the main Hawaiian Islands (from Niihau to Hawaii Island). Detailed information on MHI insular false killer whale critical habitat can be found at https://www.fisheries.noaa.gov/resource/map/main-hawaiian-islands-insular-false-killer-whale-critical-habitat-designation.

Analysis of Effects/Exposure and Response

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time

and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

In order to determine that a proposed action is not likely to adversely affect ESA-listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or completely beneficial. As defined in the *Endangered Species Consultation Handbook* (USFWS and NMFS 1998), beneficial effects are contemporaneous positive effects without any adverse effects to the species. Discountable effects are those extremely unlikely to occur. When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with our regulatory definition of "effects of the action."

Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Take of species listed as endangered is prohibited at the time of listing, while take of threatened species may not be specifically prohibited unless NMFS has issued regulations prohibiting take under section 4(d) of the ESA.

Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur (USFWS & NMFS 1998). This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions, was applied during the analysis of effects of the proposed action on ESA-listed marine species, as is described in the consultation request and biological evaluation (BE). Only activities that have the potential to adversely affect ESA-listed species are discussed here.

The following stressors may be associated with the proposed action:

- Elevated noise levels
- Elevated suspended sediments
- Vessel strikes
- Waste discharge
- Entanglement
- Direct impacts from coral translocation, habitat restoration and monitoring

Elevated noise levels

Elevated noise levels may occur in Apra Harbor associated with use of equipment including a hydraulic breaker/water jet, vibratory hammer, clamshell bucket dredge and excavator. The effects of project-related sound on our species also depends on the ambient acoustic environment. Apra Harbor has commercial and industrial vessel traffic and tourist-related recreational activities. The daytime and nighttime boat traffic in the harbor channel results in

unknown increased levels of ambient sound, however, the level may be comparable to the ambient sound levels of 120-155 dB_{peak}, and 133 dB_{rms} measured for a large marine bay, with heavy industrial use and boat traffic as measured by CALTRANS (2015).

A hydraulic breaker/water jet and vibratory hammer will be used to install both the guide stakes (22 guide stakes that are 6" diameter each) and the sensor tubes (22 sensor tubes that are 12" diameter each). The guide stakes and tubes are made of fiberglass reinforced plastic and will be jetted into the benthic substrate. The Navy BE estimated noise for the hydraulic breaker/water jetting (Table 2) by referencing noise data from a similar project that used the same equipment. In September 2017, acoustic monitoring was conducted for 16-inch round concrete pile jetting installation using a single 2-inch pipe as part of the high-pressure water jet (300 psi maximum pressure) in San Diego Bay (NAVFAC SW 2018). Source average SPLs ranged from 123.7-130.2 dB re 1µ Pa. Far-field recordings were taken at distances ranging from 19-338 m (62-1,109 ft., respectively) and recorded average SPLs ranging from 12.5-127.6 dB re 1µ Pa, demonstrating attenuation levels. Underwater noise from hydraulic breaker/water jetting of 16-in. concrete piles is likely substantially greater than the proposed action of installing the small diameter plastic sensor tubes (12" diameter) and guide stakes (6" diameter). A vibratory hammer may also be used to drive the delicate sensor tubes and small guide stakes into bottom substrates. However, no hammer strikes will occur because a hammer strike could break the sensor tubes and guide stakes. Instead, the stakes would be vibrated into the substrates. The shallow embedment depth (sensor tubes about 19.5 ft.; guide stakes about 10 ft.) is estimated to require less than two minutes of vibratory hammer use per stake/tube. Considering the above information, we assume the sound level for a hydraulic breaker/water jet or vibratory hammer will be approximately 126.5 dB re 1µ Pa (Table 2).

Table 2. Underwater noise levels from dredging and water jetting.

Equipment	**Underwater Sound Pressure Level (SPL dB re 1µ Pa)**	**Source**
Clamshell dredge	124	Dickerson et al. 2001
Handheld hydraulic breaker/water jetting	126.5 (average for 16-in concrete piles)	NAVFAC SW 2018

Noise from dredges can be variable, depending on the phase of operation and the type of dredge used, but typically occur at low frequencies (<500 Hertz [Hz]; Reine *et al.* 2014). Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. Bucket dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The mechanical dredge noise is generated from lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Underwater acoustic sound levels from bucket dredging were measured at various distances from dredge operations in the Cook Inlet, Alaska (Dickerson *et al.* 2001). The maximum noise spike occurred when the bucket hit the bottom. All other noise levels from this operation (e.g., winch motor, spuds) were insignificant. Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson et al.

2001), the estimated sound levels from dredging is not expected to exceed 124 dB re 1 micro Pascal (μPa) from the impact of the bucket hitting the bottom (Table 2).

The Navy will use various-sized vessels, from small boats for diving to large vessels like tug boats to move barges. Noise generated by the largest possible vessel (120 ft) will be approximately 173 dB rms re 1 μPa 1 meter (m) from the source. We assume the lowest sound level of vessels between 100 and 250 ft from Kipple and Gabriele (2007) because the vessel length is near the lowest end of this data and the Navy requires BMPs for vessel speed and operation. Noise generated by the small boats will be approximately 166 dB rms re 1 μPa 1 m from the source (assuming the average sound level of vessels under 40 ft from Kipple and Gabriele [2007]). We used a modified version of the publically available NMFS marine mammal sound calculator (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed 10/4/2021), to calculate the distances from vessels that noise will propagate. Because the Navy will complete almost all activities within the highly-active Apra Harbor, we assumed ambient sound of 125 dB rms re 1 μPa.

For marine mammals, the Navy (2017), in coordination with NMFS (2018), has established acoustic thresholds using the best available science that identifies the received level of underwater sound above which exposed marine species would reasonably be expected to experience a potentially significant disruption in behavior, or to incur temporary threshold shifts (TTS) or permanent threshold shifts (PTS) of some degree. The Navy (2017) identified acoustic thresholds in decibels (dB) (referenced to 1 micropascal) that identify the onset of TTS and PTS for marine mammals experiencing non-impulsive sounds. For marine mammal species, the TTS threshold ranged from 178-199 dB dB rms re 1 μPa and the PTS threshold ranged from 198-219 dB dB rms re 1 μPa. We calculated a distance from all vessels to the edge of the TTS isopleth of less than one meter for all marine mammals. The behavioral response threshold for marine mammals is 120 dB rms re 1 μPa. We calculated a distance from the largest vessels to the edge of the behavioral response isopleth of 251 meters and 200 meters for small vessels.

Direct injury and hearing impairment in marine mammals is unlikely to occur because the proposed action will not expose them to noise levels above TTS or PTS thresholds. Elevated noise levels from vessel use will likely cause some behavioral responses when marine mammals come within 251 meters of large vessels and 200 meters of small ones. Typical behavioral responses include temporary masking of communications and/or acoustic environmental cues, alteration of ongoing behaviors, and avoidance. However, these sound levels will only occur when vessels are under power and transiting, which means any exposure of individuals will be very short-lived (a vessel traveling at 5 knots will expose a stationary target to noise above the behavioral response threshold for a maximum of 3 minutes and 20 seconds). When vessels are not in transit, the engines will be under low power and noise will likely be less than behavioral response thresholds outside of the 50 m shutdown area. For these reasons, we are reasonably certain the effects from project-related noise on marine mammals will not rise to the level of harm or harassment and thus, are insignificant.

Very limited information exists regarding hearing and sea turtles. To date, no studies have been conducted specifically related to the onset of TTS or PTS in sea turtles. Therefore, the Navy (2017) has developed thresholds for other similar ESA consultations based on the most current literature on sea turtle and fishes (including as sharks and manta rays) hearing and recommendations made by Popper et al. (2014) in Sound Exposure Guidelines for Fishes and

Sea Turtles. The Navy's (2017) approach employs the same statistical methodology to derive thresholds as in NMFS' technical guidance for auditory injury of marine mammals (NOAA 2018). Based on a composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used since there are currently no data on TTS for sea turtles and fishes are considered to have hearing more similar to sea turtles than do marine mammals (Popper et al. 2014).

O'Hara and Wilcox (1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels up to 175 dBrms (referenced to 1 μPa) in a shallow canal. McCauley et al. (2000) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dBrms. At 175 dBrms, both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (McCauley et al. 2000). We will use our modified sound calculator (referenced above) because it uses a more conservative 160 dB re 1μ Pa threshold for behavioral impacts to sea turtles. Our calculator sets the thresholds for PTS and TTs for sea turtles at 220 dB re 1μ Pa and 200 dB re 1μ Pa, respectively.

Direct injury and hearing impairment in sea turtles will not occur because underwater noise produced by all activities of the proposed action will lack the amplitude or duration to exceed TTS and PTS thresholds. Noise levels from vessel use may exceed the behavioral response threshold, but we calculate the distance from vessels to the edge of this effect at 4.5 meters. It is unlikely a vessel will come within 4.5 meters of a sea turtle due to avoidance by vessel captains and sea turtles, as well as the Navy's use of a 50-meter shutdown zone. Therefore, we are reasonably certain the proposed action is extremely unlikely to expose sea turtles to noise levels above the behavioral response threshold. Thus, the effects from noise on sea turtles is discountable.

For fishes, PTS has not been documented in any of the studies researching fish hearing (including sharks and manta rays) and potential impairment from various sound sources. This is attributed to the ability for regeneration of inner ear hair cells in fishes, which differs from marine mammals and sea turtles. For this reason, thresholds for fish hearing impairment only includes the SPL related to the potential onset of TTS. A TTS in fishes is considered recoverable, although the rate of recovery is based upon the degree of the TTS sustained. Thus, auditory impairment in fishes is considered recoverable over some duration; and auditory impairment thresholds are based solely on the onset of TTS for fishes.

Stadler and Woodbury (2009) reported the onset of physical injury for fish, sharks and manta rays are expected if the peak sound levels exceed 206 dB re 1 μPa. The proposed underwater noise would be significantly less than 206 dB re 1 μPa in the water column and sound is expected to decay at distance. The probability of fishes being located at or near the array construction site in Apra Harbor is low. Any physiological stress and behavioral reactions would likely be short-term (seconds or minutes) and are expected to return to normal shortly after the disturbance ceases or the individual moves away. Therefore, the effects on sharks and manta rays from underwater noise are anticipated to be minor, temporary and will not lead to disruption of normal behavioral patterns. Thus, we are reasonably certain the effects from project-related noise will not rise to the level of harm or harassment and are insignificant.

Elevated suspended sediments

Dredging of 1200 cubic yards (CY) of bottom substrates for the sensor array installation, excavation of 225 CY seafloor and relocation of 125 CY of revetment at Polaris Point, removal of debris and placement of limestone boulders at Mound 9 in outer Apra Harbor and the use of underwater mechanical tools to install the array may elevate turbidity by dislodging, re-suspending, and dispersing sediment in the water column of Apra Harbor. Suspended sediment can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015).

Open ocean species including whales and manta rays will not be exposed to the work areas in Apra Harbor. Disposal of dredge materials at the G-DODs may elevate turbidity in the vicinity of open-ocean species. Potential effects will be minimized through implementation of BMPs described in the proposed action section above including monitoring for and suspending work when marine species are within 50 m. NMFS expects whales and manta rays would also avoid the G-DOD area when vessels are working there. Due to the proposed monitoring and avoidance of listed species, ceasing work if an animal is observed, and the expectation that whales and manta rays are dispersed and at low density, impacts to whales and manta rays from disposal at the G-DODS are extremely unlikely, and effects will be discountable.

Sea turtles, corals and sharks may occur in Apra Harbor and may be exposed to elevated turbidity from dredging and other underwater work. The Navy BE included data from a particle tracking model (PTM) for Apra Harbor in the analysis of dredging effects. NAVFAC Pacific requested assistance from the USACE Engineer Research and Development Center (ERDC) to determine the fate of re-suspended dredged sediment during dredging operations in Apra Harbor. ERDC developed a framework for quantifying turbidity and sedimentation exposure mechanisms for corals in Apra Harbor (Gailani et al. 2017). The modelled scenario included dredging operations proposed to widen the channel throughout the entire outer harbor basin plus two berthing alternative sites, all of which would be far greater (spatially and temporally) than the proposed UEMMS dredging (i.e., up to 608,000 CY in the model vs. 1,200 CY for the UEMMS array). However, the results of this modeling effort quantified exposure of the nearby coral reefs to turbidity and sedimentation, and the relative rates provide robust and reasonable comparisons for the UEMMR impact and risk assessment.

The PTM is a Lagrangian particle tracker and simulated sediment movement of multiple sediment types in a flow field (Gailani et al. 2017). PTM combined accurate and efficient transport computations with effective visualization tools, making it useful for assessment of dredging practices and proposed dredging operations. PTM modeled such processes as settling, deposition, resuspension, and particle-bed interactions to simulate site-specific transport of both fine and coarse sediment. PTM output included time-accurate horizontal and vertical positions of sediment parcels. Various other attributes such as mass, density, and suspension status are also assigned to each of the output parcels. For this application, eight scenarios were defined and modeled based on the dredging sources. The maximum values within the worst case scenario for total accumulation maps occurred within the dredging footprint (i.e., below 0.1 kg/m^3). Outside of the dredging footprint, values remained between 2 g/cm^2 and 4 g/cm^2 for the different dredging locations modelled. Daily deposition rate values remained below 0.7 g/cm^2 /day. When silt curtain effectiveness was increased to 100% and the clamshell loss reduced to 1%, maximum total accumulation decreased to 0.5 g/cm^2 outside of the dredging footprint. In the same case, the maximum values for the suspended sediment concentration were below 0.02 kg/m^3. Deposition

rates were likewise reduced to 0.10 g/cm^2/day outside the dredge footprint but within the 200 m line (Gailani et al. 2017). Further, the model results demonstrated that sediment dredged at each site generally remained near the dredge site. It was concluded that lateral transport was nominal because of the small velocities within Apra Harbor (Gailani et al. 2017). The model also indicated that sediment tends to deposit shortly after initial suspension. Thus, based on the best available scientific data for a modelled, worst-case scenario for dredging in Outer Apra Harbor, it is reasonable to conclude that the sediment transport from the proposed action would have similar or less sediment suspension and deposition and that sediment accumulation would be confined at the dredged area with minimal transport within the harbor.

In addition to the Apra Harbor modeling described above, the Navy BE referenced turbidity studies obtained from a Pearl Harbor Maintenance Dredging operation. During maintenance dredging of Pearl Harbor's Southeast Loch (SE Loch) in 2018, turbidity levels were measured by an RBRduo3 (https://rbrglobal.com/products/ standard-loggers/rbrvirtuoso-rbrduo) data logger, which recorded turbidity and depth as it was dropped (i.e., cast) through the water column. During each cast, the data logger recorded two turbidity and depth readings every second. Turbidity measurements were taken twice each day: in the middle of the shift and at the end of the shift. Three replications of measurements were taken around the turbidity curtain (with the observer facing the barge): 1) on the left side of the curtain; 2) the right side; and 3) the side of the curtain furthest away from the dredge barge (i.e., center). The unit of measure for turbidity used during the SE Loch dredging was the Nephelometric Turbidity Unit (NTU), which measured scattered white light at 90 degrees from an incident light beam.

Water quality parameters guidance from NOAA Office for Coastal Management (https://coast.noaa.gov/estuaries/science-data/) suggested that in nearshore and estuarine habitats, natural turbidity readings are between zero and 10 NTU. Readings of concern are above 20 NTU. From the SE Loch data, the heat maps suggested that turbidity levels close to or above 20 NTU mostly occurred within a meter or less of the bottom. This could have been caused by the silt curtain interacting with the bottom, especially in shallower parts of the dredge footprint. Also, the dredge operations moved slightly during the shift and some sediment may have been stirred up. Most values in the water column during calm dredging days and in the baseline data were below 5 NTU. During dredging, turbidity was slightly higher if measured closer to the silt curtain (i.e., within 16.5 ft. [5 m]). Turbidity also increased with depth, with the upper 26.4–29.7 ft. (8–9 m) at an almost-uniform and relatively high clarity.

The proposed action includes use of a silt curtain surrounding the dredge areas. Project-generated, elevated turbidity levels will be contained by the silt curtains that will create a vertical barrier in the water to contain sediment. Elevated turbidity in the work area would be temporary and is expected to settle as work progresses throughout the work area and restore to ambient upon completion, with no persistent effect.

Elevated turbidity levels could reduce light penetration throughout the water column and limit underwater visibility, possibly interfering with an individual's ability to forage. However, the action area does not overlap with important resting, nesting or foraging habitats for turtles or sharks and the risk of reduced foraging opportunities is insignificant.

Coral reef organisms are easily smothered by sediment (Golbuu et al. 2003), and rates > 100 milligrams/cm/day can kill exposed coral tissue within a few days (Riegl and Branch 1995), although corals show considerable interspecific variability. The Navy provided information on

occurrence of *Acropora globiceps* in Apra Harbor (August 22, 2021, email from K. Lino to NMFS). The sole recorded sighting of *Acropora globiceps* has been at the Spanish Steps near the entrance to Apra Harbor which is 4 km (2.5 miles) from the sensor array work area and outside the area of potential area of turbidity predicted by the models described above.

The BE contains BMPs that will be implemented to minimize effects from suspended sediments and elevated turbidity on ESA-listed species including use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions. The silt curtain will be monitored before dredging to ensure no listed species are within the curtain. Thus, the only exposure to elevated turbidity will be if sediment/turbidity escapes the silt curtain, which may occur but is expected to be very limited in scope, concentration and duration. During all in-water or overwater work, silt curtains will completely enclose the work area to the maximum extent practicable. If a plume is observed outside of the silt curtains, work will cease and corrective action will be taken before resuming work. In the event of an approaching tropical storms and typhoons, equipment will be removed or adequately secured.

NMFS expects that BMPs will limit the extent of elevated turbidity, and the curtain will mostly isolate it from exposing listed species in Apra Harbor. Therefore, we are reasonably certain the effects from project-related sediment and turbidity will not rise to the level of harm or harassment for any species listed in Table 1, and thus are insignificant.

Vessel strikes

Vessel strikes could occur along vessel transit routes in the action area including marked channels within Apra Harbor, vessel work areas around the UEMMS site, transit routes to the G-DODS (20.4 km offshore of Guam) or the coral translocation site at Mound 9 and vessel routes from other islands that will be used if additional vessels are needed for the construction. When surfacing to breathe or rest, marine fauna is at risk of being struck by a vessel.

Kelly (2020) documented vessel collisions with sea turtles resulting in lethal and sub-lethal injuries. Sea turtles may be in the action area, and could potentially be struck by transiting vessels during the proposed activities. While there are few data on vessel strikes in Guam, we have no indication that the rate of striking will be higher than it is in Hawaii. NMFS (2008) estimated 37.5 vessel strikes of sea turtles per year from an estimated 577,872 trips per year from vessels of all sizes in Hawaii. More recently, we estimated as many as 200 green sea turtle strikes annually in Hawaii (Kelly 2020). If these turtle strikes are evenly distributed around the islands, the probability of a green sea turtle strike from any one vessel trip is extremely low (on average 0.035%, calculated by dividing the most recent strike estimate of 200 per year by the best estimate of all vessel transits of 577,872 per year). However, green sea turtle strikes are not evenly distributed throughout the islands. They are concentrated in areas where small vessel activity is highest (e.g., near small boat harbors and boat launches), such as Kaneohe Bay and Pearl Harbor on Oahu (Kelly 2020). Green sea turtles are most vulnerable to small vessels (<15 m), travelling at fast rates (>10 knots) (Kelly 2020). Increased vessel speed decreases the ability of sea turtles to recognize a moving vessel in time to dive and escape being hit, as well as the vessel operator's ability to recognize the turtle in time to avoid it. The vessels used in the proposed action will be under a restriction of "no wake/idle" speeds at all times while in water depths where the draft of the vessel provides less than a 2 m clearance.

The Navy will implement BMPs that help prevent collisions and would minimize exposure to vessels including traveling with a wildlife observer who will look for marine species during transit, reduced vessel speeds in known marine species locations, and avoidance of areas where marine species are sighted. Vessels in the action area will adhere to BMPs to reduce ship strikes including the use of lookouts and transiting only in established navigation channels. The action area does not have the characteristics identified by Kelly (2020) to result in a hot spot for green sea turtle strikes (overlap of high density boating activity and sea turtle habitat). Therefore, the probability of a green sea turtle strike is likely less than the overall rate calculated above. Thus, we are reasonably certain the likelihood of exposure of any green sea turtle to a vessel strike from this action is extremely unlikely, and therefore discountable.

The other sea turtle species have a lower rate of striking than green sea turtles. This is likely mostly due to their low abundance numbers and preference for deeper offshore waters (Kelly 2020). There were only four documented vessel strikes of hawksbill sea turtles between 1984 and 2020 and two olive Ridley sea turtles in Hawaii (Kelly 2020). We have no documentation of vessel strikes on leatherback or loggerhead sea turtles in Hawaii. We have no data to indicate the rate of vessel strike with these species will be higher in Apra Harbor than Hawaii, either. Because the probability of a project-related vessel striking any other the other sea turtles is even lower than that of a green sea turtle, and because of the BMPs included in this proposed action, we are reasonably certain the likelihood of exposure of any individual is extremely unlikely, and therefore discountable.

The risk of exposure to vessel strikes is low for sharks and manta rays. These species are not routinely on the surface, and are not air breathers. Mantas are known to congregate at the surface and breach on occasion. Few, if any, vessel strikes on these particular animals have ever been recorded. Vessel collisions have been documented on other elasmobranchs, and have been most commonly documented with larger shark species (e.g., whale sharks and basking sharks) with evidence of blunt trauma and laceration scars (Schoeman et al. 2020; Speed et al. 2008). The risk of a vessel collision depends on the amount of time that an animal spends at the surface of the water, and their behaviors at the surface of the water. Behaviors such as foraging, resting, socializing with other animals, and taking care of their young may distract an animal from detecting approaching vessels. For the ESA-listed sharks and rays, these behaviors do not occur at the surface of the water, thereby reducing the likelihood of collisions with vessels during these critical behaviors. Telemetry data revealed that juvenile scalloped hammerhead sharks have a daytime preference for deeper water characterized by mud and silt (Duncan et al. 2006). Satellite-tagged adult scalloped hammerhead sharks frequently made deep dives (1,000 m) offshore at night, while mostly remaining in waters >100 m deep, and daytime shallower dives were commonly in water depths between 10 and 40 m (NMFS 2020). Based on the expected spatial distribution of sharks in deeper water depths, we are reasonably certain the likelihood of a vessel strike on ESA-listed sharks and rays is extremely unlikely, and therefore discountable.

Whales surface to breathe, with calves surfacing more regularly than adults. While at the surface, a whale is at risk of being struck by a vessel. There are few data on vessel strikes in Guam, but we have no indication that the rate of striking will be higher than it is in Hawaii. In a study by Lammers et al. (2003), 22 whale/vessel incidents were recorded between1975-2003, with 14 of those occurring during the years from 1994-2003. The vast majority (17) of the vessel strikes were from vessels traveling at speeds in excess of 15 knots, and nearly all of them occurred in close proximity to the coastline of the main four Hawaiian Islands Lammers et al. (2003).

Vessels used for the proposed action will be traveling at speeds less than 10 knots, they will use dedicated lookouts, limiting the already extremely low probability of a strike. Based on adherence to BMPs, the collision risks from the references cited above, and the low abundance and widely scattered nature of whales in the action area; the likelihood of an individual from the whale species listed in Table 1 being struck during the proposed action is extremely unlikely, and therefore discountable.

Waste discharge

The project may expose listed species to waste and discharge associated with use of equipment and vessels. Waste discharges will be avoided and minimized to the greatest extent practicable through development and implementation of an oil spill contingency plan contained within the SWPPP that will be required specific to the project activities. The SWPP is required to include measures to prevent and respond to inadvertent discharges into the marine environment. Petroleum, spill-containment devices (e.g., absorbent pads, containment booms) will be located on-site in sufficient quantity and available and accessible for immediate deployment at all times. All equipment and vehicles will be maintained and checked prior to the start of each day's activities to minimize the risk of discharge. Operators will perform daily pre-work equipment inspections for cleanliness and leaks. Should a leak be detected, all heavy equipment operations will be postponed or halted and will not proceed until the leak is repaired and equipment cleaned. Fueling of land-based vehicles and equipment will take place at least 50 ft. away from the water over an impervious surface. Fueling of vessels will be done at approved fueling facilities.

Vessels used for the dredge spoils disposal, translocation of corals and habitat restoration will only be allowed to work when weather and sea state conditions will not interfere with safe transportation and will be managed to avoid spills, leaks and loss of dredged material in transit to the G-DODS. Dredged material will not be leaked or spilled from disposal vessels during transit to the GDODS. Dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit. No more than one disposal vessel will be present within the permissible dumping target area at any time. Each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Based on implementation of BMPs including proper maintenance of all vessels and equipment, implementation of the SWPPP, and the containment of all construction materials and wastes, we are reasonably certain the risk of exposure of species listed in Table 1 to waste discharges is extremely unlikely, and therefore discountable.

Entanglement

Listed species in the action area may encounter anchor lines, turbidity curtains, cords, and ropes attached to tools, which could entangle them if contacted. Entanglement is potentially deadly or debilitating for marine species. BMPs will be implemented to minimize the potential for entanglement. Project debris and trash will be controlled so that it does not enter waters. Equipment will be managed so lines, chains, silt curtains, and flexible elements will be deployed only as long as necessary and monitored while in the water. The barge could be a site of potential entanglement risk, as it will be anchored in the water near the sensor array location. However, the barge anchor lines and all in-water equipment will be inspected and managed regularly and kept taut when deployed. All anchor lines, mooring lines, and lines attached to objects will be kept to the minimum length required and if tied, be pulled tight to minimize surface area and

probability of entanglement. Mooring lines will consist of a single line with no additional lines or material capable of entangling marine life attached to the mooring line or to any other part of the deployed system. All anchor lines, cords and tool lines will be temporary and would remain in the water only for the length of time necessary to complete construction. The applicant will monitor the work area for listed species and will halt activities when they are observed within 50 meters of work areas. Based on the proposed BMPs, and because marine species listed in Table 1 are likely to avoid the work areas, we are reasonably certain the risk of exposure to entanglement is extremely unlikely, and therefore insignificant.

Direct impacts from coral translocation

The habitat improvement actions at Mound 9 will include placement of limestone boulders, substrate stabilization, coral translocations and monitoring. We discussed the effects from noise and vessel strikes above. The Navy will use experienced coral biologists for this work. Divers will avoid interaction with species listed in Table 1 and those marine species will also naturally avoid divers. We are reasonably certain direct impacts on species listed in Table 1 from the coral translocations, habitat restoration, and monitoring will not rise to the level of harm or harassment, and therefore are insignificant.

No ESA-listed corals were observed during surveys of the translocation-associated areas and listed corals are not proposed for translocation. Based on the surveys conducted and the absence of listed corals, we are reasonably certain impacts from the coral translocations, habitat restoration and monitoring to *Acropora globiceps* are extremely unlikely, and therefore discountable.

Critical Habitat

The action area includes critical habitat for MHI insular false killer whales relative to vessel transit routes to Guam from Hawaii if additional vessels are needed for the project. BMPs will be implemented to avoid and minimize vessel/whale interactions including the use of whale lookouts on each vessel and avoidance of marine species. In the species analysis above, we were reasonably certain probabilities of waste discharges and vessel strikes on ESA-listed marine mammals are discountable and the effects from vessel noise are insignificant. Those conclusions also apply to MHI insular false killer whale critical habitat.

Conclusion

Considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available about the biology and expected behaviors of the ESA-listed marine species considered in this consultation; NMFS concurs with your determination that the proposed action is not likely to adversely affect the ESA-listed species in Table 1.

Similarly, considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available, all effects of the proposed action to essential features of critical habitat are discountable or insignificant. As a result, we concur with your determination that the proposed action is not likely to adversely affect MHI insular false killer whale.

This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs Federal agencies to consult with NMFS on all actions or proposed actions that

may adversely affect essential fish habitat (EFH). If necessary, it is your responsibility to request EFH consultation for this action with NMFS' Habitat Conservation Division.

Reinitiation Notice

ESA Consultation must be reinitiated if: 1) Take occurs to an endangered species, or to a threatened species for which NMFS has issued regulations prohibiting take under section 4(d) of the ESA; 2) new information reveals effects of the action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the identified action is subsequently modified in a manner causing effects to ESA-listed species or designated critical habitat not previously considered; or 4) a new species is listed or critical habitat designated that may be affected by the action.

If you have further questions, please contact Alice Berg at alice.berg@noaa.gov. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

GARRETT.ANN.M.1365883323 Digitally signed by GARRETT.ANN.M.1365883323 Date: 2021.10.06 10:52:43 -10'00'

Ann M. Garrett
Assistant Regional Administrator
Protected Resources Division

Cc: Kevin Lino
kevin.lino@navy.mil
NMFS File No.: PIRO-2021-02037
PIRO Reference No.: I-PI-21-1966-AG

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Appendix D
Noise Methodology and Calculations

Construction Period

Estimated impacts of the Proposed Action used Federal Transit Administration's Transit Noise and Vibration Impact Assessment guidance (Quagliata et al., 2018) to estimate noise levels from construction equipment to nearest noise sensitive receptors.

Formula for individual noise sources: $L_{eq.equip} = L_{emission} + 10log(Adj_{Usage}) - 20log(D/50) - 10Glog(D/50)$

Formula for summing noise exposure at a specified period of time from simultaneously operated equipment: $Lp = 10log_{10}(10^{L1/10} + 10^{L2/10})$

USEPA's typical sound level reduction of buildings in warm climates with closed windows (i.e., 24 dB), was used to estimate attenuation of building structures in calculating interior noise levels of nearest noise sensitive receptors.

Because both the Preferred Alternative and Concrete Block Mat Alternative would utilize the same equipment, the maximum sound levels estimated below would be similar. However, the Concrete Block Mat Alternative would require longer use of a barge-mounted crane to install the mats along the entire subsea cable route and increased noise levels associated with this alternative would be of a longer duration than the Preferred Alternative.

In-Water Construction Noise

			Qty	Unit	Notes/Source
Formula: $L_{eq.equip} = L_{emission} + 10log(Adj_{Usage}) - 20log(D/50) - 10Glog(D/50)$					Option A: General Assessment (Quagliata et al., 2018)
$L_{eq.equip}$ =	$L_{eq(t)}$ at a receiver from the operation of a single piece of equipment over a specified time period, dBA				
$L_{emission}$	is the noise emission level of the particular piece of equipment at the reference distance of 50 ft				from Table 7-1 of Quagliata et al., 2018
G	is a constant that accounts for topography and ground effects				from Eq. 7-1 of Quagliata et al., 2018
D	is the distance from the receiver to the piece of equipment		5900	ft	
Adj_{Usage}	is a usage factor that accounts for the fraction of time that the equipment is in use over the specified time period	=	1		

Crane	To Lockwood Terrace Housing & McCool School		Qty	Unit	Notes/Source
	Crane $L_{emission}$	=	88	dB	Derrick Crane from Table 7-1 in Quagliata et al., 2018
	$10log(Adj_{Usage})$	=	0		
	D	=	5900	ft	to Off-Base Residential
	G	=	0		
	D/50	=	118		
	log(D/50)	=	2.1		
	20log(D/50)	=	41.4		
	10Glog(D/50)	=	0.0		
	$L_{eq.equip}$	=	**46.6**	dB	
Tugboat	**To Lockwood Terrace Housing & McCool School**				
	Tugboat $L_{emission}$	=	87	dB	from Table 4-1 of Epsilon Associates, 2006
	$10log(Adj_{Usage})$	=	0		
	D	=	5900	ft	to Off-Base Residential
	G	=	0		
	D/50	=	118		
	log(D/50)	=	2.1		
	20log(D/50)	=	41.4		
	10G log(D/50)	=	0.0		
	$L_{eq.equip}$	=	**45.6**	dB	
Decibel Addition formula: $L_p = 10log_{10}(10^{L1/10} + 10^{L2/10})$					Appendix B.1.1 of Quagliata et al., 2018
L_p =	sound pressure level, dB				
L1 =	Crane $L_{eq.equip}$	=	46.6		
L2 =	Tugboat $L_{eq.equip}$	=	45.6		
	$10^{L1/10}$	=	45,314		
	$10^{L2/10}$	=	35,994		
	$10^{L1/10} + 10^{L2/10}$	=	81,309		
	$L_p = 10log_{10}(10^{L1/10} + 10^{L2/10})$	=	**49.1**	dB	
			-24.0	dB	attenuation of building structure
			25.1	dB	

Land-Based Construction Noise

			Qty	Unit	Notes/Source
Formula: $L_{eq.equip} = L_{emission} + 10\log(Adj_{Usage}) - 20\log(D/50) - 10Glog(D/50)$					Option A: General Assessment (Quagliata et al., 2018)
$L_{eq.equip}$ =	$L_{eq(t)}$ at a receiver from the operation of a single piece of equipment over a specified time period, dBA				
$L_{emission}$	is the noise emission level of the particular piece of equipment at the reference distance of 50 ft				from Table 7-1 Quagliata et al., 2018
G	is a constant that accounts for topography and ground effects				from Eq. 7-1 of Quagliata et al., 2018
D	is the distance from the receiver to the piece of equipment		6500	ft	
Adj_{Usage}	is a usage factor that accounts for the fraction of time that the equipment is in use over the specified time period	=	1		

Backhoe	**To Off-Base Residential**		**Qty**	**Unit**	**Notes/Source**
	Backhoe $L_{emission}$	=	80	dB	from Table 7-1 in source Quagliata et al., 2018; proxy for excavator
	$10\log(Adj_{Usage})$	=	0		
	D	=	6500	ft	to Off-Base Residential
	G	=	0		
	D/50	=	130		
	log(D/50)	=	2.1		
	20log(D/50)	=	42.3		
	10Glog(D/50)	=	0.0		
	$L_{eq.equip}$	=	**37.7**	dB	

Loader	**To Off-Base Residential**				
	Loader $L_{emission}$	=	80	dB	from Table 7-1 in source Quagliata et al., 2018; proxy for skid steer
	$10\log(Adj_{Usage})$	=	0		
	D	=	6500	ft	to Off-Base Residential
	G	=	0		
	D/50	=	130		
	log(D/50)	=	2.1		
	20log(D/50)	=	42.3		
	10G log(D/50)	=	0.0		
	$L_{eq.equip}$	=	**37.7**	dB	

Decibel Addition formula: $L_p = 10\log_{10}(10^{L1/10} + 10^{L2/10})$ Appendix B.1.1 of Quagliata et al., 2018

L_P =	sound pressure level, dB				
L1 =	Backhoe $L_{eq.equip}$	=	37.7		
L2 =	Loader $L_{eq.equip}$	=	37.7		
	$10^{L1/10}$	=	5,917		
	$10^{L2/10}$	=	5,917		
		=			
	$10^{L1/10} + 10^{L2/10}$		11,834		
	$L_p = 10\log_{10}(10^{L1/10} + 10^{L2/10})$	=	**40.7**	dB	
			-24.0	dB	attenuation of building structure
			16.7	dB	

Appendix E
CZMA Documentation

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0714
October 12, 2021

Mr. Tyrone J. Taitano
Director
Guam Coastal Management Program
P.O. Box 2950
Hagatna, Guam 96932

Subject: NOTIFICATION OF CONSISTENCY DETERMINATION FOR THE UNDERWATER ELECTROMAGNETIC MEASUREMENT SYSTEM AT NAVAL BASE GUAM, APRA HARBOR

Dear Mr. Taitano,

U.S. Naval Base Guam (NBG) is proposing to install and operate an underwater electromagnetic measurement system (UEMMS) to service Navy surface ships and submarines homeported, forward deployed, or visiting NBG, Apra Harbor, Guam. The Proposed Action would include both in-water and shoreside infrastructure to measure vessels' electromagnetic signatures and transmit data to terrestrial facilities. The Navy has determined that the proposed activity will be consistent to the maximum extent practicable with mitigating any unintended effects on the Guam Coastal Zone, per 15 CFR 930 Section 930.36(a).

The purpose of the Proposed Action is to provide the capability to measure the electromagnetic signatures of Navy ships and submarines to meet the magnetic silencing limits specified by the U.S. Navy Chief of Naval Operations. The Proposed Action is needed to support minimizing the electromagnetic signature (i.e. on board system calibrations) which ensures that ships and submarines comply with electromagnetic signature limits. A description of the proposed activity is provided in Enclosure 1.

The Navy conducted consultation with National Marine Fisheries Service (NMFS) on the effects of the Proposed Action on (1) species protected under the Endangered Species Act (ESA) and (2) essential fish habitat (EFH) (Enclosure 2). NMFS concurred with the Navy's determination that the Proposed Action is not likely to adversely affect ESA-listed species with effects being either insignificant or discountable. NMFS also agreed with the Navy's conclusion that the Proposed Action would adversely affect EFH and result in unavoidable loss. In addition, NMFS agreed that the Navy's proposed mitigation, which includes avoidance and minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH.

The Navy also conducted consultation under Section 106 of the National Historic Preservation Act in June 2019. The Navy determined that the Proposed Action would result in "no historic properties affected," and the Guam Historic Preservation Officer concurred with this determination (Enclosure 3).

Subject: NOTIFICATION OF CONSISTENCY DETERMINATION FOR THE UNDERWATER ELECTROMAGNETIC MEASUREMENT SYSTEM AT NAVAL BASE GUAM, APRA HARBOR

The Navy has completed an effects test per 15 CFR Part 930 Section 930.33(a)(1). Although the proposed federal activity is located entirely within federal property that by definition is excluded from Guam's coastal zone per 15 CFR 923, Section 923.33(a), there is a potential for spillover effects to mobile in-water resources (e.g. fisheries, marine mammals and sea turtles, etc.) that can cross-over and extend into Guam's coastal zone per 15 CFR 923, Section 923.33(b). Therefore, the Navy concluded the project has foreseeable coastal effects to Guam's defined coastal zone. The Navy assessed reasonably foreseeable direct and indirect effects on Guam's coastal use or resources, reviewed relevant enforceable policies of the GCMP, and has determined that the proposed activity would be consistent to the maximum extent practicable with the enforceable policies of the Guam Coastal Management Program (GCMP). The Navy's evaluation of the GCMP's relevant enforceable policies is provided in Enclosure 4.

The Navy is preparing a Draft Environmental Assessment (EA), which will be available for public review when completed. Notices of the availability of the Draft EA will be published in the Pacific Daily News. The Draft EA will also be available for download from a Navy website to be provided to your office at a later date.

We respectfully request a response from Bureau of Statistics and Plans within 30 days or less from receipt of this package. However, if no response is received from your office within 60 days, the Navy shall presume concurrence with the consistency determination per 15 CFR Section 930.41(a).

Should you have any questions or require additional information about this proposed project, please contact Mr. Jeffrey Lambrecht, Environmental Planner, Naval Base Guam at (671) 339-2567 or email: jeffrey.lambrecht@fe.navy.mil.

Sincerely,

E.E. Moon
Installation Environmental Program
Director
By Direction of the Commanding Officer

Enclosures: 1. UEMMS Project Description
2. ESA and EFH consultations
3. NHPA Section 106 consultation
4. GCMP Assessment and Federal Consistency Supplemental Information

Underwater Electromagnetic Measurement System

Naval Base Guam, Apra Harbor, Guam

Project Description

The United States (U.S.) Navy proposes to install and operate an underwater electromagnetic measurement system (UEMMS) to service Navy surface ships and submarines homeported at, forward deployed to, or visiting Naval Base Guam (NBG), Apra Harbor, Guam. The Proposed Action would include both in-water and shoreside infrastructure to measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a steel-hulled vessel's susceptibility to certain threat systems. Project implementation is anticipated to begin in 2021, with construction in 2022 and operation starting in 2023. See Figure 1 for location map.

Background

Electromagnetic fields associated with Navy ships and submarines may be detected by enemy threat systems if their magnetic signatures are not controlled and managed within specified limits. The magnetic signature of a submarine or surface ship is measured on a sensor range, and if the signature is out-of-specification, it must be treated to neutralize or remove the excess magnetism. Naval Base Guam is homeport to numerous Navy commands supporting the U.S. Pacific Fleet in the 7th Fleet's area of responsibility, including Los Angeles-class attack submarines under the command of Commander, Submarine Squadron Fifteen. Due to the lack of a UEMMS at their homeport, these vessels must transit to U.S. naval installations in Japan or more distant locations to have their magnetic and electric (or electromagnetic) field signatures measured. The proposed UEMMS would provide the capability at NBG to measure the electromagnetic signatures of Navy homeported, forward-deployed, or transient ships and submarines to meet the specified magnetic silencing limits.

Project Description

Overview. The project consists of three general components: (1) subsea sensor array, (2) subsea transmission cables, and (3) terrestrial data acquisition equipment. Electromagnetic triaxial (EMT) sensors, magnetometer triaxial (MT) sensors, and a conductivity, temperature, depth (CTD) sensor would be installed in an array on the seafloor of Outer Apra Harbor, within the existing navigational channel northwest of Polaris Point (see Figure 2 for Vicinity Map). The EMT and MT sensors would measure the magnetic and electric field signatures of vessels passing overhead. The CTD sensor would provide real-time measurements of water metrics.

Data collected by the sensor array would be transferred to shore via subsea transmission cables routed from the array to a new below-grade transition vault located onshore at Polaris Point. Once on shore, the cables would connect to data acquisition equipment located in an existing Polaris Point building and the data transferred to a fiber optic cable. The fiber optic cable would follow a terrestrial route entirely in existing below grade conduits from the cable transition point to another existing building further inland on Polaris Point, where the system would terminate and data from the sensor array would be collected, processed, and archived. An approximately one-acre area around the cable transition point building would be made available as a staging area during the construction period (see Figure 2).

The sensor array is designed to passively acquire data and would not emit electromagnetic radiation during its operation and would require minimal maintenance after construction. Repairs are anticipated to be minimal and would be conducted on an as-needed basis. Operation of the sensor array would not increase ship traffic from either homeported or transient vessels at NBG or effect on-base or on-island staffing levels.

Sensor Array. The sensor array comprises 13 EMT sensors, 8 MT sensors, and 1 CTD sensor, which would be aligned in a single row and secured to or suspended within sensor tubes embedded in the seafloor (see Figure 3). The 13 EMT sensors would be flanked on each side by 4 MT sensors (8 total). The CTD sensor would be installed in line with the sensor array, offset to the east of the easternmost sensor. The sensors would be spaced approximately 20 feet apart, for a total array width of about 420 feet (including CTD sensor).

Approximately 1,200 cubic yards (CY) of material are estimated to be excavated over an area of about 7,900 square feet (sq ft) in a portion of the sensor array site using a closed bucket excavator operating from a barge. The excavation is needed to achieve the optimal distance between the EMT sensors and the vessels that would be measured, while maintaining the current navigational depth of the Inner Apra Harbor entrance channel. The area that would require excavation is shown in Figure 3. The area would be backfilled to match existing depth using non-magnetic material.

All 22 sensors would have an associated sensor cable guide stake installed perpendicularly 10 feet to the southeast of the sensor positions (within the sensor array footprint) to designate the paths of the sensor cables (see Figure 3 for guide stake locations). Within the backfilled sensor array area, the guide stakes would be completely buried. Approximately 2 feet of the CTD and 6 inches for the MT sensor tubes would remain above the existing seafloor, at approximately -49 to -53 feet mean lower low water (MLLW).

Divers would install the sensor tubes and guide stakes using a handheld water jetting system, a process that uses a high-pressure water stream to create a void into which the sensor tube is pushed by a large steel pipe. If water jetting cannot successfully embed the sensor tubes due to seafloor characteristics, approximately 12-inch diameter pilot holes would be drilled into the seafloor and marine grout would be applied to secure the tubes. The sensor tube would then be installed within the cored hole and grouted in position with non-shrink grout using a tremie pour method in which a small amount of grout is placed at the bottom of the hole and a grout hose placed in the grout. The poured grout from the hose would displace water as grout fills the hole. The sensors would then be installed in the tubes, along with their individual cables.

The installation contractor would select the barge mooring or anchor type and locations for the mooring system to ensure that the affected seabed would be void of protected resources and sensitive habitats. Anchors for vessels and silt curtains would be set on hard or soft-sand bottom void of corals and seagrass and anchor locations would take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. The "stop and slow" method would be used during dredging to limit suspension of sediments in the water column and silt curtains would be installed immediately adjacent to the dredge barge.

The excavated material would be stored on scows for later disposal either at the Guam Deep Ocean Disposal Site (G-DODS) or an approved upland confined disposal facility (CDF) at NBG (see Figure 1 for potential CDF locations). The G-DODS is a USEPA-authorized ocean disposal site located approximately 11 nautical miles northwest of Apra Harbor. For ocean disposal, once each scow is filled, it would be towed during the day to the G-DODS. If the excavated material is disposed of in an upland facility, it would be transferred to the receiving CDF for dewatering and later become available for beneficial reuse applications (e.g., fill or landfill capping).

Subsea Cables. Each sensor would have an associated subsea cable, which would extend from the sensor to a common path parallel to and on the southeast side of the array. The cables would then be bundled together and extend approximately 3,150 feet to the top of the shore protection riprap at Polaris Point. The cable bundle would be held together by two-inch polypropylene webbing at each sensor, guide stake, and as necessary throughout the cable path. The subsea cable bundle would be secured to the seafloor at about 100-foot intervals by concrete anchor discs and polypropylene webbing (see Figure 4 for detail of concrete anchor discs). The concrete anchor discs would be approximately four feet in diameter and two feet high, with a hooked bar on the side that would be used to secure the cable bundles with polypropylene webbing. The subsea cable bundle would be hand-laid by divers along a pre-established path to avoid areas with coral cover. The concrete anchor discs would then be lowered into place using a crane and barge, with contractor divers securing the cable bundle to the seafloor at the anchoring points. Up to five additional PVC guide stakes would be installed at either end of the cable route (three stakes at the sensor array end and two stakes at the Polaris Point end) to secure the cable bundles at these steeply sloped areas.

At a depth of -35 feet MLLW as it approaches the Polaris Point shoreline, the cable bundle would transition into an approximately 125-foot-long high density polyethylene (HDPE) duct to protect the cables from damage in the high wave energy environment along the shoreline. A stainless steel anchor band would span the top half of the HDPE duct and be secured to the seafloor by approximately five pairs of earth anchors, which have an expandable splay (or similar) that rotates and locks into position after being driven about eight feet into the substrate (see Figure 4 for detail). The exposed footprint of each anchor would have a diameter of approximately one inch. They would be installed from a barge using a pneumatically-driven jackhammer.

Cable Shore Landing. At its shoreward end, approximately 80 linear feet of the HDPE duct would be installed below ground in an excavated trench from the -15 foot MLLW depth to a new below-grade, cast-in-place concrete transition vault (see Figure 5 for shore landing detail). At the transition vault, the individual sensor cable conduits would exit the HDPE duct and be routed into the Polaris Point building that would serve as the cable transition point through four (4), 6-inch conduits. A land-based closed bucket excavator would excavate an approximately 55-foot wide by 50-foot long by 10-foot deep oblique trench from the below grade transition vault location to a water depth of -15 feet MLLW (see Figure 5 for profile). An estimated 225 CY of subbase material would be excavated and later used as backfill after being stored on shore in a lined dewatering facility. Prior to trench excavation, approximately 60 CY of existing shoreline revetment material—consisting of large, previously placed limestone blocks—would be removed by the shore-based excavator and stored under water adjacent to the project area in substrate devoid of protected resources. The original revetment material would be

re-used as backfill material to restore the revetment to its original configuration to the maximum extent practicable.

Terrestrial Infrastructure. The individual cables would be routed from the vault into an existing building at Polaris Point via four 6-inch conduits and provide a transition point from the individual cables to a fiber optic cable. Proposed modifications to the transition point building include installation of a service platform and data acquisition equipment, electrical upgrades, and closed-circuit television cameras. From there, the fiber optic cable would be routed to its termination point in a different existing Polaris Point building entirely via existing below-grade conduits where computers would collect and analyze the transmitted data. A two-inch diameter, approximately eight-foot-long duct would be installed approximately two feet below grade between the cable transition point building and an adjacent building to supply power to the UEMMS equipment in the cable transition point building. Installation methodology for the below-grade duct would be determined by the construction contractor, but typically involves a small trench excavated using equipment similar to a backhoe.

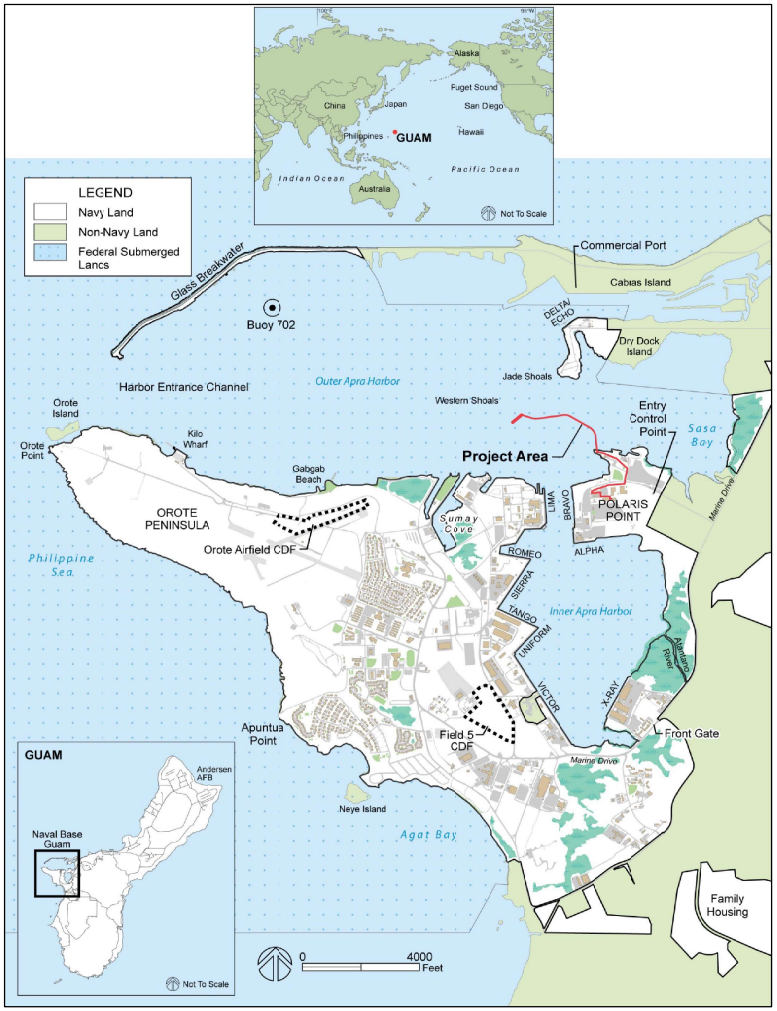

Figure 1: Location Map

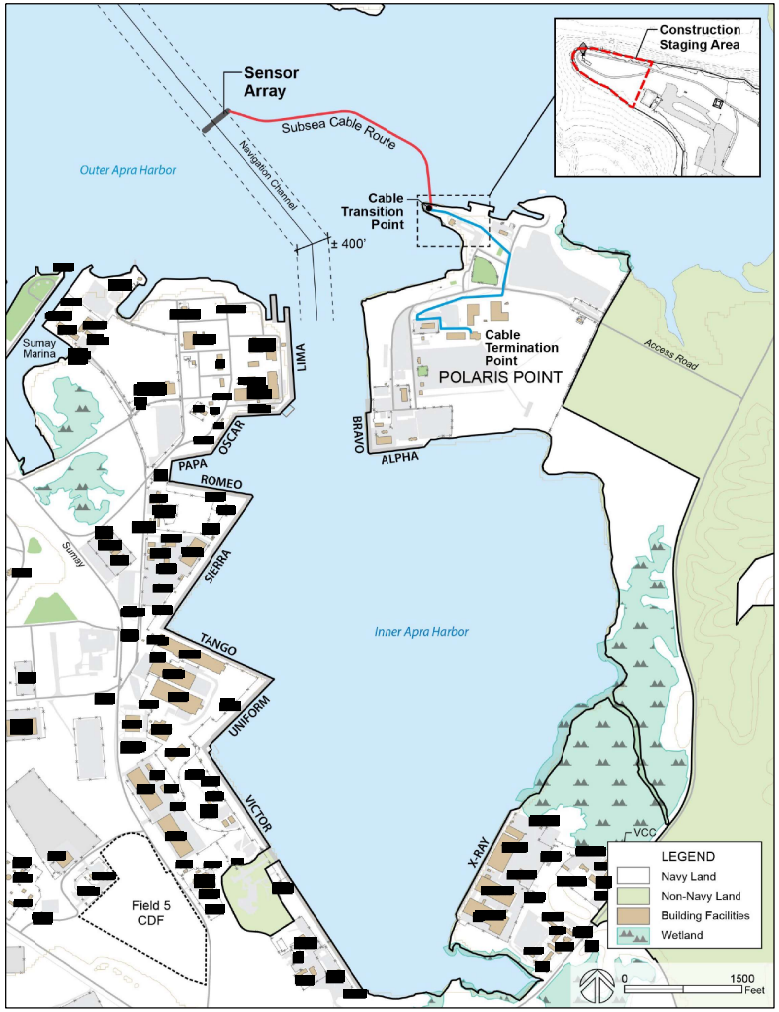

Figure 2: Vicinity Map

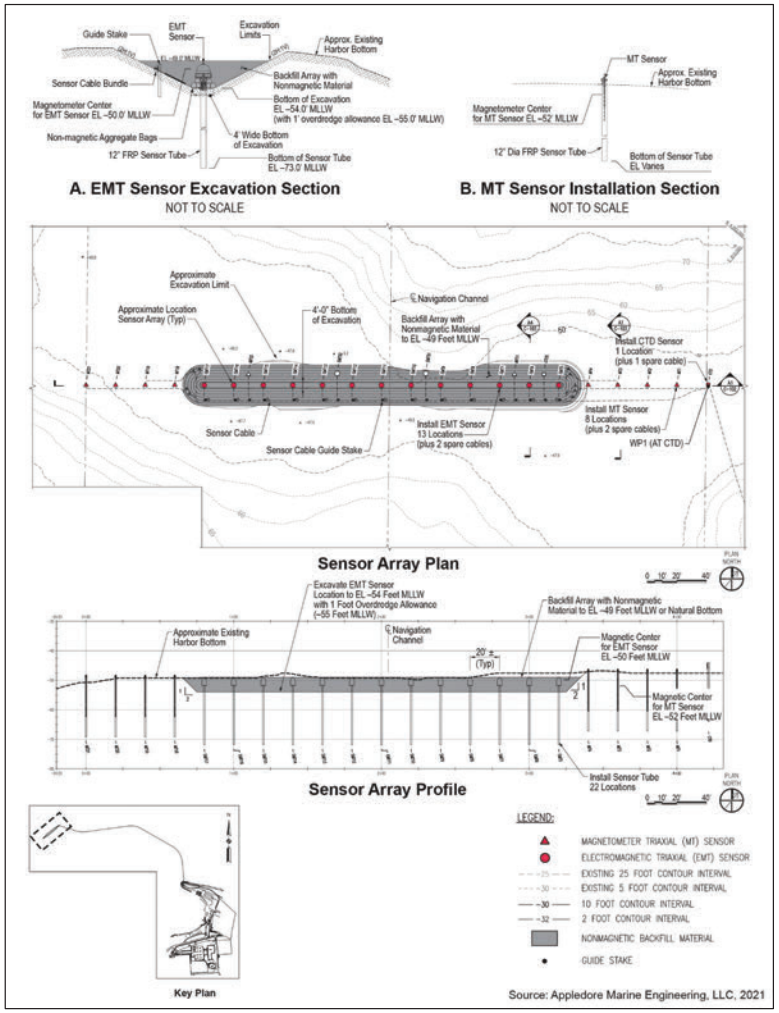

Figure 3: Sensor Array Plan and Profile

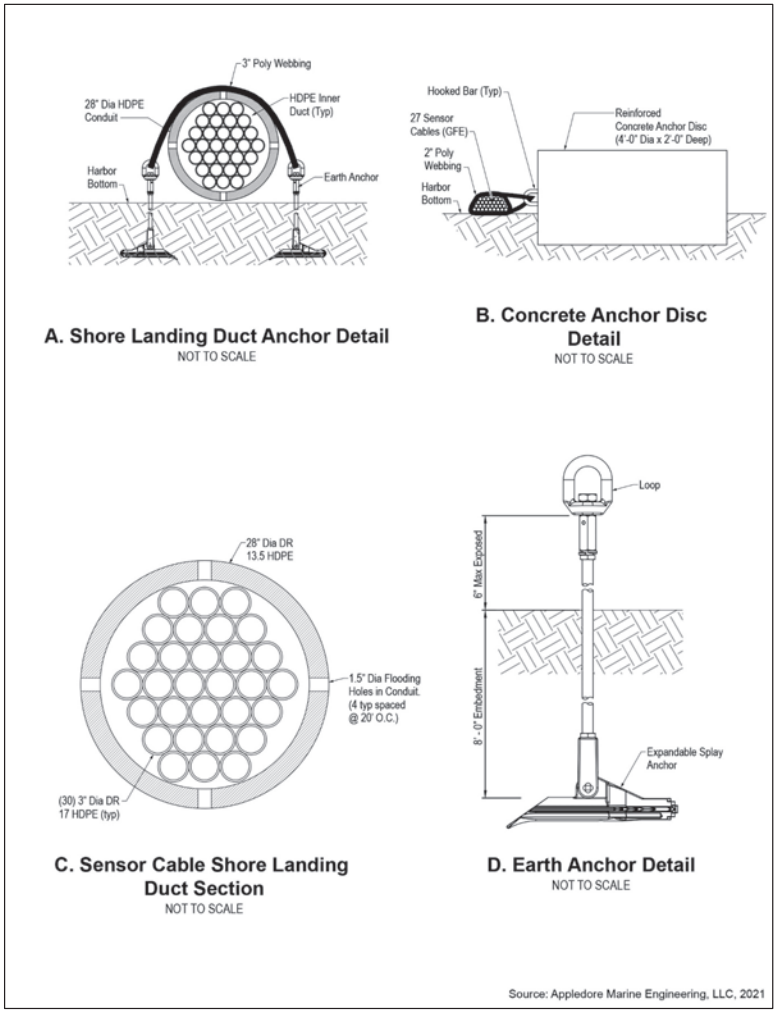

Figure 4: Subsea Cable Duct and Anchor Detail

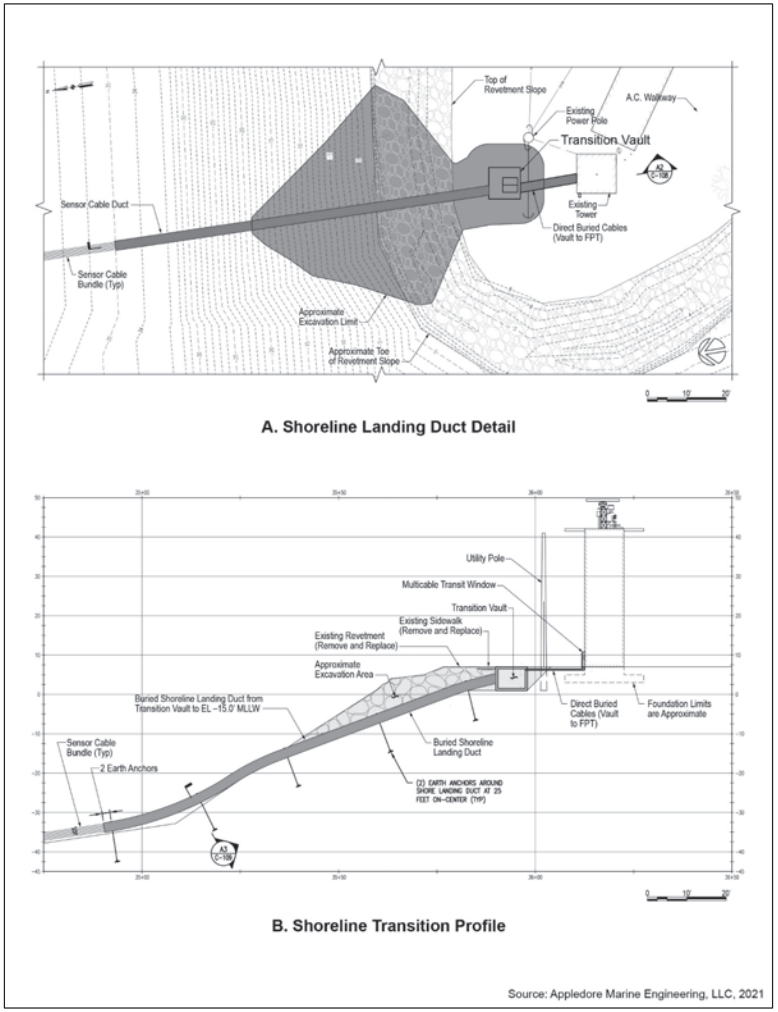

Figure 5: Cable Shore Landing

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/ 0422
June 15, 2021

Mr. Michael Tosatto
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Bldg. 176
Honolulu, HI 96818

Dear Mr. Tosatto,

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Pursuant to section 7(a)(2) of the *Endangered Species Act of 1973* (ESA), as amended (16 USC§ 153 et seq.), the U.S. Navy (Navy) requests informal consultation with the National Marine Fisheries Service regarding the proposed construction of an Underwater Electromagnetic Measuring System (UEMMS) at Outer Apra Harbor, Guam. As described in the enclosed consultation document, the proposed action may affect but is not likely to adversely affect the following ESA-listed species: the threatened green sea turtle (*Chelonia mydas*), the endangered hawksbill sea turtle (*Eretmochelys imbricata*) and the threatened scalloped hammerhead shark (*Sphyrna lewini*). We request your concurrence with our 'not likely to adversely affect' determinations, and hereby request informal consultation under Section 7 of the ESA.

This letter also requests your review and conservation recommendations to fulfill the Navy's requirements to consider the impacts of its actions on Essential Fish Habitat (EFH) as required by the *Magnuson-Stevens Fishery Conservation and Management Act* (16 USC§ 1801 et seq.).

In brief, the Navy proposes to construct and operate a UEMMS to service Navy surface ships and submarines homeported, forward-deployed or visiting Naval Base Guam. The Proposed Action includes both in-water and shore-side infrastructure to passively measure vessels' electromagnetic signatures and transmit data to facilities on land. The data received from the measurements provide a means to determine a vessel's susceptibility to certain seaborne-influenced mines. The action will permanently alter seafloor habitat in the Outer Apra Harbor navigation channel through the installation of a passive 22-sensor array with associated power and data cables connecting ashore at Polaris Point. The Project is anticipated to begin operations in 2022 for Navy ships and submarines deployed to the region, and the installation will not operationally increase vessel traffic within the harbor. The in-water actions will be undertaken in daylight hours only and will require approximately 10 months to complete.

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Regarding ESA-listed species:
Potential impacts to ESA-listed species may occur from exposure to the following stressors: disturbance from human activity and equipment operation; elevated underwater noise levels; increased suspended sediments; direct physical contact; vessel collisions; waste and discharge; and entanglement. Based on the best available data, environmental impact analysis, and the implementation of best management practices (BMPs) described in enclosure, the Navy determined that these potential impacts are discountable or insignificant to ESA-listed species. The Navy requests your concurrence with our determination that the proposed Action may affect but is not likely to adversely affect the ESA-listed species above.

Regarding EFH:
The Navy has determined that the proposed Action will adversely affect the quality and quantity of EFH at the sensor array site and cable path, but most of the effects will be managed and minimized with the incorporation of BMPs. Potential adverse effects that are likely to occur to EFH are based on exposure to the following stressors: physical removal; increased suspended sediments; elevated underwater noise levels; waste and discharge; aquatic invasive species; chemical contaminants; and hypoxia. Removal of the marine invertebrate community in the Action Area will be permanent, and the Navy is proposing avoidance, minimization, and offset mitigation measures to compensate for the unavoidable loss of ecosystem functions and services. The remaining effects will primarily be temporary, restricted to the Action Area, and rendered minimal by the implementation of BMPs.

Thank you for your consideration of our request for your review and concurrence. Should you have any questions or concerns, please contact is Kevin Lino at NAVFAC Pacific at (808) 472-1087 or kevin.lino@navy.mil.

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By direction of the Commanding Officer

Enclosure: 1. Endangered Species and Essential Fish Habitat Assessment: Consultation for the Underwater Electromagnetic Measuring System Apra Harbor, U.S. Naval Base Guam

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

Edward Moon
Installation Environmental Program Director
Naval Base Guam
PSC 455 Box 195
FPO AP 96540-2937

July 21, 2021

Dear Mr. Moon:

The National Marine Fisheries Service, Pacific Islands Regional Office (NMFS), received the Naval Facilities Engineering Command Pacific's (the Navy) essential fish habitat (EFH) consultation initiation request for the installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam. We have reviewed the EFH Assessment (EFHA) titled "Final Endangered Species and Essential Fish Habitat Assessment: Consultation for the Underwater Electromagnetic Measuring System (UEMMS)" and agree that there will be unavoidable and substantial adverse effects to sensitive and hard-to-replace EFH due to the proposed action including a conservative unavoidable loss estimate of 3,273.7 square meters (m^2) of benthic EFH and 3,270 coral colonies. We also agree that the mitigation plan put forward by the Navy, which includes avoidance through a range of best management practices (BMPs), minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. We have provided three EFH conservation recommendations pursuant to the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; Section 305(b)(2)) as described by 50 C.F.R 600.920. Your implementation of the proposed conservation recommendations and all of the proposed BMPs will ensure that expected and potential adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated.

Project Description
The Navy proposes to construct and operate an UEMMS in Outer Apra Harbor, Guam. The UEMMS will passively measure magnetic and electric field signatures of surface ships and submarines,

hereafter vessels, to ensure vessels meet magnetic signature limits specified in the Office of the Chief of Naval Operations Instruction S8950.2H. The proposed action includes both in-water and shore-side infrastructures to passively measure electromagnetic signatures of vessels and transmit data to facilities on land. The sensor array will be installed on the seafloor of Outer Apra Harbor 915 meters (m) northwest of Polaris Point in 17 m of seawater.

Installation of the senor array will require excavation, backfilling and disposal of material from the array site, water jetting or drilling of holes at the array site, deployment and anchoring of subsea cables, and excavation and backfilling at the egress location at Polaris Point. Extensive proposed mitigation, including coral translocation, is planned, detailed in the minimization and offset sections below. In-water construction activities are expected to take approximately 10 months to complete.

Sensor Array Excavation, Installation, and Backfill

Once coral translocation has occurred (detailed in the minimization section below), an estimated 918 cubic meters (m^3) of material will need to be excavated from the array site before sensor installation can occur. The material will be excavated with a closed-bucket excavator to minimize inadvertent discharges into the water column. Excavated materials will be deposited at the Guam Deep Ocean Disposal Site (G-DODS) 20.6 kilometers (km) offshore of Guam in 2,680 m of seawater. The G-DODS was designated as an exclusive ocean dredged material disposal site in 2010 (Final Rule 40 CFR Part 228; 21 FR Notice 54497).

Once excavation and disposal is completed, the Navy will begin installing the UEMMS sensor array. The sensor array proposed for deployment will consist of a line of 22 sensors (13 Electromagnetic triaxial (EMT) sensors and eight magnetometer triaxial (MT) sensors extending 128 m and spaced six m apart, as well as one conductivity, temperature and depth (CTD) sensor). The CTD sensor will be installed at the northeast end of the array. Each sensor will be mounted to a 30.5-centimeter (cm) diameter fiberglass reinforced plastic sensor tube that will be embedded six m deep into the seafloor at each location. A 15 cm diameter fiberglass reinforced plastic cable guide stake will also be embedded 1.2 m deep into the seafloor three m to the southeast of each sensor tube. Sensor tube and guide stake installations will be performed by divers using a water jetting process known as a handheld hydraulic breaker. A large steel pipe will be used to push the tubes to the appropriate depth as the high-pressure water loosens the bottom material. If water jetting is not feasible due to seafloor characteristics, 30-cm diameter pilot holes will be drilled into the seafloor and marine grout will be used to secure the tubes at the same locations. Additionally, 30 m of sensor cable will be installed between each sensor and guide stake, and secured with eyebolts, poly webbing, and zip ties. After installation, the excavated area, including the coiled cables, will be covered with 826 m^3 of non-magnetic, certified contaminant free backfill material in order to restore the excavated area to the original water depth.

Subsea Cable Installation and Anchoring

To transmit data of electromagnetic signatures collected by the UMMES to facilities on land, 27 subsea cables, 5 additional guide stakes, and 29 concrete anchor discs will need to be installed along the 975 m cable route. The subsea cables are made up of shielded and sheathed copper wires with a diameter of 2.64 cm. One cable will extend from each of the 22 sensors to a common path marked by guide stakes along the southeast side of the array. Five additional cables will also be routed to the array for future use. Three additional guide stakes will be installed adjacent to the array site and two additional guide stakes will be installed at Polaris Point to secure each end of the subsea cable. The cables will be bundled using polypropylene webbing at each sensor and at each guide stake. Divers will lay the cable along the cable route and select a location every 30 m along the pathway for deployment of a 1.2 m diameter concrete anchor disc that will secure the cable to the seafloor. The concrete anchor discs will be deployed by a crane and barge with the assistance of divers to ensure areas with coral cover are avoided.

Subsea Cable Egress and Trenching

To protect the cables from wave and storm damage at Polaris Point, high-density polyethylene (HDPE) conduits will be deployed . The HPDE conduits will be bundled together into a single 71-cm diameter, 38-m long cable duct, anchored 10.5 m below mean low low water (MLLW). The bottom of the duct will be secured in place using a stainless steel anchor band span and earth anchors. The earth anchors will be installed to a depth of 2.4 m by a vessel using a topside pneumatically-driven jackhammer. At 4.5 m below MLLW, the remaining 24 m of duct will transition underground until it reaches a concrete transition vault.

An oblique trench 17 m wide, 15 m long, and 3 m deep will be excavated by a closed-bucket excavator to create the necessary slope for burial of the conduit at the surface. Prior to excavation, 95.6 m^3 of existing shoreline revetment material will be relocated by an excavator to a similar depth adjacent to the site. The Navy estimates that 172 m^3 of subbase materials will be excavated and placed on land. After the conduit has been secured, the subbase material and revetment material will be reused as backfill to bury and protect the cable conduit duct.

Consultation History

Substantial pre-consultation occurred between NMFS and the Navy that began in February 2014. In September 2015, NMFS led a preliminary survey effort to document the resources within the proposed action area in Apra Harbor, Guam. In November 2015, the Navy presented the first set of quantitative survey findings and a report to NMFS documenting the resources in the action area. No additional coordination occurred between 2016 and 2018. In February 2019, pre-consultation continued between NMFS and the Navy. In November 2019, the Navy hosted an interagency meeting with NMFS and the US Army Corps of Engineers (USACE) to discuss concerns and proposed a mitigation strategy be conducted, similar to the approach that had recently been implemented for a project at Lima, Mike, and November wharves in Apra Harbor, Guam. The Navy and NMFS agreed to perform a similar Habitat Equivalency Analysis (HEA) model to quantify the interim loss of ecosystem services and function associated with the adverse effects of this proposed

action, and developed a quantifiable mitigation strategy focusing on EFH area replacement. The Navy worked with NMFS to generate parameters (e.g., expected injury, service levels, discount rate, and years to recover) for inclusion in the HEA model. In January 2020, NMFS and the Navy had a call to discuss final survey methods and the plan to use photogrammetric orthomosaic surveys to document benthic organisms and stationary point counts to document the fish communities at each location. In September 2020, the Navy performed extensive surveys at each of the project areas following the approaches previously agreed upon with NMFS. In November 2020, the Navy presented the updated findings (i.e., effectively replacing the 2015 information) from the benthic and fish surveys to NMFS. In December 2020, the Navy hosted an additional inter-agency coordination call with NMFS and the USACE, clarifying their plan to submit consultation documents in the spring of 2021. In January and May 2021, NMFS reviewed a draft of the consultation documents, including substantive discussions regarding the proposed mitigation and requests for additional information regarding water quality be included within the final EFHA.

Essential Fish Habitat

The marine water column from the surface to a depth of 1,000 m from shoreline to the outer boundary of the Exclusive Economic Zone (200 nautical miles (nm)), and the seafloor from the shoreline out to a depth of 400 m around each of the Mariana Islands, have been designated as EFH. As such, the water column and bottom and all surrounding waters and submerged lands around Guam are designated as EFH and support various life stages for the management unit species (MUS) identified under the Western Pacific Regional Fishery Management Council's, Pelagic and Mariana Archipelago Fishery Ecosystem Plans (hereafter, Mariana FEP). The MUS and life stages found specifically within Apra Harbor include eggs, larvae, juveniles, and adults for Bottomfish and Pelagic MUS. Habitat Areas of Particular Concern (HAPCs) only occur for these MUS within the Marianas. Specific types of habitat considered as EFH include coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, mangrove, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean.

Baseline Condition

Benthic Community

Photogrammetric orthomosaic surveys were performed within the sensor array impact area (17 sites) and adjacent to the impact area (15 sites). Coral cover within the impact area averaged 32.5% while coral cover at the adjacent sites ranged from 13.2% at the southwest to 49.1% at the northeast end of the array. The *Porites rus* coral complex, which is made up of flat, horizontal plates, and cylindrical vertical pillars, was dominant throughout the entire array area. The Navy identified 7,534 coral colonies within the direct impact area of which only 1,166 coral colonies were not part of the *Porites rus* complex. The direct impact area also included 18% macro algae and cyanobacteria cover, 7% other fauna, and 35.7% hard substrate covered in turf algae.

The cable route survey did not include photogrammetric orthomosaic grid cells because preliminary surveys had already identified a route where the scattered and overall low density of coral could be avoided. One rocky feature at 310 m which included *Porites speciosa* and *Leptosiris sp.* and a northwest-facing slope at 550 m with *Porities rus* were observed and prioritized for avoidance during the cable deployment. Coral abundance was 2.5% within the survey grid cells at the Polaris Point egress impact site, totaling 145 colonies, and dominated by *Porites rus* and other massive *Porites sp*.

The proposed mitigation site at Mound 9 was also surveyed at six photogrammetric orthomosaic grid cell sites. Coral cover across all sites was 5.4% while loose sediment and rubble made up 70.8% of the benthos. These numbers support the proposed mitigation to stabilize and recolonize target areas at Mound 9.

Fish

A total of 30 stationary point count surveys were performed in September 2020, which identified 69 species across 19 families. Analysis included a baseline species-richness comparison between the sensor array impact area and the proposed mitigation site at Mound 9, which indicated that different species could be found at each location. The continued inclusion of fish surveys at future time points has the potential to help the Navy illustrate the effectiveness of their mitigation activities at Mound 9 (Opel 2017).

Water Quality

A particle tracking model was developed to evaluate the movement of re-suspended dredge sediment in Apra Harbor in 2017 (Gailani 2017). The model tested eight scenarios for the proposed action at the outer harbor basin including 600 times more material then what is being proposed for UEMMS. The model concluded that lateral transport is nominal for Apra Harbor due to the low water velocities and that sediments will generally stay within the dredge footprint or just adjacent to the site. The Navy also examined the recent turbidity study performed during Pearl Harbor maintenance dredging activities, which concluded that rain events generated far more turbidity at collection sites than they could achieve in a worst-case scenario where turbidity BMPs failed. The Navy is also proposing a range of BMPs to ensure that the turbidly of waters outside silt curtains do not exceed 20 Nephelometric Turbidity Units (NTU), a level that NOAA's Office of Coastal Management has identified as high for nearshore and estuarine habitats. Sedimentation and turbidity caused by dredging, backfilling, and ocean disposal should be minimal and temporary if the proposed BMPs and monitoring efforts are being followed to ensure that the silt curtains are functioning properly.

Ecological Roles

The principal benthic organisms provide ecological services (e.g., water filtration and maintaining balanced nutrient concentrations) and provide physical habitat at both micro- and macro-scales. At a micro scale, the shape of benthic organisms change water movement, which can influence the settlement (McDougall 1943) and behavior of larvae and the availability of planktonic prey

(Williams 1964). Sessile organisms provide refuge from predators, particularly for larvae and small sized species (Russ 1980; Sutherland 1974). Sessile organisms provide new ecological niches increasing species diversity. At a macro-scale, corals are the primary habitat builders in the coral reef ecosystem that benefit juvenile, sub-adult, and adult life stages of the MUS that utilize this designated EFH. The non-coral invertebrate marine successional and filter feeding community also plays an important role in the ecology of these systems (Stella 2011). The morphology, shape, and composite features of benthic organisms can also influence feeding strategies of these MUS.

Adverse Effects

The proposed construction and dredge activities will result in: physical damage from dredging, water jetting and drilling, backfilling, anchor deployment, and diver activities; turbidity and sedimentation from dredging, backfilling, and ocean disposal; the potential for introduction of invasive species and chemical contamination from equipment, vessels, and deployed materials; and potential introduction of toxopathological agents during in-water diving activities.

The project activities will result in a combination of short-term, long-term, and permanent loss of hard bottom. The project activities will result in unavoidable and substantial long-term to permanent adverse effects to sensitive and hard-to-replace EFH, including the loss of corals and non-coral invertebrates (e.g., successional community, filter feeders, etc.), and their ecosystem services and functions. The action will directly affect 7,680 coral colonies, and replace or remove 1,666.9 m^2 of benthic substrate (725 m^2 direct removal from the array site, 739 m^2 from construction activities, 33.9 m^2 from permanent anchors, and 169 m^2 at egress).

Physical Impacts to Benthic and Water Column Communities (physical stressor):

Physical damage to principle benthic organisms from dredging, backfilling, jetting or drilling, anchor deployment, and diver activities is expected to cause breakage or dislocation (i.e., mortality), but can also result in sub-lethal tissue abrasion. Corals, which are primarily responsible for the structural complexity of coral reefs, are particularly vulnerable to physical damage because their slow-growing carbonate skeleton is relatively brittle and their polyps are easily damaged. In general, lobate, encrusting, and other massive colony morphologies tend to withstand breakage better than foliose, table, plating, and branching morphologies; more fragile forms tend to have higher growth rates (Riltzler 2001). Reduction of topographic complexity in the habitats of the coral reef ecosystem reduces biodiversity and productivity (Alvarez-Filip et al. 2009). The Navy has proposed BMPs, minimization (coral translocation), and offset (new habitat creation), that has the potential to replace the ecosystem services that will be unavoidably lost from proposed action.

Sedimentation and Turbidity (pollution stressor):

Suspended sediment can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015). Coral reef organisms are easily smothered by sediment (Golbuu et al. 2003), and rates > 100 milligrams/cm/day can kill exposed coral tissue within a few days (Riegl and Branch 1995),

although corals show considerable interspecific variability. Sedimentation can also reduce photosynthetic rates (Philipp and Fabricius 2003), disrupt polyp gas exchange, inhibit nutrient acquisition (Richmond 1996), cause tissue damage (Rogers, 1990), reduce recruitment success (Gilmour 1999; Hodgson 1990), and increase metabolic costs due to enhanced mucus production (Telesnicki and Goldberg 1995).

Invasive Species (biological stressor):

Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Marine species can be introduced to new biogeographies, typically via transport on vessel hulls, in ballast water, or on marine equipment. Invasive species can rapidly increase in abundance and can dominate their new environment, creating adverse ecological effects to other species of the ecosystem, and their respective functions and services that may be provided (Goldberg and Wilkinson 2004). Invasive species can decrease species diversity, change trophic structure, and diminish physical structure, but adverse effects are highly variable and species-specific. The Navy has put forward BMPs that will minimize the potential introduction of invasive species associated with this action.

Chemical Contamination (pollution stressor):

Chemical pollutants can have a variety of lethal and sublethal effects on habitat-forming marine organisms, including alteration of growth, interference with reproduction, disruption of metabolic processes, and changes in behavior. These adverse effects can cascade through ecosystems, altering species composition and ecosystem functions and services. Some pollutants are environmentally persistent and can take years or even decades to biodegrade, and others can bioaccumulate and biomagnify through the food chain, eventually posing a direct threat to human health. Many contaminants readily attach to sediment particles and are transported into the ocean where they become entrained in the bottom sediment of estuaries, reefs, and potentially deeper ocean ecosystems. Once trapped in sediment pore water, they can continue to flux into the overlying water column, creating a persistent source of contamination long after the initial input has ended, especially in the sediment of many industrialized bays and watersheds (Nalley et al. 2021). Dredging can release containments trapped in layers of accumulated sediment and pore water at concentrated levels, sometimes referred to as "black water". Petroleum contamination can adversely affect coral, with results including mortality, inhibition of reproduction, reduced calcium deposition, alteration of physiological processes, tissue loss, and reduced carbon fixation (Turner and Renegar 2017). The Navy has put forward BMPs and monitoring protocols that should minimize the threat of chemical contamination associated with this action.

Toxicopathological Agents (pollution stressor):

Recent studies have shown that sunscreens and other products containing oxybenzone, butylparaben, octinoxate, and 4-methylbenzylidene camphor can disrupt coral production, cause coral bleaching, and damage coral DNA at very low concentrations (Downs et al. 2016). The

proposed transplanting activities will result in divers working directly with, and in close proximity to, thousands of corals, creating a potential exposure pathway for toxicopathological agents to come into contact with corals or to enter the water column near corals. The Navy has not put forward BMPs that will minimize the risk of toxicopathological agents being introduced into the marine environment.

Navy-proposed BMPs
To avoid and minimize potential adverse effects to EFH, the following BMPs and minimization measures will be implemented:

Physical Impacts to Benthic and Water Column Communities

- All vessel and silt curtain anchors will be set on hard or soft, sandy bottom void of coral and seagrass, and chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel moves due to currents or tides. If practicable, all intertidal work will be conducted at low or slack tides.
- Divers will select the locations for anchors along the cable route and avoid coral colonies and substrate that supports coral growth. Divers will also ensure that anchor chains do not scour the environment where sensitive benthic organisms could occur.
- Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. Vessels will be positioned so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.
- A storm plan has been developed that includes specific conditions (Guam Condition Level III) that will require work to stop, and the removal or securing of equipment 48 hours ahead of any potential storms.
- While in water depths where the draft of the vessel provides less than a 2-m clearance, all vessels will operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should employ a dedicated "lookout" to assist the pilot with avoiding coral colonies and other benthic organisms that might extend up from the bottom.

Increase in Sedimentation and/or Turbidity

- During in-water construction and dredging activities, the Navy will ensure that a rigorous water quality monitoring plan will continuously monitor and adaptively manage the turbidity levels resulting from the proposed action and ensure BMPs are working properly. Turbidity data will be collected using real time monitoring devices at two test stations and two control stations.
- Coral translocation and all in-water activities will cease during the primary Guam coral spawning events each year for hard (scleractinian) corals. The coral spawning period is estimated to be 21 days total, including 8 days prior to the full moon and 14 days after.

- A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation.
- An 8-m length silt curtain will be deployed and monitored immediately adjacent to and around the dredge barge.
- A silt fence and silt barriers will be installed around the cable excavation area and shoreline at Polaris Point.
- If a silt plume is observed within the action area, project activity will stop and corrective action will be taken immediately. Work will not resume until after the correction is completed.
- Transportation of dredged material to the G-DODS shall only be allowed when weather and sea state conditions will not interfere with safe transportation and will not create risk of spillage, leak or other loss of dredged material in transit to the G-DODS.
- Dredged material shall not be leaked or spilled from disposal vessels during transit to the G-DODS.
- Dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit.
- No more than one disposal vessel will be present within the permissible dumping target area at any time.
- Each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Increase in Contaminants

- A plan to prevent trash and debris from entering the marine environment will be developed and include installation of a temporary floating debris boom around all in-water work areas.
- An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the proposed action.
- Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water.
- When applicable, all temporary fuel oil or petroleum storage tanks will be surrounded with a temporary berm of sufficient size and strength to contain the contents of the tanks (plus 10% freeboard for precipitation) in the event of an accidental release.
- Fueling of proposed action-related vehicles and equipment will take place at least 15 m (50 ft.) away from the water and within a containment area, preferably over an impervious surface. With respect to equipment (e.g., crane on the barge) that cannot be fueled on land, spill prevention booms will be employed to contain potential spills. All fuel spilled will be cleaned immediately.
- Lubricants and excess oil will be disposed of in accordance with applicable federal, territory, and local regulations, laws, ordinances, and permits.

- Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
- All proposed action-related materials and equipment placed in the water will be free of pollutants.
- Pre-work inspections of heavy equipment for cleanliness and leaks will be conducted daily, with all heavy equipment operations postponed or halted until leaks are repaired and equipment is cleaned.

Increase in Invasive Species

- The portions of the equipment that enter the water will be clean and free of pollutants, including aquatic invasive species (AIS). All vessels and equipment (including barges, dry docks, and dredging equipment) will be free from fouling organisms before entering Guam's coastal waters (3 nm offshore).
- A biofouling management plan will be developed for all vessels entering Guam coastal waters.
- The Navy will coordinate with and follow the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). The JRM INRMP contains objectives and actions that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication.

Navy-proposed Minimization

The Navy is proposing to translocate 6,300 of the 7,680 coral colonies from the project impact area, whichfall within the preferred size, morphology, and observed health range. The corals considered not appropriate for translocation include:

1. All corals less than 10 cm from: *Leptastrea purpurea*, *Pavona cactus*, *Pectinia paeonia*, *Astreopora spp*., *Porites spp.* massive, and the *Porites rus* complex.
2. Half of the corals less than 10 cm from: *Pachyseris speciosa*, *Porites cylindrical*, *Stylocoeniella armata*, *Galaxea spp*, *Lobophyllia spp*., and *Pavona varians sp*.
3. Select corals less than 10 cm from: *Pocillopora acuta* and *Pocillopora damicornis*.
4. All corals that are undergoing bleaching, are stressed/diseased, have encrusting or boring sponge cover, or are otherwise unhealthy.
5. All flat-encrusting growth forms.

The majority of the translocated corals will be moved to a location in Outer Apra Harbor called Mound 9. The Navy is currently planning to move 24 of the largest coral colonies, 104 other select colonies, and an additional 103 coral colonies from Polaris Point to adjacent sites and not Mound 9. The Navy is planning to monitor (i.e., quantify and assess the resource conditions) corals from each of these locations at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter).

NMFS considers this a minimization measure because the corals that survive translocation are not unavoidably lost and do not require direct offset. Based on the previous performance of similar outplanting efforts within Apra Harbor, the Navy expects a minimum of 4,410 coral colonies (70%) to survive the relocation effort and that number could be much higher based on the recent success of translocation efforts at X-Ray wharf (i.e. 4,410 is a conservative estimate). The proposed approach will leave behind 1,380 smaller corals and potentially lose an additional 1,890 corals after translocation, resulting in a conservative unavoidable loss estimate of 3,270 corals.

Navy-proposed Offset

The Navy worked with NMFS through early coordination to generate parameters (e.g. expected injury, service levels, discount rate, and years to recover) for a Habitat Equivalency Analysis (HEA) to quantify the interim loss of ecosystem services and function associated with the adverse effects of this proposed action, and developed a quantifiable mitigation strategy focusing on EFH area replacement. The Navy built in several conservative assumptions into the HEA regarding two-dimensional surface area, three-dimensional surface area, largest morphology, and estimates of coral survivorship. The Navy also included an area loss estimate for the marine successional and filter feeding community within the HEA. Collectively, these conservative choices resulted in a HEA requirement of 3,273.7 m^2 of offset for unavoidable losses to EFH, an area that justifiably exceeds the two-dimensional estimation of physical impacts, which was 1,666.9 m^2.

The Navy has proposed to offset the 3,273.7 m^2 of lost EFH through the generation of new and improved habitat. The Navy plans to remove anthropogenic debris, stabilizing substrate, and deploy limestone boulders at Mound 9. These measures will generate area for coral settlement and regrowth, increase rugosity, and increase benthic complexity in an area where corals have historically flourished (i.e. prior to WWII dredging). The proposed improvements at Mound 9 are also expected to benefit coral reef associated species known to be a food sources for benthic MUS (Nakamura et al. 2008).

To achieve the required offset the Navy plans to stabilize 1,235.9 m^2 of rubble at Mound 9, and place 615 limestone boulders that will provide 2,041.8 m^2 of new surface area. These two measures will generate 3,277 m^2 of offset. The Navy has also calculated that the coral estimated not to survive translocation have the potential to provide an additional 1,890 m^2 of new area above what was required within the HEA, providing an additional conservative buffer to the modeled requirement. The Navy is also proposing to move other invertebrates to Mound 9 as part of the translocation effort when feasible.

The Navy is planning to monitor (i.e., quantify and assess the resource conditions) the fish and benthic community at the Mound 9 restoration site at pre-determined intervals over two years after translocation (e.g., three monitoring events occurring at the time of completed translocation, 12 and 24 months thereafter). The offset effectiveness monitoring effort will likely align with the

translocation survivorship monitoring planned as part of the proposed minimization in the section above.

NMFS Concerns
NMFS is concerned that the proposed activity will cause physical damage to EFH resources, including unavoidable loss of corals and non-coral invertebrates (i.e., substantial adverse effects), turbidity and sedimentation leading to degradation of coral condition, introduction of invasive species, introduction of chemical contamination from equipment, and introduction of toxicopathological contaminants during diver activities. NMFS is also concerned that translocation of corals from the *Porites rus* complex, which make up the majority of corals within the action area, may not respond well to translocation efforts due to their size and morphology. These concerns could result in long-term to permanent loss of corals, non-coral invertebrates, and their ecosystem services and function as discussed below.

Construction and dredging activities associated with this action will directly impact an estimated 1,666.9 m^2 of two-dimensional benthic area (2,661 m^2 of modeled EFH when including coral morphology), including more than 7,680 coral colonies. Minimization measures are expected to protect approximately 4,410 of the 6,300 coral colonies proposed for translocation, leaving more than 3,000 corals unavoidably lost. The Navy has put forward a realistic mitigation strategy to offset for lost EFH (e.g., corals and filter feeders), which has the potential to increase overall habitat area over time. The proposed approach hinges on successful coral recruitment at Mound 9 to replace the lost habitat area and demonstrate a return to comparable coral densities, and ecosystem function, to what we would have seen in the action area over the next 30 years (i.e. the selected Visual HEA service recovery period). If the new boulders and stabilized areas fail to resemble a reasonable facsimile of the coral diversities and densities that would have occurred within the action area, effective offset of EFH has failed. The HEA has proven to be an effective tool in developing the theoretical offset, but should be supported by long-term monitoring and adaptive management to ensure that the expected level of recovery occurs.

The mitigation projects proposed as minimization and offset have the potential to adversely affect EFH through vessel (e.g. physical damage and chemical contamination risks) and diver interactions (e.g. physical damage, introduction of toxicopathological agents, and invasive species risks) associated with the surveying, coral transplanting, staging and moving of the limestone boulders at Mound 9.

EFH Determination
NMFS agrees with the Navy's determination that the proposed action will adversely affect EFH and result in unavoidable loss. Furthermore, NMFS determines that even with the avoidance, minimization, and offset measures proposed by the Navy, the proposed action could still have long-term to permanent adverse effects to EFH associated with the implementation of the proposed

mitigation strategies, unexpectedly low survivorship for translocated corals (e.g. *Porites rus complex*), or resulting from delays in coral recovery and/or recruitment at Mound 9.

Conservation Recommendations
NMFS provides the following EFH conservation recommendations in accordance with the EFH provisions of the Magnuson-Stevens Act (50 C.F.R. 600.920) to help the Navy ensure that adverse effects to EFH including corals are avoided, minimized, offset for, or otherwise mitigated.

Conservation Recommendation #1: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2019 JRM INRMP, Marine Habitat Management section. If the 2019 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Mound 9 surveys within the next update to the JRM INRMP.

Conservation Recommendation #2: Coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment, and anchoring activities will all require the staging of materials in the marine environment and/or be supported by divers. The Navy should ensure that these activities avoid any unnecessary contact with marine organisms and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Conservation Recommendation #3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event. Each report should clearly documents the performance of the *Porites rus* complex and include a comparison of performance between morphology types, colony sizes, and translocation location (i.e. those moved to Mound 9, moved adjacent to the array area, or to Polaris Point). If survivorship of translocated corals does not meet the 70% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Please be advised that regulations (Section 305(b)(4)(B)) of the Magnuson-Stevens Act to implement the EFH provisions require that Federal action agencies provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. The final response must include a description of measures to avoid, minimize, and offset the adverse impacts of the activity. If the response is inconsistent with our EFH conservation recommendations, an adequate explanation for not implementing the recommendations must be provided.

Conclusion

Upon review of the consultation documents for the proposed construct and operation of an underwater electromagnetic measuring system in Outer Apra Harbor, Guam, NMFS determines that there will be unavoidable loss and substantial adverse effects to sensitive and hard-to-replace EFH. NMFS expects that many adverse effects to EFH from these project activities can be avoided and/or minimized if all of the proposed BMPs are fully implemented, and coral translocation achieves the targeted success levels. Additionally, NMFS believes that full offset can be realized so long as the Navy follows the EFH conservation recommendations provided by NMFS and reengages using the HEA to confirm that natural settlement and recovery of corals is meeting or exceeding the recovery rates put forth in the model. NMFS provides the EFH conservation recommendations as described above to help the Navy ensure that adverse effects to EFH including coral reef resources are avoided, minimized, offset for, or otherwise mitigated. Please don't hesitate to contact Steve McKagan at 670-234-0004 and/or steven.mckagan@noaa.gov should you have any questions, comments, or require additional technical assistance.

Sincerely,

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division

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DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0524
18 August 2021

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Building 176
Honolulu, HI 96818

Dear Mr. Davis,

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

In accordance with the Essential Fish Habitat (EFH) provisions of the *Magnuson-Stevens Fishery Conservation and Management Act* (MSA; 6 U.S.C. § 1801 et seq.), the Navy is providing this letter as a response to the National Marine Fisheries Service (NMFS) conservation recommendations letter dated 21 July 2021. The EFH consultation is for proposed installation the underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, U.S. Naval Base Guam. Many of the effects from the project can be avoided and minimized through the implementation of the Best Management Practices (BMPs) that were described in the Navy's EFH assessment that was submitted to NMFS on 21 June 2020. The Navy understands that conservation recommendations from NMFS are intended to enhance, or to be in addition to, BMPs and the Navy provides its responses to the conservation recommendations below.

NMFS Conservation Recommendation #1: To ensure that the proposed offset from the Habitat Equivalency Analysis (HEA) is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2019 JRM INRMP, Marine Habitat Management section. If the 2019 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Mound 9 surveys within the next update to the JRM INRMP.

Navy Response to Conservation Recommendation #1: The Navy understands that while the HEA is currently the best available program that provides an efficient method of predicting likely loss and recovery of coral and calculating the required compensation, subsequent monitoring of coral recruitment and growth will confirm the accuracy of the HEA predictions and the efficacy of the implemented mitigation measures. The Navy's subject matter experts will

develop a two-year monitoring and maintenance plan consistent with the five-year adjacent monitoring for the Lima, Mike, and November Whurves (LMN) translocation project at Mound 9. In response to this conservation recommendation, the Navy plans to evaluate the HEA analysis (or an equivalent and improved model analysis) for the impact area of LMN and Mound 9 after five years of monitoring that can be compared with the UEMMS monitoring data later in 2025.

Furthermore, the Navy agrees with this Conservation Recommendation, that the monitoring plan for all Mound 9 projects should consider aligning with the 2019 JRM INRMP. In addition, subject to available funds, the Navy will consider including funding support for the long-term monitoring events at Mound 9 within the next update to the JRM INRMP. As per the policy set forth in Chief of Naval Operations Instruction (OPNAVINST) 5090.1E, Environmental Readiness Program, all mitigation requirements must be coordinated in advance with natural resources managers representing the Installation Commanding Officers. If appropriate, the responsibility for the compensatory requirement can be realigned to the Natural Resources Conservation program at Naval Base Guam.

NMFS Conservation Recommendation #2: Coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment, and anchoring activities will all require the staging of materials in the marine environment and/or be supported by divers. The Navy should ensure that these activities avoid any unnecessary contact with marine organisms and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Navy Response to Conservation Recommendation #2: The Navy agrees with Conservation Recommendation 2 and will ensure that the appropriate BMPs are implemented during the coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, cable deployment and anchoring activities, including avoidance of physical contact with organisms not transplanted (especially coral). The Navy will stabilize and secure materials that are staged on the bottom, while also avoiding movement during inclement weather. The Navy will be using experienced coral biologists for the coral transplantation and habitat restoration. The divers are knowledgeable about the risk of disease to corals including the use of reef-safe sunscreen. To the best of their ability, all divers will avoid exposing corals directly or indirectly to toxicopathological agents.

NMFS Conservation Recommendation #3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event. Each report should clearly documents the performance of the *Porites rus* complex and include a comparison of performance between morphology types, colony sizes, and translocation location (i.e. those moved to Mound 9, moved adjacent to the array area, or to Polaris Point). If survivorship of translocated corals does not meet the 70% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE INSTALLATION OF THE UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Navy Response to Conservation Recommendation #3: The Navy agrees with Conservation Recommendation 3 and will ensure that three monitoring reports documenting the performance of the translocated corals at the three translocation sites, including the *Porites rus* complex, will be provided to NMFS upon completion of coral translocation and after both subsequent monitoring events (12 & 24 months). The Navy agrees to coordinate with NMFS if the rate of survival does not meet the 70% survivorship target after the final monitoring period.

The Navy appreciates NMFS's effort and careful deliberation invested in evaluating the proposed actions and providing these three EFH conservation recommendations. Should you have any questions or concerns, please contact Kevin Lino at NAVFAC Pacific at (808) 472-1087 or kevin.c.lino.civ@us.navy.mil.

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

U.S. DEPARTMENT OF COMMERCE
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NATIONAL MARINE FISHERIES SERVICE
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October 6, 2021

Kevin Lino
Natural Resources Management Specialist EV24
Naval Facilities Engineering Command, Pacific
258 Makalapa Drive
Pearl Harbor, HI 96860
808-472-1087

RE: Installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam (PIRO-2021-02037; I-PI-21-1966-AG)

Dear Mr. Lino:

This letter responds to the Naval Facilities Engineering Command Pacific (the Navy) June 15, 2021, request to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1536(a)(2)) for the installation of an underwater electromagnetic measuring system (UEMMS) in Outer Apra Harbor, Guam. In the request, you determined that the proposed action is not likely to adversely affect (NLAA) the endangered or threatened species or designated critical habitat under National Marine Fisheries Service's (NMFS) jurisdiction listed below in Table 1. The consultation request included a biological evaluation (BE) that described the proposed project and evaluated the potential effects of the action on ESA-listed species under NMFS' jurisdiction. On August 7, 2021, we requested additional information regarding project equipment noise levels. On August 8, 2021, we requested a more detailed action area map. On August 21, 2021, we requested additional information on the location of *Acropora globiceps* in Apra Harbor. On August 18 and 23, 2021, you responded to our requests for additional information. After a phone conversation pertaining to the action area and species present on August 25, 2021, we concluded that we had sufficient information to initiate informal consultation that same day.

This response to your request was prepared by NMFS pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq*.), implementing regulations at 50 CFR 402, and agency guidance for the preparation of letters of concurrence.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554. A complete record of this consultation is on file at the Pacific Island Regional Office, Honolulu, Hawaii.

Proposed Action

The Navy proposes to construct and operate an UEMMS in Outer Apra Harbor, Guam. The UEMMS will passively measure magnetic and electric field signatures of surface ships and submarines (hereafter vessels) to ensure vessels meet the magnetic signature limits specified in the Office of the Chief of Naval Operations Instruction S8950.2H. The proposed action includes both in-water and shore-side infrastructures to passively measure electromagnetic signatures of vessels and transmit data to facilities on land. The Navy will install the sensor array on the seafloor of Outer Apra Harbor 915 meters (m) northwest of Polaris Point in 17 m of seawater.

Installation of the sensor array will require excavation, backfilling and disposal of material from the array site, water jetting or drilling of holes at the array site, deployment and anchoring of subsea cables, and excavation and backfilling at the egress location at Polaris Point. In-water construction activities are expected to take approximately 10 months to complete.

Coral translocation, habitat restoration and monitoring

Due to the need for coral translocations from the array location, substantial pre-consultation for Essential Fish Habitat (EFH) impacts and mitigations occurred between NMFS Habitat Conservation Division (HCD) and the Navy beginning in February 2014 and continuing through 2021. NMFS HCD concluded EFH consultation in a letter dated July 21, 2021, and determined that full offset of habitat impacts can be realized with full implementation of the EFH conservation recommendations.

In September 2020, the Navy performed extensive surveys at each of the project areas following the approaches previously agreed upon with NMFS HCD. No ESA-listed corals were observed during surveys and listed corals are not proposed for translocation.

To minimize impacts to EFH, translocation of approximately 6,300 coral colonies from the UEMMS project site to a recipient site (Mound 9) will first require habitat enhancement including sediment stabilization and rugosity uplift. These measures are part of compensatory mitigation. Divers will first remove anthropogenic debris from Mound 9. At least 615 locally sourced limestone boulders will be lowered from a barge and placed into clusters using a hydraulic grab. In order to ensure accurate placement, the barge will be positioned with a guide vessel to demarcated areas previously identified by divers and marked with temporary surface marker floats identifying each cluster. If winds occur during implementation, divers will place anchors in sand substrate (avoiding impacts to substrates) to hold the barge in position. Divers will use hand tools to remove corals from the UEMMS project site. Small vessels will be nearby with crates for the coral translocations. Divers will then stabilize translocation sites at Mound 9 using a combination of mesh mats, reinforcement rods and concrete cement. These materials will stabilize loose rubble and affix coral colonies. All dive team members will be experienced coral biologists and boat technicians skilled in conducting coral translocation. Divers and crews will wear gloves and minimize contact with living coral tissue. Biological observers will be present aboard vessels and in-water in order to ensure BMPs are implemented, avoiding impacts to protected species and documenting listed species sightings. As for all work proposed, if a listed marine species is observed within 50 m, work will cease until the animal leaves the area.

Habitat restoration on Mound 9 will generate new areas for coral settlement and regrowth, increase rugosity, and increase benthic complexity in an area where corals historically flourished prior to WWII dredging. The proposed improvements at Mound 9 are also expected to benefit coral reef associated species known to be a food sources for benthic species (Nakamura et al. 2008).

The Navy is planning to use experienced coral divers for the translocation, habitat restoration and monitoring at the array location and Mound 9. Three monitoring events using standardized

protocols will occur at Mound 9: at the time of completed translocation, and at 12 and 24 months thereafter.

Sensor Array Excavation, Installation, and Backfill
Once coral translocation has occurred, an estimated 918 cubic m (m^3) of material will need to be excavated from the array site before sensor installation can occur. The material will be excavated with a closed-bucket excavator to minimize inadvertent discharges into the water column. The BE included BMPs to minimize sediment and turbidity impacts to listed species including the following: during in-water construction and dredging activities, the Navy will ensure rigorous water quality monitoring and will manage turbidity levels to contain them within the sensor array work area; turbidity data will be collected using real time monitoring devices at two test stations and two control stations; all in-water activities will cease during the primary Guam coral spawning events each year for hard (Scleractinian) corals estimated to be 21 days total, including 8 days prior to the full moon and 14 days after; a Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation; an 8-m length silt curtain will be deployed and monitored immediately adjacent to and around the dredge barge; a silt fence and silt barriers will be installed around the cable excavation area and shoreline at Polaris Point; and, if a silt plume is observed within the action area, project activities will cease until corrective action is taken.

Excavated materials will be deposited at the Guam Deep Ocean Disposal Site (G-DODS) 20.6 kilometers (km) offshore of Guam in 2,680 m of seawater. The G-DODS was designated as an exclusive ocean dredged material disposal site in 2010 (Final Rule 40 CFR Part 228; 21 FR Notice 54497). Formal consultation on disposal and vessel transits to and from the G-DODS was conducted with U.S. Fish and Wildlife Service and NMFS in 2009. The BE included BMPs for dredge disposal including the following: transportation of dredged material to the G-DODS shall only be allowed when weather and sea state conditions will not interfere with safe transportation and will not create risk of spillage, leak or other loss of dredged material in transit to the G-DODS; dredged material shall not be leaked or spilled from disposal vessels during transit to the G-DODS; dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit; no more than one disposal vessel will be present within the permissible dumping target area at any time; and, each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Once excavation and disposal is completed, the Navy will begin installing the UEMMS sensor array. The sensor array will consist of a line of 22 sensors (13 Electromagnetic triaxial (EMT) sensors and eight magnetometer triaxial (MT) sensors extending 128 m and spaced six m apart, as well as one conductivity, temperature and depth (CTD sensor). The CTD sensor will be installed at the northeast end of the array. Each sensor will be mounted to a 30.5-centimeter (cm) diameter fiberglass reinforced plastic sensor tube that will be embedded six m deep into the seafloor at each location. A 15 cm diameter fiberglass reinforced plastic cable guide stake will also be embedded 1.2 m deep into the seafloor three m to the southeast of each sensor tube. Sensor tube and guide stake installations will be performed by divers using a water jetting process known as a handheld hydraulic breaker. A large steel pipe will be used to push the tubes to the appropriate depth as the high-pressure water loosens the bottom material. If water jetting is not feasible due to seafloor characteristics, 30-cm diameter pilot holes will be drilled into the seafloor and marine grout will be used to secure the tubes at the same locations. Additionally, 30

m of sensor cable will be installed between each sensor and guide stake, and secured with eyebolts, poly webbing, and zip ties. After installation, the excavated area, including the coiled cables, will be covered with 826 m^3 of non-magnetic, certified contaminant free backfill material in order to restore the excavated area to the original water depth.

Subsea Cable Installation and Anchoring
To transmit data of electromagnetic signatures collected by the UEMMS to facilities on land, 27 subsea cables, 5 additional guide stakes, and 29 concrete anchor discs will need to be installed along the 975 m cable route. The subsea cables are made up of shielded and sheathed copper wires with a diameter of 2.64 cm. One cable will extend from each of the 22 sensors to a common path marked by guide stakes along the southeast side of the array. Five additional cables will also be routed to the array for future use. Three additional guide stakes will be installed adjacent to the array site and two additional guide stakes will be installed at Polaris Point to secure each end of the subsea cable. The cables will be bundled using polypropylene webbing at each sensor and at each guide stake. Divers will lay the cable along the cable route and select a location every 30 m along the pathway for deployment of a 1.2 m diameter concrete anchor disc that will secure the cable to the seafloor. The concrete anchor discs will be deployed by a crane and barge with the assistance of divers to ensure areas with coral cover are avoided.

Subsea Cable Egress and Trenching
To protect the cables from wave and storm damage at Polaris Point, high-density polyethylene (HDPE) conduits will be deployed. The HPDE conduits will be bundled together into a single 71-cm diameter, 38-m long cable duct, anchored 10.5 m below mean low water (MLLW). The bottom of the duct will be secured in place using a stainless steel anchor band span and earth anchors. The earth anchors are only a few inches in diameter and will be installed using a hand tool such as a hammer. At 4.5 m below MLLW, the remaining 24 m of duct will transition underground until it reaches a concrete transition vault.

An oblique trench (17m wide x 15m long x 3m deep) will be excavated by a closed-bucket excavator to create the necessary slope for burial of the conduit at the surface. Prior to excavation, 95.6 m^3 of existing shoreline revetment material will be relocated by an excavator to a similar depth adjacent to the site. The Navy estimates that 172 m^3 of subbase materials will be excavated and placed on land. After the conduit has been secured, the subbase material and revetment material will be reused as backfill to bury and protect the cable conduit duct.

Construction, which includes performance of any required mitigation activities, is planned to begin November 2021 and will require 10 months (including anticipated weather and standby days) to complete. Within the 10 month time frame, the in-water work will require approximately five months to complete.

Best Management Practices (BMPs) are included in the BE (Section 1.4) as part of the proposed action and will be implemented to minimize adverse effects.

Action Area
The action area is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). For this action, the extent of vessel noise covers all areas affected. Thus, we delineate the action area as the following vessel transit paths as well as 251 meters in every direction to account for project-related noise propagating from the vessels to the edge of the behavioral response isopleth:

- From Inner Apra Harbor to the UEMMS site (Figure 1) and Mound 9 (Figure 2) in Outer Apra Harbor
- From the UEMMS site to the dredge disposal site (G-DODS) located 20.4 km offshore of Guam (Figure 3)
- From the Hawaiian Islands to Guam if additional vessels are needed for the construction.

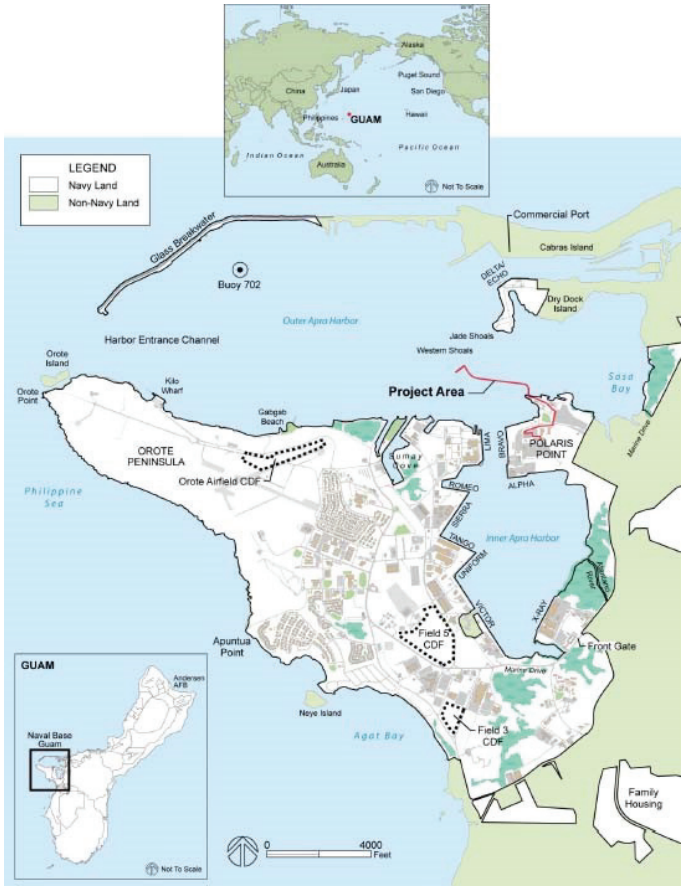

Figure 1. Navy UEMMS action area in Apra Harbor.

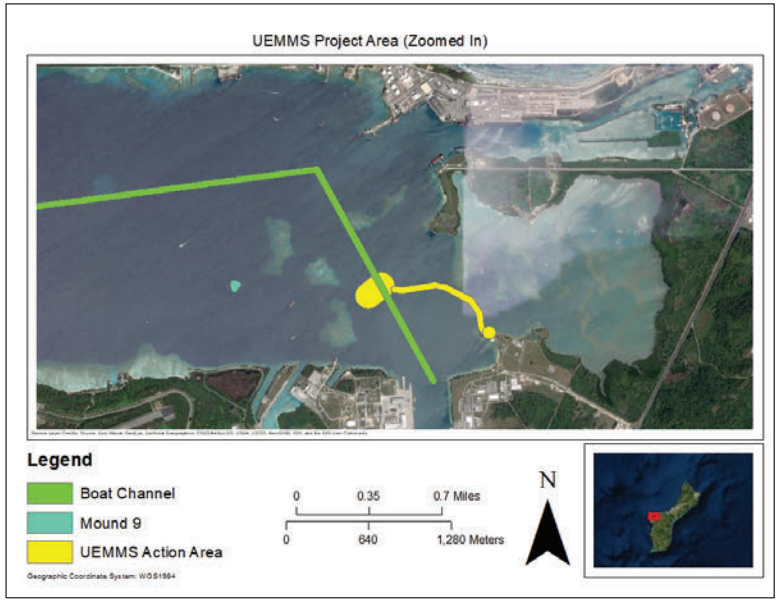

Figure 2. Navy UEMMS Mound 9 coral translocation site relative to the UEMMS site in Apra Harbor.

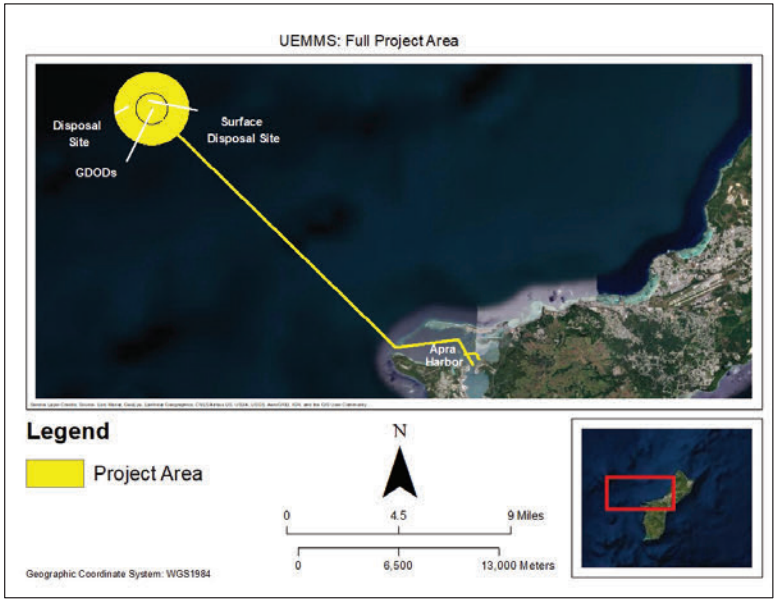

Figure 3. Action area diagram including Navy UEMMS G-DODS dredge disposal area 20.4 km offshore of Guam.

Listed Species

The ESA-listed threatened and endangered species under NMFS' jurisdiction listed in Table 1 are known to occur, or could reasonably be expected to occur, in the action area, and may be affected by the proposed activities. Detailed information about the biology, habitat, and conservation status of the animals listed in Table 1 can be found in their status reviews, recovery plans, federal register notices, and other sources at http://www.nmfs.noaa.gov/pr/species/esa/.

Table 1. Common name, scientific name, ESA status, effective listing date, and Federal Register reference for ESA-listed species considered in this consultation.

Species	Scientific Name	ESA Status	Effective Listing Date	Federal Register Reference
Central South Pacific Green Sea Turtle	*Chelonia mydas*	Endangered	5/06/2016	81 FR 20057
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	7/28/1978	43 FR 32800

Species	Scientific Name	ESA Status	Effective Listing Date	Federal Register Reference
Loggerhead Sea Turtle North Pacific DPS	*Caretta caretta*	Endangered	9/22/2011	76 FR 58868
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened	7/28/1978	43 FR 32800
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	6/02/1970	35 FR 8491
Indo-Pacific Scalloped Hammerhead Shark	*Sphyrna lewini*	Threatened	09/02/2014	79 FR 38213
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened	1/30/2018	83 FR 4153
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter microcephalus*	Endangered	12/02/1970	35 FR 18319
North Pacific Right Whale	*Eubalaena japonica*	Endangered	12/27/2006	71 FR 77694
False Killer Whale Main Hawaiian Island Insular	*Pseudorca crassidens*	Endangered	11/28/2012	77 FR 70915
Giant Manta Ray	*Manta birostris*	Threatened	1/22/2018	83 FR 2916
Corals	*Acropora globiceps*	Threatened	10/10/2014	79 FR 53852

Critical Habitat

Critical habitat for MHI insular false killer whales includes waters from 45 m to 3,200 m in depth surrounding the main Hawaiian Islands (from Niihau to Hawaii Island). Detailed information on MHI insular false killer whale critical habitat can be found at https://www.fisheries.noaa.gov/resource/map/main-hawaiian-islands-insular-false-killer-whale-critical-habitat-designation.

Analysis of Effects/Exposure and Response

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time

and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

In order to determine that a proposed action is not likely to adversely affect ESA-listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or completely beneficial. As defined in the *Endangered Species Consultation Handbook* (USFWS and NMFS 1998), beneficial effects are contemporaneous positive effects without any adverse effects to the species. Discountable effects are those extremely unlikely to occur. When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with our regulatory definition of "effects of the action."

Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Take of species listed as endangered is prohibited at the time of listing, while take of threatened species may not be specifically prohibited unless NMFS has issued regulations prohibiting take under section 4(d) of the ESA.

Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur (USFWS & NMFS 1998). This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions, was applied during the analysis of effects of the proposed action on ESA-listed marine species, as is described in the consultation request and biological evaluation (BE). Only activities that have the potential to adversely affect ESA-listed species are discussed here.

The following stressors may be associated with the proposed action:

- Elevated noise levels
- Elevated suspended sediments
- Vessel strikes
- Waste discharge
- Entanglement
- Direct impacts from coral translocation, habitat restoration and monitoring

Elevated noise levels

Elevated noise levels may occur in Apra Harbor associated with use of equipment including a hydraulic breaker/water jet, vibratory hammer, clamshell bucket dredge and excavator. The effects of project-related sound on our species also depends on the ambient acoustic environment. Apra Harbor has commercial and industrial vessel traffic and tourist-related recreational activities. The daytime and nighttime boat traffic in the harbor channel results in

unknown increased levels of ambient sound, however, the level may be comparable to the ambient sound levels of 120-155 dB_{peak}, and 133 dB_{rms} measured for a large marine bay, with heavy industrial use and boat traffic as measured by CALTRANS (2015).

A hydraulic breaker/water jet and vibratory hammer will be used to install both the guide stakes (22 guide stakes that are 6" diameter each) and the sensor tubes (22 sensor tubes that are 12" diameter each). The guide stakes and tubes are made of fiberglass reinforced plastic and will be jetted into the benthic substrate. The Navy BE estimated noise for the hydraulic breaker/water jetting (Table 2) by referencing noise data from a similar project that used the same equipment. In September 2017, acoustic monitoring was conducted for 16-inch round concrete pile jetting installation using a single 2-inch pipe as part of the high-pressure water jet (300 psi maximum pressure) in San Diego Bay (NAVFAC SW 2018). Source average SPLs ranged from 123.7-130.2 dB re 1µ Pa. Far-field recordings were taken at distances ranging from 19-338 m (62-1,109 ft., respectively) and recorded average SPLs ranging from 12.5-127.6 dB re 1µ Pa, demonstrating attenuation levels. Underwater noise from hydraulic breaker/water jetting of 16-in. concrete piles is likely substantially greater than the proposed action of installing the small diameter plastic sensor tubes (12" diameter) and guide stakes (6" diameter). A vibratory hammer may also be used to drive the delicate sensor tubes and small guide stakes into bottom substrates. However, no hammer strikes will occur because a hammer strike could break the sensor tubes and guide stakes. Instead, the stakes would be vibrated into the substrates. The shallow embedment depth (sensor tubes about 19.5 ft.; guide stakes about 10 ft.) is estimated to require less than two minutes of vibratory hammer use per stake/tube. Considering the above information, we assume the sound level for a hydraulic breaker/water jet or vibratory hammer will be approximately 126.5 dB re 1µ Pa (Table 2).

Table 2. Underwater noise levels from dredging and water jetting.

Equipment	**Underwater Sound Pressure Level (SPL dB re 1µ Pa)**	**Source**
Clamshell dredge	124	Dickerson et al. 2001
Handheld hydraulic breaker/water jetting	126.5 (average for 16-in concrete piles)	NAVFAC SW 2018

Noise from dredges can be variable, depending on the phase of operation and the type of dredge used, but typically occur at low frequencies (<500 Hertz [Hz]; Reine *et al.* 2014). Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. Bucket dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The mechanical dredge noise is generated from lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Underwater acoustic sound levels from bucket dredging were measured at various distances from dredge operations in the Cook Inlet, Alaska (Dickerson *et al.* 2001). The maximum noise spike occurred when the bucket hit the bottom. All other noise levels from this operation (e.g., winch motor, spuds) were insignificant. Based on the peak underwater sound levels measured during a bucket dredging operation (Dickerson et al.

2001), the estimated sound levels from dredging is not expected to exceed 124 dB re 1 micro Pascal (μPa) from the impact of the bucket hitting the bottom (Table 2).

The Navy will use various-sized vessels, from small boats for diving to large vessels like tug boats to move barges. Noise generated by the largest possible vessel (120 ft) will be approximately 173 dB rms re 1 μPa 1 meter (m) from the source. We assume the lowest sound level of vessels between 100 and 250 ft from Kipple and Gabriele (2007) because the vessel length is near the lowest end of this data and the Navy requires BMPs for vessel speed and operation. Noise generated by the small boats will be approximately 166 dB rms re 1 μPa 1 m from the source (assuming the average sound level of vessels under 40 ft from Kipple and Gabriele [2007]). We used a modified version of the publically available NMFS marine mammal sound calculator (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed 10/4/2021), to calculate the distances from vessels that noise will propagate. Because the Navy will complete almost all activities within the highly-active Apra Harbor, we assumed ambient sound of 125 dB rms re 1 μPa.

For marine mammals, the Navy (2017), in coordination with NMFS (2018), has established acoustic thresholds using the best available science that identifies the received level of underwater sound above which exposed marine species would reasonably be expected to experience a potentially significant disruption in behavior, or to incur temporary threshold shifts (TTS) or permanent threshold shifts (PTS) of some degree. The Navy (2017) identified acoustic thresholds in decibels (dB) (referenced to 1 micropascal) that identify the onset of TTS and PTS for marine mammals experiencing non-impulsive sounds. For marine mammal species, the TTS threshold ranged from 178-199 dB dB rms re 1 μPa and the PTS threshold ranged from 198-219 dB dB rms re 1 μPa. We calculated a distance from all vessels to the edge of the TTS isopleth of less than one meter for all marine mammals. The behavioral response threshold for marine mammals is 120 dB rms re 1 μPa. We calculated a distance from the largest vessels to the edge of the behavioral response isopleth of 251 meters and 200 meters for small vessels.

Direct injury and hearing impairment in marine mammals is unlikely to occur because the proposed action will not expose them to noise levels above TTS or PTS thresholds. Elevated noise levels from vessel use will likely cause some behavioral responses when marine mammals come within 251 meters of large vessels and 200 meters of small ones. Typical behavioral responses include temporary masking of communications and/or acoustic environmental cues, alteration of ongoing behaviors, and avoidance. However, these sound levels will only occur when vessels are under power and transiting, which means any exposure of individuals will be very short-lived (a vessel traveling at 5 knots will expose a stationary target to noise above the behavioral response threshold for a maximum of 3 minutes and 20 seconds). When vessels are not in transit, the engines will be under low power and noise will likely be less than behavioral response thresholds outside of the 50 m shutdown area. For these reasons, we are reasonably certain the effects from project-related noise on marine mammals will not rise to the level of harm or harassment and thus, are insignificant.

Very limited information exists regarding hearing and sea turtles. To date, no studies have been conducted specifically related to the onset of TTS or PTS in sea turtles. Therefore, the Navy (2017) has developed thresholds for other similar ESA consultations based on the most current literature on sea turtle and fishes (including as sharks and manta rays) hearing and recommendations made by Popper et al. (2014) in Sound Exposure Guidelines for Fishes and

Sea Turtles. The Navy's (2017) approach employs the same statistical methodology to derive thresholds as in NMFS' technical guidance for auditory injury of marine mammals (NOAA 2018). Based on a composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used since there are currently no data on TTS for sea turtles and fishes are considered to have hearing more similar to sea turtles than do marine mammals (Popper et al. 2014).

O'Hara and Wilcox (1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels up to 175 dBrms (referenced to 1 μPa) in a shallow canal. McCauley et al. (2000) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dBrms. At 175 dBrms, both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (McCauley et al. 2000). We will use our modified sound calculator (referenced above) because it uses a more conservative 160 dB re 1μ Pa threshold for behavioral impacts to sea turtles. Our calculator sets the thresholds for PTS and TTs for sea turtles at 220 dB re 1μ Pa and 200 dB re 1μ Pa, respectively.

Direct injury and hearing impairment in sea turtles will not occur because underwater noise produced by all activities of the proposed action will lack the amplitude or duration to exceed TTS and PTS thresholds. Noise levels from vessel use may exceed the behavioral response threshold, but we calculate the distance from vessels to the edge of this effect at 4.5 meters. It is unlikely a vessel will come within 4.5 meters of a sea turtle due to avoidance by vessel captains and sea turtles, as well as the Navy's use of a 50-meter shutdown zone. Therefore, we are reasonably certain the proposed action is extremely unlikely to expose sea turtles to noise levels above the behavioral response threshold. Thus, the effects from noise on sea turtles is discountable.

For fishes, PTS has not been documented in any of the studies researching fish hearing (including sharks and manta rays) and potential impairment from various sound sources. This is attributed to the ability for regeneration of inner ear hair cells in fishes, which differs from marine mammals and sea turtles. For this reason, thresholds for fish hearing impairment only includes the SPL related to the potential onset of TTS. A TTS in fishes is considered recoverable, although the rate of recovery is based upon the degree of the TTS sustained. Thus, auditory impairment in fishes is considered recoverable over some duration; and auditory impairment thresholds are based solely on the onset of TTS for fishes.

Stadler and Woodbury (2009) reported the onset of physical injury for fish, sharks and manta rays are expected if the peak sound levels exceed 206 dB re 1 μPa. The proposed underwater noise would be significantly less than 206 dB re 1 μPa in the water column and sound is expected to decay at distance. The probability of fishes being located at or near the array construction site in Apra Harbor is low. Any physiological stress and behavioral reactions would likely be short-term (seconds or minutes) and are expected to return to normal shortly after the disturbance ceases or the individual moves away. Therefore, the effects on sharks and manta rays from underwater noise are anticipated to be minor, temporary and will not lead to disruption of normal behavioral patterns. Thus, we are reasonably certain the effects from project-related noise will not rise to the level of harm or harassment and are insignificant.

Elevated suspended sediments

Dredging of 1200 cubic yards (CY) of bottom substrates for the sensor array installation, excavation of 225 CY seafloor and relocation of 125 CY of revetment at Polaris Point, removal of debris and placement of limestone boulders at Mound 9 in outer Apra Harbor and the use of underwater mechanical tools to install the array may elevate turbidity by dislodging, re-suspending, and dispersing sediment in the water column of Apra Harbor. Suspended sediment can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015).

Open ocean species including whales and manta rays will not be exposed to the work areas in Apra Harbor. Disposal of dredge materials at the G-DODs may elevate turbidity in the vicinity of open-ocean species. Potential effects will be minimized through implementation of BMPs described in the proposed action section above including monitoring for and suspending work when marine species are within 50 m. NMFS expects whales and manta rays would also avoid the G-DOD area when vessels are working there. Due to the proposed monitoring and avoidance of listed species, ceasing work if an animal is observed, and the expectation that whales and manta rays are dispersed and at low density, impacts to whales and manta rays from disposal at the G-DODS are extremely unlikely, and effects will be discountable.

Sea turtles, corals and sharks may occur in Apra Harbor and may be exposed to elevated turbidity from dredging and other underwater work. The Navy BE included data from a particle tracking model (PTM) for Apra Harbor in the analysis of dredging effects. NAVFAC Pacific requested assistance from the USACE Engineer Research and Development Center (ERDC) to determine the fate of re-suspended dredged sediment during dredging operations in Apra Harbor. ERDC developed a framework for quantifying turbidity and sedimentation exposure mechanisms for corals in Apra Harbor (Gailani et al. 2017). The modelled scenario included dredging operations proposed to widen the channel throughout the entire outer harbor basin plus two berthing alternative sites, all of which would be far greater (spatially and temporally) than the proposed UEMMS dredging (i.e., up to 608,000 CY in the model vs. 1,200 CY for the UEMMS array). However, the results of this modeling effort quantified exposure of the nearby coral reefs to turbidity and sedimentation, and the relative rates provide robust and reasonable comparisons for the UEMMR impact and risk assessment.

The PTM is a Lagrangian particle tracker and simulated sediment movement of multiple sediment types in a flow field (Gailani et al. 2017). PTM combined accurate and efficient transport computations with effective visualization tools, making it useful for assessment of dredging practices and proposed dredging operations. PTM modeled such processes as settling, deposition, resuspension, and particle-bed interactions to simulate site-specific transport of both fine and coarse sediment. PTM output included time-accurate horizontal and vertical positions of sediment parcels. Various other attributes such as mass, density, and suspension status are also assigned to each of the output parcels. For this application, eight scenarios were defined and modeled based on the dredging sources. The maximum values within the worst case scenario for total accumulation maps occurred within the dredging footprint (i.e., below 0.1 kg/m^3). Outside of the dredging footprint, values remained between 2 g/cm^2 and 4 g/cm^2 for the different dredging locations modelled. Daily deposition rate values remained below 0.7 g/cm^2 /day. When silt curtain effectiveness was increased to 100% and the clamshell loss reduced to 1%, maximum total accumulation decreased to 0.5 g/cm^2 outside of the dredging footprint. In the same case, the maximum values for the suspended sediment concentration were below 0.02 kg/m^3. Deposition

rates were likewise reduced to 0.10 g/cm^2/day outside the dredge footprint but within the 200 m line (Gailani et al. 2017). Further, the model results demonstrated that sediment dredged at each site generally remained near the dredge site. It was concluded that lateral transport was nominal because of the small velocities within Apra Harbor (Gailani et al. 2017). The model also indicated that sediment tends to deposit shortly after initial suspension. Thus, based on the best available scientific data for a modelled, worst-case scenario for dredging in Outer Apra Harbor, it is reasonable to conclude that the sediment transport from the proposed action would have similar or less sediment suspension and deposition and that sediment accumulation would be confined at the dredged area with minimal transport within the harbor.

In addition to the Apra Harbor modeling described above, the Navy BE referenced turbidity studies obtained from a Pearl Harbor Maintenance Dredging operation. During maintenance dredging of Pearl Harbor's Southeast Loch (SE Loch) in 2018, turbidity levels were measured by an RBRduo3 (https://rbrglobal.com/products/ standard-loggers/rbrvirtuoso-rbrduo) data logger, which recorded turbidity and depth as it was dropped (i.e., cast) through the water column. During each cast, the data logger recorded two turbidity and depth readings every second. Turbidity measurements were taken twice each day: in the middle of the shift and at the end of the shift. Three replications of measurements were taken around the turbidity curtain (with the observer facing the barge): 1) on the left side of the curtain; 2) the right side; and 3) the side of the curtain furthest away from the dredge barge (i.e., center). The unit of measure for turbidity used during the SE Loch dredging was the Nephelometric Turbidity Unit (NTU), which measured scattered white light at 90 degrees from an incident light beam.

Water quality parameters guidance from NOAA Office for Coastal Management (https://coast.noaa.gov/estuaries/science-data/) suggested that in nearshore and estuarine habitats, natural turbidity readings are between zero and 10 NTU. Readings of concern are above 20 NTU. From the SE Loch data, the heat maps suggested that turbidity levels close to or above 20 NTU mostly occurred within a meter or less of the bottom. This could have been caused by the silt curtain interacting with the bottom, especially in shallower parts of the dredge footprint. Also, the dredge operations moved slightly during the shift and some sediment may have been stirred up. Most values in the water column during calm dredging days and in the baseline data were below 5 NTU. During dredging, turbidity was slightly higher if measured closer to the silt curtain (i.e., within 16.5 ft. [5 m]). Turbidity also increased with depth, with the upper 26.4–29.7 ft. (8–9 m) at an almost-uniform and relatively high clarity.

The proposed action includes use of a silt curtain surrounding the dredge areas. Project-generated, elevated turbidity levels will be contained by the silt curtains that will create a vertical barrier in the water to contain sediment. Elevated turbidity in the work area would be temporary and is expected to settle as work progresses throughout the work area and restore to ambient upon completion, with no persistent effect.

Elevated turbidity levels could reduce light penetration throughout the water column and limit underwater visibility, possibly interfering with an individual's ability to forage. However, the action area does not overlap with important resting, nesting or foraging habitats for turtles or sharks and the risk of reduced foraging opportunities is insignificant.

Coral reef organisms are easily smothered by sediment (Golbuu et al. 2003), and rates > 100 milligrams/cm/day can kill exposed coral tissue within a few days (Riegl and Branch 1995), although corals show considerable interspecific variability. The Navy provided information on

occurrence of *Acropora globiceps* in Apra Harbor (August 22, 2021, email from K. Lino to NMFS). The sole recorded sighting of *Acropora globiceps* has been at the Spanish Steps near the entrance to Apra Harbor which is 4 km (2.5 miles) from the sensor array work area and outside the area of potential area of turbidity predicted by the models described above.

The BE contains BMPs that will be implemented to minimize effects from suspended sediments and elevated turbidity on ESA-listed species including use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions. The silt curtain will be monitored before dredging to ensure no listed species are within the curtain. Thus, the only exposure to elevated turbidity will be if sediment/turbidity escapes the silt curtain, which may occur but is expected to be very limited in scope, concentration and duration. During all in-water or overwater work, silt curtains will completely enclose the work area to the maximum extent practicable. If a plume is observed outside of the silt curtains, work will cease and corrective action will be taken before resuming work. In the event of an approaching tropical storms and typhoons, equipment will be removed or adequately secured.

NMFS expects that BMPs will limit the extent of elevated turbidity, and the curtain will mostly isolate it from exposing listed species in Apra Harbor. Therefore, we are reasonably certain the effects from project-related sediment and turbidity will not rise to the level of harm or harassment for any species listed in Table 1, and thus are insignificant.

Vessel strikes

Vessel strikes could occur along vessel transit routes in the action area including marked channels within Apra Harbor, vessel work areas around the UEMMS site, transit routes to the G-DODS (20.4 km offshore of Guam) or the coral translocation site at Mound 9 and vessel routes from other islands that will be used if additional vessels are needed for the construction. When surfacing to breathe or rest, marine fauna is at risk of being struck by a vessel.

Kelly (2020) documented vessel collisions with sea turtles resulting in lethal and sub-lethal injuries. Sea turtles may be in the action area, and could potentially be struck by transiting vessels during the proposed activities. While there are few data on vessel strikes in Guam, we have no indication that the rate of striking will be higher than it is in Hawaii. NMFS (2008) estimated 37.5 vessel strikes of sea turtles per year from an estimated 577,872 trips per year from vessels of all sizes in Hawaii. More recently, we estimated as many as 200 green sea turtle strikes annually in Hawaii (Kelly 2020). If these turtle strikes are evenly distributed around the islands, the probability of a green sea turtle strike from any one vessel trip is extremely low (on average 0.035%, calculated by dividing the most recent strike estimate of 200 per year by the best estimate of all vessel transits of 577,872 per year). However, green sea turtle strikes are not evenly distributed throughout the islands. They are concentrated in areas where small vessel activity is highest (e.g., near small boat harbors and boat launches), such as Kaneohe Bay and Pearl Harbor on Oahu (Kelly 2020). Green sea turtles are most vulnerable to small vessels (<15 m), travelling at fast rates (>10 knots) (Kelly 2020). Increased vessel speed decreases the ability of sea turtles to recognize a moving vessel in time to dive and escape being hit, as well as the vessel operator's ability to recognize the turtle in time to avoid it. The vessels used in the proposed action will be under a restriction of "no wake/idle" speeds at all times while in water depths where the draft of the vessel provides less than a 2 m clearance.

The Navy will implement BMPs that help prevent collisions and would minimize exposure to vessels including traveling with a wildlife observer who will look for marine species during transit, reduced vessel speeds in known marine species locations, and avoidance of areas where marine species are sighted. Vessels in the action area will adhere to BMPs to reduce ship strikes including the use of lookouts and transiting only in established navigation channels. The action area does not have the characteristics identified by Kelly (2020) to result in a hot spot for green sea turtle strikes (overlap of high density boating activity and sea turtle habitat). Therefore, the probability of a green sea turtle strike is likely less than the overall rate calculated above. Thus, we are reasonably certain the likelihood of exposure of any green sea turtle to a vessel strike from this action is extremely unlikely, and therefore discountable.

The other sea turtle species have a lower rate of striking than green sea turtles. This is likely mostly due to their low abundance numbers and preference for deeper offshore waters (Kelly 2020). There were only four documented vessel strikes of hawksbill sea turtles between 1984 and 2020 and two olive Ridley sea turtles in Hawaii (Kelly 2020). We have no documentation of vessel strikes on leatherback or loggerhead sea turtles in Hawaii. We have no data to indicate the rate of vessel strike with these species will be higher in Apra Harbor than Hawaii, either. Because the probability of a project-related vessel striking any other the other sea turtles is even lower than that of a green sea turtle, and because of the BMPs included in this proposed action, we are reasonably certain the likelihood of exposure of any individual is extremely unlikely, and therefore discountable.

The risk of exposure to vessel strikes is low for sharks and manta rays. These species are not routinely on the surface, and are not air breathers. Mantas are known to congregate at the surface and breach on occasion. Few, if any, vessel strikes on these particular animals have ever been recorded. Vessel collisions have been documented on other elasmobranchs, and have been most commonly documented with larger shark species (e.g., whale sharks and basking sharks) with evidence of blunt trauma and laceration scars (Schoeman et al. 2020; Speed et al. 2008). The risk of a vessel collision depends on the amount of time that an animal spends at the surface of the water, and their behaviors at the surface of the water. Behaviors such as foraging, resting, socializing with other animals, and taking care of their young may distract an animal from detecting approaching vessels. For the ESA-listed sharks and rays, these behaviors do not occur at the surface of the water, thereby reducing the likelihood of collisions with vessels during these critical behaviors. Telemetry data revealed that juvenile scalloped hammerhead sharks have a daytime preference for deeper water characterized by mud and silt (Duncan et al. 2006). Satellite-tagged adult scalloped hammerhead sharks frequently made deep dives (1,000 m) offshore at night, while mostly remaining in waters >100 m deep, and daytime shallower dives were commonly in water depths between 10 and 40 m (NMFS 2020). Based on the expected spatial distribution of sharks in deeper water depths, we are reasonably certain the likelihood of a vessel strike on ESA-listed sharks and rays is extremely unlikely, and therefore discountable.

Whales surface to breathe, with calves surfacing more regularly than adults. While at the surface, a whale is at risk of being struck by a vessel. There are few data on vessel strikes in Guam, but we have no indication that the rate of striking will be higher than it is in Hawaii. In a study by Lammers et al. (2003), 22 whale/vessel incidents were recorded between1975-2003, with 14 of those occurring during the years from 1994-2003. The vast majority (17) of the vessel strikes were from vessels traveling at speeds in excess of 15 knots, and nearly all of them occurred in close proximity to the coastline of the main four Hawaiian Islands Lammers et al. (2003).

Vessels used for the proposed action will be traveling at speeds less than 10 knots, they will use dedicated lookouts, limiting the already extremely low probability of a strike. Based on adherence to BMPs, the collision risks from the references cited above, and the low abundance and widely scattered nature of whales in the action area; the likelihood of an individual from the whale species listed in Table 1 being struck during the proposed action is extremely unlikely, and therefore discountable.

Waste discharge

The project may expose listed species to waste and discharge associated with use of equipment and vessels. Waste discharges will be avoided and minimized to the greatest extent practicable through development and implementation of an oil spill contingency plan contained within the SWPPP that will be required specific to the project activities. The SWPP is required to include measures to prevent and respond to inadvertent discharges into the marine environment. Petroleum, spill-containment devices (e.g., absorbent pads, containment booms) will be located on-site in sufficient quantity and available and accessible for immediate deployment at all times. All equipment and vehicles will be maintained and checked prior to the start of each day's activities to minimize the risk of discharge. Operators will perform daily pre-work equipment inspections for cleanliness and leaks. Should a leak be detected, all heavy equipment operations will be postponed or halted and will not proceed until the leak is repaired and equipment cleaned. Fueling of land-based vehicles and equipment will take place at least 50 ft. away from the water over an impervious surface. Fueling of vessels will be done at approved fueling facilities.

Vessels used for the dredge spoils disposal, translocation of corals and habitat restoration will only be allowed to work when weather and sea state conditions will not interfere with safe transportation and will be managed to avoid spills, leaks and loss of dredged material in transit to the G-DODS. Dredged material will not be leaked or spilled from disposal vessels during transit to the GDODS. Dredged material will only be discharged from the center of the surface disposal zone (i.e. center of the G-DODS) designated in the permit. No more than one disposal vessel will be present within the permissible dumping target area at any time. Each disposal vessel will be inspected and certified (EPA and USACE approved Scow Certification Checklist) prior to every trip to the G-DODS.

Based on implementation of BMPs including proper maintenance of all vessels and equipment, implementation of the SWPPP, and the containment of all construction materials and wastes, we are reasonably certain the risk of exposure of species listed in Table 1 to waste discharges is extremely unlikely, and therefore discountable.

Entanglement

Listed species in the action area may encounter anchor lines, turbidity curtains, cords, and ropes attached to tools, which could entangle them if contacted. Entanglement is potentially deadly or debilitating for marine species. BMPs will be implemented to minimize the potential for entanglement. Project debris and trash will be controlled so that it does not enter waters. Equipment will be managed so lines, chains, silt curtains, and flexible elements will be deployed only as long as necessary and monitored while in the water. The barge could be a site of potential entanglement risk, as it will be anchored in the water near the sensor array location. However, the barge anchor lines and all in-water equipment will be inspected and managed regularly and kept taut when deployed. All anchor lines, mooring lines, and lines attached to objects will be kept to the minimum length required and if tied, be pulled tight to minimize surface area and

probability of entanglement. Mooring lines will consist of a single line with no additional lines or material capable of entangling marine life attached to the mooring line or to any other part of the deployed system. All anchor lines, cords and tool lines will be temporary and would remain in the water only for the length of time necessary to complete construction. The applicant will monitor the work area for listed species and will halt activities when they are observed within 50 meters of work areas. Based on the proposed BMPs, and because marine species listed in Table 1 are likely to avoid the work areas, we are reasonably certain the risk of exposure to entanglement is extremely unlikely, and therefore insignificant.

Direct impacts from coral translocation

The habitat improvement actions at Mound 9 will include placement of limestone boulders, substrate stabilization, coral translocations and monitoring. We discussed the effects from noise and vessel strikes above. The Navy will use experienced coral biologists for this work. Divers will avoid interaction with species listed in Table 1 and those marine species will also naturally avoid divers. We are reasonably certain direct impacts on species listed in Table 1 from the coral translocations, habitat restoration, and monitoring will not rise to the level of harm or harassment, and therefore are insignificant.

No ESA-listed corals were observed during surveys of the translocation-associated areas and listed corals are not proposed for translocation. Based on the surveys conducted and the absence of listed corals, we are reasonably certain impacts from the coral translocations, habitat restoration and monitoring to *Acropora globiceps* are extremely unlikely, and therefore discountable.

Critical Habitat

The action area includes critical habitat for MHI insular false killer whales relative to vessel transit routes to Guam from Hawaii if additional vessels are needed for the project. BMPs will be implemented to avoid and minimize vessel/whale interactions including the use of whale lookouts on each vessel and avoidance of marine species. In the species analysis above, we were reasonably certain probabilities of waste discharges and vessel strikes on ESA-listed marine mammals are discountable and the effects from vessel noise are insignificant. Those conclusions also apply to MHI insular false killer whale critical habitat.

Conclusion

Considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available about the biology and expected behaviors of the ESA-listed marine species considered in this consultation; NMFS concurs with your determination that the proposed action is not likely to adversely affect the ESA-listed species in Table 1.

Similarly, considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available, all effects of the proposed action to essential features of critical habitat are discountable or insignificant. As a result, we concur with your determination that the proposed action is not likely to adversely affect MHI insular false killer whale.

This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs Federal agencies to consult with NMFS on all actions or proposed actions that

may adversely affect essential fish habitat (EFH). If necessary, it is your responsibility to request EFH consultation for this action with NMFS' Habitat Conservation Division.

Reinitiation Notice

ESA Consultation must be reinitiated if: 1) Take occurs to an endangered species, or to a threatened species for which NMFS has issued regulations prohibiting take under section 4(d) of the ESA; 2) new information reveals effects of the action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the identified action is subsequently modified in a manner causing effects to ESA-listed species or designated critical habitat not previously considered; or 4) a new species is listed or critical habitat designated that may be affected by the action.

If you have further questions, please contact Alice Berg at alice.berg@noaa.gov. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

GARRETT.ANN.M.1365883323 Digitally signed by GARRETT.ANN.M.1365883323 Date: 2021.10.06 10:52:43 -10'00'

Ann M. Garrett
Assistant Regional Administrator
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NMFS File No.: PIRO-2021-02037
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Department of Parks and Recreation
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Agaña Heights, Guam 96910

Dear Ms. Aguon,

Subject: CONSTRUCTION OF UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM AT APRA HARBOR, NAVAL BASE GUAM, MARIANAS ISLANDS

Pursuant to Section 106 of the National Historic Preservation Act (NHPA), Navy Base Guam (NBG) requests your review of the proposed project to construct and operate an Underwater Electromagnetic Measuring System (UEMMS) in Outer Apra Harbor, Guam (Enclosures 1 and 2). In accordance with Section 106 of the NHPA, we have reviewed the proposed project scope and determined that it is an undertaking as defined by 36 CFR 800.16 (y).

PROJECT DESCRIPTION

The proposed project is to establish a UEMMS in Outer Apra Harbor to measure the electromagnetic signatures and electric fields of surface ships and submarines (Enclosure 3). The UEMMS would consist of an array of 20 magnetic and electrical field sensors that would be installed underwater within the navigational channel (leading to Inner Apra Harbor). A cable would connect from the sensor array to an existing onshore facility to gather and store measured data. This project would enable NBG to support the calibration process which ensures that ships and submarines are in compliance with electromagnetic signatures limits to perform their existing mission and ongoing military operations.

The sensors would be installed in a single line arranged perpendicular to, and extending approximately 200 feet on either side of, the navigational channel center line. The sensors are 20 feet long and would be encased inside 10-inch diameter fiberglass tubes spaced about 20 feet apart, and buried approximately four feet deep below the existing ocean floor depth at -48 to -55 feet mean low water (MLW) (Enclosure 4). The excavation footprint for the sensor array will encompass a rectangular area approximately 20 feet wide by 400 feet long and 10-12 feet deep (excavation depth of up to -72 feet MLW). Sensor cables from the array will use a "deep water" route to connect to onshore facilities at Polaris Point with a transition vault to be constructed along the shoreline. The sensor cables would then connect

to data acquisition equipment in the [redacted] with data cables routed subsurface to the [redacted] for data transfer (see Enclosure 3).

AREA OF POTENTIAL EFFECT

The Area of Potential Effect (APE) includes underwater and terrestrial components. The underwater locations include the site of the sensor array within the navigational channel and the routing of the sensor cable from the array to the onshore facilities at Polaris Point. The APE took into consideration multiple variables that have the potential to affect historic properties including the direct effects from construction, as well as visual and auditory effects.

IDENTIFICATION OF HISTORIC PROPERTIES

Archaeology

There are no known archaeological resources identified either underwater or terrestrially. The onshore route of the data cable is within an area that has been determined to have no potential for archaeological resources (SEARCH 2015). Polaris Point is an artificial land segment constructed of dredged fill material from Apra Harbor during the late 1940s (Helgesson 1964). There is no integrity to these sediments and therefore no possibility of Pre-Contact or WWII sites. Hence, there are no concerns in terms of archaeological resources being present in the vicinity of the terrestrial portion of the project area above or below the ground surface (Enclosure 3).

Built Environment

Equipment used for the UEMMS operation would be installed within Buildings [redacted]. Neither of the facilities or the structures along the route of the cabling are eligible for inclusion on the National Register of Historic Places (Mason Architects 2009).

Underwater Archaeology

Although no known ship wrecks are within the area of the sensor array, or the route of the cabling, a magnetic survey of these areas was conducted to determine if any were present. No large magnetic return signals were observed within 200 feet of the navigation range with most detected features being debris (Ocean Surveys 2009). Although anomalies were located within the area of the sensor array, this is also within the navigational channel, which is dredged when necessary (Enclosure 5).

DETERMINATION OF EFFECT

In consideration of the above information, the Navy has made the determination of "No Historic Properties Affected" for the proposed project. In the unlikely event that any historic items are inadvertently discovered during activities associated with this project, the Standard Operating Procedures contained within the Final

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Integrated Cultural Resources Management Plan, Naval Base Guam, Joint Region Marianas (SEARCH 2015) will be followed as well as provisions of 36 CFR 800.13 Post-Review Discoveries.

We request your review and concurrence with our determination of effect within 30 days of receipt of this letter. We value your support of our efforts in continuing to carry out the United States Department of the Navy's responsibility in regards to the management of cultural resources located in its areas of operation.

Should you have any questions regarding this undertaking, please contact Mr. Lon Bulgrin at (671) 339-2093 or by email at lon.bulgrin@fe.navy.mil, or Mr. Jeffrey Fong at (808) 472-1383 or by email at jeffrey.fong@navy.mil.

Sincerely,

Ed Moon

E.E. Moon
Installation Environmental Program
Director
By Direction of the Commanding Officer

Enclosures: 1. UEMMS Project Location Map 1 (Aerial Photo)
2. UEMMS Project Location Map 2 (USGS Map)
3. UEMMS Site Plan
4. UEMMS Plan and Profile for Sensor Array
5. Magnetic Survey Results showing anomaly detection

Subject: CONSTRUCTION OF UNDERWATER ELECTROMAGNETIC MEASURING SYSTEM AT APRA HARBOR, NAVAL BASE GUAM, MARIANAS ISLANDS

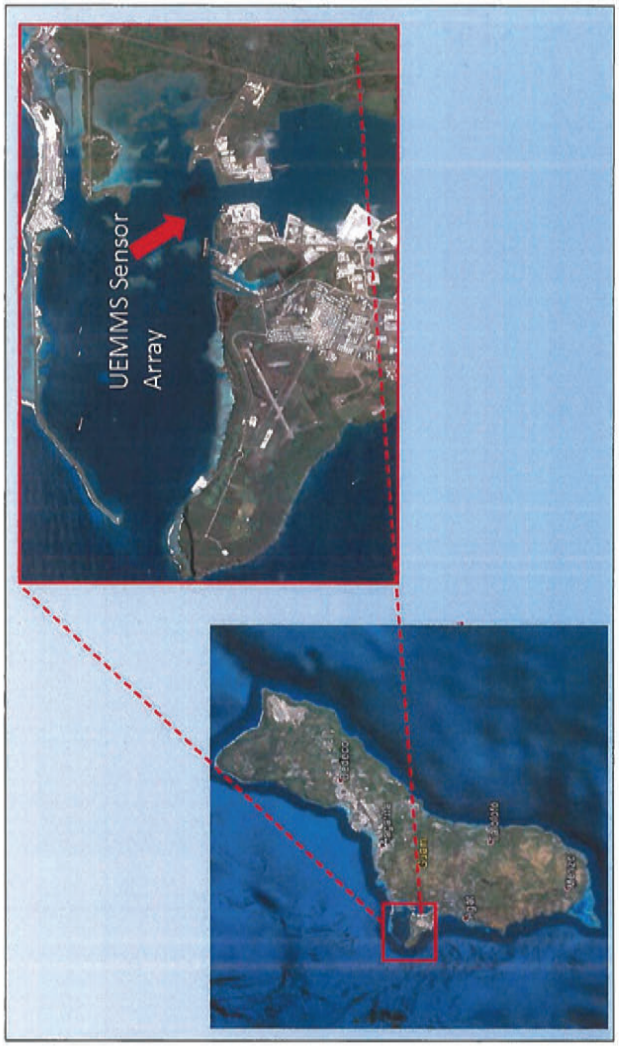
REFERENCES

Hegelson, L.A.
1964 Study of Apra Harbor: Apra Harbor Military Reservation Guam, M.I. Tudor Engineering Company, San Francisco, CA.

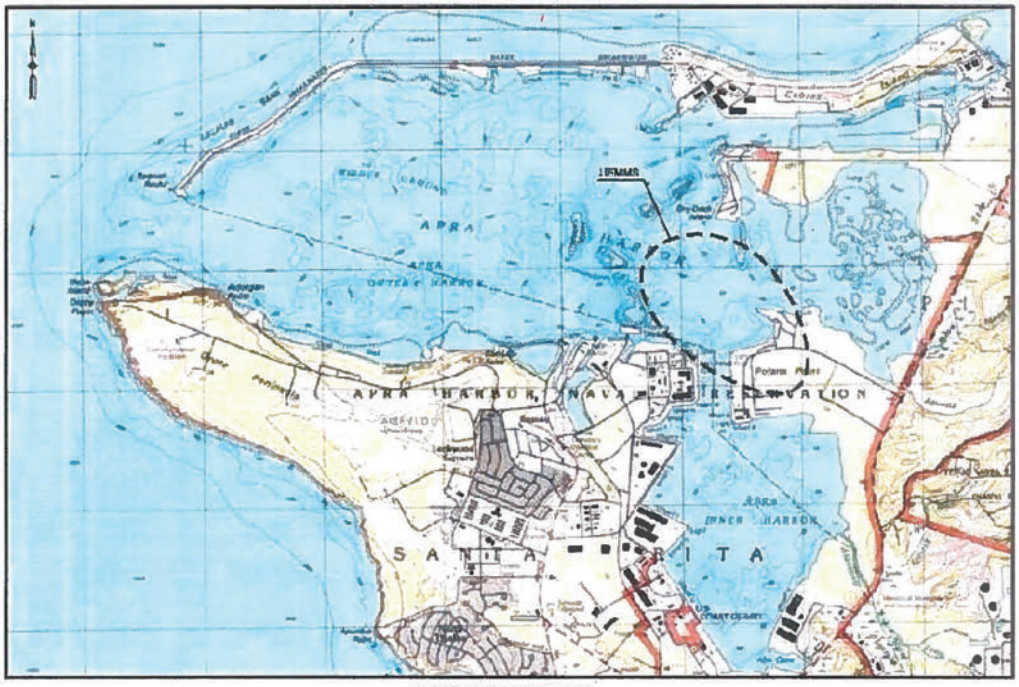
Mason Architects, Inc.
2010 *Cold War Historic Context and Architectural Inventory for Naval Base Guam: Main Base, Piti Power Station, Drydock Island and Polaris Point*. Prepared for Department of the Navy, Naval Facilities Engineering Command, Pacific and Commander Navy Region Marianas. Honolulu, HI.

Ocean Surveys, Inc.
2009 *Final Report: Geophysical Survey Proposed Magnetic Measurement Range, Apra Harbor, Guam. OSI Report No. 08ES086*. Prepared for EG&G Technical Services, Inc. and Naval Sea Systems Command. Old Saybrook, CT.

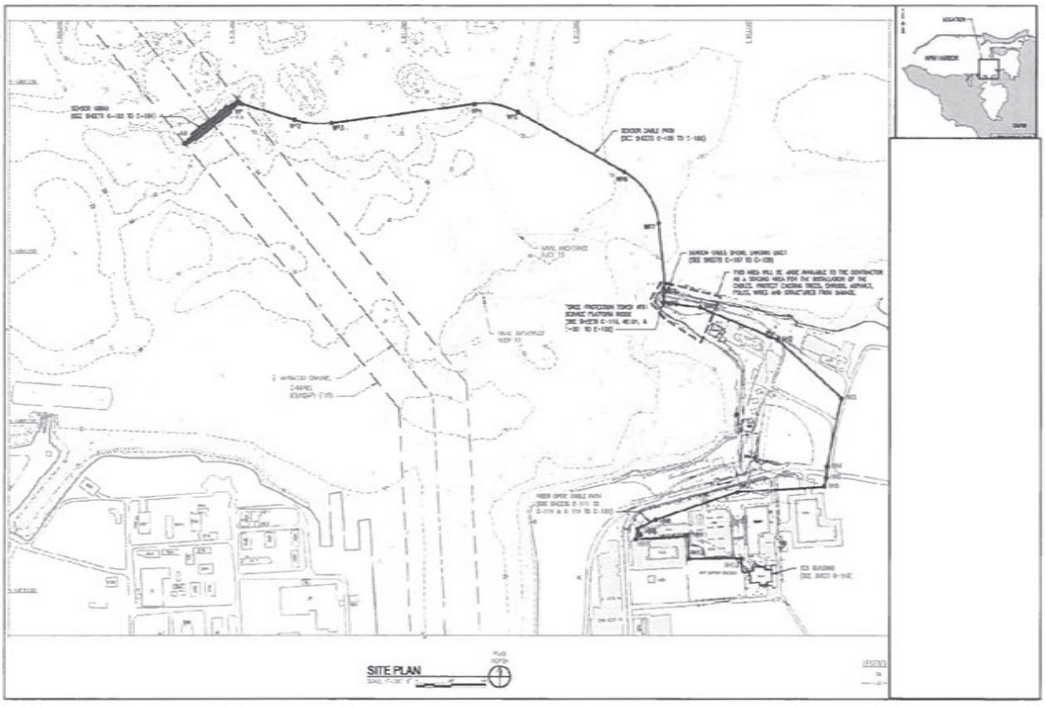
Southeastern Archaeological Research, Inc. (SEARCH)
2015 *Final Integrated Cultural Resources Management Plan Naval Base Guam, Joint Region Marianas*. Prepared for Naval Facilities Engineering Command, Marianas



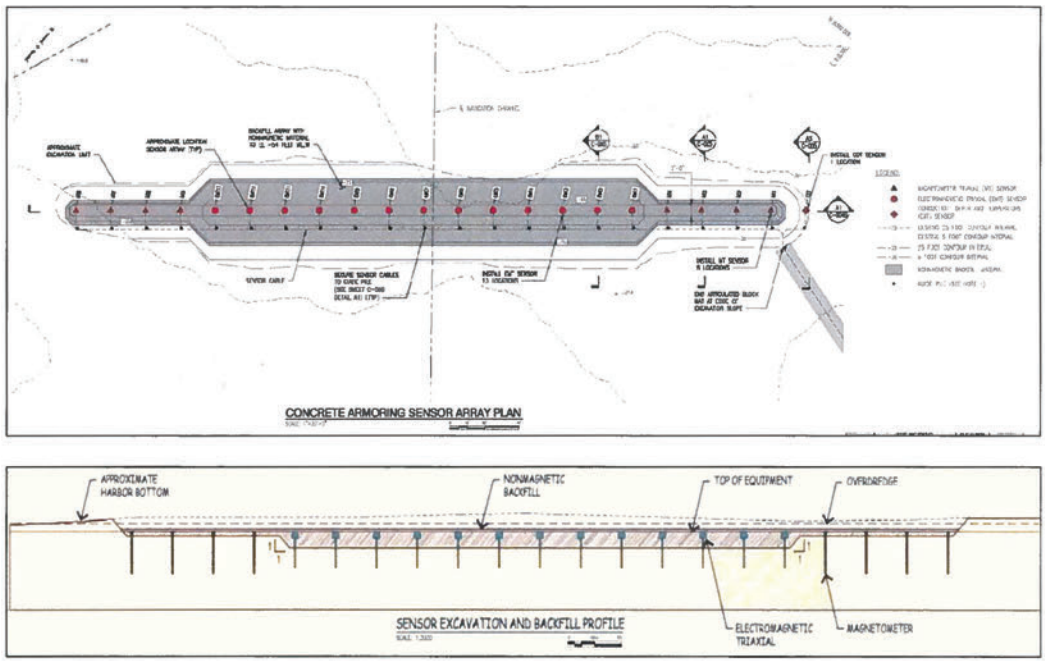
Enclosure 1. UEMMS Project Location Map 1 - Aerial Photo.



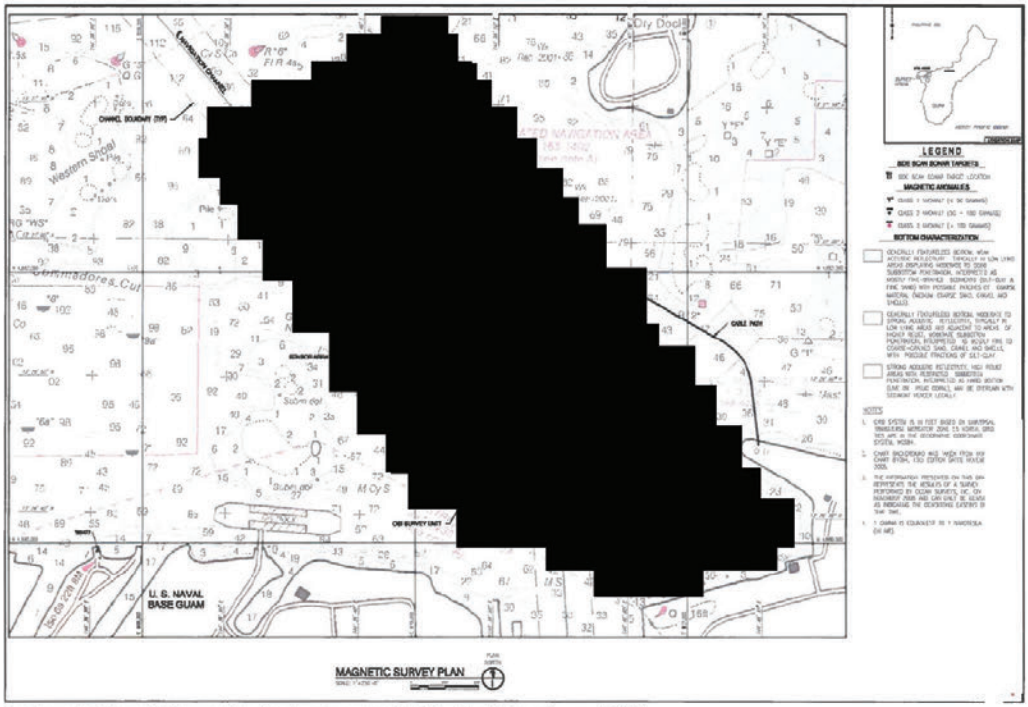
Enclosure 2. UEMMS Project Location Map 2 - USGS Map.



Enclosure 3. UEMMS Site Plan.



Enclosure 4. UEMMS Sensor Array Plan and Profile drawings.



Enclosure 5. Magnetic Survey Results showing anomaly detection (Ocean Survey 2009).

Lourdes A. Leon Guerrero
Governor
Joshua F. Tenorio
Lt. Governor

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Dipattamenton Plaset yan Dibuetsion
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#1 Paseo de Susana, Hagåtña, Guam 96910
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Richard Y. Ybanez
Acting Director
Victor R. Villagomez
Deputy Director

In reply refer to:
RC2019-0180

July 5, 2019

E.E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer
Department of the Navy
U.S. Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000

Subject: Section 106 Review of:
Construction of Underwater Electromagnetic Measuring System at Apra Harbor, Naval Base Guam, Mariana Islands
5090 Ser EV/0490 June 6, 2019

Dear Mr. Moon:

We have reviewed the subject Section 106 undertaking and concur with the Navy's determination of "No Historic Properties Affected." The Navy proposes to construct and operate an Underwater Electromagnetic Measuring System (UEMMS) in outer and inner Apra Harbor Area of Potential Effect (APE), which includes the site of the sensor array within the navigational channel, and the routing of the sensor cable from the array to the onshore facilities at Polaris Point, to Buildings [redacted] and [redacted]

In the event that historic properties are discovered during activities within outer-inner Apra Harbor and Onshore APE, associated with the subject undertaking, the Standard Operation Procedures of the Final ICRMP, Naval Base Guam, Joint Region Marianas, as well as the 36 CFR Sec.800.13 Post-review discoveries, will be followed.

Should you have any questions or need clarification, please do not hesitate to contact Mr. Jose (Joe) Garrido at 475-6292 or Mr. John Mark Joseph at 475-6339.

Sincerely,

Richard Y. Ybanez
Acting Director

Patrick Q. Lujan
Acting State Historic Preservation Officer

Cc: Lon Bulgrin, CRM, NAVFAC Marianas
lon.bulgrin@fe.navy.mil

GUAM COASTAL MANAGEMENT PROGRAM

ASSESSMENT FORMAT

DATE OF APPLICATION: 23 September 2021
NAME OF APPLICANT: Jeffrey Lambrecht, Environmental Planner for Naval Base Guam
ADDRESS: Naval Facilities Engineering Systems Command Marianas, ATTN: EV Jeff Lambrecht PSC 455 Box 195, FPO AP 96540-2937

TELEPHONE NO.: (671) 339-2587 Fax No. _____ Cell No: _____
E-MAIL ADDRESS: Jeffrey.lambrecht@fe.navy.mil

TITLE OF PROPOSED PROJECT: Underwater Electromagnetic Measurement System

COMPLETE FOLLOWING PAGES

FOR BUREAU OF STATISTICS AND PLANS ONLY:

DATE APPLICATION RECEIVED: _____

OCRM NOTIFIED: _____ LIC. AGENCY NOTIFIED: _____
APPLICANT NOTIFIED: _____ PUBLIC NOTICE GIVEN: _____
OTHER AGENCY REVIEW

REQUESTED: _____

DETERMINATION:
( ) CONSISTENT ( ) NON-CONSISTENT ( ) FURTHER INFORMATION REQUESTED

OCRM NOTIFIED: _____ LIC. AGENCY NOTIFIED: _____
APPLICANT NOTIFIED: _____
ACTION LOG:

1. _____
2. _____
3. _____
4. _____
5. _____

DATE REVIEW COMPLETED: _____

DEVELOPMENT POLICIES (DP):

DP 1. Shore Area Development

Intent: To ensure environmental and aesthetic compatibility of shore area land uses.

Policy: Only those uses shall be located within the Seashore Reserve which:

- enhance, are compatible with or do not generally detract from the surrounding coastal area's aesthetic and environmental quality and beach accessibility; or
- can demonstrate dependence on such a location and the lack of feasible alternative sites.

Discussion: DP 1 is not applicable. The project is not located within Guam's Seashore Reserve.

DP 2. Urban Development

Intent: To cluster high impact uses such that coherent community design, function, infrastructure support and environmental compatibility are assured.

Policy: Commercial, multi-family, industrial and resort-hotel zone uses and uses requiring high levels of support facilities shall be concentrated within appropriate zone as outlined on the Guam Zoning Code.

Discussion: DP 2 is not applicable. The project does not involve introduction of high impact uses such as commercial, multi-family residential, or resort-hotel uses. After construction, operation of the UEMMS would include passive acquisition of electromagnetic measurement data with minimal supporting activities.

DP 3. Rural Development

Intent: To provide a development pattern compatible with environmental and infrastructure support suitability and which can permit traditional lifestyle patterns to continue to the extent practicable.

Policy: Rural districts shall be designated in which only low density residential and agricultural uses will be acceptable. Minimum lot size for these uses should be one-half acre until adequate infrastructure including functional sewering is provided.

Discussion: DP 3 is not applicable. The project does not involve new development in a rural district and does not involve residential or other new urban development.

DP 4. Major Facility Siting

Intent: To include the national interest in analyzing the siting proposals for major utilities, fuel and transport facilities.

Policy: In evaluating the consistency of proposed major facilities with the goals, policies, and standards of the Comprehensive Development and Coastal Management Plans, Guam shall recognize the national interest in the siting of such facilities, including those associated with electric power production and transmission, petroleum refining and transmission, port and air installations, solid waste disposal, sewage treatment, and major reservoir sites.

Discussion: The proposed project is consistent with DP 4. The project does not involve major new utility, fuel, or transportation facilities. It supports the national interest by installing equipment that would improve the Department of Defense's (DoD) efficiency and effectiveness in protecting U.S. Navy ships and submarines from detection and threats by hostile forces.

DP 5. Hazardous Areas

Intent: Development in hazardous areas will be governed by the degree of hazard and the land use regulations.

Policy: Identified hazardous lands, including flood plains, erosion-prone areas, air installations' crash and sound zones and major fault lines shall be developed only to the extent that such development does not pose unreasonable risks to the health, safety or welfare of the people of Guam, and complies with the land use regulations.

Discussion: The proposed project is consistent with DP 5. The project will continue existing land and water uses and not involve new development in hazardous areas. Based on Flood Insurance Rate Maps for the area, the proposed UEMMS would be partially located in Zone A Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood, No Base Flood Elevations determined. However, all of the landside infrastructure would be located either below grade or within existing structures and would not affect the existing floodplain area or function. The in-water components would be either below the seafloor or have a minimal profile (e.g., sensor array, CTD sensor, and subsea cables). The cable shore landing area on Polaris Point would be excavated and generally returned to pre-construction conditions; no changes in ground elevations or grade are proposed or anticipated. No development would occur in erosion-prone areas or air installations' crash and noise zones and the project would not pose unreasonable risks to the health, safety, or welfare of the people of Guam.

DP 6. Housing

Intent: To promote efficient community design placed where the resources can support it.

Policy: The government shall encourage efficient design of residential areas, restrict such development in areas highly susceptible to natural and manmade hazards, and

recognize the limitations of the island's resources to support historical patterns of residential development.

Discussion: DP 6 is not applicable. The project does not involve residential development.

DP 7. Transportation

Intent: To provide transportation systems while protecting potentially impacted resources.

Policy: Guam shall develop an efficient and safe transportation system, while limiting adverse environmental impacts on primary aquifers, beaches, estuaries, coral reefs and other coastal resources.

Discussion: The proposed project is consistent with DP 7. The project does not involve the construction of new public roadways or other transportation systems. The UEMMS sensor array and related in-water infrastructure would be placed at depths that would not impact navigation in Apra Harbor. Landside improvements associated with the UEMMS would be located below grade or within existing structures and would not increase stormwater runoff into adjacent coastal resources. Best management practices (BMPs) would avoid or minimize potential construction period contaminants from being transported from the terrestrial project area to receiving waters and coastal resources. The CDF sites are contained within earthen berms and stormwater runoff is properly managed to avoid sediment or pollutant transport offsite. During the operational period, there would be little to no potential for the UEMMS components to adversely affect wetland areas, as the terrestrial cables would be contained below grade or within existing structures.

DP 8. Erosion and Siltation

Intent: To control development where erosion and siltation damage is likely to occur.

Policy: Development shall be limited in areas of 15% or greater slope by requiring strict compliance with erosion, sedimentation, and land use regulations, as well as other related land use guidelines for such areas.

Discussion: The proposed project is consistent with DP 8. The project would employ BMPs and a Storm Water Pollution Prevention Plan (SWPPP) would be developed by the installation contractor to reduce on-site erosion and off-site sedimentation. The project would comply with permit conditions of its required NPDES permit and Clean Water Act (CWA) Section 401 Water Quality Certification permit to avoid or minimize erosion and sedimentation resulting from construction activities. The contractor would prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains.

RESOURCES POLICIES (RP):

RP 1. Air Quality

Intent: To control activities to insure good air quality.

Policy: All activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.

Discussion: The proposed project is consistent with RP 1. The project would not introduce major new air emissions sources or stationary air emissions sources and the proposed activity would comply with applicable air pollution regulations and air quality standards. Short-term, temporarily-emitted air emissions (e.g., fugitive dust, combustion of fossil fuels) would be generated during the construction period. BMPs would be implemented to minimize fugitive dust during construction. Example BMPs include using wind screens, keeping adjacent paved roads clean, covering of open-bodied trucks, limiting the area that is disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked.

During the operational period, use of the sensor array would not increase ship traffic from either homeported or transient vessels at NBG. Operation of the UEMMS would not increase the movements to or from Apra Harbor of NBG homeported vessels and would not generate demand for field signature measurement of transient vessels. Operation of the UEMMS is not expected to effect on-base or on-island staffing levels and traffic because current NBG staff would assume the role of collecting its data.

The proposed project is located within a nonattainment area for sulfur dioxide. Total construction sulfur dioxide emissions are expected to be below de minimis thresholds for Clean Air Act general conformity, and the project would not trigger a general conformity determination under Section 176(c) of the Clean Air Act. The Navy prepared a Record of Non-Applicability for Clean Air Act Conformity.

RP 2. Water Quality

Intent: To control activities that may degrade Guam's drinking, recreational, and ecologically sensitive waters.

Policy: Safe drinking water shall be assured and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuaries, reef and aquifer areas.

Discussion: The proposed project is consistent with RP 2. The project area is not located over a drinking water source and would have no impact on Guam’s drinking water. In-water construction activities would require a Clean Water Act Section 404/Rivers and Harbors Act Section 10 permit from the U.S. Army Corps of Engineers and would comply with the conditions of these permits. Construction period BMPs would be employed and a SWPPP will be developed by the construction contractor to reduce on-site erosion and off-site sedimentation into receiving waters that may be ecologically

sensitive or support recreation. For example, silt containment devices would installed immediately adjacent to and around the dredge barge, around the cable excavation area at Polaris Point, and along the shoreline at Polaris Point. No in-water construction would occur during the spawning period for both hard (scleractinian) and soft (octocorallia) corals and a rigorous water quality monitoring plan would be implemented to continuously monitor and adaptively manage turbidity levels resulting from the project's in-water work. During terrestrial construction activities, the construction contractor would prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains. Fueling of construction vehicles and equipment at least 50 feet away from water and within a containment area. Complying with the NPDES permit and CWA Section 401 Water Quality Certification conditions will also avoid or minimize pollution risks to nearby recreational and ecologically sensitive areas.

RP 3. Fragile Areas

Intent: To protect significant cultural areas, and natural marine and terrestrial wildlife and plant habitats.

Policy: Development in the following types of fragile areas including Guam's Marine Protected Areas (MPA) shall be regulated to protect their unique character.

- historical and archeological sites
- wildlife habitats
- pristine marine and terrestrial communities
- limestone forests
- mangrove stands and other wetlands
- coral reefs

Discussion: The proposed project is consistent with RP3 to the maximum extent practicable with the implementation of BMPs and proposed impact avoidance, minimization, and offset measures, including those identified in the project's ESA Section 7 and Essential Fish Habitat consultations (see Enclosure 3 for correspondence). Specific fragile areas identified in RP 3 are addressed in the subsections below.

Historical and Archaeological Sites. The project would have no impacts to cultural resources during project construction or operation. No archaeological resources, historic architectural resources, or traditional cultural properties exist in the project area, including the construction staging area. In accordance with Section 106 of the National Historic Preservation Act (NHPA), the Navy consulted with the Guam Historic Preservation Officer regarding the undertaking. In consideration of the information on terrestrial and underwater archaeology and the built environment, DON determined that there would be no historic properties affected by the Proposed Action under NHPA Section 106. By letter dated July 5, 2019, the Guam Historic Preservation Officer concurred with the Navy's determination

(see correspondence in Enclosure 3).

Terrestrial Wildlife Habitats (including pristine terrestrial communities and limestone forests). No development is proposed in terrestrial project area in pristine terrestrial wildlife habitats or limestone forest areas. Minor and temporary impacts to terrestrial vegetation would occur from land-based construction activities. Project construction activities would occur in locations that have been previously disturbed and do not include limestone forest. The project would not impact any federal- or Guam-listed endangered plant because there are no protected terrestrial vegetation species known to occur in the project area or surrounding areas.

Minor and temporary impacts to terrestrial wildlife may occur from land-based construction activities. Minimal areas of vegetation may be cleared during construction, and noise and human activity would increase during construction. Because construction activities are expected to occur during normal daytime work hours, additional lighting is not anticipated. The project would not have a significant impact on terrestrial wildlife because there is no native terrestrial wildlife in the project area. No impacts would occur to any federal- or Guam-listed threatened or endangered animal, birds protected under the Migratory Bird Treaty Act, and Guam-designated species of greatest conservation need. No foraging, nesting, or roosting sites for protected animals were identified in the project area. Ponded water, which could attract migrating birds, is not anticipated to occur in the CDFs. If the CDF becomes an attractive site for migrating birds, installation land managers and construction contractors would discourage use of the sites by migratory birds through various means, such as deploying decoys and using noise makers. Because UEMMS terrestrial operations would consist of data transmission and acquisition that occur below grade or within existing structures, operational period impacts to terrestrial wildlife habitats are not anticipated.

Marine Wildlife Habitats (including pristine marine communities and coral reefs). The project area includes three sites within Outer Apra Harbor: sensor array site, subsea cable route, and cable shore landing at Polaris Point. The project would directly impact approximately 16,000 square feet (sq ft) of benthic substrate in Outer Apra Harbor, including impacts to corals and soft-sediment infauna. Indirect impacts from in-water construction activity are presumed in the marine waters adjacent to and up to an approximately 410-foot (ft) radius of the in-water work. During the operational period, project-related activities (e.g., maintenance and repair) would be minimal and infrequent due to the passive nature of UEMMS operations, resulting in less than significant impacts to coral.

There is no designated critical habitat in Apra Harbor, including the project area. Only three ESA-listed species (green sea turtle [*Chelonia mydas*], hawksbill sea turtle [*Eretmochelys imbricata*], and scalloped hammerhead shark [*Sphyrna lewini*]) have reasonable potential to occur where most of the Proposed Action would occur. No ESA-listed coral species (e.g., *Acropora globiceps*) were observed within the project area. Based on the anticipated low occurrence of ESA-listed species within the project area, the Navy determined that project has the potential to affect, but is not likely to adversely affect ESA-listed species, as such adverse effects have been determined either insignificant or discountable. See Enclosure 2 for correspondence.

A 2020 marine survey of the project area found that substantial healthy coral communities fall within the UEMMS footprint, with high percent coral cover occurring in a majority of the direct impact area. The survey and photogrammetric orthomosaics image analysis found that the overall dominant biotic

cover comprises hard substrate, with coral, algae (macro & cyanobacteria), other fauna (sponge, sessile invertebrates, etc.), and sand or silt substrate cover varying by location (i.e., direct vs. indirect impact area). In the direct impact area, 33 species of fish were documented. Two turtles (one green and one hawksbill turtle) were observed surfacing in or near the direct impacts area on separate occasions during the 2020 survey.

The subsea cable route contains fine, unconsolidated sediments along the majority of the route in water depths greater than 59 ft. At the seaward end of the cable corridor (subsea slope immediately east of the array), coral habitat was similar to that found within the UEMMS array footprint. There is low coral abundance at depths of 45 ft along the cable route. Sponges and macroalgae were present in limited locations along the cable route, but the shore approach was entirely sand and rubble. The Polaris Point shore landing survey area crossed the steep slope to the shore, and comprised a predominantly disturbed sand and coral rubble substrate with low coral abundance.

The project would result in the physical removal of 7,680 coral communities (7,535 in the sensor array footprint and 145 in the cable shore landing footprint) and increased suspended sediments that would adversely impacts corals in and adjacent to the project area during the construction period. The following environmental stressors on coral in the project area unlikely to occur due to project construction: wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and unexploded ordnance (UXO). The implementation of avoidance, minimization, and offset actions would result in less than significant impacts to these coral communities (see Enclosure 3 for details). Avoidance measures include establishing a subsea cable route that avoids corals and utilizing diver-guided cable installation to avoid sensitive benthic resources. Minimization measures include revising the project design to reduce the excavation area needed to install the sensor array; relocating the CTD sensor closer to the array to reduce impacts to coral resources; selecting a subsea cable attachment method that has fewer impacts to benthic communities; and translocating about 6,300 corals and maintaining and monitoring the translocated corals. Measures to offset temporary losses of biological services include habitat restoration and conservation of 35,240 sq ft at Mound 9 (24,590 sq ft to offset coral cover loss and 10,650 sq ft to offset EFH loss).

Mangrove Stands and Other Wetlands. There are no mangrove stands or delineated wetlands within the project area or CDF sites. Aside from the excavation activities related to the sensor cable shore landing on Polaris Point, there would be no subsurface work. Adherence to the project's NPDES permit conditions, BMPs, and provisions of its forthcoming SWPPP would avoid or minimize potential contaminants from being transported from the terrestrial project area on Polaris Point to the nearest wetlands, an approximately 4-acre mangrove wetland about 1,300 feet east of the proposed construction staging area. The CDF sites are contained within earthen berms and stormwater runoff is properly managed to avoid sediment or pollutant transport offsite.

Coral Reefs. See discussion above under RP 3 "Marine Wildlife Habitats."

RP 4. Living Marine Resources

Intent: To protect marine resources in Guam's waters.

Policy: All living resources within the waters of Guam, particularly fish, shall be protected from over harvesting and, in the case of corals, sea turtles and marine mammals,

from any taking whatsoever.

Discussion: The project is consistent with RP 4. The ESA Section 7 and Essential Fish Habitat consultation materials (Enclosure 2) provide analyses of impacts on fish, corals, sea turtles, and marine mammals, including avoidance, minimization, and offset actions to protect marine resources in Guam's waters.

Essential Fish Habitat. The project has the potential to affect EFH through physical removal (likely), increased suspended sediments (likely), elevated underwater noise levels (unlikely), wastes and discharges (unlikely), aquatic invasive species (unlikely), chemical contaminants (unlikely), hypoxia (unlikely), and UXO (unlikely). With the implementation of avoidance and minimization measures, the impacts would be temporary and indirect in all cases except the physical removal of marine invertebrate community. The Navy conducted EFH consultation with NOAA Fisheries and determined that the project would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for Bottomfish and Seamount Groundfish Management Unit Species and Pelagic Management Unit Species within Apra Harbor (see Enclosure 3 for consultation correspondence). The indirect adverse effects to EFH from project-related degradation of water quality would be minimized through implementation of appropriate silt-containment BMPs. Unavoidable loss of ecosystem function and services that support Management Unit Species would be minimized through implementation of the proposed coral transplantation plan. Due to the containment of impacts to Apra Harbor, the quantity and quality of the EFH within the harbor, the size and scale of the impacts, implementation of temporary and permanent avoidance and minimization measures built into the project and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion of 10,650 sq ft at Mound 9), the Navy determined that the anticipated impacts do not have the potential to cause substantial adverse effects to EFH.

During the operational period, the project would have less than significant impacts on EFH in Apra Harbor. Operation of the UEMMS would not involve additional structural changes to the benthic habitat, increased sediment resuspension, elevated noise levels, additional waste, discharge, or chemical contaminants, exposure to aquatic invasive species, hypoxia, or UXO.

By letter dated July 21, 2021, NMFS agreed with the Navy's EFH determination that the Proposed Action would adversely affect EFH and result in unavoidable loss (see Enclosure 3) and agreed that the Navy's proposed mitigation that includes avoidance (BMPs), minimization through the translocation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. In its July 2021 letter, NMFS also proposed conservation measures to ensure that adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated. A summary of these conservation measures and the Navy's corresponding response follow (see Enclosure 3 for the full text of the Navy's response letter, dated August 18, 2021).

Conservation Recommendation 1: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify coral recruitment and growth over time (i.e., out years) at Mound 9. The Navy should consider coordinating this monitoring plan with actions listed in the 2019 JRM INRMP and consider including Mound 9 surveys in the next INRMP update.

Discussion: The Navy will develop a two-year monitoring and maintenance plan consistent with the five-year adjacent monitoring for the Lima, Mike, and November Wharves translocation project at Mound 9.

The Navy agrees that the monitoring plan for all Mound 9 projects should consider aligning with the 2019 JRM INRMP, and will consider including funding to support long-term monitoring events at Mound 9 within the next update to the JRM INRMP.

Conservation Recommendation 2: The Navy should ensure that in-water construction and mitigation activities avoid any unnecessary contact with marine organisms by divers and/or materials, and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

Discussion: The Navy agrees with this Conservation Recommendation and will ensure that the appropriate BMPs are implemented during coral translocation, benthic surveys, boulder deployment, benthic stabilization activities, sensor installation, and cable deployment and anchoring activities to avoid unnecessary contact with marine organisms. To the best of their ability, all divers will avoid exposing corals directly or indirectly to toxicopathological agents.

Conservation Recommendation 3: To ensure that the translocation of coral colonies from the *Porites rus* complex (>80% of corals in the action area) is meeting early survivorship targets, the Navy should provide NMFS a monitoring report after each monitoring event.

Discussion: The Navy agrees with this Conservation Recommendation and will ensure that subject monitoring reports will be provided to NMFS upon completion of the coral translocation and after both subsequent monitoring events (at 12 and 24 months). The Navy agrees to coordinate with NMFS if the rate of survival does not meet the 70% survivorship target after the final monitoring period.

RP 5. Visual Quality

Intent: To protect the quality of Guam's natural scenic beauty

Policy: Preservation and enhancement of, and respect for the island's scenic resources shall be encouraged through increased enforcement of and compliance with sign, litter, zoning, subdivision, building and related land-use laws. Visually objectionable uses shall be located to the maximum extent practicable so as not to degrade significant views from scenic overlooks, highways and trails.

Discussion: The proposed project is consistent with RP 5. All the project components would be located under water, below grade (onshore), or within existing facilities and would not affect existing scenic resources. Onshore disposal of excavated material resulting from project construction would occur in existing permitted facilities (Orote Airfield CDF or Field 5 CDF), which are generally screened from public view points by vegetation.

RP6. Recreation Areas

Intent: To encourage environmentally compatible recreational development.

Policy: The Government of Guam shall encourage development of varied types of recreational facilities located and maintained so as to be compatible with the surrounding environment and land uses, adequately serve community centers and urban areas and protect beaches and such passive recreational areas as wildlife,

marine conservation and marine protected areas, scenic overlooks, parks, and historical sites.

Developments, activities and uses shall comply with the Guam Recreational Water Use Management Plan (RWUMP).

Discussion: The proposed project is consistent with RP 6. The project does not involve development of recreational facilities. It would not impede or otherwise affect Guam's existing recreational areas or facilities.

RP 7. Public Access

Intent: To ensure the right of public access.

Policy: The public's right of unrestricted access shall be ensured to all non-federally owned beach areas and all Guam recreation areas, parks, scenic overlooks, designated conservation areas and their public lands. Agreements shall be encouraged with the owners of private and federal property for the provision of releasable access to and use of resources of public nature located on such land.

Discussion: The proposed project is consistent with RP 7. The terrestrial project area is located within existing Navy-controlled land, which does not provide access to Guam's public recreation areas. While recreational vessels may traverse the waters near the sensor array construction area, construction activities would not restrict public access to public beaches or other recreation areas. During the operational period, all of the UEMMS components would either be secured to the seafloor at depths that would not affect navigation, or located below grade or within existing facilities at Polaris Point.

RP 8. Agricultural Lands

Intent: To stop urban types of development on agricultural land.

Policy: Critical agricultural land shall be preserved and maintained for agricultural use.

Discussion:
RP 8 is not applicable. The project is not located on agricultural lands.

FEDERAL CONSISTENCY

SUPPLEMENTAL INFORMATION FORM

Date: 23 September 2021

Project/Activity Title or Description: Underwater Electromagnetic Measurement System

Location: Piti, Guam

Other applicable area(s) affected, if appropriate: _____

Est. Start Date: May 2022 Est. Duration: 10 months

APPLICANT

Name & Title: Jeffrey Lambrecht, Environmental Planner

Agency/Organization: Department of the Navy, Joint Region Marianas

Address: PSC 455, Box 195, FPO AP

_____ Zip Code 96540-2937

Telephone No. during business hours:

A/C (671) 339-2587

A/C (___) _____

Fax (___) _____

E-mail Address: _____

AGENT

Name & Title: _____

Agency/Organization Address: _____

Zip Code: _____

Telephone No. during business hours:

A/C (___) _____

A/C (___) _____

Fax (___) _____

E-mail Address: _____

CATEGORY OF APPLICATION (check one only)

(x) I - Federal Agency Activity
( ) II - Federal Permit or License
( ) III - Federal Grants & Assistance

TYPE OF STATEMENT (check one only) (x)

(x) Consistency
( ) General Consistency (Category I only)
( ) Negative Determination (Category I only) ( )
Non-Consistency (Category I only)

APPROVING FEDERAL AGENCY (Categories II & III only)

Agency _____

Contact Person _____

Telephone No. during business hours:
Area Code ( )_____
Area Code ( )_____

FEDERAL AUTHORITY FOR ACTIVITY

Title of Law Title 10 – Armed Forces, United States Code
Section Subtitle A – General Military Law, Part IV Service, Supply, and Procurement

OTHER GUAM APPROVALS REQUIRED:

Agency	Type of Approval	Date of Application	Status
NOAA National Marine Fisheries Service	Completion of Essential Fish Habitat Consultation	June 15, 2021	Consultation completed Aug. 18, 2021
NOAA National Marine Fisheries Service	Completion of Endangered Species Act (ESA) Section 7 Consultation	Consultation initiated	Reference concurrence letter when available
U.S. Army Corps of Engineers	Clean Water Act 401 Water Quality Certification	Pending	Pending submittal of applications
U.S. Army Corps of Engineers	Section 10 Rivers and Harbors Act permit	Pending	Pending submittal of applications
State Historical Preservation Office	Section 106 concurrence	June 12, 2019	Consultation completed July 5, 2019

Lourdes A. Leon Guerrero
Governor of Guam

Joshua F. Tenorio
Lieutenant Governor

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Tyrone J. Taitano
Director
Matthew Santos
Deputy Director

DEC 23 2021

Edward Moon
Director
U.S. Naval Base Guam
Department of the Navy
PSC 455 Box 152
FPO AP 96540-1000

RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for Department of the Navy's proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor (GCMP FC 2021-0041)

Hafa adai! The Guam Coastal Management Program of the Bureau of Statistics and Plans (Bureau) has completed its review of the Federal Consistency Determination by Department of the Navy received on October 13, 2021. The Department of the Navy ("the federal agency") has submitted its consistency determination relative to its proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor.

The Bureau coordinated this review with partnering agencies, provided Public Notice, and received comments from the Department of Agriculture, the Department of Land Management, and the Guam Waterworks Authority. Furthermore, the Bureau hereby concurs with the federal agency's determination that the proposal is consistent with the enforceable policies of the Bureau's Guam Coastal Management Program (GCMP) based upon the following comments and conditions:

Resource Policy 1. Air Quality. *All activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.*

The federal agency represents:

> "Short-term, temporarily-emitted air emissions (e.g., fugitive dust, combustion of fossil fuels) would be generated during the construction period. BMPs would be implemented to minimize fugitive dust during construction. Example BMPs include using wind screens, keeping adjacent paved roads clean, covering of open-bodied trucks, limiting the area that is disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked."

Resource Policy 2. Water Quality. *Safe drinking water shall be assured and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuarine, reef and aquifer areas.*

The federal agency agrees that "there is a potential for spillover effects to mobile in-water resources" from its project and that, therefore, they have "concluded the project has foreseeable coastal effects to Guam's defined coastal zone."

The federal agency further represents:

> "The project would employ BMPs and a Storm Water Pollution Prevention Plan (SWPPP) would be developed by the installation contractor to reduce on-site erosion and off-site sedimentation. The project would comply with permit conditions of its required NPDES permit and Clean Water Act (CWA) Section 401 Water Quality Certification permit to avoid or minimize erosion and sedimentation resulting from construction activities. The contractor would prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains."

The federal agency additionally represents:

> "In-water construction activities would require a Clean Water Act Section 404/Rivers and Harbors Act Section 10 permit from the U.S. Army Corps of Engineers and would comply with the conditions of these permits. Construction period BMPs would be employed and a SWPPP will be developed by the construction contractor to reduce on-site erosion and off-site sedimentation into receiving waters that may be ecologically sensitive or support recreation. For example, silt containment devices would installed immediately adjacent to and around the dredge barge, around the cable excavation area at Polaris Point, and along the shoreline at Polaris Point. No in-water construction would occur during the spawning period for both hard (scleractinian) and soft (octocorallia) corals and a rigorous water quality monitoring plan would be implemented to continuously monitor and adaptively manage turbidity levels resulting from the project's in-water work. During terrestrial construction activities, the construction contractor would prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains. Fueling of construction vehicles and equipment at least 50 feet away from water and within a containment area. Complying with the NPDES permit and CWA Section 401 Water Quality Certification conditions will also avoid or minimize pollution risks to nearby recreational and ecologically sensitive areas."

The construction phase of the proposed action will result in disturbance of the ground surface. Thus, the ground surface must be protected through appropriate implementation of erosion and sediment control (E&SC) Best Management Practices (BMPs)

Construction vehicles and equipment may be a source of leakage of oil, hydraulic fluids, or other contaminants of concern if not properly maintained and preventative measures are not taken in the event of inadvertent leakage.

Pursuant to Resource Policy 2, Water Quality, the federal agency shall:

(1) protect the ground surface through appropriate implementation of erosion and sediment control (E&SC) Best Management Practices (BMPs) installed in accordance with the

Guam Soil Erosion and Sediment Control Regulations, in 22 GAR Chapter 10. E&SC Permits must be secured prior to the start of the project.

(2) ensure that equipment used at the project site will not cause oil leaks and that spill prevention kits must be readily available at the site. Proper housekeeping must also be strictly implemented to avoid contaminants being spilled or carried by stormwater runoff which could impact surface or groundwater quality.

Resource Policy 3. Fragile Areas. *Development in the following types of fragile areas shall be regulated to protect their unique character.*

- *historical and archeological sites*
- *wildlife habitats*
- *pristine marine and terrestrial communities*

Navy represents that, "The project would directly impact approximately 16,000 square feet (sq ft) of benthic substrate in Outer Apra Harbor, including impacts to corals and soft-sediment infauna. Indirect impacts from in-water construction activity are presumed in the marine waters adjacent to and up to an approximately 410-foot (ft) radius of the in-water work." These impacts are expected primarily within the construction phase of the project. Based upon an analysis of the site, the 410-foot radius indicated may include an area within the Sasa Bay Marine Preserve. According to Public Law 28-107, "All forms of fishing, and the taking or altering of aquatic life, living or dead coral and any resources to include, but not limited to, mangroves, seagrass, sand, and rocks within a preserve, is unlawful except as specifically permitted by the Director of Agriculture through regulations."

The Navy further represents that:

> "A 2020 marine survey of the project area found that substantial healthy coral communities fall within the UEMMS footprint, with high percent coral cover occurring in a majority of the direct impact area. The survey and photogrammetric orthomosaics image analysis found that the overall dominant biotic cover comprises hard substrate, with coral, algae (macro & cyanobacteria), other fauna (sponge, sessile invertebrates, etc.), and sand or silt substrate cover varying by location (i.e., direct vs. indirect impact area). In the direct impact area, 33 species of fish were documented. Two turtles (one green and one hawksbill turtle) were observed surfacing in or near the direct impacts area on separate occasions during the 2020 survey. … The project would result in the physical removal of 7,680 coral communities (7,535 in the sensor array footprint and 145 in the cable shore landing footprint) and increased suspended sediments that would adversely impacts corals in and adjacent to the project area during the construction period. The following environmental stressors on coral in the project area unlikely to occur due to project construction: wastes and discharges, aquatic invasive species, chemical contaminants, hypoxia, and unexploded ordnance (UXO). The implementation of avoidance, minimization, and offset actions would result in less than significant impacts to these coral communities (see Enclosure 3 for details). Avoidance measures include establishing a subsea cable route that avoids corals and utilizing diver-guided cable installation to avoid sensitive benthic resources. Minimization measures include revising the project design to reduce the excavation area needed to install the sensor array; relocating the CTD sensor closer to the array to reduce impacts to coral resources; selecting a subsea cable attachment method that has fewer impacts to benthic communities; and translocating about 6,300 corals and maintaining and monitoring the translocated corals. Measures to offset temporary losses of biological services include habitat restoration and

> conservation of 35,240 sq ft at Mound 9 (24,590 sq ft to offset coral cover loss and 10,650 sq ft to offset EFH loss)."

Live corals are protected from taking under 5 GCA Chapter 63 Article 6. Permits or waivers therefor should be obtained from the Department of Agriculture for any translocation of corals. Conducting in-water work during coral spawning periods poses an unnecessary risk to corals. Weather conditions, sedimentation or turbidity may adversely affect the health of corals, resulting in unintentional take, which should be avoided.

Information should be provided to local resource agencies, particularly DoAg's Division of Aquatic and Wildlife Resources (DAWR) relative to any changes to the project's scope of work and to allow such agencies to monitor compliance with BMPs.

Pursuant to Resource Policy 3, Fragile Areas, the federal agency shall:

(1) provide the Bureau and DoAg a map or other document which delineates the boundaries of the proposed project area. A 15-foot buffer must be established between the boundary of the project area and the Sasa Bay Marine Protected Area (MPA) boundary. The project area must not encroach upon the MPA boundary. If the MPA is within the radius, then the federal agency shall secure any permit or waiver thereof as may be required under 5 GCA §63116.2.
(2) provide DAWR, at permits@doag.guam.gov, and the Bureau with GPS coordinates of the project area and Mound 9.
(3) provide DAWR, at permits@doag.guam.gov, and the Bureau with monitoring reports of relocated corals, providing percent survival and species survival information.
(4) obtain a permit or waiver therefor from the Department of Agriculture as may be required under 5 GCA Chapter 63 Article 6.
(5) cease in-water work during the primary coral spawning periods in Guam, which include 8 days prior to the full moon and 14 days after the full moon in July and August.
(6) monitor weather conditions during in-water work. Cease activities if weather conditions are not favorable, and removal and securing of equipment must occur 48 hours prior to any potential storm.
(7) monitor sedimentation and turbidity during in-water construction and dredging activities, to avoid impacts to the marine environment and to Sasa Bay Marine Preserve.
(8) ensure that it or its contractor, as applicable, communicates any changes to the project's scope of work to DAWR and other agencies for consultation prior to moving forward.
(9) allow access to GovGuam regulatory agencies during the project timeline to monitor compliance with established BMPs.

Resource Policy 4. Living Marine Resources. *All living resources within the territorial waters of Guam, particularly corals and fish, shall be protected from over harvesting and, in the case of marine mammals, from any taking whatsoever.*

The federal agency identified three ESA-listed species that have reasonable potential to occur within the area of the proposed action, the green sea turtle (Chelonia mydas), hawksbill sea turtle (Eretmochelys imbricata), and scalloped hammerhead shark (Sphyrna lewini).

Little Fire Ant (LFA) colonies are widely and quickly spreading through the island and may cause harm to the ecosystem and the public. To control the spread of LFA, construction materials and equipment should be sanitized before leaving and entering the project area.

Pursuant to Resource Policy 4, Living Marine Resources, the federal agency shall:

(1) be advised to rigorously monitor activities to avoid ESA-protected species that may occur such as sea turtles, hammerhead sharks, and marine mammals. Activities should cease when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area.
(2) rigorously monitor activities to avoid species listed under the Endangered Species Act of Guam that may occur. Activities shall cease when Endangered Species Act of Guam marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area.
(3) be advised to avoid migratory birds, seabirds, and shorebirds. If migratory birds occur within the project area, activities must cease until the species leave on their own volition.
(4) ensure that workers, whether employed by the federal agency, its contractors, or its subcontractors, have training to identify protected species that may occur in or near the project site, such as sea turtles, hammerhead sharks, marine mammals, corals, and other sea life of concern, and migratory seabirds and shorebirds.
(5) all in-water activities must be performed with extreme caution to avoid take of protected species. Take is defined as causing harm, harassment, capturing, pursuing and killing of animals and plants.
(6) avoid intentional or unintentional take of species listed under the Endangered Species Act of Guam and otherwise comply with regulations or rules pertaining to endangered species, in accordance with 5 GCA §63206 (b) and (d).
(7) ensure that all construction-related vehicles, materials and equipment, is cleaned and free from invasive species and contaminants before being employed at the project area. Contractors must keep a log of all maintenance activities to ensure that all equipment used at the project area is clean and free of invasive species and contaminants.
(8) inspect silt curtains and silt barriers prior to and during dredging activities. If silt curtains or barriers are faulty, such activities must cease and such mechanisms must be repaired or replaced before beginning/resuming such activities.

Therefore, based on the conditional concurrence stated above and the Bureau's review of all other information submitted, we find the application to be consistent with the approved development and resource policies of the Guam Coastal Management Program (GCMP), in accordance with the Coastal Zone Management Act of 1972, (P.L. 92-583) as amended, (P.L. 94-370). The Federal Consistency concurrence, however, does not preclude the need for securing other federal and Government of Guam permits, clearances and approvals prior to the start of this project.

Per 15 CFR §930.4(b), if the requirements for conditional concurrences specified in 15 CFR §930.4(a), (1) through (3), are not met, then all parties shall treat this conditional concurrence letter as an objection pursuant to 15 CFR Part 930 subpart D. Furthermore, if an objection is determined, you are hereby notified that, pursuant to 15 CFR §930.63(e) and 15 CFR Part 930, subpart H, you have the opportunity to appeal an objection resulting from not meeting the requirements of 15 CFR §930.4(a), (1) through (3), to the Secretary of Commerce within 30 days after receiving this

conditional concurrence letter, or 30 days after receiving notice from the Federal agency that your application will not be approved as amended by the conditions required by this concurrence.

The proposed action shall be operated and completed as represented in the Coastal Zone Management (CZM) federal consistency determination. Significant changes to the subject proposal shall be submitted to the Bureau for review and approval and may require a full CZM federal consistency review, including publication of a public notice and provision for public review and comment. This condition is necessary to ensure that the proposed actions are implemented as reviewed for consistency with the enforceable policies of GCMP. Guam Land Use policies (E.O. 78-37), are the federally approved enforceable policies of GCMP that applies to this condition.

Please do not hesitate to contact Mr. Julian Janssen, Federal Activities Planner at 475-9664 or email julian.janssen@bsp.guam.gov or Mr. Edwin Reyes, Coastal Program Administrator at 475-9672 or email edwin.reyes@bsp.guam.gov. *Si Yu'os Ma'åse'.*

Sincerely,

TYRONE J. TAITANO
Director

Cc: NOAA-OCM
DoAgr-DAWR
DLM
DPR-SHPO
DPW
GEPA
GWA

DEPARTMENT OF THE NAVY
JOINT REGION MARIANAS
PSC 455, BOX 211
FPO AP 96540-1000

5090
Ser J4/ 0067
14 Feb 22

Mr. Tyrone J. Taitano
Director
Guam Coastal Zone Management Program
P.O. Box 2950
Hagatna, Guam 96932

Hafa Adai Mr. Taitano:

SUBJECT: NOTIFICATION OF CONSISTENCY DETERMINATION FOR THE UNDERWATER ELECTROMAGNETIC MEASUREMENT SYSTEM AT NAVAL BASE GUAM, APRA HARBOR – CONDITIONAL CONCURRENCE

Joint Region Marianas (JRM) has received your letter to Naval Base Guam (NBG) dated December 23, 2021 regarding the Underwater Electromagnetic Measurement System at Naval Base Guam. I appreciate your agency's review and efforts in this important project. The Navy will continue to work to ensure our project is consistent with all the enforceable policies of Guam's coastal zone management program per Section 307 of the Coastal Zone Management Act (CZMA).

I would like to take this opportunity to clarify one of the conditional concurrences stated in the letter: "If the MPA (Marine Protected Area) is within the radius, then the federal agency shall secure any permit or waiver thereof as may be required under 5 GCA §63116.2." As a federal agency, the Navy is not required to obtain Territorial permits unless Congress has provided clear and unambiguous authorization for Territorial regulation of federal activities under federal statutes other than the CZMA. Accordingly, in the absence of such clear and unambiguous authorization under other statutes, the Navy cannot be required to obtain permits under 5 GCA §63116.2. However, the Navy will continue to ensure that our activities are consistent to the maximum extent practicable with Guam's coastal resource management provisions, and will implement such protective measures or mitigations as are necessary to ensure the preservation of Guam's vital coastal resources during this project.

Should you have any questions, my point of contact for this matter is Mr. Mark Cruz, Regional Environmental Coordinator at mark.cruz@fe.navy.mil or 671-349-1104.

Sincerely,

B. R. NICHOLSON
Rear Admiral, U.S. Navy
Commander

Lourdes A. Leon Guerrero
Governor of Guam

Joshua F. Tenorio
Lieutenant Governor

BUREAU OF STATISTICS & PLANS
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Tyrone J. Taitano
Director

Matthew Santos
Deputy Director

MAR 03 2022

B.R. Nicholson
Rear Admiral, U.S. Navy
Commander
Joint Region Marianas
Department of the Navy
PSC 455 Box 211
FPO AP 96540-1000

RE: Joint Region Marianas' letter on the Guam Coastal Management Program's Official Response to the Department of the Navy's Consistency Determination for its proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor (GCMP FC 2021-0041)

Hafa adai! The Guam Coastal Management Program (GCMP) of the Bureau of Statistics and Plans (Bureau) received your letter, dated February 14, 2022, regarding GCMP's Coastal Zone Management Act (CZMA) Federal Consistency Review for the Department of the Navy's proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor (GCMP FC 2021-0041), dated December 23, 2021 (Conditional Concurrence). In response to GCMP's Conditional Concurrence to secure a permit under 5 GCA § 63116.2 for activities within marine preserves, your letter states "in the absence of such clear and unambiguous authorization under other statutes, the Navy cannot be required to obtain permits under 5 GCA §63116.2." While we agree that a state or territory cannot impose permitting requirements in the absence of federal authorization, as we shall explain later, the CZMA provides such authorization. GCMP finds that your letter is a rejection of the Conditional Concurrence to obtain a local permit. In accordance with 15 CFR 930.4(b), the Conditional Concurrence shall be treated as an **objection**.[1]

Pursuant to the CZMA and its implementing regulations, NOAA approved the following:

- Executive Order 78-37 as Guam's "enforceable policies";[2] and
- 5 G.C.A. § 63116.2 (P.L. 28-107.4) as an "enforceable mechanism" during a routine program change in 2013.[3]

[1] Please note that the Bureau's Conditional Concurrence letter also provides: "if the requirements for conditional concurrences specified in 15 CFR 930.4(a), (1) through (3), are not met, then all parties shall treat this conditional concurrence letter as an objection[.]"

[2] 16 U.S.C. §§ 1455, 1456(c)(1)(A); 15 CFR § 930.11(h).

[3] 16 U.S.C. § 1455(e); 15 CFR § 923.83; *see also* NOAA's correspondence dated, November 5, 2013, regarding Guam's Coastal Management Program's federally approved enforceable mechanisms, *available at:* https://bsp.guam.gov/wp-bsp-content/uploads/2021/12/GU-2013-1-Decision-Letter-11-5-2013.pdf

Here, the Navy's proposed activities to take corals without a local permit are inconsistent with GCMP's enforceable policies, if such activities occur within the Sasa Bay Marine Preserve.[4] Pursuant to 15 CFR § 930.4(a)(1), the Bureau's Conditional Concurrence letter included a condition to obtain a permit under 5 GCA § 63116.2 because it is "necessary to ensure consistency" with GCMP Resource Policy for "Fragile Areas."[5] 5 GCA § 63116.2 is the means by which GCMP "shall" regulate "fragile areas" to protect their unique character.[6] In other words, obtaining a permit from the Department of Agriculture is one way to regulate Guam's Sasa Bay Marine Preserve, which must be protected.

Coral reefs are under increasing threat from direct and indirect anthropogenic stressors, deriving from the effects of Global Climate Change and coastal uses. The proposed development increases the cumulative impact to corals on Guam by intentional removal of coral from a marine preserve, which was established to protect the pristine marine communities and living marine resources in the area.

Guam's enforceable policies, Resource Policy for "Fragile Areas" state: "Development in the following types of fragile areas shall be regulated to protect their unique character: historic and archaeologic sites, wildlife habitats, pristine marine and terrestrial communities, limestone forests, and mangrove stands and other wetlands."[7] Under 15 CFR § 923.83(a)(4)(vi), "enforceable mechanism" means "a state authority that makes an enforceable policy legally binding under state law, as described in this subpart and § 930.11(h) of this subchapter."[8] Moreover, "[e]xamples of an enforceable mechanism include state statutes, regulations, or permitting programs."[9] The condition to obtain a local permit pursuant to 5 GCA § 63116.2 is a NOAA-approved enforceable mechanism that is anchored in the enforceable Resource Policy for "Fragile Areas."[10] Thus, 5 G.C.A. § 63116.2 is a state authority, i.e., enforceable mechanism, that makes the Resource Policy for "Fragile Areas" legally binding under Guam law.[11]

Accordingly, GCMP disagrees with your letter's statement that "[a]s a federal agency, the Navy is not required to obtain Territorial permits [under 5 GCA §63116.2] unless Congress has provided clear and unambiguous authorization for Territorial regulation of federal activities under federal statutes other than the CZMA."[12] Based on the CZMA and its implementing regulations on enforceable policies and mechanisms, the Navy is required to obtain a local permit for activities within marine preserves. Moreover, the CZMA's implementing regulations include requirements for state permits. While 15 CFR § 930.39(c) acknowledges "Federal law, other than the CZMA, may require a Federal agency to obtain a State permit," it later adds that, "[e]ven when Federal

[4] *See* 15 § CFR 930.11(h) (providing that a "State agency . . . must base its objection on enforceable policies").

[5] Guam Executive Order 78-37.

[6] See *id.*

[7] Executive Order 78-37.

[8] 15 CFR § 923.83; 84 Fed. Reg. 38118, 38125 (2019) (codifying 15 CFR § 923.83(a)(4)(vi)).

[9] 15 CFR § 923.83(a)(4)(vi) (providing state "permitting programs" as an example of an enforceable policy).

[10] *Id.*

[11] *See id.*

[12] GCMP notes an absence of legal authority in the Navy's letter to support this proposition.

GCMP FC No. 2021-0041
RE: Joint Region Marianas' letter on the Guam Coastal Management Program's Official Response to the Department of the Navy's Consistency Determination for its proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor (GCMP FC 2021-0041)
Piti, Guam

agencies are not required to obtain State permits, Federal agencies shall still be *consistent to the maximum extent practicable* with the enforceable policies that are contained in such State permit programs that are part of a management program." (emphasis added). The term "consistent to the maximum extent practicable" means "fully consistent with the enforceable policies of management programs unless full consistency is prohibited by existing law applicable to the Federal agency."[13] The basis for applying this permit condition is that there are reasonable and foreseeable effects to resources within Guam's Coastal Zone and marine preserve even though the project footprint is in what the Navy claims as federal submerged lands. Nevertheless, the CZMA's implementing regulations do not negate the federal requirement to obtain a state permit.

Finally, GCMP finds that your letter does not provide adequate basis under 15 CFR § 930.32 to assert "that full consistency with the management program is prohibited"[14] as the Navy has not "clearly describe[d], in writing, to the State agency the statutory provisions, legislative history, or other legal authority which limits the Federal agency's discretion to be fully consistent with the enforceable policies of the management program."[15] In addition, the phrasing of your letter infers that you intend to proceed with the proposed activity to occur without adhering to the requirements of the enforceable policies of Guam, as implemented with the supporting enforceable mechanism by either securing a permit or waiver thereof as may be required 5 GCA §63116.2, as provided in GCMP's Conditional Concurrence. Therefore, the Conditional Concurrence, dated December 23, 2021, is now an **objection** to your determination.

Please do not hesitate to contact Mr. Julian Janssen, Federal Activities Planner at 475-9664 or email julian.janssen@bsp.guam.gov or Mr. Edwin Reyes, Coastal Program Administrator at 475-9672 or email edwin.reyes@bsp.guam.gov. *Si Yu'os Ma'åse'.*

Sincerely,

TYRONE J. TAITANO
Director

Cc: Governor Leon Guerrero
NOAA-OCM
DoAgr-DAWR
DLM
DPR-SHPO
DPW
GEPA
GWA

[13] 15 CFR § 930.32(a)

[14] 15 CFR § 930.32

[15] 15 CFR § 930.32(a)

LOLA E. LEON GUERRERO
(Acting) Director
MATTHEW C. SANTOS
Deputy Director

THE BUREAU OF STATISTICS AND PLANS

Sagan Planu Siha Yan Emfotmasion

LOURDES A. LEON GUERRERO
Governor of Guam
JOSHUA F. TENORIO
Lieutenant Governor

APR 06 2022

B.R. Nicholson
Rear Admiral, U.S. Navy
Commander
Joint Region Marianas
Department of the Navy
PSC 455 Box 211
FPO AP 96540-1000

RE: Withdrawal of the Guam Coastal Management Program's Objection to the Department of the Navy's Consistency Determination for its proposed Underwater Electromagnetic Measurement System at Naval Base Guam, Apra Harbor (GCMP FC 2021-0041)

Hafa adai! The Guam Coastal Management Program (GCMP) of the Bureau of Statistics and Plans (Bureau) submitted a letter from Director Tyrone J. Taitano to you dated March 3, 2022, to inform Joint Region Marianas that the Conditional Concurrence submitted in response to the Department of the Navy's (Navy) Consistency Determination on December 23, 2021, shall be treated as an objection.

Since the submission of that letter, GCMP has conducted supplemental coordination with Joint Region Marianas to ensure that any concerns with regard to adherence to the enforceable policies of GCMP have been resolved. GCMP hosted a meeting with a Legal Counsel of the Governor of Guam, a representative of the Guam Department of Agriculture (DoAg), and representatives of Navy on March 17, 2022.

During the supplemental coordination meeting, Navy representatives discussed the Coral Translocation Plan with DoAg. DoAg agreed that the proposed BMPs ensured that if the action is conducted as represented, then the activity would be consistent with the enforceable policies under the purview of DoAg and would meet the standards for permitted activities in a Marine Protected Area, if one was applicable for this project. The Navy had not objected to the Conditional Concurrence requirement that GovGuam regulatory agencies have access during the project timeline to monitor compliance with established BMPs.

Based upon the BMPs and monitoring access agreed to under the Consistency Determination, the Conditional Concurrence as applicable, and the Coral Translocation Plan, the supplemental coordination between GCMP and Navy is concluded and the **objection** communicated in the letter of March 3, 2022, ***is hereby withdrawn.***

Please do not hesitate to contact Mr. Julian Janssen, Federal Activities Planner at 671-475-9664 or email julian.janssen@bsp.guam.gov or Mr. Edwin Reyes, Coastal Program Administrator at 671-475-9672 or email edwin.reyes@bsp.guam.gov. *Si Yu'os Ma'åse'.*

Sincerely,

LOLA E. LEON GUERRERO
(Acting) Director

Cc: NOAA-OCM
DoAgr-DAWR
DLM
DPR-SHPO
DPW
GEPA
GWA