DEPARTMENT OF DEFENSE
DEPARTMENT OF THE NAVY

FINDING OF NO SIGNIFICANT IMPACT (FONSI) FOR THE ENVIRONMENTAL ASSESSMENT (EA) FOR THE LIMA, MIKE, AND NOVEMBER WHARF REPAIR AND MODERNIZATION AT NAVAL BASE GUAM, APRA HARBOR, GUAM

Pursuant to Section 102 of the National Environmental Policy Act of 1969, as amended; the Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508) implementing the NEPA and Department of the Navy (DON) NEPA instructions (32 CFR Part 775); and Chief of Naval Operations Instruction 5090.1E CH-10, the Commander, Navy Installations Command (CNIC) gives notice that an Environmental Assessment (EA) for the proposed repair and modernization of Lima, Mike, and November wharves at Naval Base Guam has been prepared and an Environmental Impact Statement (EIS) is not required for the implementation of this project.

Proposed Action: The Navy proposes to repair and modernize Lima, Mike, and November wharves in Apra Harbor, Guam starting in Fiscal Year (FY) 2021. The Proposed Action would include structural and subsurface repair and upgrade of infrastructure to meet current Unified Facilities Criteria code requirements.

Purpose and Need: The purpose of the Proposed Action is to repair and modernize the existing wharves to working condition and to ensure structural integrity. The need for the Proposed Action is to ensure that Lima, Mike, and November wharves fulfill waterfront infrastructure needs and meet assigned operational mission requirements to enable combat capable naval forces to be ready for deployment worldwide. In this regard, the Proposed Action furthers the Navy's execution of its congressionally mandated roles and responsibilities under 10 U.S. Code (U.S.C.) section 5062.

Proposed Action Location: The main base at NBG Apra Harbor is located in Santa Rita, Guam, and is approximately 3,700 miles (5,955 kilometers) west of Hawaii, 1,500 miles (2,494 kilometers) east of the Republic of the Philippines, and 1,550 miles (2,494 kilometers) south of Japan. The island of Guam is the westernmost territory of the U.S. and is the southernmost island of the Mariana Islands.

The main base at NBG is located at the southern end of Marine Corps Drive on the west side of the island, about mid-way between the northern and southern ends. The Proposed Action Location lies south of Outer Apra Harbor and at the mouth of the entrance to Inner Apra Harbor. The project area for the Proposed Action at Lima, Mike, and November wharves lies north of Papa and Oscar wharves along the western shoreline of the entrance to Apra Harbor and west across the entrance to Apra Harbor from Bravo Wharf. The area has historically been used for ship repair and maintenance activities.

Alternatives Analyzed: Based on the reasonable alternative screening factors and meeting the purpose of and need for the Proposed Action, only the No Action Alternative and the Proposed Action were carried forward and are analyzed in this EA. Under the No Action Alternative to the Proposed Action, the Navy would not implement repairs to Lima, Mike, and November wharves. This alternative represents the status quo. Under the No Action Alternative, the Proposed Action would not occur resulting in the continued deterioration of wharf infrastructure at these locations.

A key difference between the No Action Alternative and the Proposed Action is that the latter repairs and modernizes Lima, Mike, and November wharves. However, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA.

Alternatives Considered: Several possible alternatives were considered but not carried forward for detailed analysis in this EA due to the application of the following screening factors: ability to meet the purpose and need for the Proposed Action, compatibility with NBG's overall ship repair requirements and waterfront plans, and compliance with Navy regional guidance (including meeting the Navy's security requirements and minimization of footprint expansion beyond existing military installation boundaries). The alternatives below were considered for analysis in this EA.

<u>Lease</u>

Leasing private or non-federal lands is not a viable option as there are no suitable public or private facilities on the island that can be leased to satisfy the requirements of this project.

New Footprint/New Location

New construction at a different location would fail to address the deterioration of the Navy wharves. Although a new location could potentially be operationally feasible for the type of activities currently conducted at the wharves, the Lima, Mike, and November wharves would continue to deteriorate and would adversely affect operations and the immediate environment.

Construct a Seawall

Construction of a new seawall surrounding Lima, Mike, and November wharves to prevent eventual collapse would render the wharves defunct and, thus, would fail to meet operational mission requirements.

New Construction/Replacement of Current Wharf with a Wharf or Other Design (Open Wharf or Solid Fill Relieving Platform)

Replacement of the current type of wharf (a steel pile bulkhead) with an alternative design such as an open wharf or solid fill relieving platform was eliminated from further consideration. Replacement with a different type of wharf would result in a larger construction footprint. This would produce greater environmental impacts (e.g., larger areas of seabed would be taken) than the current project, increasing project time and cost while decreasing the chances of project approval.

Environmental Effects: No significant direct, indirect, or cumulative environmental impacts would occur as a result of implementing the Proposed Action.

In compliance with NEPA, CEQ, and Navy guidelines, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. 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, Visual Resources, Airspace, Noise, Terrestrial Biological Resources, Transportation, Public Health and Safety, Socioeconomics, and Environmental Justice.

All of the following resources were analyzed in the EA.

Marine Biological Resources

Habitat and Marine Species

The Proposed Action would cause direct impacts to all abiotic marine resources, marine habitats, marine vegetation, non-coral benthic invertebrates, coral, and fish associated with wharf infrastructure in the Proposed Action Location. The impacts would include turbidity, noise, and temporary avoidance of the area during the action. There would also be lethal loss for all but the most mobile species. Because the Preferred Alternative would repair and modernize the wharf infrastructure in similar quantity and layout, the adjacent marine resources (abiotic marine resources, marine habitats, marine vegetation, non-coral benthic invertebrates, coral, and fish) would rapidly re-colonize the new wharf infrastructure. This disturb-and-re-colonize process has occurred relatively rapidly after all prior episodes of maintenance dredging and wharf repair and modernization have taken place. Most organisms in the dominant fouling community are particularly well-adapted to rapidly colonize new areas (Coles et al. 1999; Paulay 2003; Paulay et al. 1997; Navy 2019c). The loss of marine resources would be short term with a duration of months to several years for non-coral invertebrates (Briggs 2007; Coles et al. 2009; Miller 2014; Paulay et al. 2002; Navy 2015). With implementation of Best Management Practices (BMPs) and Impact Avoidance and Minimization Measures, impacts to habitat and marine species would not be significant.

Essential Fish Habitat (EFH) and Protected Marine Habitats

The Endangered Species Act (ESA) and EFH assessment prepared by NAVFAC Pacific and submitted to National Marine Fisheries (NMFS) in February 2020 (Appendix A of the EA) determined that the proposed activities and their resulting impacts would reduce the quantity and quality of EFH, and accordingly would adversely affect EFH for Bottomfish Management Unit Species (BMUS) and Pelagic Management Unit Species (PMUS) within the Proposed Action Location. Unavoidable loss of ecosystem function and services that support MUS would be minimized through implementation of a proposed coral translocation plan (Navy 2019b). The Navy determined that the anticipated adverse effects do not have the potential to cause substantial adverse effects to EFH. This is due to containment of impacts to the Proposed

Action Location, 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 Proposed Action, and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion). Implementation of BMPs and Impact Avoidance and Minimization Measures would further reduce the intensity of stressors and likelihood of impacts to EFH and protected marine habitats.

NMFS responded in concurrence with the assessment on March 13, 2020 (Appendix A, Essential Fish Habitat and Endangered Species Act Documentation). NMFS acknowledged the unavoidable loss of EFH from the Proposed Action; the potential for long term impacts on EFH even with BMPs implemented; as well as, the potential for the proposed mitigation strategies to impede coral recovery or recruitment. NMFS provided two conservation recommendations in support of the efforts by the Navy to effectively avoid, minimize, offset or mitigate impacts to EFH by the Proposed Action.

First, NMFS recommended a coral translocation data management plan that will collect quantitative data on coral recruitment and coral growth over time at the translocation site (i.e. Mound 9) as well as within and near the dredge footprint. The data will be compared against the Habitat Equivalency Analysis for the offset and proposed recovery rates. The recommendation includes alignment with the 2019 Joint Region Marianas Integrated Natural Resources Management Plan and encourages this approach to inform monitoring activities prescribed in the next Joint Region Marianas Integrated Natural Resources Management Plan.

Second, NMFS recommended that the coral transplanting effort avoid damaging organisms that are not being transplanted, especially other coral. Additionally, transplanted corals and materials should be stabilized and secured to avoid movement during rough water conditions like those produced by typhoons. The coral translocation effort should avoid direct and indirect exposure of corals to toxicopathological agents.

The two aforementioned coral translocation conservation recommendations by NFMS will be fully adopted and implemented. Maintenance of the corals and monitoring will be conducted to quantify their survival, growth, health, and habitat cover changes over multiple years.

Threatened and Endangered Species

There are no reports of ESA-listed corals in the vicinity of the Proposed Action Location, and there are no reports from Inner Apra Harbor (Navy 2019b). Large numbers of scalloped hammerhead sharks are unlikely to occur in the area and encountering a solitary shark is rare. Survey efforts conducted in 2019 did not observe any scalloped hammerhead sharks (Navy 2019b).

Two ESA-listed species are likely to occur within the Proposed Action area of the Preferred Alternative: the green sea turtle (*Chelonia mydas*) and the endangered hawksbill sea turtle (*Eretmochelys imbricata*). Both are listed as endangered and both have been reported in the Proposed Action Location, but little suitable habitat exists within the Preferred Alternative Action Area for these species. Implementation of BMPs would avoid impacts to sea turtles. Marine mammals are not known to be common in Apra Harbor, particularly not in Inner Apra Harbor, and have been excluded from prior agency consultations for substantially similar actions.

NMFS responded in concurrence with the assessment on April 8, 2020 (Appendix A, Essential Fish Habitat and Endangered Species Act Documentation) that the Proposed Action is not likely to adversely affect ESA-listed species. The NMFS response expanded the action area to include the inner and outer Apra Harbor, Sasa Bay, and the high seas route given that the Proposed Action includes the potential to use an additional barge brought from outside of Guam. Even with the expanded area, NMFS further concluded that effects are likely to be insignificant or discountable given, but not limited, to the habituation of some species to human activity and ability to voluntarily move away from the Proposed Action. In addition, there is a low likelihood that some species would occur in the area given review of best available science, and that BMPs will be implemented during the Proposed Action.

Underwater Noise

The proposed activities that will produce elevated noise levels under water include pre-drilling, pile driving, and navigational dredging. Of these activities, only pile driving is likely to generate noise levels with the potential to cause adverse impacts to ESA-listed species. Apra Harbor is a working harbor with a likely ambient sound pressure level (SPL) >100 decibels (dB) referenced to 1 micropascal (re 1 μPa) (California Department of Transportation 2015). Marine fauna residing in this environment function and thrive within an acoustic background of relatively high, ambient sound levels. The potential environmental effects of elevated noise levels may include:

- Direct, physiological effects - serious injury or mortality.
- Direct, behavioral effects - disruptions to feeding, mating, breeding, or nursery activities in such a way that impacts the survival or abundance of populations.
- Indirect effects - disruptions to the abundance and behavior of prey species; long-term change to population survival.

The direct, physiological effects from acoustic impacts include hearing damage, injury, or mortality. Permanent threshold shifts (PTS) occur when an animal experiences a shift in their hearing sensitivity caused by prolonged or repeated exposure to high sound levels that results in permanent and irreversible damage (Richardson et al. 1995). Temporary threshold shifts (TTS) occur when an animal's hearing threshold is temporarily increased (i.e., temporarily less sensitive to sound) during and immediately after exposure to a loud sound source (Richardson et al. 1995). TTS may have a duration of minutes to days to weeks, after which time full recovery is expected. Both TTS and PTS can result from a single pulse, from accumulated effects of multiple pulses from an impulsive sound source (e.g., impact pile driving) or from accumulated effects of non-pulsed sound from a continuous sound source. TTS and PTS occur only in the sound frequencies to which an animal is exposed.

Fish

The underwater noise threshold criterion for fish injury from a single impact hammer pile strike is peak SPL. Cumulative Sound Exposure Level (SEL) is a measure of the risk of injury from exposure to multiple pile strikes or other impulsive sounds over a continuous workday.

Popper et al. (2014) proposed dual threshold interim criteria for pile driving based on a review of available data associated with fishes and pile driving. The data used to set the criteria was from controlled experiments that mimicked pile driving on several fish species that varied in body type, swim bladder configuration, and internal morphologies. Guidelines were developed for mortality and the lowest level where injury was found (recoverable injury). No injuries were found in the species without a swim bladder (hogchoker) exposed to a cumulative SEL of 216 dB. In addition, Popper et al. (2014) developed guidance for the onset of TTS of which guidelines are based on data from exposure of several riverine species to seismic airgun pulses (Popper et al. 2005). TTS in fish is the temporary shift in hearing sensitivity, decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996).

Although there are no known studies on the auditory sensitivity of scalloped hammerhead sharks, their hearing sensitivity is likely to be similar to that of other sharks and elasmobranchs, which have poor hearing sensitivities and cannot likely detect sound pressure (Casper and Mann 2006). Unlike many bony fishes, sharks do not possess swim bladders or other structures that can convert acoustic pressure into a displacement stimulus and, therefore, respond only to the particle motion component of sound (e.g., acceleration, velocity, or displacement) and not the pressure component, although this remains to be demonstrated conclusively (Nelson 1967; Gardiner et al. 2014, Hart and Collin 2015). Sharks are able to hear sounds up to approximately 1,000 Hertz and are most sensitive to frequencies below approximately 100 Hertz (Nelson 1967; Popper and Fay 1977; Casper and Mann 2006, 2007a,b, 2009; Hart and Collin 2015). As a group, sharks appear to be less sensitive to sound at all frequencies compared to teleosts fishes. This is 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 and Mann 2007a; Hart and Collin 2015). Calculated distances from the loudest noise source (impact pile driving sheet piles) would be 69 feet (21 meters) or less to onset of injury thresholds for fish with a swim bladder and 10 feet (3 meters) or less for fish without a swim bladder. Sharks are unlikely to approach construction activity, particularly at that distance. Thus, acoustic impacts to scalloped hammerhead sharks are discountable.

Sea Turtles

Sea turtles are susceptible to underwater noise. There have been military, commercial, and recreational vessel operations in Apra Harbor for several decades. During this time, it is possible that marine animals in its vicinity have become habituated to underwater sound levels generated by these activities (NMFS 2011b, 2014a).

Exposure of animals to high levels of sound, as are likely during pile driving, are not anticipated to result in any mortality, but may result in permanent (PTS) or temporary hearing loss (TTS), or behavioral effects (Popper et al. 2014), depending on the sound level. Regulatory acoustic thresholds have not been established for sea turtles. NMFS provides technical acoustic guidance for marine mammal species only. Based on the best available scientific data, Popper et al. (2014) developed guidelines and presented a set of numerical thresholds or, if data were insufficient, the relative likelihood of effects occurring in fish and sea turtles (Navy 2017). Sounds above the thresholds are considered likely to result in that effect, with higher sound levels likely to produce greater effects, and different guideline levels are provided for different sound sources and different receptor species. This guidance provides reasonable, threshold values, beyond which potential effects to green and hawksbill sea turtles may occur from pile driving noise.

Pile driving would be the project's greatest noise source in the underwater environment. The frequency and intensity of the sound energy generated by pile driving is primarily a function of the type and size (diameter or length) of the piling or sheet pile, the driving mechanism (e.g., impact or vibratory hammer), and the type of substrate into which the pile is being driven.

In prior agency consultations for substantially similar actions, NOAA Fisheries/NMFS concluded that it expects no sea turtles and no marine mammals to be exposed to in-water sound levels capable of causing injury (NMFS 2011a, b, 2014a).

Because pile driving would be conducted using only impact hammers (see Appendix A, Essential Fish Habitat and Endangered Species Act Documentation), the PTS and TTS thresholds for impulsive noise were used in the analysis.

Under the Proposed Action, approximately six steel sheet piles with a maximum of eight steel sheet piles would be driven per day into the substrate fronting the existing Lima, Mike, and November wharves to create an enclosure that would be backfilled to repair and modernize the wharves. Proxy source levels (root mean square [RMS] or peak SPL in dB, re 1 μPa; and SEL in dB referenced to 1 micropascal squared-second [re 1 μPa^{2-s}]) for piles similar to those used in the Proposed Action and example distances were from California Department of Transportation Compendium of Pile Driving Sound Data (California Department of Transportation 2014).

Pile driving will generate underwater noise that potentially could result in disturbance to sea turtles swimming by the Proposed Action Location. Transmission Loss (TL) underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source until the source becomes indistinguishable from ambient sound. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, bottom composition and topography. A standard sound propagation model was used to estimate the range from pile driving activity to various expected SPLs at potential project structures. This model follows a geometric propagation loss based on the distance from the driven pile, resulting in a 4.5 dB reduction in level for each doubling of distance from the source. In this model, the SPL at some distance away from the source (e.g., a driven pile) is governed by a measured source level, minus the TL of the energy as it dissipates with distance. The TL equation is:

$$TL = 15\log_{10}\left(\frac{R_1}{R_2}\right)$$

where

TL is the transmission loss in dB,

R_1 is the distance of the modeled SPL from the driven pile, and

R_2 is the distance from the driven pile of the initial measurement (in this case, 10 meters).

Injury and behavioral effects thresholds for marine mammals, sea turtles, and fish are based on peak or RMS SPL, and on the cumulative SEL (SEL_{cum}), which is calculated as follows:

- For impact pile driving,

SEL_{cum} = single-strike SEL (dB) + 10 $\log_{10}$ (number of strikes)

Unweighted peak pressure thresholds for TTS and PTS were developed for sea turtles based on auditory sensitivity in marine mammals (Navy 2017). Popper et al. (2014) recommended applying SEL-based impact thresholds developed for fishes without a swim bladder to sea turtles, which was adjusted based on an 11 dB difference found between the SEL-based non-impulsive TTS threshold and the SEL-based impulsive TTS thresholds for marine mammals. The NMFS User Spreadsheet tool (NMFS 2018) for calculating PTS onset thresholds for marine mammals was modified to adjust the weighting factor adjustments and calculate distances to PTS and TTS thresholds for turtles. The threshold values for injury (PTS) and TTS to sea turtles from impact pile driving are estimated as 204 dB re 1 μPa^2-sec SEL and 189 dB re 1 μPa^2-sec SEL, respectively (Navy 2017). Sea turtles are expected to avoid exposure to underwater RMS SPL of 175 dB re 1 μPa or greater (Navy 2017). This threshold is considered the behavioral threshold. Behavioral reactions would not rise to the level of take under the ESA unless they result in a significant curtailment of feeding, movement, and other activities affecting fitness.

The calculated ranges to PTS and TTS are small and consistent with previous Navy and NOAA Fisheries/NMFS expectations. Behavioral effects are likely to occur, and it is anticipated that behavioral responses (i.e., moving away from the sound source) would result in turtles avoiding sustained exposure to sounds that could otherwise lead to PTS. These behavioral reactions are considered unlikely to rise to a level of take under the ESA or significance under NEPA given very limited use of the immediate project area by sea turtles.

The threshold distances do not account for other factors that would reduce the distance that sound would propagate. Some of the more obvious features in Apra Harbor that would reduce sound propagation are:

- *Depth:* Much of Apra Harbor is relatively shallow. The water's surface and the bottom are, relative to a physical phenomenon like sound, close together and they interact with sound waves causing reflection, backscatter, reverberation, and sound attenuation (Faulkner et al. 2018; Popper et al. 2014). Scattering from surfaces and elements in the water such as bubbles and suspended sediment dampens sound and causes "clutter" (Popper et al. 2014).

- *Soft Sediment:* The substrate contributes to sound loss through reflection loss and absorption. Generally speaking, soft bottom reduces sound transmission more than hard substrates like rock. Reduction of sound by fine sand, sandy silt, sand-mud, and mud substrate has been partially quantified (Faulkner et al. 2018; Popper et al. 2014). The bottom of Inner Apra Harbor is comprised of unconsolidated sand and silt (HDR 2015b; HDR et al. 2011). It is expected that absorptive loss is greater for higher frequencies (ICF Jones and Stokes and Illinworth and Rodkin, Inc. 2009). The values range from 3 dB (fine sand at 7.5 kilohertz) to 16 dB (mud at 24 kilohertz) loss (Faulkner et al. 2018; Popper et al. 2014), assuming a single reflection off the substrate.

- *Narrow Harbor Mouth:* Sound passing from the Inner to the Outer Apra Harbor would pass through a bottleneck that is bounded on the sides by Lima and Bravo wharves. The narrow channel makes complex bathymetry that reflects and causes interference in sound propagation. The narrow area for sound propagation is expected to reduce sound levels significantly (Faulkner et al. 2018; Popper et al. 2014), but the extent of affects to sound propagation would require physical modeling or hydroacoustic measurements.

- *Complex Bathymetry in Outer Apra Harbor:* This complex environment reflects and attenuates sound emerging from the Inner Apra Harbor. The area of the Outer Apra Harbor that is immediately outside of the mouth of the Inner Apra

Harbor is a basin that is surrounded by shoals and coral reefs that are considered as a rough surface that contributes to propagation loss (HDR and CSA 2012; Krebs et al. 2016; Popper et al. 2014). Some of the shoals, such as Jade Shoals and Middle Shoals, rise to within a few feet of the surface of the water, and would act like berms that would block or reflect sound.

  - Other factors compound the noise reduction: Sound wrapping around a corner coming out of the Inner Apra Harbor and decreasing depth between the channel and Sasa Bay are expected to have strong effects at reducing received sound levels in Sasa Bay.

- *Ambient Sound Sources:* Both the Inner Apra Harbor and the Outer Apra Harbor have sound sources that would mask sounds from the Inner Apra Harbor (i.e., vessel noise) (California Department of Transportation 2001; Popper et al. 2014).

The effects to sea turtles from the Proposed Action would not cause permanent damage to individuals or harm the population of sea turtles in the area, but it could cause avoidance of the area. Because relatively few turtles enter Inner Apra Harbor (during the recent survey of the Proposed Action Location, only three green sea turtle observations were recorded over 5 days and approximately 40 hours of observation time [Navy 2019b]), the potential consequences of avoidance of the area would be minimal and temporary.

The ESA and EFH assessment prepared by NAVFAC Pacific and submitted to NMFS in February 2020 (Appendix A) for elevated underwater noise determined that exposure to elevated underwater noise levels from the Proposed Action may affect, but is not likely to adversely affect, green sea turtles and hawksbill sea turtles. With implemented BMPs, activities would stop if an ESA-listed species is observed within 50 yards (46 meters) and would not commence until the animal leaves the area voluntarily. Also, noise from activities would be short term and intermittent. Furthermore, the proposed operations (in-water only) would be restricted to daylight hours for approximately 13 months. Therefore, it is likely that an ESA-listed species would be exposed to noise levels that would result in a temporary and recoverable behavioral response. Based on the regular but small occurrence of green sea turtles in the Proposed Action area, the rare and infrequent occurrence of hawksbill sea turtles, 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.

BMPs, including "soft start" ramp-up techniques for pile driving and dredging along with safety zones, would minimize exposure risks. As previously discussed, pile driving would be halted when sea turtles are within 50 yards (46 meters) of pile driving operations until the animals have voluntarily moved beyond 50 yards (46 meters) or until 30 minutes have passed without an animal observation. These BMPs minimize risks to sea turtles that may be within Inner Apra Harbor during construction activities.

The determination of effects on sea turtles is consistent with prior agency formal consultations (NMFS 2011a, b, 2014a). In those prior agency consultations, NOAA Fisheries/NMFS concluded that it expects no sea turtles to be exposed to in-water sound levels capable of causing injury. Consequently, the Proposed Action is not likely to reduce the abundance of sea turtles in Guam or to reduce the likelihood of both survival and recovery of ESA-protected turtles in Guam or across Oceania.

With implementation of BMPs and mitigation measures described above, no significant impacts to threatened and endangered species from underwater noise would result.

Therefore, implementation of the Proposed Action would not result in significant adverse impacts to marine biological resources.

<u>Water Resources.</u> The Preferred Alternative would not impact groundwater resources or surface water. The Proposed Action Location is located entirely within an established industrial area where waters from Apra Harbor meet sheet pile and do not overlay drinking water sources. The Proposed Action Location is not within or directly adjacent to any wetland. The Proposed Action Location is along the shoreline within the 100-year floodplain (Federal Emergency Management Agency 2020). Proposed construction would not impede the functions of floodplains in conveying floodwaters, change the local hydrology, soils, or vegetation that support a wetland, or affect shoreline

ecological functions. Therefore, the Preferred Alternative would not impact surface water or groundwater resources, nor would it impact wetlands or floodplains.

The Preferred Alternative would not significantly impact marine water quality during the construction period. There would be temporary, insignificant adverse water quality impacts during construction (i.e., sediment loading and potential releases of pollutants entrained in dredged materials into the water column) in the areas surrounding the active in-water construction sites. Construction equipment, construction-related debris, vessels, vehicles, fueling of project-related vehicles, and equipment all have the potential to release petroleum products, hydraulic fluids, or other pollutants into marine waters. Potential adverse marine water quality impacts would be minimized through compliance with NBG MSGP and NBG SWPPP. The proposed wharf improvements would not increase the potential for flooding and would decrease the potential for a collapse of the wharves during a large rain event or flooding. To comply with EO 11988, a public notice would be published in local newspapers.

During the operational period, water quality in Inner Apra Harbor would be similar to existing conditions, with high levels of turbidity. The Preferred Alternative would have a beneficial impact on marine water quality due to the inclusion of Storm Water Quality Units (SWQUs) on the extended wharf discussed in the infrastructure section. The SWQUs provide storm water treatment by removing finer sediment, oils and grease, and floating and sinking debris from the storm water runoff prior to its discharge into the harbor.

Therefore, implementation of the Proposed Action would not result in significant impacts to surface water resources, groundwater resources, or marine water resources.

<u>Cultural Resources.</u> As defined in the implementing regulations for Section 106 of the National Register of Historic Places (NHPA), impacts to an undertaking on significant cultural resources are considered adverse if they "diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association" (36 CFR 800.5(a)(1)). The Navy consulted with the Guam State Historic Preservation Officer (SHPO) regarding the Proposed Action (see Appendix B). The Navy determined the Proposed Action would result in no adverse effect

on these NRHP-eligible wharves because the repairs would be conducted in accordance with the Secretary of the Interior Standards. The Navy received Guam SHPO concurrence on this determination via correspondence dated February 21, 2017 (Lizama and Aguon 2017; see Appendix B). In planning for this and future repairs to the historic wharves, the Navy prepared a Level II Historic American Engineering Report and survey of Lima, Mike, and November wharves, which has been provided to the National Park Service and Guam SHPO for donation to the Library of Congress. The original profile of the wharves would be maintained and the existing gantry tracks would be retained (Moon 2017).

There are no archaeological sites within the Area of Potential Effect (APE). The traditional cultural properties (Sumay Village) are located outside of the APE and would not be affected by the Proposed Action. In the event there are inadvertent discoveries of historic properties during any ground-disturbing activity, the Standard Operating Procedures (SOPs) listed in the Programmatic Agreement among the Commander, Navy Region Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) would be implemented.

Therefore, the proposed action would have no significant impacts on cultural resources.

<u>Land Use.</u> The repair of Lima, Mike, and November wharves would be consistent with operations and industrial support activities in Inner Apra Harbor and the Former Ship Repair Facility (SRF). Additionally, there would be no change in the intended use of the wharves. There would be close coordination with PortOps before the start of and during the Proposed Action. Coordination would be conducted to resolve any construction-related and waterborne vehicle access issues. The Former SRF is not currently in use and is considered a "working area;" therefore, construction and repair of Lima, Mike, and November wharves are consistent with industrial activities within the working areas of NBG.

The Navy determined that the Proposed Action would be conducted in a manner fully consistent or consistent to the maximum extent practicable with the federally approved enforceable policies of the Guam Coastal Management Program.

Therefore, implementation of the Proposed Action would not result in significant impacts to land use.

Infrastructure. The Preferred Alternative would repair and modernize Lima, Mike, and November wharves including the repair of wharf pavement areas, mechanical utilities, electrical power substation, lighting, telecommunications, storm water systems, and fire protection systems. However, no increase in personnel at NBG or population change in the regional area is anticipated as a result of the Preferred Alternative. Implementation of the Preferred Alternative would result in significant improvements to the infrastructure at Lima, Mike, and November wharves.

Potable Water

The Preferred Alternative would replace and improve potable water infrastructure at the wharves. The potable water line serving the wharf risers would be fed by the landside potable water infrastructure. Fire protection improvements would include fire mains, valves, and lead-ins to building sprinklers and hydrants. Utilities and connection points for portable boiler system steam generators including aboveground steam risers would be provided and may be routed underground or in a utility trench in a paved area at Lima Wharf. Furthermore, no substantial increase in potable water load is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the potable water system.

Wastewater

Under the Preferred Alternative, the existing sewer lift station at Lima Wharf would be demolished and the sewer system at Lima, Mike, and November wharves would be renovated to meet wastewater needs. No substantial increase in sewer system load is anticipated under the Preferred Alternative.

Sewage sludge from the Apra Harbor Wastewater Treatment Plant is disposed of in the Apra Harbor landfill and does not have a history of elevated metals. Plant and collection system capacities at the Apra Harbor treatment plant are sufficient to treat the new wastewater flows from the transient ship population. Military construction projects that are underway would further improve collection system and plant treatment performance. There are no significant impacts anticipated to collection or treatment plant capacities or efficiencies from the sewage resulting in the repair and future use of Lima, Mike, and November wharves. Additionally, these new sewage flows are not expected to contribute significant quantities of metals in sludge at the plant that would impact the ultimate disposal of the sludge. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the wastewater system.

Storm Water

Under the Preferred Alternative, drainage improvements would be provided at Lima, Mike, and November wharves. The wharf deck drainage system would generally maintain the existing drainage flow patterns. Runoff within the wharves would be directed into a longitudinal slotted drain. Slotted drains would be installed for the entire length of the wharf. Drainage manholes or junction structures would be provided to facilitate connection of drainage lines or laterals to the Storm Water Quality Units (SWQU). The SWQUs would be strategically located between the existing bulkhead wall tie-backs. In addition, the SWQUs would be equipped with a bypass line for excess storm water to flow through during heavy rainfall events. The outfall pipes would be capped at existing wharf outfall pipes to prevent any erosion or sediment from entering Apra Harbor. All drainage system improvements, including SWQUs, would be designed based on the NBG MS4 permit compliant with Guam Environmental Protection Agency (GEPA) storm frequency requirements.

The Preferred Alternative would improve storm water management and control by reducing the number of storm drain outlets at Lima Wharf to four outfalls and preventing silt buildup by redirecting storm water away from the shallow Finger Pier area to the deeper Inner Apra Harbor.

The Former SRF has not been in use for several years. Currently, the Navy is working to include the Former SRF in the 2020 Multi-Sector General Permit (MSGP) to properly add and address the Former SRF areas and their activities, and in the NBG Storm Water Pollution Prevention Plan (SWPPP) updates by July 2020. A site-specific SWPPP would be included for the Lima, Mike, and

November wharves as part of this plan. The 2020 MSGP and associated SWPPP would include similar BMPs and treatment of storm water through the use of SWQUs. The appropriate BMPs for the activities and potential pollutant sources would be included as part of this site-specific SWPPP. The activities, potential pollutants, and BMPs are anticipated to be similar and more stringent than those referenced in Volume 5 of the July 2018 NBG SWPPP. Compliance with the 2020 MSGP and SWPPP would minimize or avoid adverse impacts to storm water drainage receiving waters associated with the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the storm water system.

Solid Waste Management

A temporary, short-term increase in solid waste would occur as a result of demolition and construction activities including products of demolition or removal, excess or unusable construction materials, packaging materials, and other materials generated during the construction process. However, no significant long-term change to solid waste management at NBG is anticipated under the Preferred Alternative. Any long-term increase in solid waste as a result of repairing and modernizing Lima, Mike, and November wharves would be negligible compared to the amount of solid waste generated at NBG and would be handled by the current solid waste management practices. Therefore, implementation of the Preferred Alternative would not result in significant impacts to solid waste management.

Energy

Electrical utilities work includes the demolition and replacement of Lima Wharf substation and improvements to power mounds, lighting, and the underground main primary power feeder circuit from the switch station to Lima, Mike, and November wharves. Electrical utilities would be renovated at Lima, Mike, and November wharves, but no significant change to the electrical utilities or load is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to energy use.

Communications

Site telecommunications work includes an underground duct bank system with mains, laterals, communication riser system with associated conduits, cable television system, and a Supervisory Control and Data Acquisition system. The communications systems would be upgraded at Lima, Mike, and November wharves, but no significant change to communications is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to communications infrastructure.

Therefore, implementation of the Proposed Action would not result in significant impacts to infrastructure.

Hazardous Materials and Wastes. There are known Hazardous Materials (HAZMAT) and Hazardous Wastes (HAZWASTE) constituents, components, and cleanup sites within and adjacent to the Proposed Action Location. During construction activities, other forms of HAZMAT and HAZWASTE may also be encountered or generated. HAZMAT and HAZWASTE hazards are meticulously surveyed, documented, and characterized in advance. Handling plans, procedures, and training are developed and completed prior to any construction activities. Potentially significant HAZMAT and HAZWASTE hazards are avoided through the implementation of this approach.

With the implementation of all of the HAZMAT and HAZWASTE and environmental protection and worker safety measures listed in the EA, the Preferred Alternative would not result in significant HAZMAT and HAZWASTE impacts to the project, personnel, or the environment. If previously unforeseen suspect materials are encountered, work would cease at the location of the encounter, the situation would be assessed for safety, the occurrence would be documented and reported, and samples of the material would be analyzed at the appropriate time in compliance with applicable laws and regulations.

Air Quality. Air quality impacts under the Preferred Alternative were assessed by evaluating the additional emissions associated with the proposed construction (the additional emissions due to the Proposed Action). Under the Preferred Alternative, demolition and repair activities for the three wharves would require construction over two phases, so that construction would extend through 4 years. The deteriorated steel sheet pile including concrete cap, curbs, wall, tie rods, and cathodic protection system would be replaced. The implementation would be phased as two separate projects: FY 2021 RM14-1420 Repair Lima Wharf and FY 2022 RM14-1423 Repair Mike and November Wharves. The construction duration of each of the projects is estimated at 24 months.

For the purposes of this air quality analysis, air emissions were calculated based on equipment associated with demolition, excavation/filling, paving, hauling, piling installation, building construction, infrastructure repair and replacement, maintenance dredging, and removal of materials from NBG for relocation to an off-site landfill. The construction activities were evaluated for each calendar year. For fugitive dust emissions, 10% moisture and 23% silt content were used in the calculations based on Andersen Air Force Base sampling (Andersen Air Force Base 2012).

Air quality impacts would occur from the use of heavy equipment during construction activities, other project-related vehicles, and hauling truck trips. These emissions would primarily be related to fossil fuel combustion from mobile sources such as trucks and construction equipment and fugitive dust from earth-moving equipment and trucks hauling materials on roads. The area of greatest activity is the wharves area. Implementation of the Preferred Alternative would result in temporary increases in criteria pollutant emissions associated with construction and demolition activities.

General Conformity

Under the Preferred Alternative, SO_2 emissions would not exceed the general conformity threshold. A Record of Non-Applicability can be found in Appendix D.

Greenhouse Gases

The estimated carbon dioxide emissions attributed to construction operations under the Preferred Alternative is 10,694 tons. Emissions of Greenhouse Gases (GHGs) from the Preferred Alternative alone would not cause global warming. However, these emissions would increase the atmosphere’s concentration of GHGs, and in combination with past and future emissions from all other sources, contribute incrementally to the global warming that is producing the adverse effects of climate change.

Therefore, implementation of the Proposed Action would not result in significant impacts to air quality.

Public Involvement: The Navy has prepared this EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. The Draft EA review period began with a public notice published in local newspapers on April 24, 2020 indicating the availability of the Draft EA on the following websites: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information.html or https://go.usa.gov/xvkcP.

The Navy publication of a Notice of Availability of the Draft EA lasted for 3 consecutive days in the Guam Daily Post and the Guam Pacific Daily News. The notice described the Proposed Action, solicited public comments on the Draft EA, provided dates of the public comment period, and announced that a copy was available for review online. The public review period was 15 days and lasted from April 24, 2020 through May 9, 2020. Comments received during the Draft EA public comment period were evaluated during preparation of the Final EA. No comments resulted in changes to the Proposed Action or analyses.

Finding: Based on the information gathered during the preparation of this EA and the analysis presented; and coordination with National Oceanic and Atmospheric Administration Fisheries/National Marine Fisheries Service; Guam Bureau of Statistics and Plans, Coastal Management Program; Guam Historic Preservation Officer; Naval Ordnance Safety and Security Activity and the Department of Defense Explosives Safety Board; and completion of a public involvement process, the Commander Joint Region Marianas has determined that the Proposed Action will have no significant impacts on the quality of the human environment or generate significant controversy.

Interested parties may obtain a copy of the Final EA and FONSI from Naval Facilities Engineering Command Pacific, Building 258 Makalapa Drive Suite 100, JBPHH, HI 96860-3134, Attention Code EV21IB.

The Final EA is temporarily available at:

https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information.html

Or:

https://go.usa.gov/xvkcP

11 AUG 20

J. V. MENONI
COMMANDER
JOINT REGION MARIANAS

FINAL

ENVIRONMENTAL ASSESSMENT

Lima, Mike, and November Wharf Repair and Modernization

at

Naval Base Guam, Apra Harbor

July 2020

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Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Lima, Mike, and November Wharf Repair and Modernization
Project Location:	Inner Apra Harbor, Guam
Lead Agency for the EA:	Department of the Navy
Cooperating Agency:	None
Affected Region:	Guam
Action Proponent:	Naval Base Guam
Point of Contact:	Ian Bordenave NAVFAC PACIFIC 258 Makalapa Drive Suite 100 JBPHH, HI 96860 NFPAC-Receive@navy.mil
Date:	July 2020

Naval Base Guam, a Command of the United States Navy (hereinafter, referred to as the Navy), prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations and Navy regulations for implementing NEPA. The Proposed Action would repair and modernize Lima, Mike, and November Wharves at Apra Harbor, Guam starting in Fiscal Year 2021 to ensure the wharves continue to fulfill waterfront infrastructure needs and meet assigned operational mission requirements. This EA evaluates the potential environmental impacts of the Preferred Alternative and the No Action Alternative to the following resource areas: marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, hazardous materials and wastes, and air quality.

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Final
Environmental Assessment
Lima, Mike, and November Wharf Repair and Modernization
Naval Base Guam, Apra Harbor, Guam

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Abbreviations and Acronyms

Acronym	Definition
%	percent
ACM	Asbestos-containing Material
APE	Area of Potential Effect
BMP	Best Management Practice
BMUS	Bottomfish Management Unit Species
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
COC	Contaminants of Concern
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DAWR	Division of Aquatic and Wildlife Resources
dB	decibel
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DLADS	Defense Logistics Agency Disposition Services
DoD	United States Department of Defense
DRMO	Defense Reutilization and Marketing Office
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFM	Electrical Manhole
EMH	Electrical Manhole
EO	Executive Order
ESA	Endangered Species Act
ESS	Explosives Safety Submission
FACD	Functional Analysis Concept Development
FEP	Fishery Ecosystem Plan
FONSI	Finding of No Significant Impact
FUDS	Formerly Used Defense Sites
FY	Fiscal Year
GEPA	Guam Environmental Protection Agency
GHG	Greenhouse Gases
HAZMAT	Hazardous Materials
HAZWASTE	Hazardous Waste
IR	Installation Restoration
IRP	Installation Restoration Program
LBP	Lead-based Paint
M	Manual
MEC	Munitions and Explosives of Concern
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MS4	Municipal Separate Storm Sewer System
MSGP	Multi-Sector General Permit
MUS	Management Unit Species
NAAQS	National Ambient Air Quality Standards
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NFA	No Further Action
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOSSA	Naval Ordnance Safety and Security Activity
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSRF	Naval Ship Repair Facility
OPNAV	Chief of Naval Operations

Acronym	Definition
Pb	lead
PCB	Polychlorinated biphenyl
$PM_{2.5}$	fine particulate matter less than or equal to 2.5 microns in diameter
PM_{10}	suspended particulate matter less than or equal to 10 microns in diameter
PMUS	Pelagic Management Unit Species
POL	petroleum, oils, and lubricants
ppm	parts per million
PTS	Permanent Threshold Shift
RABs	Restoration Advisory Boards
RCRA	Resource Conservation and Recovery Act
re 1 μPa	referenced to 1 micropascal
re 1 $\mu Pa^{2\text{-}s}$	referenced to 1 micropascal squared-second
RMS	root mean square
ROI	Region of Influence
SEI	Sea Engineering, Inc.
SEL	Sound Exposure Level
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	sulfur dioxide
SOP	Standard Operating Procedure
SPL	Sound Pressure Level
SRF	Ship Repair Facility
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Plan
SWQUs	Storm Water Quality Units
TCP	Traditional Cultural Properties
TL	Transmission Loss
TEMES	Taiwan Electrical and Mechanical Engineering Services
TTS	Temporary Threshold Shift
U.S.	United States
USACE	United States Army Corp of Engineers
U.S.C.	United States Code
USEPA	U.S Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WWTP	Wastewater Treatment Plant

1 Purpose of and Need for the Proposed Action

1.1 Introduction

Naval Base Guam (NBG), a Command of the United States (U.S.) Navy (hereinafter, referred to as the Navy), 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. The mission of NBG is to support the forces of the U.S. Pacific Fleet, the warfighters based on NBG, the warfighters serviced and supplied by NBG, the commands that provide support to the warfighters, and the families of those stationed at NBG.

The Proposed Action would repair and modernize Lima, Mike, and November wharves at Apra Harbor, Guam starting in Fiscal Year (FY) 2021 to ensure the wharves continue to fulfill waterfront infrastructure needs and meet assigned operational mission requirements.

1.2 Background

Lima, Mike, and November wharves were built in 1945 and serve as berthing and ship repair wharves. Concrete caps on the wharves are damaged and there are cracks in the concrete throughout the wharves due to damage from natural disasters (e.g., earthquakes and typhoons). The anodes, fenders, moorings, bumpers, wall anchor plates, ship tie downs, and heavy-weather mooring anchor are damaged and beyond their useful life. The telecommunication, utilities, storm water, and fire protection systems serving the wharves are old, outdated, and do not meet current code requirements.

Lima, Mike, and November wharves are located at the entrance of Inner Apra Harbor, which is connected to the Atantano River and to the estuarine and marine environments of Inner and Outer Apra Harbor, respectively. Although Inner Apra Harbor was naturally formed, it has been extensively modified by construction, dredging, and filling beginning around 1944. Most of the modern Inner Apra Harbor is an artificially built environment, intensively managed/used for maritime military and industrial activities. Consequently, Inner Apra Harbor has been repeatedly exposed to dredging, maintenance, repairs, and modernization. The history of dredging and wharf repair and modernization in this area is found in Table 1-1 (HDR 2015a; Navy 2016, 2019a). Maintenance dredging in recent years occurs within 5- to 7-year intervals, or as required. The duration of maintenance dredging varies, but for context approximately 15 months were needed to complete maintenance dredging in the area of all of Alpha-Bravo, Lima, Mike, and November wharves in 2003.

A 2012 condition survey of Lima Wharf documented the extent of corrosion of steel sheet piling and inadequate cathodic protection. The survey also determined that additional repairs are needed to meet seismic requirements for the area. Repairs to Lima, Mike, and November wharves are necessary to fulfill waterfront infrastructure needs and meet assigned operational mission requirements to enable combat capable naval forces to be ready for deployment worldwide.

Table 1-1 Previous Dredging or Wharf Repair and Modernization at or in the Vicinity of the Proposed Action

Wharf	*Years Dredging Occurred*
Alpha-Bravo	1948, 1964, 1978, 2003, 2008
Delta	1964, 1993, 2005, 2013
Echo	1993, 1998, 2005, 2013
Entrance channel	1948, 1964, 1978, 2003, 2004, 2008 (partial)
Kilo	2008
Lima	1948, 1964, 1978, 2003
Mike	1948, 1964, 1978, 2003
November	1948, 1964, 1978, 2003
Romeo	2015 (east half)
Sierra	2015
Submarine turning basin	1948, 1964, 1978, 2003, 2008
Tango	2015
Uniform	2014
Victor	2003, 2012
X-Ray	2003, 2012, 2014, 2017 (construction turning basin)

Sources: HDR 2015a; Navy 2016, 2019a.

Additionally, the 2016 Functional Analysis Concept Development (FACD) reduced Lima Wharf vertical load bearing capacity from 600 pounds per square foot to 200 pounds per square foot due to major corrosion of the steel sheet piles. Sheet pile steel sectional losses range from 20 to 80 percent (%) due to severe deterioration. The FACD also placed operational loading restrictions on the entire length of Lima Wharf 60 feet (18 meters) from the sheet piles.

The Waterfront Facilities Inspection and Condition Assessment study conducted in May 2016 by a team of engineer-divers concluded that Lima Wharf has reached the end of its design life. It recommended that vertical loads on Lima Wharf be reduced by 50% within 20 feet (6 meters) of the sheet piles and recommended a complete replacement of the steel sheet piles.

1.3 Location

The main base at NBG Apra Harbor is located in Santa Rita, Guam, and is approximately 3,700 miles (5,955 kilometers) west of Hawaii, 1,500 miles (2,494 kilometers) east of the Republic of the Philippines, and 1,550 miles (2,494 kilometers) south of Japan. The island of Guam is the westernmost territory of the U.S. and is the southernmost island of the Mariana Islands (Figure 1-1).

The main base at NBG is located at the southern end of Marine Corps Drive on the west side of the island, about mid-way between the northern and southern ends. The Proposed Action Location lies south of Outer Apra Harbor and at the mouth of the entrance to Inner Apra Harbor (Figure 1-2). The project area for the Proposed Action at Lima, Mike, and November wharves lies north of Papa and Oscar wharves along the western shoreline of the entrance to Apra Harbor and west across the entrance to Apra Harbor from Bravo Wharf. The area has historically been used for ship repair and maintenance activities.

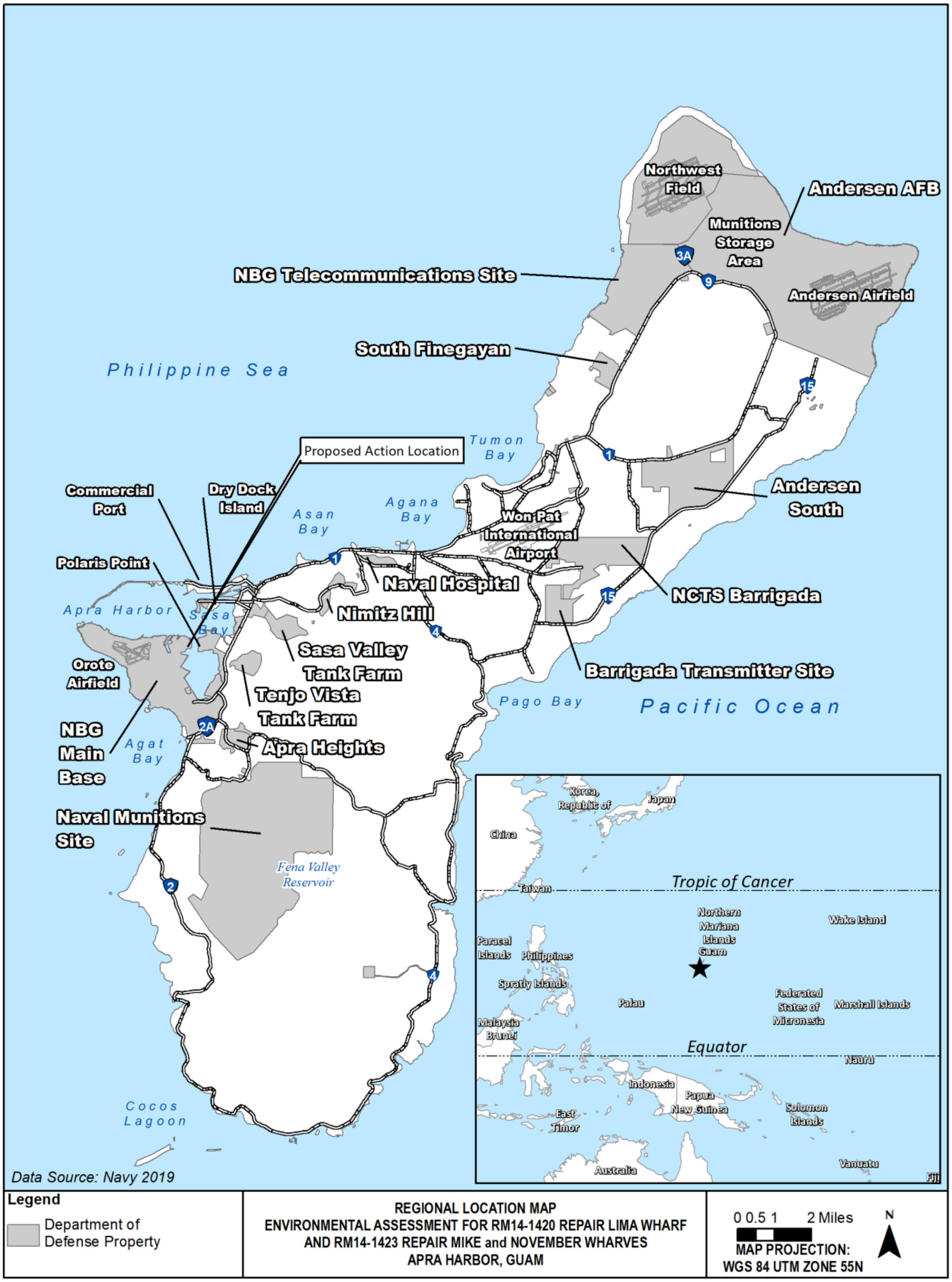

Figure 1-1 Regional Location Map

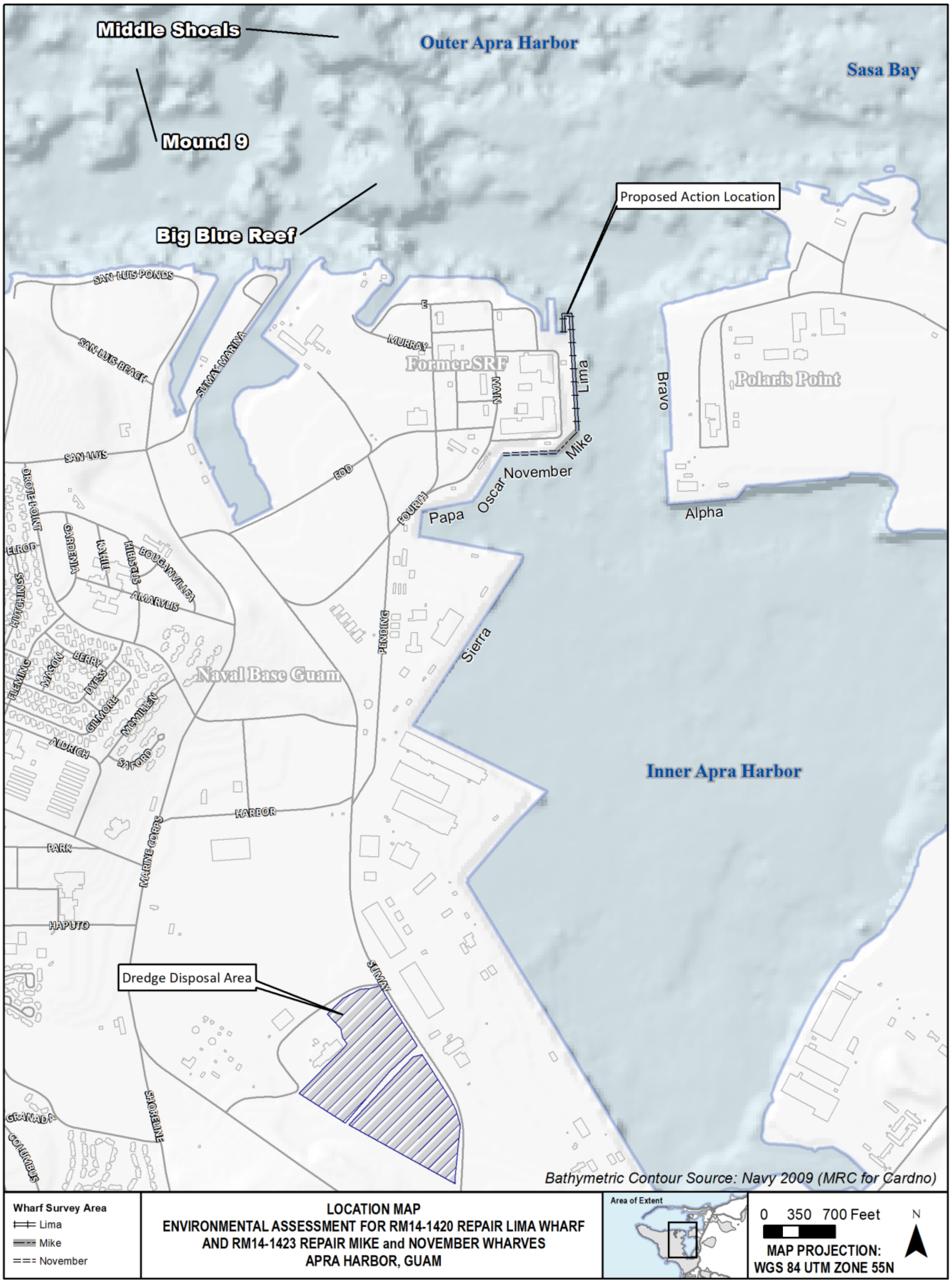

Figure 1-2 Proposed Action Location Map

1.4 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to repair and modernize the existing wharves to working condition and to ensure structural integrity.

The need for the Proposed Action is to ensure that Lima, Mike, and November wharves fulfill waterfront infrastructure needs and meet assigned operational mission requirements to enable combat capable naval forces to be ready for deployment worldwide. In this regard, the Proposed Action furthers the Navy's execution of its congressionally mandated roles and responsibilities under 10 U.S. Code (U.S.C.) section 5062.

> 10 U.S.C. section 5062: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

1.5 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternative and the No Action Alternative. The environmental resource areas analyzed in this EA include: marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, hazardous materials and hazardous waste, and air quality. The study area for each resource analyzed may differ depending on how the Proposed Action interacts with or impacts the resource.

1.6 Key Documents

Key documents are sources of information incorporated into this EA and involve similar actions, analyses, or impacts that may apply to this Proposed Action. CEQ guidance encourages incorporating documents by reference. Documents incorporated by reference in part or in whole include:

- X-Ray Wharf Improvements Military Construction P-518 and P-519 Final Environmental Assessment, May 2014. This EA concluded with a Finding of No Significant Impact (FONSI) for X-Ray Wharf Improvements. X-Ray Wharf is located at the southeastern area of Inner Apra Harbor. The repairs and modernization proposed for Lima, Mike, and November wharves are similar to the improvements analyzed for X-Ray Wharf.
- Final Standard Permit Authorization for X-Ray Wharf Improvements Berth 1 Project, Naval Base Guam, DA File No. POH-2014-00209, July 2015. The permit for X-Ray Wharf construction identifies additional detail for the project.
- Final Environmental Assessment for Inner Apra Harbor Maintenance Dredging, Guam, October 2003. This EA concluded with a FONSI for maintenance dredging in Inner Apra Harbor, Guam. Dredging location included the area adjacent to Lima, Mike, and November wharves.
- Final Apra Harbor Sediment Remedial Investigation, Naval Base Guam, May 2016. This document evaluates the nature and extent of contaminants in sediments within the harbor and calculates the risk to human health and the environment.
- Final Feasibility Study, Apra Harbor Sediment, Naval Base Guam, June 2019 (Naval Facilities Engineering Command [NAVFAC] Pacific 2019a). This document presents additional data collected in 2017 and evaluates several remedial alternatives to address potential risks to human health and the environment due to contaminated sediments.

- Final Coral Translocation Experiment from X-Ray Wharf in Inner Apra Harbor, Guam, Project Report 1, April 2016. This report presents observations and results from a 30-month coral relocation experiment initiated in July 2015 in Inner Apra Harbor, Guam.
- Final Essential Fish Habitat (EFH) Assessment: Inner Apra Harbor Maintenance Dredging, Naval Base Guam, August 2016. The purpose of this document is to address the effect of the maintenance dredging in Inner Apra Harbor to EFH.
- Final Biological Evaluation: Inner Apra Harbor Maintenance Dredging, Naval Base Guam, February 2016. The report provides a full description and analysis of the Proposed Action, the Action Area, and impacts and finding for Endangered Species Act (ESA) species.

1.7 Relevant Laws and Regulations

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

- Chief of Naval Operations (OPNAV) Instruction, OPNAV Instruction 5090.1E; Environmental Readiness Program Manual (M), OPNAV-M 5090.1
- Clean Air Act (CAA) (42 U.S.C. section 7401 et seq.)
- Clean Water Act (CWA) (33 U.S.C. section 1251 et seq.)
- Coastal Zone Management Act (CZMA) (16 U.S.C. section 1451 et seq.)
- Comprehensive Environmental Response and Liability Act (42 U.S.C. section 9601 et seq.)
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] parts 1500–1508)
- Emergency Planning and Community Right-to-Know Act (42 U.S.C. sections 11001–11050)
- ESA (16 U.S.C. section 1531 et seq.)
- Executive Order (EO) 11988, Floodplain Management
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13089, Coral Reef Protection
- EO 13112, Invasive Species
- EO 13751, Safeguarding the Nation from the Impacts of Invasive Species
- Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. section 136 et seq.)
- Federal Water Pollution Control Act, 33 U.S.C. sections 1251–1387
- Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews
- Guam Air Pollution Control Standards and Regulations (Regulation 1302, Chapter 1, Title 22 of Guam Administrative Rules and Regulations)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. section 1801 et seq.)
- Marine Mammal Protection Act (MMPA) (16 U.S.C. section 1361 et seq.)
- Marine Protection, Research, and Sanctuaries Act Title I (Ocean Dumping Act)
- Migratory Bird Treaty Act (16 U.S.C. sections 703–712)

- NEPA of 1969 (U.S.C., Title 42, sections 4321–4370f [42 U.S.C. section 4321, et seq.]), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. section 306108 [Section 106 Consultation])
- National Invasive Species Act (16 U.S.C. section 4701)
- Navy regulations for explosives safety review and verification of munitions responses, which provide procedures and reporting requirements to enable oversight of Naval Ordnance Safety and Security Activity (NOSSA); Naval Sea Systems Command OP5 volume 1 Seventh Revision Change 14, 1 June 2017; NOSSA Instruction 8020.15D
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Resource Conservation and Recovery Act (RCRA) (42 U.S.C. section 6901 et seq.)
- Rivers and Harbors Act (33 U.S.C. section 407)
- Section 106, Post Review Discoveries (36 CFR section 800.13)
- Toxic Substances Control Act (15 U.S.C. sections 2601–2629)

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 (see Table 5-1).

1.8 Public and Agency Participation and Intergovernmental Coordination

CEQ regulations direct agencies to involve the public in preparing and implementing their NEPA procedures.

The Navy has prepared this Draft EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. The Draft EA review period began with a public notice published in local newspapers on April 24, 2020 indicating the availability of the Draft EA on the following websites: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information.html or https://go.usa.gov/xvkcP.

The Navy publication of a Notice of Availability of the Draft EA lasted for 3 consecutive days in the Guam Daily Post and the Guam Pacific Daily News. The notice described the Proposed Action, solicited public comments on the Draft EA, provided dates of the public comment period, and announced that a copy was available for review online. The public review period was 15 days and lasted from April 24, 2020 through May 9, 2020. Comments received during the Draft EA public comment period were evaluated during preparation of the Final EA. No comments resulted in changes to the Proposed Action or analyses.

During the development of the Proposed Action, the Navy coordinated and consulted with the National Oceanic and Atmospheric Administration (NOAA) Fisheries/National Marine Fisheries Service (NMFS) (see consultation documents in Appendix A). NMFS responded in concurrence with the EFH assessment on March 13, 2020 and provided two conservation recommendations in support of the efforts (see Appendix A). NMFS responded in concurrence with the ESA assessment on April 8, 2020 that the Proposed Action is not likely to adversely affect ESA-listed species (see Appendix A). The Navy has determined that consultation with the U.S. Fish and Wildlife Service (USFWS) is not required. A Coastal

Consistency Determination was prepared for submittal to the Guam Bureau of Statistics and Plans, Coastal Management Program. The Navy received Guam Bureau of Statistics and Plans concurrence on this determination via correspondence dated June 19, 2020 (see Appendix C).

The Navy also consulted with the Guam State Historic Preservation Officer (SHPO) regarding this Proposed Action (see Appendix B). The Navy determined the Proposed Action would result in no adverse effect on these National Register of Historic Places (NRHP). The Navy received Guam SHPO concurrence on this determination via correspondence dated February 21, 2017 (Lizama and Aguon 2017; see Appendix B).

The Explosives Safety Submission (ESS) submittal will be reviewed by NOSSA and the Department of Defense Explosives Safety Board (DDESB). The ESS will be prepared due to the Proposed Action including intrusive activities such as dredging and the installation of sheet piles in the water adjacent to Lima, Mike, and November wharves – an area where Munitions and Explosives of Concern (MEC) and/or Material Potentially Presenting an Explosive Hazard (MPPEH) have been previously been found as a result of World War II-era activities.

2 Proposed Action and Alternatives

This chapter includes an overview of the Proposed Action, the screening factors used to determine reasonable alternatives, alternatives carried forward for analysis, alternatives considered but not carried forward for detailed analysis, and best management practices (BMPs) included in the Proposed Action.

2.1 Proposed Action

The Navy proposes to repair and modernize Lima, Mike, and November wharves in Apra Harbor, Guam starting in FY 2021. The Proposed Action would include structural and subsurface repair and upgrade of infrastructure to meet current Unified Facilities Criteria code requirements.

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.

The screening factors used to select reasonable alternatives that would allow mission, operational, and support functions to be fulfilled are as follows:

- Ability to meet the purpose and need for the Proposed Action.
- Compatibility with NBG's overall ship repair requirements and waterfront plans.
- Compliance with Navy regional guidance including meeting the Navy's security requirements and minimization of footprint expansion beyond existing military installation boundaries.

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

- No Action
- Repair and Modernize Lima, Mike, and November wharves
- Lease
- New Footprint at a Different Location
- Construct a Seawall
- New Construction/Replacement of Current Wharf with a Wharf of Other Design (Open Wharf or Solid Fill Relieving Platform)

2.3 Alternatives Carried Forward for Analysis

Although several possible alternatives were evaluated, as described in Section 2.4, only one reasonable alternative was identified. Based on the screening factors identified above, this action alternative will be carried forward for analysis in this EA. The No Action Alternative will also be carried forward for analysis in this EA.

2.3.1 Alternative 1 - No Action Alternative

Under Alternative 1, the No Action Alternative, the Navy would not implement repairs to Lima, Mike, and November wharves, resulting in the continued deterioration of wharf infrastructure at these locations. This scenario would continue to jeopardize the structural integrity of the wharves and the continuation of operational and mission requirements of NBG.

Failure to repair and modernize Lima, Mike, and November wharves would result in increased deterioration of the steel bulkhead, formation of holes, and loss of backfill material. Loss of material would cause voids, failure of wharf deck paving, and potential utility outages from broken piping. Load restrictions resulting from the structural deterioration of the wharves would eventually eliminate crane operations that are necessary for continued Navy operations at NBG. Lima, Mike, and November wharves would no longer be effective as ship repair wharves, which would severely reduce ship repair capability within Apra Harbor, leading to increased likelihood to delay ship operational schedules at NBG. Furthermore, the continued deterioration of the wharves could adversely affect activities at surrounding wharves and the entrance to Apra Harbor.

This 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 will be used to analyze the consequences of not undertaking the Proposed Action and will serve to establish a comparative baseline for analysis.

2.3.2 Alternative 2 - Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)

Alternative 2 would repair and modernize Lima, Mike, and November wharves. The deteriorated steel sheet pile including concrete cap, curbs, wall, tie rods, and cathodic protection system would be replaced. The implementation would be phased as two separate projects: FY 2021 RM14-1420 Repair Lima Wharf and FY 2022 RM14-1423 Repair Mike and November Wharves. The construction duration of each of the projects is estimated at 24 months.

Repair work would include a new sheet pile bulkhead to be constructed in front of the existing steel sheet pile structure. This would include on land pile driving of approximately 200 to 300 piles as well as excavation. Construction would utilize interlocking metal sheet piles. Sheet piles would be driven in close contact or interlocking with others to provide a tight wall to resist lateral loads including water, adjacent earth, or other materials. The sheet pile structure would be anchored near the top and controlled density fill placed behind the structure. A concrete cap would be formed along the top and outside face of the sheet pile structure to tie the structure together and provide a berthing surface for vessels (Figure 2-1). Repairs would be made to the wharf pavement areas, mechanical utilities, electrical power substation, lighting, telecommunications, storm water systems, and fire protection systems. The mooring system, including hardware and foundations, would be demolished, removed for disposal, and replaced with fenders, bumpers, wall anchor plates, bollards, bitts, and cleats. Construction would include paving and drainage repairs in accordance with storm water and structural designs.

This alternative would repair the utility system by replacing the sewer lines, sewer lift station, potable water line, steam line, utility trenching, and connections. The telecommunications system would be repaired by replacing the cabling, duct bank, manholes, risers, and a cable television cabinet. The electrical substation would be repaired by removing existing substation/power mounds and replacing the substation, power system distribution, and power mounds. A Bilge and Oily Wastewater Treatment System would be installed. This alternative would also install new wharf site lighting and repair the fire protection system. Figure 2-2 depicts the general site layout. Proposed utilities and upgrades are anticipated to follow the same general footprint as the existing infrastructure layout.

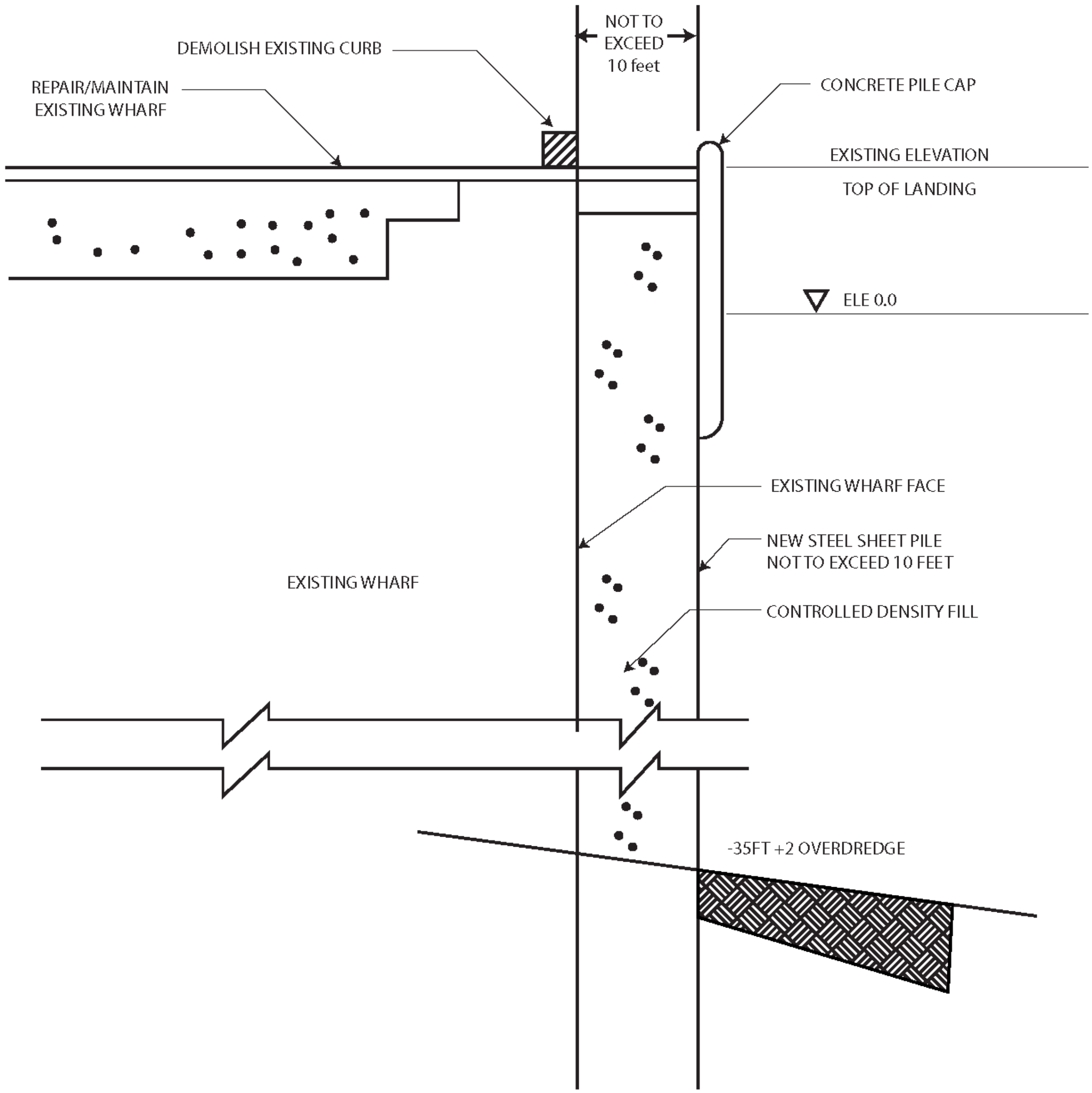

Figure 2-1 Typical Lateral View of Wharf Bulkhead Replacement

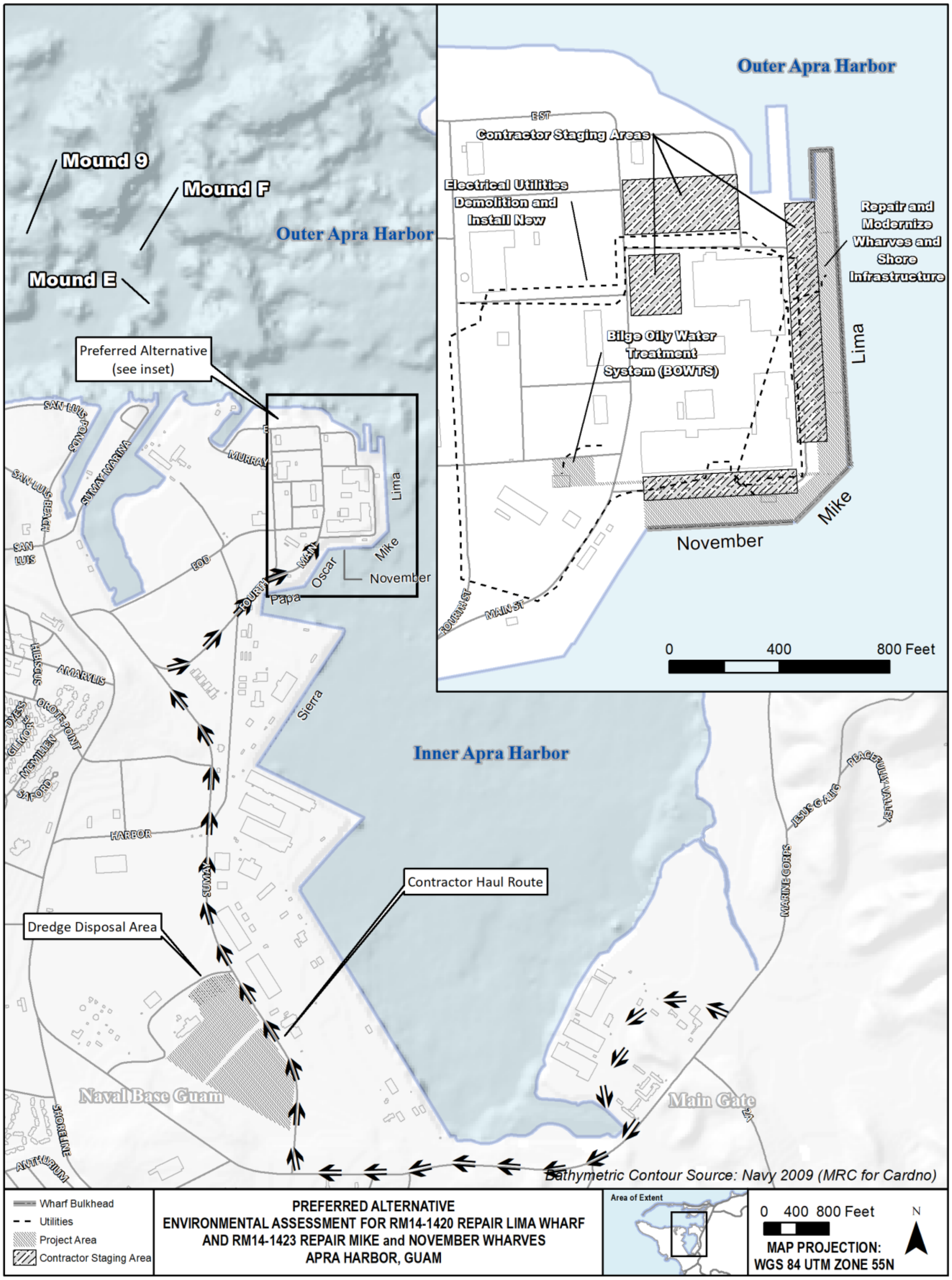

Figure 2-2 General Site Layout

2.3.2.1 Construction Activities

Construction activities would include the following:

- Demolish existing concrete pile cap, wharf deck (old pavement), and utilities (including lateral supply lines from utilities such as water and electrical)
- Remove existing miscellaneous obstructions
- Install new steel bulkhead with tie-back anchors
- Place a combination of fill between existing and new walls
- Install new concrete cap that partially encases the new steel wall
- Install sacrificial anode cathodic protection system for the new steel wall
- Install new fenders
- Install new utilities
- Replace and repair wharf deck
- Upgrade area lighting fixtures

2.3.2.2 Construction Sequence

Preparation and Demolition

Prior to wharf construction commencing, NBG is planning to undertake maintenance dredging of the sediments in front of Lima to -35 feet (-11 meters). Transplantable corals will be removed prior to the maintenance dredging as an avoidance/minimization measure. Following that work, there is the possibility of some areas of sediments remaining for the Lima contractor to remove. This is expected to be accomplished with a clam shell bucket. The bucket would be operated such that drop heights of material during loading and offloading would be as close to zero as possible. Shielding with appropriate thickness of material would be required for personnel essential to the operation and equipment will be used that maximizes the separation distance between the operators and the bucket. These sediments would be placed in sealed dump trucks and hauled from the top side of the new wharf to the same approved Dredge Disposal Area used for the maintenance dredging (see Figure 2-2). Due to the risk of encountering MEC and MPPEH during dredging, transportation, and disposal of dredge material, exclusion zones would be established based on the primary munition with the greatest fragmentation distance to keep non-essential personnel in the water and on the land safe from exposure to potential effects from unintentional detonations (in water and on land). Screening of dredge material for MEC and/or MPPEH would take place at the approved disposal site. An exclusion zone would be established for screening operations and operators of mechanical equipment to protect from unintentional detonation by shielding and operator minimum separation distance. Any MEC and/or MPPEH identified during screening would be handled in accordance with procedures approved in the ESS.

Before dredging work commences, transplantable corals will be removed from the in-water Proposed Action as an avoidance/minimization measure. After the transplantable corals are removed, the first months of work would then include mobilization of equipment and demolition. The removals include demolishing old pavement, utilities, a substation building, and miscellaneous wharf hardware. The crane rail would be removed and stored for future re-installation. After the scheduled maintenance dredging is accomplished in 2020, divers and cranes would remove any remaining visible debris and obstructions that may interfere with the installation of the new steel sheet pile wall. Any points where the new steel sheet pile wall attaches to the existing wharves would be demolished above and below the water line to expose the existing steel.

A curb and portion of existing concrete cap along the face of the existing sheet would be removed to accommodate the new controlled density fill that would be placed between the new sheet pile structure and the existing sheet pile structure. The concrete apron along the waterside perimeter of the wharves and the utilities (including lateral supply lines from utilities such as water, fuel, wastewater, electrical, and communications) would be removed.

Installation of New Bulkhead

A new bulkhead would be installed. A bulkhead is a vertical shoreline stabilization structure. Excavation depths at the wharf are estimated at 8 feet to expose existing tie rods and would be backfilled with clean fill material. The contractor would drive piles on shore to construct a tie-back anchor block. These tie-back anchor blocks are structural elements that provide additional stability to the bulkhead by transferring load to the ground. Following, or in conjunction with the tie-back anchor block piles, the contractor would install the King-Pile and sheet piles on the water side. This work is expected to take 5 months. Following installation of waterside H-Z piles and landside tie-back anchor block construction, tie rods would be installed connecting the two systems together. The waterside H-Z sheet piles would then be capped with a concrete bulkhead cap. The area behind the bulkhead and above the new tie-back anchor block would be filled and compacted. Crane barges are anticipated to be utilized in addition to shore-based equipment due to existing degradation of structural integrity on the wharves. Equipment consisting of a pile installation suite (pile leads and impact hammer) would be mobilized to the project site. Once aligned, the metal sheet piles would be driven to the appropriate depth using the pile leads and impact hammer. It is unlikely that MEC and/or MPPEH will be encountered on the land portion of the Proposed Action, but MEC and/or MPPEH resulting from World War II-era activities has previously been encountered elsewhere in Apra Harbor, and may be encountered during the in-water work (e.g., dredging and pile driving). Therefore, exclusion zones will be established and shielding and operator minimum separation distance would be employed.

The number of piles installed per day and the number of blows it would take to drive a pile would vary depending on the type of pile and its location. Installation of up to a maximum of eight sheet piles per pile driving day is anticipated. On average, it is anticipated that approximately six piles would be driven per day**.** The pile driving process begins by placing a choker cable around a pile and lifting it into vertical position with a crane. The in-water pile is then lowered into position inside the template and set in place at the mudline. Impact hammers have guides that hold the hammer in alignment with the pile while a heavy piston moves up and down, striking the top of the pile, driving the pile into the substrate from the downward force of the hammer. The number of blows from the impact hammer to drive each pile is estimated at 5 blows per foot for 15 feet (5 meters) for an average of 75 blows per pile. This number will vary depending on factors such as soil condition, tip elevation, size of hammer, and final dimensions of the piles.

A grand total of 40 concrete fender piles would be installed seaward of the new sheet piles. At the north end of Lima Wharf, a total of 24 concrete fender piles would be installed (12 each at each corner). At the corner of Mike/Lima, an additional eight concrete fender piles would be installed. At the corner of November/Mike, an additional eight concrete fender piles would be installed. The concrete fender pile installation process is similar to the sheet piles; however, concrete fender tip elevations are designated as -67 feet (-20 meters). The top of the bulkhead is about +9 feet (+3 meters) and the total pile length is about 76 feet (23 meters). Only the portion between -35 feet (-11 meters) and -67 feet (-23 meters) will be driven 32 feet (10 meters). Once concrete fender piles are in position, installation typically takes 364 blows to 884 blows to reach the required tip elevation, depending on site conditions, driving method, and equipment used (hammers HHK 5A vs HHS9). Once all of the piles are driven, closure plates would be attached between the existing adjacent sheet pile walls and new wall end terminations. These are typically welded in place using underwater welding techniques.

Due to the poor structural condition of Lima, Mike, and November wharves and their inability to support heavy cranes, pile driving would be performed primarily by use of a waterside derrick crane mounted barge. The estimated draft of the fully loaded pile driving and dredging barges is no more than 7-10 feet (2-3 meters). North Lima Wharf water depth is approximately 12-28 feet (4-9 meters) and west Lima Wharf depth is approximately 8-9 feet (2-3 meters). To install the King and Z sheet piling, the contractor would likely use a template to place the piling in the correct location and alignment. Refer to the photo below for examples of specific equipment and terminology. Note that waterside equipment would be used rather than the landside equipment shown in the example on Trinidad Island (Figure 2-3). Photo courtesy of J. Sircar, WSP (Figure 2-3).

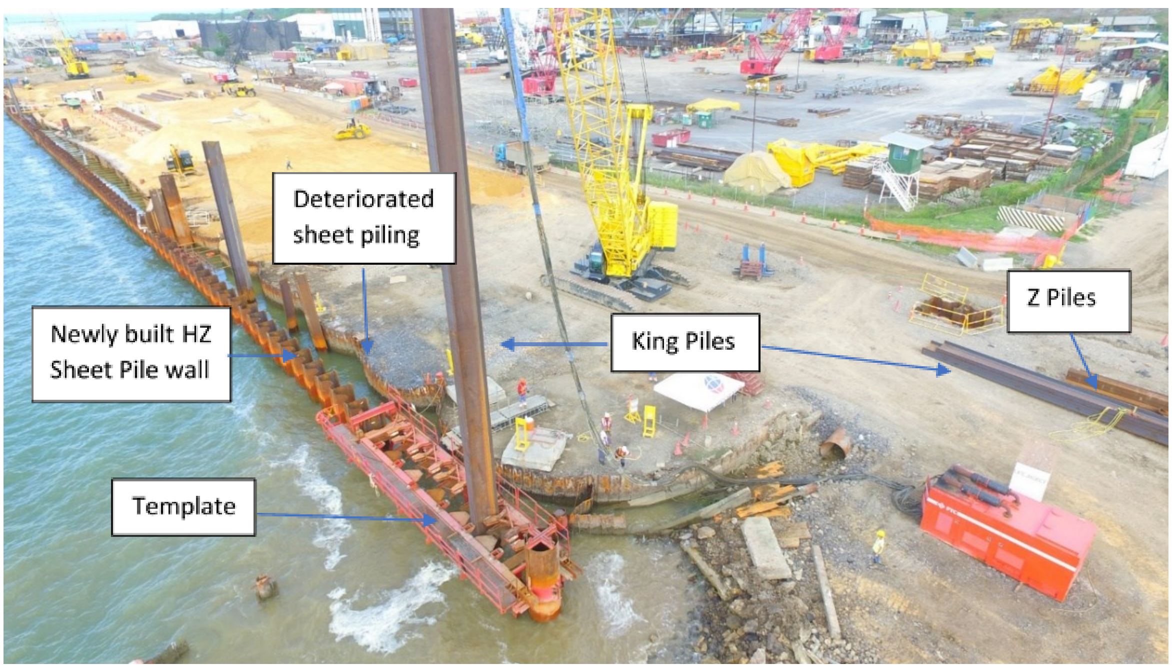

Figure 2-3 Installation of Sheet Piling by Pile Driver

Anchors would be installed or existing tie-backs utilized to reinforce the new wharf face for stability. After the anchors are installed, gravel or controlled density fill would be placed into the space behind the wall. Trapped water behind the wall would be discharged in compliance with Section 401 of the CWA.

After the fill operation has been completed, the concrete pile cap would be formed and placed along the top of the new interlocking sheet pile wall. Wood, steel, or fiberglass forms would be installed along the top of the wall down to some point below mean low water elevation. Water would be removed from the forms, steel reinforcement would be placed in the forms, and concrete would be poured to the required elevations.

After the pile cap is in place, asphalt pavement would be installed. A new high-mast lighting system, new security fencing, and new utilities would be installed to replace those that were removed. A new wharf lighting system would be installed. The new lighting would consist of high-pressure sodium light fixtures utilizing shielding features (e.g., combination of fixture design, internal optics, and aiming restrictions) to minimize lighting beyond the wharf deck or beyond the minimum over-water security lighting requirement. The lighting would conform to U.S. Coast Guard regulations to avoid interference with navigation on adjacent waterways. The existing substation/power mounds would be removed and the substation, power system distribution, and power mounds would be replaced. Telecommunication system cabling, duct bank, manholes, risers, and cable television cabinet would be replaced. Storm water, wastewater, and potable water infrastructure would be replaced and modernized. A new fire protection system would be installed meeting current code requirements. Cathodic protection (i.e., corrosion-control measures) would be provided for infrastructure replacement and upgrades. The corrosion-control measures would include coatings, electrical isolation devices, test stations, galvanic anode cathodic protection, and/or impressed current cathodic protection systems. Wastewater and portable water utilities would be replaced.

During the [site utilities work] activity, crane rail re-installation, site paving, fencing, lighting, striping, fender installation, and commissioning of equipment would be completed. This activity will take 2–3 months.

2.4 Alternatives Considered but not Carried Forward for Detailed Analysis

Application of screening factors identified in Section 2.2 resulted in elimination of various action alternatives. The following alternatives were considered but not carried forward for detailed analysis in this EA due to the application of these screening factors.

2.4.1 Lease

Leasing private or non-federal lands is not a viable option as there are no suitable public or private facilities on the island that can be leased to satisfy the requirements of this project. The Commercial Port (see Figure 1-1) would not provide adequate landside or waterside security for military ships and their cargo. The Commercial Port serves its customers on a first-come, first-served basis, which would be inadequate in contingency conditions, where rapid loadouts (i.e., loading of supplies onto vessels in preparation for transport) are necessary. This situation would negatively impact mission performance and Fleet support capabilities and would not be compatible with NBG's overall ship repair requirements and waterfront plans.

2.4.2 New Footprint/New Location

New construction at a different location would fail to address the deterioration of the Navy wharves. Although a new location could potentially be operationally feasible for the type of activities currently conducted at the wharves, the Lima, Mike, and November wharves would continue to deteriorate and would adversely affect operations and the immediate environment. This alternative would not meet the purpose and need for the Proposed Action, which is one of the screening factors. In addition, new construction at a different location would not meet the intent of Navy regional guidance for minimization of footprint expansion beyond existing military installation boundaries. The current capabilities can be maintained by implementing proposed improvements at the existing Lima, Mike, and November wharves location without expanding the footprint within NBG. Consequently, new construction would not meet the footprint expansion screening factor. For these reasons, this alternative was considered but eliminated from further consideration.

2.4.3 Construct a Seawall

Construction of a new seawall surrounding Lima, Mike, and November wharves to prevent eventual collapse would render the wharves defunct and thus fail to meet operational mission requirements. The purpose of a seawall is to provide shore stabilization and prevention of erosion (U.S. Department of Defense [DoD] Unified Facilities Criteria, September 2012). This purpose does not serve the purpose of the Proposed Action, which is repair berthing. Therefore, this alternative was considered but eliminated from further consideration.

2.4.4 New Construction/Replacement of Current Wharf with a Wharf of Other Design (Open Wharf or Solid Fill Relieving Platform)

Replacement of the current type of wharf (a steel pile bulkhead) with an alternative design such as an open wharf or solid fill relieving platform was eliminated from further consideration. Replacement with a different type of wharf would result in a larger construction footprint, which would in turn produce greater environmental impacts (e.g., larger areas of seabed would be taken) than the current project, increasing project time and cost while decreasing the chances of project approval. Further, alternatives to the existing type of wharf would exceed reasonable replacement costs and available funding. Compatibility with NBG's overall ship repair requirements, waterfront plans, and compliance with Navy regional guidance would not be met under this alternative.

2.5 Best Management Practices Included in Proposed Action

This section presents an overview of the 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. Table 2-1 includes a list of BMPs. Mitigation measures are discussed separately in Chapter 3.

Table 2-1 Best Management Practices

Best Management Practice	*Description*	*Impacts Reduced/Avoided*
Conditions of USACE Permit (Section 401 and 404)	Project-specific conditions (including compliance with Section 401 Water Quality Certification process of the CWA) will be identified by USACE and Guam Environmental Protection Agency during the relevant permit approval stage.	Minimization of discharges into Waters of the U.S.
Installation Restoration Program management of contaminated sediments	Contaminated sediments adjacent to the new sheet piling may be exposed during pile driving activities. BMPs such as turbidity curtains shall be used to limit or prevent the suspension and migration of contaminants.	Impacts to protected marine species and water quality.
Explosives Safety	All relevant construction activities will implement response actions prescribed by the 2020 Amendment 7 of the ESS for Munitions Response Sites Guam Construction Support. An approved ESS will be obtained to specify response actions for activities that are not covered by the 2020 Amendment 7 ESS.	Impacts to human safety.
Marine Species Monitoring During Construction	Trained observers will be designated to visually survey the project area for protected species each day beginning 30 minutes prior to the start of work and repeated frequently throughout the day. Observers will remain continuously alert for protected species starting 30 minutes prior to start of pile driving through 30 minutes after shut-down. Resumption of work following a break of 30 minutes or more requires a 30-minute pre-work area visual search. Project-related vessel operators will maintain constant vigilance for and avoid all marine mammals and sea turtles while piloting their vessels. This must include the tug, and scow, and barge transport operators that would transit within Inner Apra Harbor.	Impacts to protected marine species.
Invasive Species and Biosecurity	All marine equipment (barges, drill rigs, dredging equipment, etc.) must be inspected and cleaned of pollutants, organic matter, and invasive species prior to mobilization and demobilization. Ensure that equipment and gear will be clean and free of soil, seeds, plant and animal material (terrestrial and aquatic) that could become established as non-native (noxious, invasive).	Prevent the movement of non-native invasive species and potential impacts to marine resources.

Table 2-1 Best Management Practices

Best Management Practice	*Description*	*Impacts Reduced/Avoided*
Pile Driving Practices	No in-water pile driving will be conducted after dark unless the work has proceeded uninterrupted since at least one hour prior to sunset, and no protected species have been observed near the 50-yard safety range for that work. Pile driving and dredging will use a ramp-up technique at the start of each workday or following a break of more than 30 minutes or longer. Impact pile driving will use a slow increase in hammering. Pile driving will be postponed or halted when marine mammals or sea turtles are within 50 yards of pile driving operations until the animals have voluntarily moved beyond 50 yards.	Impacts to protected marine species.
Avoidance Practices for Construction-Related Ocean Vessels	Vessel operations will alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles. Vessels will be operated at maximum speeds of 10 knots or less in areas of known or suspected turtle activity. If approached by a sea turtle within Inner Apra Harbor, the vessel engine will be put in neutral, and the animal will be allowed to pass. Sea turtles will not be encircled or trapped between multiple vessels or between vessels and the shore.	Impacts to protected marine species.
Fugitive Dust	Use of water or suitable chemicals for control of fugitive dust in the demolition of the wharf structures, construction operations, or excavation processes. Application of water or suitable chemicals on material stockpiles and other surfaces which may allow release of fugitive dust. Installation of appurtenances that provide an enclosure and ventilation for all crushing, aggregate screening, and conveying of material likely to become airborne. Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Reasonable containment methods shall be employed during sandblasting, spray painting, or other similar operations.	Impacts to air pollution.

Table 2-1 Best Management Practices

Best Management Practice	*Description*	*Impacts Reduced/Avoided*
	Covering all moving, open-bodied trucks transporting materials that may release fugitive dust. Identify planned air pollution-generating processes and management control measures (including, but not limited to, spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions). Log hours of operations and track quantities of materials used.	
General Conservation Measures for Marine Species	There will be no attempt to feed, touch, ride, or otherwise intentionally interact with any protected species. All in-water activities will cease during the primary coral spawning events each year for hard (scleractinian) and soft (octocorallia) corals. The spawning period is estimated to be 21 days total (1 week before and 2 weeks after)[1]. These dates, by year, are as follows: • 2021 o Soft corals: May 18–June 8 (Full moon May 26) o Hard corals: July 5–Aug 6 (Full moon July 23–24) • 2022 o Soft corals: May 7–29 (Full moon May 15–16) o Hard corals: July 5–27 (Full moon July 13-14).	Impacts to protected marine species and habitat.
Seismic Event	To reduce the risk of damage during a significant seismic event, the wharf improvements will be designed for no or minor structural damage and temporary or no interruptions in operations due to a Level 1 seismic event (return period of 72 years).	Minimization of structural damage.
Spill Prevention and Response	A contingency plan to control and contain toxic spills will be developed. Secondary containment will be used for storage of on-site materials. Appropriate materials (including spill kits) will be maintained and readily available on site to respond to potential spills. Any spills will be cleaned up immediately. Fueling of land-based construction-related vehicles and equipment will take place at least 50 feet away from the water. Spill prevention booms will be employed in the refueling of construction-	Minimization and control of discharges into Waters of the U.S.

Table 2-1 Best Management Practices

Best Management Practice	*Description*	*Impacts Reduced/Avoided*
	related equipment that cannot be fueled out of the water. HAZMAT used in construction, including aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags will be managed according to environmental law.	
SWPPP	Surface water discharges from storm drain systems are potential pathways for the release of land-based contaminants to Apra Harbor. SWPPP measures will be implemented, including: protection of storm drain inlets and other drainage facilities; filtration, maintenance, and regular cleaning to keep areas exposed to storm water clean and free of rubbish, construction debris, and spills; storing material under shelter or covering material to avoid contact with storm water; and controlling spills; installing containment; provide a berm or dike around crucial areas; preparation of and compliance with a site-specific SWPPP. A plan will be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project. Avoid allowing debris to enter the harbor.	Impacts to Guam Water Quality.
Water Quality Monitoring	Turbidity and siltation from project-related work will be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose pile driving operations to the maximum extent practicable. A Water Quality Monitoring Plan will be prepared for pre-construction, construction and post-construction sampling. The Water Quality Monitoring Plan will include parameters to be identified during the Section 401 Water Quality Certification process to meet CWA standards. Project operations will be adaptively managed (e.g., by adjustment of silt curtains and construction methodology) in response to results of turbidity monitoring.	Impacts to Guam Water Quality.
Conformance with the Programmatic Agreement among the Commander, Navy Region Marianas; Advisory	In the event there are inadvertent discoveries of historic properties during any ground-disturbing activity, the SOPs listed in the Programmatic Agreement among the Commander, Navy Region	Inadvertent discoveries of historic properties will be documented per the NHPA

Table 2-1 Best Management Practices

Best Management Practice	*Description*	*Impacts Reduced/Avoided*
Council on Historic Preservation; and the Guam Historic Preservation Office	Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) will be implemented.	and associated regulations 36 CFR 800.

Legend: BMP = Best Management Practices; CFR = Code of Federal Regulations; CWA = Clean Water Act; ESS = Explosives Safety Submission; HAZMAT = Hazardous Materials; NHPA = National Historic Preservation Act; SOP = Standard Operating Procedure; SWPPP = Storm Water Pollution Prevention Plan; U.S. = United States; USACE = United States Army Corps of Engineers

Sources: [1]Kojis and Quinn 1984; Jokiel 1985; Harrison and Wallace 1990; Richmond 1993, 1997; Slattery et al. 1999; Miller and Mundy 2003.

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 EA. In compliance with NEPA, CEQ, and 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 (see 40 CFR 1508.27 for complete definition). 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 needs to be in order to be considered significant.

This section includes marine biology (including underwater acoustics); water quality; cultural resources; land use (including coastal zone management federal consistency); infrastructure; hazardous materials and hazardous waste; and air quality.

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: The Proposed Action would involve excavating and removing non-structural fill material and replacing it with structural fill material, and it would also involve maintenance dredging preceding construction. However, the Proposed Action would not impact unique geologic features or landmarks, as it would alter a man-made shoreline area. All temporary staging of construction equipment would occur on paved surfaces in the vicinity of the Proposed Action Location. These activities would occur on previously developed areas and would not result in impacts to geological resources. The proposed wharf improvements and associated infrastructure would be designed and constructed in accordance with Unified Facilities Criteria and seismic standards.

Visual Resources: The project repairs an existing wharf/waterfront area with no substantial change to the existing general industrial landscape. The Proposed Action includes a new high-mast lighting system; however, this lighting system would use shielding features to minimize lighting beyond the wharf deck and would not be a notable change to the existing lighting system. The appearance of the proposed waterfront repair and modernization would be consistent with its surroundings in a military industrial waterfront. Therefore, the proposed improvements would be visually consistent with the current visual setting.

Airspace: The project does not create a requirement for, nor does it affect, any designated airspace.

Noise: In-air noise would be associated with construction activities and industrial use of the area following construction. Pile driving would be the dominant in-air noise producer during construction. However, proposed pile driving activities would be short term in duration, and the area is currently an industrial use area on the interior of the base and away from residential sensitive receptors. These activities would generate in-air noise consistent with other industrial noise sources in the immediate area. The Proposed Action would generate underwater noise during construction, which is addressed in the marine biology section. An exclusion zone would be established for screening operations, and operators of mechanical equipment would be protected from unintentional detonation by shielding and by operator minimum separation distance. Since planning would occur to avoid unintentional detonation, this possible scenario is not anticipated to occur during construction and is not included in the acoustic analysis.

Terrestrial Biological Resources: All temporary staging of construction equipment would occur on paved surfaces in the vicinity of the Proposed Action Location. Due to the lack of listed terrestrial biological species or their designated habitat that would be affected by the Proposed Action, these activities would not result in impacts to terrestrial biological resources.

Transportation: The project is a repair to the existing wharf and would increase the efficiency of activities currently conducted at the wharf. However, it is not anticipated to change throughput at Apra Harbor. Therefore, would not cause notable temporary or permanent impact to land-based or marine transportation or transportation systems.

Public Health and Safety: Construction safety is extensively regulated to minimize risk; applicable construction safety protocol would be followed for construction and industrial facilities. The Navy would prepare and follow an ESS for construction activities. The details of response actions for encountering MEC/MPPEH would be defined through NOSSA review of the project.

Socioeconomics: The Proposed Action would have insignificant impacts to Guam's socioeconomic environment. It would have temporary effects on Guam's economy because of construction-related employment and income. The economic components of proposed construction expenditures would be similar to those for other construction projects on NBG; therefore, the Proposed Action would not cause a reduction of jobs on base, change labor income, or have a notable effect to local industries. The Proposed Action would not result in changes to ship or personnel loading at NBG.

Environmental Justice: All construction activities would occur on NBG property and in the immediately adjacent waters of Inner Apra Harbor. No low-income or minority populations would be disproportionately or adversely affected, so no environmental justice impacts would occur.

3.1 Marine 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 species or assemblage of species.

Within this EA, marine biological resources are divided into eight categories: (1) abiotic marine resources-bathymetry, currents, sediments, water quality; (2) marine habitat; (3) marine vegetation; (4) non-coral benthic invertebrates; (5) coral; (6) fish; (7) sea turtles; and (8) marine mammals. Threatened, endangered, and other special status species are discussed in their respective categories.

3.1.1 Regulatory Setting

Special status species for the purposes of this assessment are those species listed as threatened or endangered under the ESA and species afforded federal protection under the MMPA.

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend on to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the USFWS or NOAA Fisheries/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.

All marine mammals are protected under the provisions of the MMPA. The MMPA prohibits any person or vessel from "taking" marine mammals in the U.S. 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."

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of the fisheries. Under the Act, EFH is designated for managed fishery species and consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. If a Proposed Action may adversely affect EFH, consultation with NOAA Fisheries/NMFS is required.

3.1.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under marine resources at NBG. The discussion of water and water quality is included in Section 3.2, Water Resources.

3.1.2.1 Abiotic Marine Resources - Bathymetry, Currents, Sediments, Water Quality

Inner Apra Harbor was an estuary prior to human interventions, and the abiotic attributes of Inner Apra Harbor (i.e., bathymetry, currents, sediments, and water quality) are notably different from Outer Apra Harbor. The entire Proposed Action Location and most of the surrounding area has been extensively modified by construction, dredging, and landfills beginning around 1943 (see Table 1-1) (HDR 2015a; Navy 2003, 2016, 2019a). Nearly the entire modern Inner Apra Harbor is an artificially built environment, intensively managed for maritime military and industrial activities, and repeatedly exposed to maintenance dredging and 'Wharf Repair and Modernization' (see Table 1-1).

The bathymetry of Inner Apra Harbor and much of Outer Apra Harbor is the result of extensive dredging and filling work begun by the U.S. Government around 1943 (HDR and CSA 2012; HDR et al. 2011; HDR and CSA 2018; Navy 2014a, b). Bathymetry of the channel between Inner Apra Harbor and Outer Apra Harbor is now much larger and deeper than the pre-construction size, and the increased water flow eliminated much of the estuarine characteristics of the pre-construction Inner Apra Harbor. Fill projects created the Glass Breakwater, Dry Dock Peninsula, Polaris Point, much of the shoreline of Inner Apra Harbor, and much of Outer Apra Harbor's northeastern and southeastern shorelines (Figure 3.1-1).

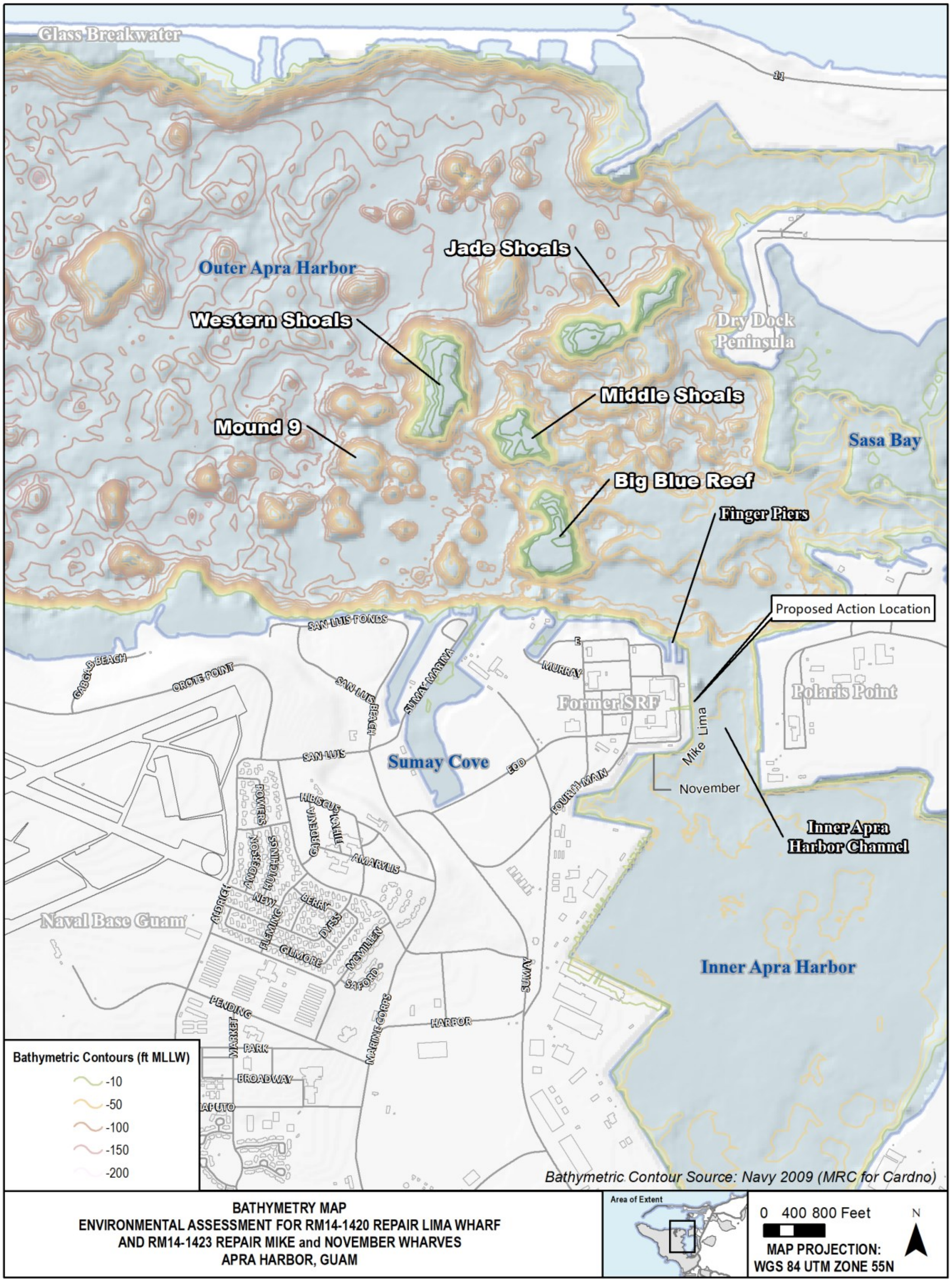

Figure 3.1-1 Bathymetry Map

The current flow pattern in Inner Apra Harbor is caused by tides, rainwater outflow, and wind-driven wave action (HDR 2015a; Minton et al. 2009; Smith et al. 2009). Currents are generally less than 0.1 knots (0.19 kilometers per hour). The Inner Apra Harbor channel and southeastern Outer Apra Harbor near Lima Finger Piers (see Figure 3.1-1) are much more dynamic than the interior of Inner Apra Harbor, reflecting greater interaction with water movement of Outer Apra Harbor (Gailani et al. 2011; King et al. 2012; Sea Engineering, Inc. [SEI] 2009).

Water quality of Inner Apra Harbor is notably different from water quality at the Harbor channel and the Outer Apra Harbor portions of the Proposed Action Location. Inner Apra Harbor has generally high turbidity due to resuspension of fine unconsolidated sediment on the harbor floor and rainwater inflows. The Outer Apra Harbor portions of the Proposed Action Location and the outer portions of the Harbor channel have generally lower turbidity and greater circulation. Water quality is highly variable due to frequent ship movements and substantial rainwater inflows (HDR 2015a; Minton et al. 2009; Smith et al. 2013). Further discussion of water and water quality is included in Section 3.2, *Water Resources*.

3.1.2.2 Marine Habitat

Marine habitats from Inner Apra Harbor through Sasa Bay and eastern Outer Apra Harbor are notably different than other habitat complexes in Guam (HDR et al. 2019). Marine habitats and marine resources of Inner Apra Harbor and Outer Apra Harbor are relatively well studied compared to other sites in the Mariana Islands. There have been broad scale resource inventories (Paulay et al. 2002; Paulay et al. 1997; Paulay et al. 2001); investigations into baseline conditions of Inner Apra Harbor (Smith et al. 2009); and resource assessments to support specific infrastructure improvement projects (Dollar et al. 2009; Donaldson et al. 2009; HDR 2015a, b; HDR and CSA 2012; McManus and McManus 2012; Minton et al. 2009; Nelson et al. 2015; Paulay et al. 1997; Reynolds et al. 2014; Schils et al. 2017; Smith et al. 2009; Smith 2004, 2006; Taylor et al. 2009; Navy 2007, 2014d; Weston Solutions and Belt Collins Hawaii, Ltd. 2006). These studies, in addition to the recently completed focused marine resource survey of the Proposed Action Location (Navy 2019b) were analyzed for this EA. The latest study that was completed in September 2019 serves to improve and update the environmental baseline of the Proposed Action Location (see Figure 3.1-1).

Hard Bottom Marine Habitat

Native hard bottom habitat has been essentially, completely removed from Inner Apra Harbor (Donaldson et al. 2009; Smith et al. 2013). Dominant hard bottom habitats are anthropomorphic structures with littered native rubble and debris (HDR et al. 2011; Smith et al. 2013). Wharf faces and other man-made structures support fish communities (Figure 3.1-2) (Navy 2019b). The September 2019 biological and benthic habitat survey of the Proposed Action Location found that on the wharf faces, coral density and colony size were substantially higher on the upper portions of the sheet piling, likely in response to increased light availability. Coral colonies in the upper wharf faces ranged in size from several centimeters to approximately 4.9 feet (1.5 meters) in diameter (Navy 2019b).

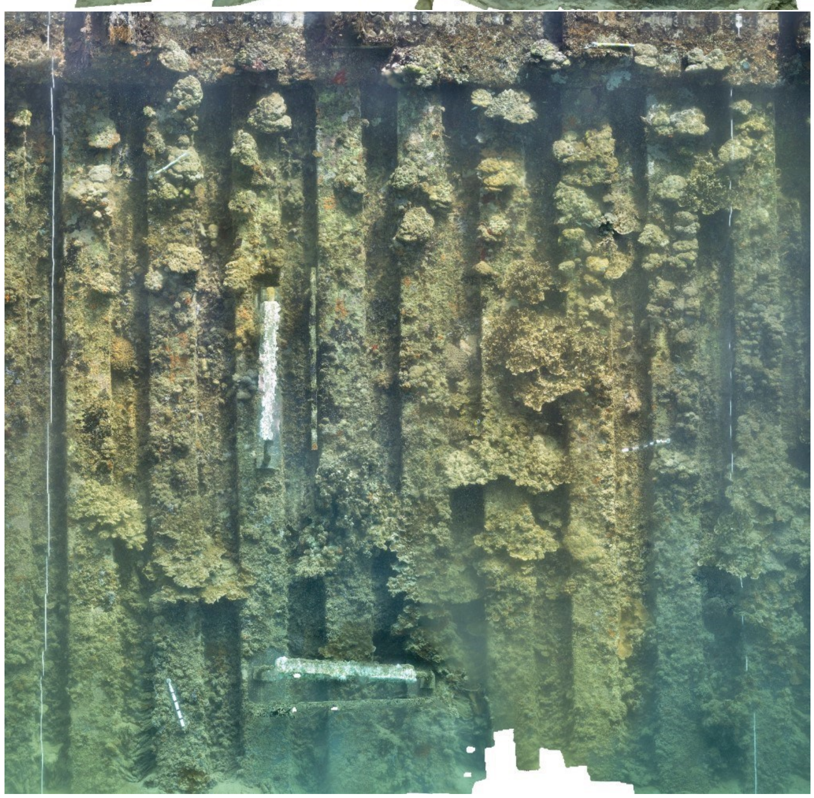

Figure 3.1-2 Wharf Face Images of Typical "low coral" Zones (top), and "high coral" Zones (bottom)

Notes: Both orthomosaic images represent areas approximately 30 feet (9 meters) wide and 30 feet (9 meters) tall, true to scale. Small white objects are 0.5-meter scale bars. Large white objects are anti-corrosion zinc plates. Top image is from Lima Wharf near Mike Wharf. Bottom image is from Mike Wharf near November Wharf.

Source: Navy 2019b.

Soft Bottom Marine Habitat

Inner Apra Harbor is almost uniformly soft bottom habitat with the exception of portions of the Inner Apra Harbor channel. Inner Apra Harbor is subject to regular maintenance dredging (see Table 3.1-1) and the substrate is mostly unconsolidated sand or mud. This soft bottom habitat is typical of harbors in the tropics with frequently disturbed sediment and typical fouling fauna (HDR et al. 2011). The only two areas of Inner Apra Harbor with soft bottom habitat that resembles the pre-construction conditions are Abo Cove and the mangrove shoreline northeast of X-Ray Wharf (Donaldson et al. 2009; HDR et al. 2011; Smith et al. 2009).

Coral Habitat

Coral habitats are found adjacent to the Proposed Action Location as coral colony assemblages on the artificial structures of Lima, Mike, and November wharves and throughout Outer Apra Harbor as coral reefs, including fringing and patch reefs (HDR 2015a, b; HDR and CSA 2012; McManus and McManus 2012; Minton et al. 2009; Nelson et al. 2015; Paulay et al. 1997; Smith 2004, 2006; Taylor et al. 2009; Navy 2007, 2014d; Weston Solutions and Belt Collins Hawaii, Ltd. 2006). Reef-like areas are found in the mouth of the channel between the Outer and Inner Harbor (Dollar et al. 2009; Donaldson et al. 2009; Schils et al. 2017; Smith et al. 2009). There are no coral reefs in the main body of Inner Apra Harbor, but isolated remnant or incipient patch reefs occur (e.g., the small patch reef at Abo Cove) (HDR 2015a, b; HDR and CSA 2012; Navy 2007, 2014d). The September 2019 biological and benthic habitat survey of the Proposed Action Location found that areas where barges were moored for long periods (November and the central area of Lima wharves), corals occur in low abundance with predominantly small colony sizes. In areas where long-term mooring did not appear to occur (Mike and outer sections of Lima wharves), corals were substantially more abundant; this included higher species abundance and larger size classes. Based on survey estimates, there are a total of approximately 25,700 corals on the wharf faces and 5,000 on the harbor floor of Lima, Mike, and November wharves (Navy 2019b).

Estuarine Habitat

Estuarine habitats occur in Inner and Outer Apra Harbor particularly along the eastern shore of Inner Apra Harbor at the Atantano River delta, and at Sasa Bay (Guam Division of Aquatic and Wildlife Resources [Guam DAWR] 2006; HDR 2015b; Navy 2010b; Wiles and Ritter 1993). Wetland habitat, including estuarine habitat, is also discussed in Section 3.2, *Water Resources*.

Protected Marine Habitats

There are no Conservation Areas or Marine Preserves designated within or adjacent to the Lima, Mike, and November wharves Proposed Action Location. The nearest marine protected area is the Sasa Bay Marine Preserve, which is approximately 0.6 miles (1 kilometer) from the Proposed Action Location. The 770 acres (3.1 square kilometers) Sasa Bay Marine Preserve is a Government of Guam, designated marine preserve between Dry Dock Island and Polaris Point (see Figure 3.1-1). There is no critical habitat designated under the ESA within or adjacent to the Proposed Action Location but EFH is present and discussed below in Section 3.1.2.5, *Fish*. Joint Region Marianas-administered submerged land on NBG has specific regulations in place for fishing and harvesting for safety reasons, and Inner Apra Harbor is an unauthorized fishing area where no forms of fishing are permitted (Navy, 2019c).

3.1.2.3 Marine Vegetation

Mangrove forests are native to the Marianas, though they are only present on the islands of Guam and Saipan, with the mangroves of Guam being the most extensive and diverse. Nearly all of Guam's mangrove forest is along the eastern shore of Inner Apra Harbor and the eastern shore of Outer Apra Harbor at the Sasa Bay Marine Preserve. Approximately 50% of Guam's mangrove forest occurs on Navy-owned lands in Apra Harbor (approximately 89 of 173 acres) (HDR 2015b; Navy 2005). There is no mangrove habitat within the Proposed Action Location (Navy 2019b).

Three species of seagrass are known on Guam, *Enhalus acoroides*, *Halophila minor*, and *Halodule uninervis* (Lobban and Tsuda 2003), and only two of these occur in Apra Harbor (*Enhalus acoroides* and *Halophila minor*). Established seagrass beds can be important nursery habitat for fish and forage habitat for green sea turtles (Navy 2011; Waycotta et al. 2009). Seagrass beds are not extensive in all of Apra Harbor (inclusive of Inner and Outer Apra Harbor) with only a limited amount of *Halophila minor* has been found and in very low abundances (covering less than 0.5% of the substrate) (HDR and CSA 2012). There is a small bed of *Halophila minor* on the sand substrate well inside the Lima Wharf Finger Pier and outside of the Proposed Action Location (Figure 3.1-3). The extent of the bed is only several meters across and coverage is a low-to-sparse footprint (Navy 2019b).

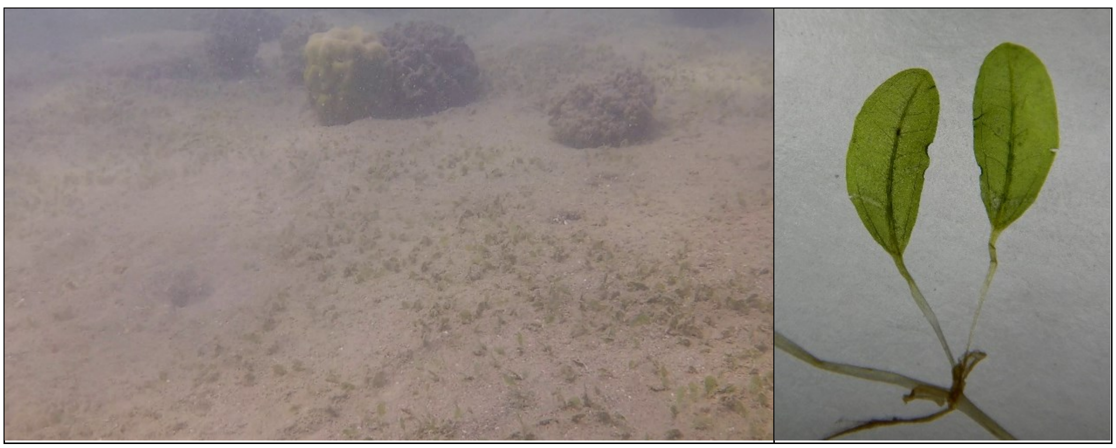

Figure 3.1-3 Small Seagrass Patch on the Sand Substrate Inside Lima Wharf Finger Piers, and Voucher Photo of the Species *Halophila minor*

Source: Navy 2019b.

The genus *Halophila* produces prolific quantities of sand-grain-sized seeds that can lay dormant in the sediment for many years (Erftemeijer and Robin Lewis III 2006; Fonseca et al. 1998). Consequently, *Halophila* beds are more ephemeral (variable in space and time) than other seagrass genera (Fonseca et al. 1998; McDermid et al. 2002).

Macroalgae species are common on hard substrates throughout Inner and Outer Apra Harbor. Approximately 35 species of macroalgae were documented in the September 2019 survey of the project area, and a selection of the more certain species identifications are in Table 3.1-1 (Navy 2019b).

Table 3.1-1 Macroalgae and Cyanobacteria species at Lima, Mike, and November Wharves

Green Algae	Red Algae	Brown Algae	Cyanobacteria
Caulerpa racemosa *Caulerpa serrulata* *Caulerpa sertularoides* *Caulerpa verticillata* *Caulerpa* sp. (decumbent) *Caulerpa* sp. *Dictyosphaeria cavernosa* *Dictyosphaeria verslusyii* *Codium* sp. *Halimeda cuneata* *Halimeda gracilis* *Halimeda* cf. *discoidea* & *gigas* & *macroloba* *Microdictyon* sp. *Neomeris* sp.	*Acanthophora specifera* Crustose Coralline Algae *Galaxaura* cf. *cohaerens/rugosa* *Galaxaura marginata* *Galaxaura* sp. aff. *Gelidiopsis* sp.	*Dictyota alvolata* *Dictyota bartayresiana* *Dictyota ceylanica* *Dictyota grossedentata* *Dictyota* sp. *Lobophora* sp. *Padina* sp. *Padina* sp. (ciliated) *Peysonellia* sp. *Sargassum oligocystum*	Unidentified spp. *Lyngbya majuscula*

Notes: "cf." means the specimens were slightly different, but almost certainly the same as the named species. "aff." means the specimens were very similar to the named species but is almost certainly different. "Genus sp." or "spp." means the specimens were unidentifiable.

Source: Navy 2019b.

Protected Marine Vegetation

Wetlands, salt marsh, mangroves, and seagrass are considered Special Aquatic Sites under Section 404 of the CWA. No wetlands, salt marsh, or mangroves occur within or adjacent to the Lima, Mike, and November wharves Proposed Action Location. A small patch of seagrass occurs inside the Lima Wharf Finger Piers. The bed extent is only several meters across and coverage is low-to-sparse (Navy 2019b) (see Figure 3.1-3). Nearby protected habitats are discussed below in Section 3.1.2.6, *Fish*.

3.1.2.4 Non-Coral Benthic Invertebrates

Typical benthic invertebrates include sea anemones, sponges, corals, sea stars, sea urchins, worms, crabs, and bivalves. Corals are discussed separately in Section 3.1.2.5, *Coral*.

Overall (across all of the Lima, Mike, and November Proposed Action Location), the fouling community on the wharf faces was relatively homogeneous (Navy 2019b). Lateral distribution trends of the benthic invertebrate community horizontally along all of the Proposed Action Location were unremarkable. Vertical distribution trends of the benthic invertebrate community were distinctive (see Figure 3.1-2 and Table 3.1-2):

- **Wharf Face – Shallow**: The intertidal benthic invertebrate community on the typical wharf face in the Lima, Mike, and November Proposed Action Location was approximately 80% oysters and 20% sponges and turf, with trace contributions of other biota.
- **Wharf Face – Shallow:** Just below the intertidal, the uppermost 3 to 7 feet (1 to 2 meters) of the typical wharf face that was constantly submerged was approximately 30% coral, 30% sponge, and 30% macroalgae and turf.

- **Wharf Face – Near Bottom**: The typical fouling community on wharf faces was approximately 30% sponge and 30% macroalgae and turf, with trace contributions of coral, hydroid, bivalve, bryozoan, and tunicate.
- **Harbor Floor – Near Wharf**: The typical harbor floor within 7 feet (2 meters) of the typical wharf face was approximately 80% silt-covered debris and 20% turf, with trace contributions of other biota.

Table 3.1-2 Percent Cover 105 1-m^2 Quadrat Samples within the Proposed Action Location

Percent cover across all of LMN, based on 105 1 square meters quadrat samples	*Lima Wharf face – shallow (n=24)*	*Mike Wharf face - near-bottom (n=37)*	*November Harbor floor near wharf face (n=44)*	*Total (n=105)*
Silt	3%	17%	56%	30%
Macroalgae	40%	28%	3%	20%
Porifera	21%	32%	5%	18%
Coral	26%	16%	8%	15%
Sand	NA	5%	10%	6%
Debris	NA	1%	12%	5%
Rubble	NA	1%	4%	2%
Turf	1%	1%	2%	1%
Tunicate	3%	1%	*	1%
Bivalve-oyster	3%	*	NA	1%
Bivalve-unspecified	1%	*	*	*
Coral	1%	NA	NA	*
Bare	1%	NA	NA	*
CCA	*	*	*	*
Hydroid	*	*	NA	*
Annelid	*	*	NA	*
Barnacle	*	NA	NA	*
Total	**100%**	**100%**	**100%**	**100%**

Note: * indicates numbers that are less than 0.5%.
Legend: % = percent; CCA = crustose coralline algae; LMN = Lima, Mike, and November; NA = not applicable.
Source: Navy 2019b.

In general, hard bottom benthic invertebrate communities within and adjacent to the Proposed Action Location are typical of Inner Apra Harbor. Most hard bottom benthic invertebrate communities of Inner Apra Harbor occur on wharf faces and other man-made structures (Donaldson et al. 2009; Smith et al. 2009; Smith et al. 2013). These structures support communities of fouling organisms that are generally typical of any harbor in the tropical western Pacific (Coles et al. 1999; Paulay 2003; Paulay et al. 1997; Navy 2019c), with prominent exceptions for restricted and endemic species (Paulay et al. 2002; Paulay et al. 1997). The preliminary species richness of non-coral invertebrates in the Proposed Action Location is 119 (Table 3.1-3) (Navy 2019b). These are only the most prominent and readily identified species; the true richness of non-coral macro-invertebrates in Apra Harbor is at least one thousand (Paulay 2003; Paulay et al. 1997). Nearby invertebrate communities of Outer Apra Harbor include unique and diverse coral reef ecosystems and reef-associated invertebrates (Paulay et al. 1997).

Table 3.1-3 Preliminary Richness of Non-coral Invertebrates

Animal Group	*Preliminary Count of Distinct Species*
Arthropod	4
Bivalve	9
Bryozoan	1
Echinoderm	3
Hydroid	8
Octocoral	1
Porifera	73
Tunicate	15
Worms	8
Grand Total	119

Source: Navy 2019b.

In general, soft bottom benthic invertebrate communities within and adjacent to the Proposed Action Location are typical of tropical harbors with frequently disturbed sediment. These soft bottom benthic invertebrate communities are diverse, but also common to other locations on Guam and other Pacific Islands (Bailey-Brock 1999; Coles et al. 2009; HDR et al. 2011; Paulay et al. 2002). The two areas of the Inner Apra Harbor that have a more natural assemblage of soft bottom invertebrates species are Abo Cove and the mangrove shoreline northeast of X-Ray Wharf. The marine invertebrate fouling community includes many species that are considered non-native, invasive, and nuisance marine species (Miller 2014; Paulay et al. 2002; Navy 2019b, c).

Non-Coral Benthic Invertebrate Protected Species

No ESA-listed non-coral invertebrates are known on Guam (NMFS 2017; Navy 2019c). One species of ESA-candidate giant clams occurs in Guam (*Tridacna derasa*) and has not been positively identified inside Apra Harbor (NMFS 2017; Paulay et al. 2001; Smith et al. 2009; Navy 2019b). Presence of *Tridacna derasa* in the Proposed Action Location is unlikely because the species' preferred habitat is absent.

3.1.2.5 Coral

The coral community in the Proposed Action Location was recently surveyed (September 2019). This marine resource assessment directly sampled approximately 30% of the 2,200-linear foot Proposed Action Location using an array of methods (Navy 2019b). The September 2019 survey revealed major transitions separating habitats of abundant coral and sparse coral on the wharf faces. In areas where barges were moored for long periods (November and the central area of Lima wharves) corals occur in low abundance with predominantly small colony sizes. In areas where long-term mooring did not appear to occur (Mike and outer sections of Lima wharves), corals were substantially more abundant, with both higher species abundance and larger size classes. On the wharf faces, coral density and colony size were substantially higher on the upper portions of the sheet piling, likely in response to increased light availability. Coral colonies in the upper wharf faces ranged in size from several centimeters to approximately 4.9 feet (1.5 meters) in diameter.

The main lateral feature of the coral community along the Lima, Mike, and November wharves Proposed Action Location, were segments with strikingly little coral development in areas of long-term moorings. Coral demographics (Table 3.1-4) is based on direct measurements and identifications of 1,195 coral colonies from 98, 1-square meter quadrats (approximately 2% of the study area). The typical coral community along the Lima, Mike, and November wharves Proposed Action Location had approximately 12 coral colonies per square meter (Table 3.1-4), and four coral species in a typical square meter. Total coral species richness along Lima, Mike, and November wharves was 95 species. Coral species records include potentially new records for Inner Apra Harbor, Outer Apra Harbor, and Guam. *Lobophyllia hatai, Pectinia paeonia*, *Pectinia alcicornis,* and *Symphyllia hassi* are the likely first confirmed records from Inner Apra Harbor with a photo record. *Coscinaraea exesa* is the first record from Outer and Inner Apra Harbor and possibly first record on Guam.

The uppermost 3 to 7 feet (1 to 2 meters) of the typical wharf face along the Lima, Mike, and November wharves Proposed Action Location (Wharf Face – Shallow) has about twice the density of coral colonies and half the number of coral species compared to the remaining strata (Wharf Face – Near Bottom and Harbor Floor – Near Wharf) (Table 3.1-4). The deeper harbor floor within 2 meters of the typical wharf face has many more species than the shallower areas (Table 3.1-4).

Table 3.1-4 Coral Demographics in the Proposed Action Location

Coral Demographics by Wharf, and by Depth	***Density (per m^2)***	***Species Richness***	***Min (cm^2)***	***Max (cm^2)***	***Average (cm^2)***	***Sample size (number of quadrats)***
Coral Total by Wharf						
November	9.2	17	3	2553	101	18
Mike	8.9	12	3	990	42	11
Lima	12.9	32	1	2199	57	41
Lima Wharf Finger Piers	13.7	18	1	15119	242	28
Coral Total by Strata						
Wharf face - shallow (Q1) Subtotal	21.3	12	1	2553	41	24
Wharf face - near-bottom (Q2) Subtotal	8.1	30	1	15119	264	39
Floor near wharf face - mid (Q3) Subtotal	9.9	35	1	3829	112	35
Coral – Hermatypic (Reef Building) Total n=1,176 colonies, n=98 1 square meter quadrats	12.0	50	1	15119	122	98
Ahermatypic Coral – *Tubastraea* spp.						
Mike	0.1	1	7	7	7	11
Lima	0.5	1	1	12	3	41
Wharf face - shallow (Q1) Subtotal	0.8	1	1	12	3	24
Coral - Ahermatypic (Non-Reef Building) Total n=20 colonies, n=98 1 square meter quadrats	0.2	1	1	12	3	98

Notes: Average size is the weighted mean for the corresponding sample size.
Legend: cm^2 = square centimeter; m^2 = square meter
Source: Navy 2019b.

The wharf face and harbor floor coral communities change over time; therefore, the concept of a stable baseline does not apply. For example in 2016, a qualitative estimate of 40 to 60% of coral colonies in front of Lima Wharf were affected during a well-documented period of bleaching and disease affecting Outer Apra Harbor (Hoot and Burdick 2017; Raymundo et al. 2017). Bleaching events reoccurred during 2017 and 2018, and surveys documented further damage to corals in Apra Harbor and elsewhere, although some recovery by re-sheeting and/or larval recruitment was observed (Raymundo et al. 2019).

The environmental baseline also includes episodes of maintenance dredging and wharf repair and modernization (see Table 1-1).

Coral Protected Species

No federally ESA-listed corals were observed in the Proposed Action Location, and there are no reports from Inner Apra Harbor (Navy 2019b). Presence of ESA-listed corals in the Proposed Action Location is unlikely because the species' preferred habitat is absent. Several colonies of ESA-listed coral *Acropora globiceps* have been positively identified near the ocean entrance to Outer Apra Harbor at Spanish Steps and Glass Breakwater (Navy 2019c). There are no reports from the vicinity of the Proposed Action Location (Navy 2019b).

3.1.2.6 Fish

The fish community in the Proposed Action Location was recently surveyed (September 2019). This marine resource assessment directly sampled approximately 30% of the 2,200-linear foot Proposed Action Location (Navy 2019b). Fish species richness included 97 species of 65 genera, within 28 families (Table 3.1-). Overall (across all of the Lima, Mike, and November wharves Proposed Action Location), the dominant trend in the fish community was increasing diversity and abundance towards Outer Apra Harbor. Relatively more juvenile fish were recorded in the uppermost 3 to 7 feet (1 to 2 meters) of the typical wharf face. Relatively large fish were recorded along the deeper harbor floor within 7 feet (2 meters) of the typical wharf face (Navy 2019b).

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]). The Magnuson-Stevens Fishery Conservation and Management Act, 50 CFR 600.10, provides further definition for interpreting EFH. The Proposed Action Location is within the boundaries of the *Fishery Ecosystem Plan for the Mariana Archipelago* (Western Pacific Regional Fishery Management Council 2009a). The Fishery Ecosystem Plan (FEP) used an ecosystem-based approach with "geographically defined ecosystem plans containing identical fishery regulations." Also, the FEP identified and categorized Management Unit Species (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 Pelagic Fisheries of the Western Pacific Region (Western Pacific Regional Fishery Management Council 2009b) 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 3,280 feet (1,000 meters) from shoreline to the outer boundary of the EEZ (i.e., 5,150 kilometers; 200 nautical miles; 230 miles), and the seafloor from the shoreline out to a depth of 1,312 feet (400 meters) around each of the Mariana Islands. As such, the water column, seafloor, and all surrounding waters submerged lands within the Mariana's 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 Marian's Archipelago include eggs, larvae, juveniles, and adults for Bottomfish and Pelagic MUS (Table

3.1-7). No Habitat Areas of Particular Concerns are designated within or adjacent to the Proposed Action Location.

Table 3.1-5 Fish Species Richness at Lima, Mike, and November Wharves, Grouped by Family

Fish Identifications (Scientific Names) Grouped by Family			
Acanthuridae *Acanthurus blochii* *Acanthurus maculiceps* *Acanthurus nigrofuscus* *Acanthurus nigroris* *Acanthurus xanthopterus* Aff. *Acanthurus nubilis* *Ctenochaetus marginatus* *Ctenochaetus* sp. *Naso unicornis* *Acanthuridae* sp. *Zanclus cornutus* *Zebrasoma scopas* **Apogonidae** *Apogon angustatus* *Apogon lateralis* *Apogon leptacanthus* *Cheilodipterus* aff. *macrodon* *Cheilodipterus artus* *Cheilodipterus quinoquelineatus* *Rhabdamia* aff. *cypselurus* *Rhabdamia cypselurus* **Balistidae** *Balistoides viridescens* *Pseudobalistes flavimarginatus* *Rhinecanthus aculeatus* **Blenniidae** *Ecsenius bicolor* *Meiocanthus atrodorsalis* **Caesionidae** *Caesio caerulaurea* **Carangidae** *Carangoides ferdau* *Caranx melampygus* *Caranx sexfasciatus*	**Carcharhinidae** *Carcharhinus melanopterus* **Chaetodontidae** *Chaetodon lunulatus* *Chaetodon auriga* *Chaetodon bennetti* *Chaetodon ephippium* *Chaetodon lunula* *Chaetodon ulietensis* **Cirrhitidae** *Paracirrhites forsteri* or *Pleurosicya micheli* **Clupidae** *Spratelloides delicatulus* **Dasyatidae** *Urogymnus asperimmus* or *Himantura granulate* **Engraulidae** *Engraulidae sp.* **Fistulariidae** *Fistularia commersonii* **Gobiidae** *Amblybogius phaelena* *Amblyeleotris* sp. *Amblygobius* aff. *sphynx* *Amblygobius nocturnus* *Eviota* sp. or *Cryptocentrus strigilliceps* *Gnatholepis caurensis* *Istigobius* sp. *Meiocanthus atrodorsalis* *Paragobion lacunicolus*	**Labridae** *Bodianus axillaris* *Cheilinus fasciatus* *Cheilinus trilobatus* *Cheilinus undulatus* *Halichoeres biocellatus* *Hemigymnus melapterus* *Labroides dimidiatus* **Lethrinidae** *Gymnocranius euanus* *Lethrinus harak* *Lethrinus olivaseus* *Monotaxis grandoculus* *Monotaxis grandulis* **Lutjanidae** *Lutjanus fulvus* *Lutjanus vitta* **Microdesmidae** *Ptereloetris* aff. *microlepis* **Mullidae** *Parupeneus* aff. *cyclostomus* **Muraenidae** *Gymnothorax javanicus* **Nemipteridae** *Scolopsis trileata* **Pomacentridae** *Abudefduf sexfasciatus* Aff. *Stegastes fasciolatus or* *Pomacentrys amboinensis* *Amblyglyphidodon curacao* *Amblyglyphidodon ternatensis* *Chromis viridis*	**Pomacentridae** *Chrysiptera* aff. *traceyi* *Chrysiptera cyanea* *Chrysiptera traceyi* *Dascyllus aruanus* *Neopomacentrus violascens* *Plectroglyphydodon phoenixensis* *Pomacentrus aboinensis* *Pomacentrus coelestis* *Pomacentrus pavo* *Pomachromis guamensis* *Pomacentridae sp.* **Scaridae** *Chlorurus bleekeri* *Hipposcarus longiceps* *Scarus sordidus* *Canthigaster valentine* **Serranidae** *Cephalopholis argus* *Plectropomus arelatus* *Plectropomus laevis* **Sphyraenidae** *Sphyraena barracuda* **Syngnathidae** *Corythoichthys* sp. **Synodontidae** *Synodus variegatus* **Tetraodontidae** *Canthigaster solandri* *Canthigaster* sp.

Notes: "cf." means the specimens were slightly different, but almost certainly the same as the named species. "aff." means the specimens were very similar to the named species but is almost certainly different. "Genus sp." or "spp." means the specimens were unidentifiable.

Source: Navy 2019b.

Table 3.1-6 EFH Designated within Inner Apra Harbor, Guam

MUS	*Species Complex*	*Designated EFH*
BMUS	Bottomfish, Shallow (0-330 feet [0 – 100 meters] and Deep-water (330-1,320 feet) [100 – 400 meters] Complexes	Adults and juveniles – water column and all bottom habitat from the shoreline to 1,320 feet (400 meters) encompassing steep drop-offs and high-relieve habitat Eggs and larvae – water column extending from the shoreline to the outer limit of the EEZ to a depth of 1,320 feet (400 meters)
PMUS	Temperate/Tropical Species, Sharks, and Squid Complexes	Adults and juveniles – water column from the surface to 3,300 feet (1,000 meters); from shoreline to the outer limit of the EEZ. Eggs and larvae – water column from the surface to 660 feet (200 meters); from shoreline to outer limit of the EEZ

Legend: BMUS = Bottomfish Management Unit Species; EEZ = Exclusive Economic Zone; PMUS = Pelagic Management Unit Species
Source: NOAA n.d.

All life stages of some species from BMUS and PMUS could occur within the Proposed Action Location (Western Pacific Regional Fishery Management Council 2009a, 2016; Western Pacific Regional Fishery Management Council and NMFS 2018) (also please see Appendix A).

Fish Protected Species

Three ESA-threatened fish species may occur in Apra Harbor (scalloped hammerhead sharks [*Sphyrna lewini*], giant manta ray [*Mobula birostris*], and oceanic whitetip shark [*Carcharhinus longimanus*]). Of these three, the scalloped hammerhead shark may occur in the Proposed Action Location. Adult scalloped hammerhead have been anecdotally observed at multiple locations of Outer Apra Harbor, Sasa Bay, and the southernmost part of Inner Apra Harbor. These observations are unconfirmed (NMFS 2015). Juvenile scalloped hammerhead sharks have been observed near Sasa Bay. Observations of adults or juveniles are rare. The species information suggests that Sasa Bay in Outer Apra Harbor is a potential nursery area (Miller et al. 2013). There is no proof that the site is used as a nursery, although there are several secondhand accounts of anglers who have accidentally hooked young-of-the-year hammerheads near Sasa Bay (Resko 2018a, b). If Apra Harbor acts as a nursery for this species, it would be reasonable to expect neonates, juveniles, and adult females to occur seasonally. They could conceivably use Inner Apra Harbor as habitat, but the amount of human activity and the lack of quality habitat may limit their presence in the area.

No other ESA-listed fish are likely to occur near the Proposed Action Location.

3.1.2.7 Sea Turtles

Two ESA-listed sea turtles are likely to occur in Apra Harbor: hawksbill sea turtle (*Eretmochelys imbricate*) and green sea turtle (*Chelonia mydas*) (Navy 2019b), and could be affected by the Proposed Action. Both species are listed as endangered under the ESA. No critical habitat has been designated for any sea turtles on Guam.

Hawksbill sea turtles have been observed via aerial surveys near river mouths, including inside Apra Harbor (Smith et al. 2013) and have been sighted within Sasa Bay in Apra Harbor (Navy 2019b). There have been no documented sightings within Inner Apra Harbor, and while hawksbill sea turtles could occur within Inner Apra Harbor, they would be expected to occur even less than green sea turtles because of their low numbers and the lack of habitat.

Green sea turtles have relatively few sightings in Inner Apra Harbor, and are not likely to be resident or semi-resident in Inner Apra Harbor (NMFS 2011a; Smith et al. 2013). During the recent survey of the Proposed Action Location, only three green sea turtle observations were recorded over 5 days and approximately 40 hours of observation time (Navy 2019b). A young green sea turtle was sighted during natural resources surveys in 2008 between Abo Cove and the south end of Victor Wharf (Navy 2019b). Sightings of green sea turtles did occasionally trigger mitigation actions during pile driving for the Uniform/Tango Wharf improvements in 2012 and 2013. There are no unique attributes of Inner Apra Harbor that render this area as a special or preferred habitat for green and hawksbill sea turtles (Smith et al. 2013). No preferred green or hawksbill sea turtle resting habitat was observed during Navy marine monitoring surveys and no significant quantities of preferred green sea turtle algal forage was sighted.

There are no records of hawksbill sea turtles or green sea turtles nesting in Inner Apra Harbor. Hawksbill sea turtle nesting was reported in Sumay Cove; however, nesting has not been observed since 1995 (NMFS 2011b). Sumay Cove is outside of the Proposed Action Location (see Figure 3.1-1). The beaches in the vicinity of the Proposed Action Location are not considered potential nesting sites for ESA-listed turtles due to their fine-grained, muddy composition (NMFS and USFWS 2007; Smith et al. 2009; USFWS and NMFS 2016). Green and hawksbill sea turtles can nest on Outer Apra Harbor beaches; however, the majority of sea turtle nesting on Guam occurs on the beaches well north and south of NBG. The Navy monitors for sea turtle nesting on selected Joint Region Marianas beaches throughout the year.

3.1.2.8 Marine Mammals

Thirty-two marine mammal species protected under the ESA or the MMPA have confirmed or possible occurrence in Guam and the Commonwealth of the Northern Mariana Islands (Navy 2019c), 23 of which are considered to have a regular occurrence in the area (regardless of their abundance). While these marine mammals are found around Guam, they are not known to enter Apra Harbor, particularly not in Inner Apra Harbor (Deakos et al. 2014; Hill et al. 2012; Ligon et al. 2011). Further, marine mammals have been excluded from prior agency consultations for substantially similar actions.

3.1.3 Environmental Consequences

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

> Potential Impacts to Biological Resources with Implementation of Preferred Alternative:
>
> - Less than significant impacts to marine resources (abiotic marine, marine habitat, marine vegetation, non-coral benthic invertebrates, coral, fish, and marine mammals) after minimization and BMPs.
> - Would have no significant impacts to EFH for BMUS and PMUS as unavoidable losses would be offset through habitat restoration and coral transplanting.
> - No significant impacts to green sea turtle and hawksbill sea turtle with implementation of minimization measures and BMPs.

3.1.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and the fouling community would continue to grow on the wharf face, including coral, incrementally creating additional habitat for marine fauna. There is long-term potential for wharf disrepair and collapse. This could adversely impact marine resources short term (months-years). This collapse "may affect, not likely to adversely affect" ESA species.

3.1.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

The study area for the analysis of effects to biological resources associated with the Preferred Alternative includes areas of potential direct and indirect effects. Direct effects may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment. Indirect effects are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.

Habitat and Marine Species

The Proposed Action would cause direct impacts to all abiotic marine resources, marine habitats, marine vegetation, non-coral benthic invertebrates, coral, and fish associated with wharf infrastructure in the Proposed Action Location. The impacts would include turbidity, noise, and temporary avoidance of the area during the action. There would also be lethal loss for all but the most mobile species. Because the Preferred Alternative would repair and modernize the wharf infrastructure in similar quantity and layout, the adjacent marine resources (abiotic marine resources, marine habitats, marine vegetation, non-coral benthic invertebrates, coral, and fish) would rapidly re-colonize the new wharf infrastructure. This disturb-and-re-colonize process has occurred relatively rapidly after all prior episodes of maintenance dredging and wharf repair and modernization have taken place. Most organisms in the dominant fouling community are particularly well-adapted to rapidly colonize new areas (Coles et al. 1999; Paulay 2003; Paulay et al. 1997; Navy 2019c). The loss of marine resources would be short term with a duration of months to several years for non-coral invertebrates (Briggs 2007; Coles et al. 2009; Miller 2014; Paulay et al. 2002; Navy 2015). With implementation of BMPs (see Section 2.5) and Impact Avoidance and Minimization Measures (see Table 3.8-2), impacts to habitat and marine species would not be significant.

EFH and Protected Marine Habitats

The ESA and EFH assessment prepared by NAVFAC Pacific and submitted to NMFS in February 2020 (Appendix A) 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 the Proposed Action Location. Unavoidable loss of ecosystem function and services that support MUS would be minimized through implementation of a proposed coral translocation plan (Navy 2019b). The Navy determined that the anticipated adverse effects do not have the potential to cause substantial adverse effects to EFH. This is due to containment of impacts to the Proposed Action Location, 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 Proposed Action, and compensatory mitigation for unavoidable loss (i.e., coral translocation and habitat conversion). Implementation of BMPs (see Section 2.5) and Impact Avoidance and Minimization Measures (see Table 3.8-2) would further reduce the intensity of stressors and likelihood of impacts to EFH and protected marine habitats.

NMFS responded in concurrence with the assessment on March 13, 2020 (Appendix A, Essential Fish Habitat and Endangered Species Act Documentation). NMFS acknowledged the unavoidable loss of EFH from the Proposed Action; the potential for long term impacts on EFH even with BMPs implemented; as well as, the potential for the proposed mitigation strategies to impede coral recovery or recruitment. NMFS provided two conservation recommendations in support of the efforts by the Navy to effectively avoid, minimize, offset or mitigate impacts to EFH by the Proposed Action.

First, NMFS recommended a coral translocation data management plan that will collect quantitative data on coral recruitment and coral growth over time at the translocation site (i.e. Mound 9) as well as within and near the dredge footprint. The data will be compared against the Habitat Equivalency Analysis for the offset and proposed recovery rates. The recommendation includes alignment with the 2019 Joint Region Marianas Integrated Natural Resources Management Plan and encourages this approach to inform monitoring activities prescribed in the next Joint Region Marianas Integrated Natural Resources Management Plan.

Second, NMFS recommended that the coral transplanting effort avoid damaging organisms that are not being transplanted, especially other coral. Additionally, transplanted corals and materials should be stabilized and secured to avoid movement during rough water conditions like those produced by typhoons. The coral translocation effort should avoid direct and indirect exposure of corals to toxicopathological agents.

The two aforementioned coral translocation conservation recommendations by NFMS will be fully adopted and implemented. Maintenance of the corals and monitoring will be conducted to quantify their survival, growth, health, and habitat cover changes over multiple years.

3.1.3.3 Threatened and Endangered Species

There are no reports of ESA-listed corals in the vicinity of the Proposed Action Location, and there are no reports from Inner Apra Harbor (Navy 2019b). Large numbers of scalloped hammerhead sharks are unlikely to occur in the area and encountering a solitary shark is rare. Survey efforts conducted in 2019 did not observe any scalloped hammerhead sharks (Navy 2019b).

Two ESA-listed species are likely to occur within the Proposed Action area of the Preferred Alternative: the green sea turtle (*Chelonia mydas*) and the endangered hawksbill sea turtle (*Eretmochelys imbricata*).

Both are listed as endangered and both have been reported in the Proposed Action Location, but little suitable habitat exists within the Preferred Alternative Action Area for these species. Implementation of BMPs would avoid impacts to sea turtles (see Section 2.5). Marine mammals are not known to be common in Apra Harbor, particularly not in Inner Apra Harbor, and have been excluded from prior agency consultations for substantially similar actions.

NMFS responded in concurrence with the assessment on April 8, 2020 (Appendix A, Essential Fish Habitat and Endangered Species Act Documentation) that the proposed action is not likely to adversely affect ESA-listed species. The NMFS response expanded the action area to include the inner and outer Apra Harbor, Sasa Bay, and the high seas route given that the proposed action includes the potential to use an additional barge brought from outside of Guam. Even with the expanded area, NMFS further concluded that effects are likely to be insignificant or discountable given, but not limited, to the habituation of some species to human activity and ability to voluntarily move away from the proposed action. In addition, there is a low likelihood that some species would occur in the area given review of best available science, and that BMPs will be implemented during the proposed action.

Underwater Noise

The proposed activities that will produce elevated noise levels under water include pre-drilling, pile driving, and navigational dredging. Of these activities, only pile driving is likely to generate noise levels with the potential to cause adverse impacts to ESA-listed species. Apra Harbor is a working harbor with a likely ambient sound pressure level (SPL) >100 decibels (dB) referenced to 1 micropascal (re 1 μPa) (California Department of Transportation 2015). Marine fauna residing in this environment function and thrive within an acoustic background of relatively high, ambient sound levels. The potential environmental effects of elevated noise levels may include:

- Direct, physiological effects – serious injury or mortality.
- Direct, behavioral effects – disruptions to feeding, mating, breeding, or nursery activities in such a way that impacts the survival or abundance of populations.
- Indirect effects – disruptions to the abundance and behavior of prey species; long-term change to population survival.

The direct, physiological effects from acoustic impacts include hearing damage, injury, or mortality. Permanent threshold shifts (PTS) occur when an animal experiences a shift in their hearing sensitivity caused by prolonged or repeated exposure to high sound levels that results in permanent and irreversible damage (Richardson et al. 1995). Temporary threshold shifts (TTS) occur when an animal's hearing threshold is temporarily increased (i.e., temporarily less sensitive to sound) during and immediately after exposure to a loud sound source (Richardson et al. 1995). TTS may have a duration of minutes to days to weeks, after which time full recovery is expected. Both TTS and PTS can result from a single pulse, from accumulated effects of multiple pulses from an impulsive sound source (e.g., impact pile driving) or from accumulated effects of non-pulsed sound from a continuous sound source. TTS and PTS occur only in the sound frequencies to which an animal is exposed.

Fish

The underwater noise threshold criterion for fish injury from a single impact hammer pile strike is peak SPL. Cumulative Sound Exposure Level (SEL) is a measure of the risk of injury from exposure to multiple pile strikes or other impulsive sounds over a continuous workday.

Popper et al. (2014) proposed dual threshold interim criteria for pile driving based on a review of available data associated with fishes and pile driving. The data used to set the criteria was from controlled experiments that mimicked pile driving on several fish species that varied in body type, swim bladder configuration, and internal morphologies. Guidelines were developed for mortality and the lowest level where injury was found (recoverable injury). No injuries were found in the species without a swim bladder (hogchoker) exposed to a cumulative SEL of 216 dB. In addition, Popper et al. (2014) developed guidance for the onset of TTS of which guidelines are based on data from exposure of several riverine species to seismic airgun pulses (Popper et al. 2005). TTS in fish is the temporary shift in hearing sensitivity, decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Table 3.1-7 lists impact pile driving guidance for the lowest level where injury was found and the onset of TTS.

Table 3.1-7 Fish Impact Pile Driving Injury Guidance

Fish Size	*Recoverable Injury*	*Temporary Threshold Shift*
No swim bladder	> 216 dB cumulative SEL or > 213 dB PEAK	>> 186 dB cumulative SEL
Swim bladder not involved in hearing	203 dB cumulative SEL > 207 dB PEAK	> 186 dB cumulative SEL
Swim bladder involved in hearing	203 dB cumulative SEL > 207 dB PEAK	186 dB cumulative SEL

Note: Peak levels are relative to 1 µPa and cumulative SEL levels are relative to 1 μPa^2*sec.
Legend: >> = much greater than, > = greater than; SEL = Sound Exposure Level; dB = decibel
Source: Popper et al. 2014.

Although there are no known studies on the auditory sensitivity of scalloped hammerhead sharks, their hearing sensitivity is likely to be similar to that of other sharks and elasmobranchs, which have poor hearing sensitivities and cannot likely detect sound pressure (Casper and Mann 2006). Unlike many bony fishes, sharks do not possess swim bladders or other structures that can convert acoustic pressure into a displacement stimulus and, therefore, respond only to the particle motion component of sound (e.g., acceleration, velocity, or displacement) and not the pressure component, although this remains to be demonstrated conclusively (Nelson 1967; Gardiner et al. 2014, Hart and Collin 2015). Sharks are able to hear sounds up to approximately 1,000 Hertz and are most sensitive to frequencies below approximately 100 Hertz (Nelson 1967; Popper and Fay 1977; Casper and Mann 2006, 2007a,b, 2009; Hart and Collin 2015). As a group, sharks appear to be less sensitive to sound at all frequencies compared to teleosts fishes. This is 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 and Mann 2007a; Hart and Collin 2015). Calculated distances from the loudest noise source (impact pile driving sheet piles) would be 69 feet (21 meters) or less to onset of injury thresholds for fish with a swim bladder and 10 feet (3 meters) or less for fish without a swim bladder. Sharks are unlikely to approach construction activity, particularly at that distance. Thus, acoustic impacts to scalloped hammerhead sharks are discountable.

Sea Turtles

Sea turtles are susceptible to underwater noise. There have been military, commercial, and recreational vessel operations in Apra Harbor for several decades. During this time, it is possible that marine animals in its vicinity have become habituated to underwater sound levels generated by these activities (NMFS 2011b, 2014a).

Exposure of animals to high levels of sound, as are likely during pile driving, are not anticipated to result in any mortality, but may result in permanent (PTS) or temporary hearing loss (TTS), or behavioral effects (Popper et al. 2014), depending on the sound level. Regulatory acoustic thresholds have not been established for sea turtles. NMFS provides technical acoustic guidance for marine mammal species only. Based on the best available scientific data, Popper et al. (2014) developed guidelines and presented a set of numerical thresholds or, if data were insufficient, the relative likelihood of effects occurring in fish and sea turtles (Navy 2017, Table 3.1-8). Sounds above the thresholds are considered likely to result in that effect, with higher sound levels likely to produce greater effects, and different guideline levels are provided for different sound sources and different receptor species. This guidance provides reasonable, threshold values, beyond which potential effects to green and hawksbill sea turtles may occur from pile driving noise.

Table 3.1-8 Maximum Range to Sea Turtle Thresholds from Impact Pile Driving

Pile Type	*Source Level (Peak SPL in dB re 1 μPa at 10 meters)*	*Source Level (RMS SPL in dB re 1 μPa at 10 meters)*	*Source Level (SEL in dB re 1 μPa²-sec at 10 meters)*	*Maximum Range to PTS threshold 204 dB re μPa²⁻ˢ*	*Maximum Range to TTS threshold 189 dB re μPa²⁻ˢ*	*Range to behavior threshold*
24-inch steel sheet [1]	205	190	180	1.3 feet (0.4 meters)	13.8 feet (4.2 meters)	330 feet (100 meters)
16-inch concrete pile[2]	192	172	160	0.33 feet (0.1 meters)	2 feet (0.6 meters)	20 feet (6 meters)

Notes: [1]Assumes 75 blows/pile and 8 piles installed/day.
[2]Assumes 880 blows/pile and 4 piles installed/day.
Legend: dB = decibel; PTS = permanent threshold shift; re 1 μPa = referenced to 1 micropascal; re 1 μPa²- = referenced to 1 micropascal squared-second; RMS = root mean square; SPL = Sound Pressure Level; TTS = temporary threshold shift
Source: [3]California Department of Transportation 2014.

Pile driving would be the project's greatest noise source in the underwater environment. The frequency and intensity of the sound energy generated by pile driving is primarily a function of the type and size (diameter or length) of the piling or sheet pile, the driving mechanism (e.g., impact or vibratory hammer), and the type of substrate into which the pile is being driven.

Because pile driving would be conducted using only impact hammers (see Appendix A, Essential Fish Habitat and Endangered Species Act Documentation), the PTS and TTS thresholds for impulsive noise were used in the analysis.

Under the Proposed Action, approximately six steel sheet piles with a maximum of eight steel sheet piles would be driven per day into the substrate fronting the existing Lima, Mike, and November wharves to create an enclosure that would be backfilled to repair and modernize the wharves (see Section 2.3.2.2). Proxy source levels (root mean square [RMS] or peak SPL in dB, re 1 μPa; and SEL in dB referenced to 1 micropascal squared-second [re 1 $\mu Pa^{2\text{-}s}$]) for piles similar to those used in the Proposed Action and example distances in Table 3.1-8 were from California Department of Transportation Compendium of Pile Driving Sound Data (California Department of Transportation 2014).

Pile driving will generate underwater noise that potentially could result in disturbance to sea turtles swimming by the Proposed Action Location. Transmission Loss (TL) underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source until the source becomes indistinguishable from ambient sound. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, bottom composition and topography. A standard sound propagation model was used to estimate the range from pile driving activity to various expected SPLs at potential project structures. This model follows a geometric propagation loss based on the distance from the driven pile, resulting in a 4.5 dB reduction in level for each doubling of distance from the source. In this model, the SPL at some distance away from the source (e.g., a driven pile) is governed by a measured source level, minus the TL of the energy as it dissipates with distance. The TL equation is:

$$TL = 15\log_{10}\left(\frac{R_1}{R_2}\right)$$

where

TL is the transmission loss in dB,

R_1 is the distance of the modeled SPL from the driven pile, and

R_2 is the distance from the driven pile of the initial measurement (in this case, 10 meters).

Injury and behavioral effects thresholds for marine mammals, sea turtles, and fish are based on peak or RMS SPL, and on the cumulative SEL (SEL_{cum}), which is calculated as follows:

- For impact pile driving,

SEL_{cum} = single-strike SEL (dB) + 10 $\log_{10}$ (number of strikes)

Unweighted peak pressure thresholds for TTS and PTS were developed for sea turtles based on auditory sensitivity in marine mammals (Navy 2017). Popper et al. (2014) recommended applying SEL-based impact thresholds developed for fishes without a swim bladder to sea turtles, which was adjusted based on an 11 dB difference found between the SEL-based non-impulsive TTS threshold and the SEL-based impulsive TTS thresholds for marine mammals. The NMFS User Spreadsheet tool (NMFS 2018) for calculating PTS onset thresholds for marine mammals was modified to adjust the weighting factor adjustments and calculate distances to PTS and TTS thresholds for turtles. The threshold values for injury (PTS) and TTS to sea turtles from impact pile driving are estimated as 204 dB re 1 μPa^2-sec SEL and 189 dB re 1 μPa^2-sec SEL, respectively (Navy 2017). Sea turtles are expected to avoid exposure to underwater RMS SPL of 175 dB re 1 µPa or greater (Navy 2017). This threshold is considered the behavioral threshold. Behavioral reactions would not rise to the level of take under the ESA unless they result in a significant curtailment of feeding, movement, and other activities affecting fitness.

The calculated ranges to PTS and TTS are small and consistent with previous Navy and NOAA Fisheries/NMFS expectations. Behavioral effects are likely to occur, and it is anticipated that behavioral responses (i.e., moving away from the sound source) would result in turtles avoiding sustained exposure to sounds that could otherwise lead to PTS. These behavioral reactions are considered unlikely to rise to a level of take under the ESA or significance under NEPA given very limited use of the immediate project area by sea turtles.

The threshold distances in Table 3.1-8 do not account for other factors that would reduce the distance that sound would propagate. Some of the more obvious features in Apra Harbor that would reduce sound propagation are:

- *Depth:* Much of Apra Harbor is relatively shallow. The water's surface and the bottom are, relative to a physical phenomenon like sound, close together and they interact with sound waves causing reflection, backscatter, reverberation, and sound attenuation (Faulkner et al.

2018; Popper et al. 2014). Scattering from surfaces and elements in the water such as bubbles and suspended sediment dampens sound and causes “clutter” (Popper et al. 2014).

- *Soft Sediment:* The substrate contributes to sound loss through reflection loss and absorption. Generally speaking, soft bottom reduces sound transmission more than hard substrates like rock. Reduction of sound by fine sand, sandy silt, sand-mud, and mud substrate has been partially quantified (Faulkner et al. 2018; Popper et al. 2014). The bottom of Inner Apra Harbor is comprised of unconsolidated sand and silt (HDR 2015b; HDR et al. 2011). It is expected that absorptive loss is greater for higher frequencies (ICF Jones and Stokes and Illinworth and Rodkin, Inc. 2009). The values range from 3 dB (fine sand at 7.5 kilohertz) to 16 dB (mud at 24 kilohertz) loss (Faulkner et al. 2018; Popper et al. 2014), assuming a single reflection off the substrate.
- *Narrow Harbor Mouth:* Sound passing from the Inner to the Outer Apra Harbor would pass through a bottleneck that is bounded on the sides by Lima and Bravo wharves. The narrow channel makes complex bathymetry that reflects and causes interference in sound propagation. The narrow area for sound propagation is expected to reduce sound levels significantly (Faulkner et al. 2018; Popper et al. 2014), but the extent of affects to sound propagation would require physical modeling or hydroacoustic measurements.
- *Complex Bathymetry in Outer Apra Harbor:* This complex environment reflects and attenuates sound emerging from the Inner Apra Harbor. The area of the Outer Apra Harbor that is immediately outside of the mouth of the Inner Apra Harbor is a basin that is surrounded by shoals and coral reefs that are considered as a rough surface that contributes to propagation loss (HDR and CSA 2012; Krebs et al. 2016; Popper et al. 2014). Some of the shoals, such as Jade Shoals and Middle Shoals (see Figure 3.1-1), rise to within a few feet of the surface of the water, and would act like berms that would block or reflect sound.
    - Other factors compound the noise reduction: Sound wrapping around a corner coming out of the Inner Apra Harbor and decreasing depth between the channel and Sasa Bay are expected to have strong effects at reducing received sound levels in Sasa Bay.
- *Ambient Sound Sources:* Both the Inner Apra Harbor and the Outer Apra Harbor have sound sources that would mask sounds from the Inner Apra Harbor (i.e., vessel noise) (California Department of Transportation 2001; Popper et al. 2014).

The effects to sea turtles from the Proposed Action would not cause permanent damage to individuals or harm the population of sea turtles in the area, but it could cause avoidance of the area. Because relatively few turtles enter Inner Apra Harbor (during the recent survey of the Proposed Action Location, only three green sea turtle observations were recorded over 5 days and approximately 40 hours of observation time [Navy 2019b]), the potential consequences of avoidance of the area would be minimal and temporary.

The ESA and EFH assessment prepared by NAVFAC Pacific and submitted to NMFS in February 2020 (Appendix A) for elevated underwater noise determined that exposure to elevated underwater noise levels from the Proposed Action may affect, but is not likely to adversely affect, green sea turtles and hawksbill sea turtles. With implemented BMPs, activities would stop if an ESA-listed species is observed within 50 yards (46 meters) and would not commence until the animal leaves the area voluntarily. Also, noise from activities would be short term and intermittent. Furthermore, the proposed operations (in-water only) would be restricted to daylight hours for approximately 13 months. Therefore, it is likely that an ESA-listed species would be exposed to noise levels that would result in a temporary and recoverable behavioral response. Based on the regular but small occurrence of green sea turtles in the Proposed Action area, the rare and infrequent occurrence of hawksbill sea turtles, 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.

BMPs (described in Chapter 2, Table 2-1), including “soft start” ramp-up techniques for pile driving and dredging along with safety zones, would minimize exposure risks. As previously discussed, pile driving would be halted when sea turtles are within 50 yards (46 meters) of pile driving operations until the animals have voluntarily moved beyond 50 yards (46 meters) or until 30 minutes have passed without an animal observation. These BMPs minimize risks to sea turtles that may be within Inner Apra Harbor during construction activities.

The determination of effects on sea turtles is consistent with prior and current agency formal consultations (NMFS 2011a, b, 2014a). In these agency consultations, NOAA Fisheries/NMFS concluded that it expects no sea turtles to be exposed to in-water sound levels capable of causing injury. Consequently, the Proposed Action is not likely to reduce the abundance of sea turtles in Guam or to reduce the likelihood of both survival and recovery of ESA-protected turtles in Guam or across Oceania.

With implementation of BMPs and mitigation measures described above and in Section 2.5, no significant impacts to threatened and endangered species from underwater noise would result.

3.2 Water Resources

This discussion of water resources includes groundwater, surface water, marine waters, wetlands, floodplains, and shorelines. Marine wildlife, vegetation, and bathymetry are addressed in Section 3.1, *Biological Resources*.

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 U.S Environmental Protection Agency (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., storm water) of water pollution.

NPDES Multi-Sector General Permit (MSGP), Municipal Separate Storm Sewer System (MS4) permit, and NBG Storm Water Pollution Prevention Plan (SWPPP) requires construction site operators engaged in clearing, grading, and excavating activities that disturb 1 acre or more to obtain coverage under an NPDES Construction General Permit for storm water discharges. NBG’s MS4 permit (GUS040000) also requires construction activities with total land disturbance of more than 1 acre to select, install, implement and maintain runoff control measure consistent with the requirements of the comprehensive construction SWPPP for the Guam Military Relocation Defense Policy Review Initiative Construction Program. Construction or demolition that necessitates an individual permit also requires preparation of a Notice of Intent to discharge storm water and a SWPPP 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 regulated by the U.S. Army Corps of Engineers (USACE) under Section 404 of the CWA and by the Navigable Waters Protection Rule (effective June 22, 2020) when adjacent to "Waters of the U.S." Waters of the U.S. are defined as the territorial seas and traditional navigable waters; perennial and intermittent tributaries that contribute surface water flow to such waters; certain lakes, ponds, and impoundments of jurisdictional waters; and wetlands adjacent to other jurisdictional waters. An adjacent wetland is jurisdictional in its entirety when a road or similar artificial structure divides the wetland, as long as the structure allows for a direct hydrologic surface connection through or over that structure in a typical year.

The CWA requires that Guam establish a Section 303(d) list to identify impaired waters and establish Total Maximum Daily Loads 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 U.S. Any discharge of dredge or fill into Waters of the U.S. 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 square feet (465 square meters) 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." Post development and redevelopment stormwater control must be consistent with the performance standard of the following documents:

- 2006 Commonwealth of the Northern Mariana Islands and Guam Stormwater Management Manual
- 2010 Guam Transportation Stormwater Drainage Manual

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, wharves, 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; dredging and 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 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 is discussed in Section 3.4, *Land Use*.

EO 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.

EO 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 1% chance of inundation by a flood event in a given year.

EO 13690, *Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*, amends EO 11988 and establishes the Federal Flood Risk Management Standard to improve the nation's resilience to current and future flood risks, which are anticipated to increase over time due to the effects of climate change and other threats. EO 13690 was revoked by Section 6 of EO 13807, *Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure*. EO 13807 did not revoke or otherwise alter EO 11988. As such, USACE will continue to implement EO 11988 according to USACE Engineering Regulation 1165-2-26. This existing USACE guidance for EO 11988 applies to planning, design, and construction of civil works projects, operations and maintenance activities, and real estate program activities.

3.2.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under water quality resources at NBG. The discussion of bathymetry is included in Section 3.1, *Biological Resources*.

3.2.2.1 Groundwater

The primary aquifer on Guam is the Northern Guam Lens Aquifer that extends from the northernmost tip of the island to where the southern highlands start north of Apra Harbor. The groundwater quality within the Northern Guam Lens Aquifer is considered good, but the aquifer is highly vulnerable to contamination from chlorides and raw sewage leaking from the collection system. The Proposed Action Location is located over 4 miles (6.4 kilometers) west of the Northern Guam Lens Aquifer and is not located within the groundwater protection zone (Guam Environmental Protection Agency [GEPA] 2001). Like the surrounding areas of south Guam, the low permeability of the aquifer materials preclude groundwater being pumped in any usable quantities.

3.2.2.2 Surface Water

All of the rivers and streams on Guam are found in the central and southern half of the island. Four rivers flow into Apra Harbor (Atantano, Sasa, Laguas, and Aguada), with one emptying into Inner Apra Harbor (Atantano River), and the other three emptying into Sasa Bay (Figure 3.2-1). The Atantano River transitions to the Atantano Wetlands in NBG on its way to Inner Apra Harbor. The only potential for surface water within the Proposed Action Location is storm water on impervious surface directed to existing storm drains that empty into Inner Apra Harbor.

3.2.2.3 Marine Water

The waters of Inner Apra Harbor are categorized as marine waters by GEPA's Guam Water Quality Standards. Marine waters are divided into three sub-categories: excellent (M-1), good (M-2) and fair (M-3) (GEPA 2001). The waters within Inner Apra Harbor are designated M-2. According to the Northern Guam Lens Aquifer, 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. Inner Apra Harbor is characterized by high levels of turbidity due to the fine unconsolidated sediment present on the sea floor that are routinely resuspended into the water column by frequent ship movements. In addition, there are substantial freshwater inflows and very low natural currents (Navy 2018).

3.2.2.4 Wetlands

There are wetlands located within the southern and eastern shores of Inner Apra Harbor; however, the Proposed Action Location is not within or directly adjacent to any wetland.

3.2.2.5 Floodplains

Floodplains are areas of low level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. The Proposed Action Location is located within a 100-year floodplain as shown in Figure 3.2-1. The Proposed Action Location is located within the Former Ship Repair Facility (SRF), an established industrial area where waters of Apra Harbor meet sheet pile (see Figure 3.2-1).

3.2.3 Environmental Consequences

Water Resources Potential Impacts:

- Groundwater
- Surface water
- Wetlands
- Floodplains
- Marine water

The analysis of water resources looks at the potential impacts on groundwater, surface water, wetlands, floodplains, and 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. The impact assessment of wetlands considers the potential for impacts that may change the local hydrology, soils, or vegetation that support a wetland. The analysis of floodplains considers if any new construction is proposed within a floodplain or may impede the functions of floodplains in conveying floodwaters. Marine waters analysis includes potential changes to physical and chemical characteristics.

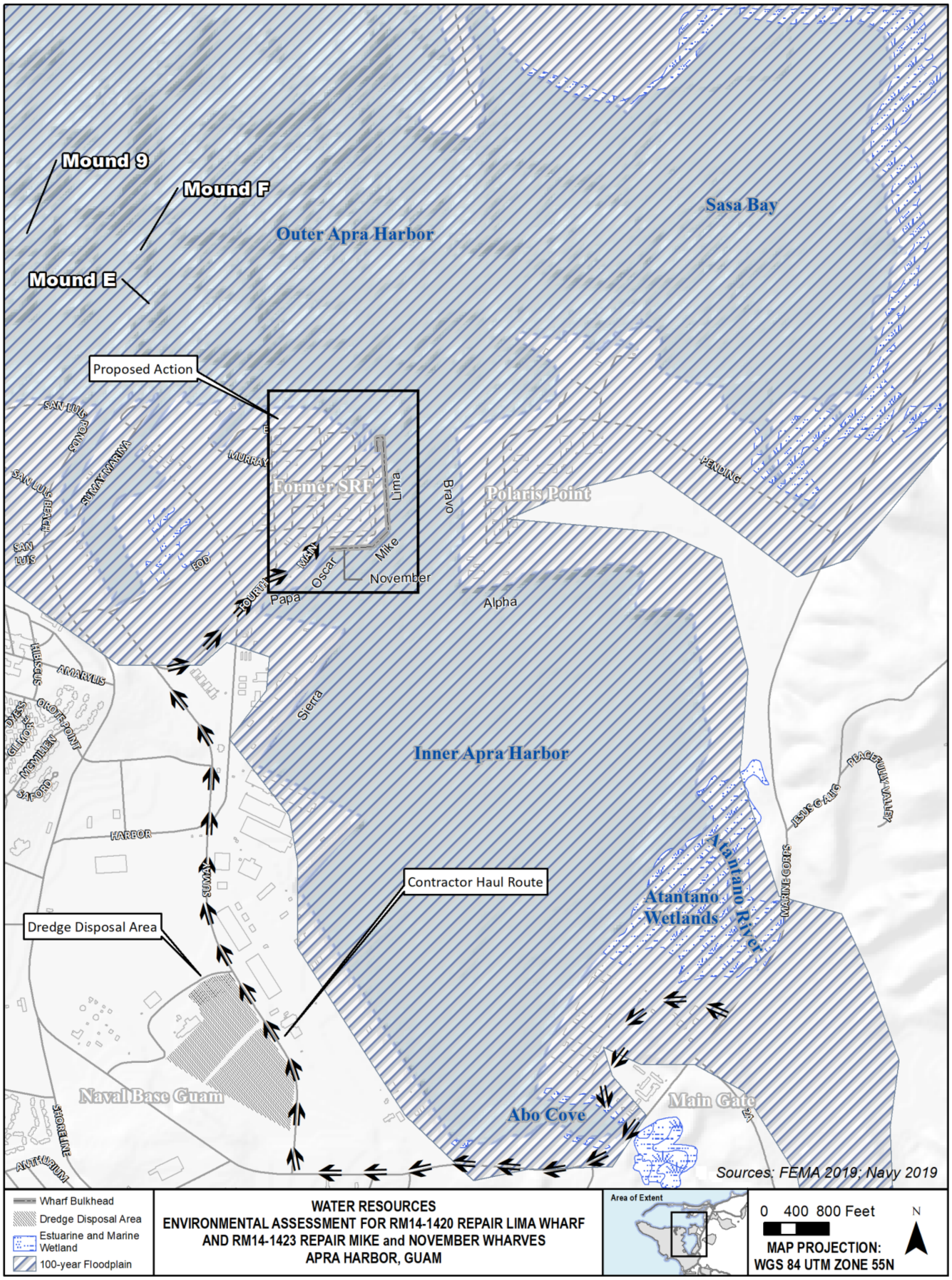

Figure 3.2-1 100-year Flood Plain and the Project Area

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 in the short term. Under the No Action Alternative there is potential for significant impacts to water resources over time due to the potential for Lima, Mike, and, November wharves to fail and collapse into Inner Apra Harbor.

3.2.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

The Preferred Alternative would not impact groundwater resources or surface water. The Proposed Action Location is located entirely within an established industrial area where waters from Apra Harbor meet sheet pile and do not overlay drinking water sources. The Proposed Action Location is not within or directly adjacent to any wetland. The Proposed Action Location is along the shoreline within the 100-year floodplain (Federal Emergency Management Agency 2020). Proposed construction would not impede the functions of floodplains in conveying floodwaters, change the local hydrology, soils, or vegetation that support a wetland, or affect shoreline ecological functions. Therefore, the Preferred Alternative would not impact surface water or groundwater resources, nor would it impact wetlands or floodplains.

The Preferred Alternative would not significantly impact marine water quality during the construction period. There would be temporary, insignificant adverse water quality impacts during construction (i.e., sediment loading and potential releases of pollutants entrained in dredged materials into the water column) in the areas surrounding the active in-water construction sites. Construction equipment, construction-related debris, vessels, vehicles, fueling of project-related vehicles, and equipment all have the potential to release petroleum products, hydraulic fluids, or other pollutants into marine waters. Potential adverse marine water quality impacts would be minimized through compliance with NBG MSGP and NBG SWPPP. The proposed wharf improvements would not increase the potential for flooding and would decrease the potential for a collapse of the wharves during a large rain event or flooding. To comply with EO 11988, a public notice would be published in local newspapers.

During the operational period, water quality in Inner Apra Harbor would be similar to existing conditions, with high levels of turbidity. The Preferred Alternative would have a beneficial impact on marine water quality due to the inclusion of Storm Water Quality Units (SWQUs) on the extended wharf discussed in Section 3.5, *Infrastructure*. The SWQUs provide storm water treatment by removing finer sediment, oils and grease, and floating and sinking debris from the storm water runoff prior to its discharge into the harbor.

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 federal laws and regulations, including the NHPA, Archeological and Historic Preservation Act, American Indian Religious Freedom Act, and the Archaeological Resources Protection Act of 1979. 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 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 SHPO. An NRHP-eligible property has the same protections as a property listed in the NRHP. Historic properties include archaeological and architectural resources.

The Navy has conducted inventories of cultural resources at NBG, Apra Harbor to identify historic properties that are listed or potentially eligible for listing in the NRHP (NAVFAC Marianas 2015).

The area of potential effects (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. For this Proposed Action, the Navy determined that the APE includes approximately 6 acres (2.4 hectares). This includes an area defined as Lima, Mike, and November wharves and their associated wharf pavement areas, mechanical utilities, electrical power substation, lighting, telecommunications, storm water systems, and fire protection systems (Figure 3.3-1).

3.3.2.1 Archaeological Resources

The proposed Lima, Mike, and November Wharf improvement areas are located in areas where no archaeological resources have been discovered (Carrell 1991; Welch et al. 2009; NAVFAC Marianas 2015). Archaeological predictive modeling, reflected in current NBG archaeological probability maps, indicate the proposed Lima, Mike, and November wharves improvement areas would be entirely in an area designated as having no/low archaeological probability due to its location on fill lands created from mid-20th century dredged materials (Welch 2010; Welch et al. 2009; NAVFAC Marianas 2015). Inner Apra Harbor, including the areas proposed for dredging in this project, is a post-World War II man-made facility constructed through massive earth-moving and dredging to establish its current water depth (Welch et al. 2009; Yoklavich and Reinman 1997). Therefore, submerged World War II resources and intact archaeological deposits are not expected.

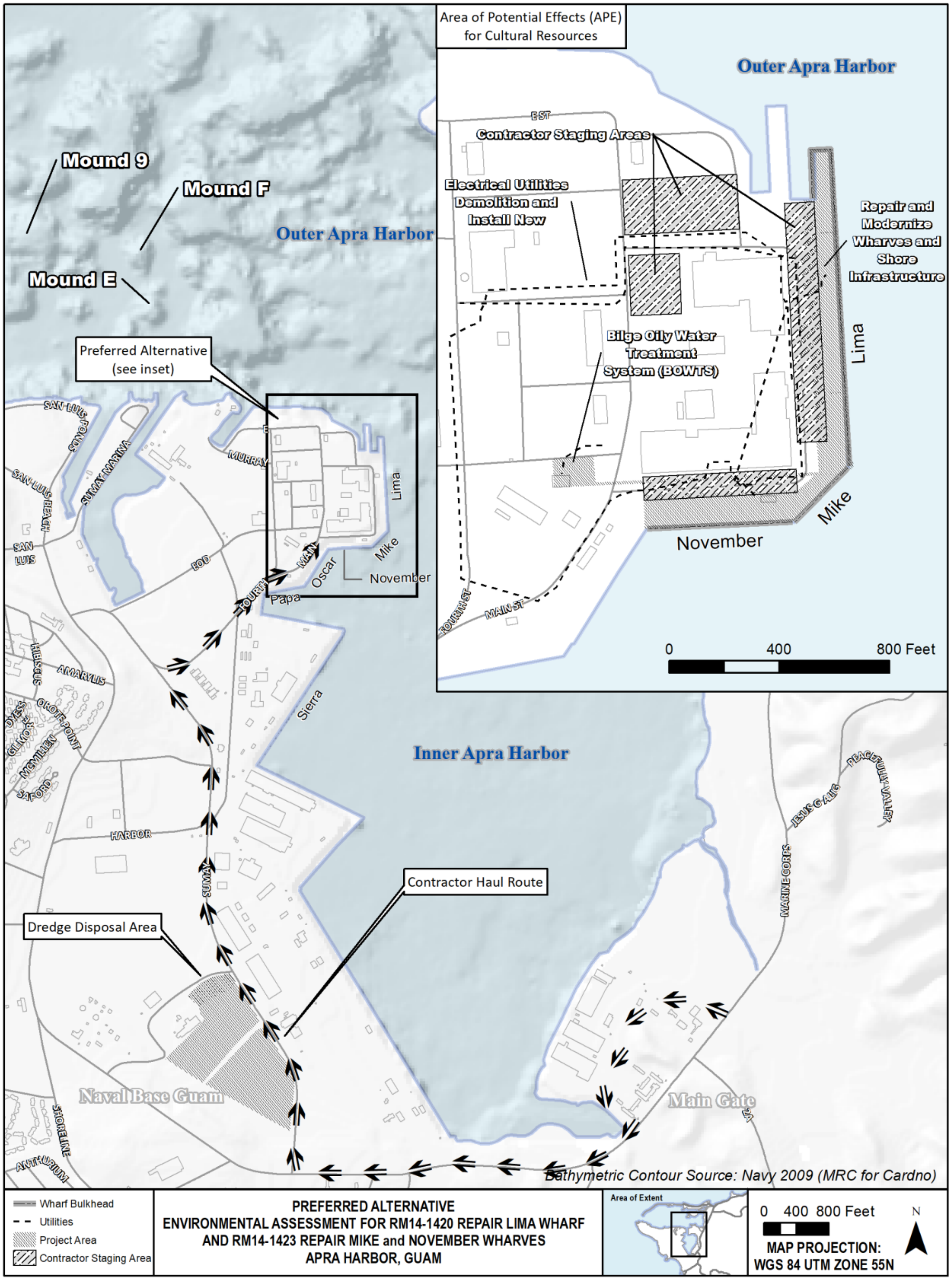

Figure 3.3-1 Area of Potential Effect

3.3.2.2 Architectural Resources

Buildings built prior to 1990 have been evaluated for NRHP eligibility (NAVFAC Marianas 2015). Mason Architects, Inc. and Weitze Research (Mason and Weitze 2010) evaluated the Lima, Mike, and November wharves for NRHP eligibility under Criterion A (associated with the activities of the Former SRF at the Naval Operating Base) and Criterion C (as an example of harbor and wharf design and engineering at Inner Apra Harbor) (Table 3.3-1). These wharves were recommended eligible for the NRHP and the Guam SHPO concurred. These three facilities are the only architectural resources located within the APE (NAVFAC Marianas 2015).

Table 3.3-1 Facilities Eligible for Listing in the National Register of Historic Places within the Area of Potential Effect

Facility No.	*Facility Name*	*Location*	*Build Date*	*Historic Context*	*NRHP Criteria*	*Reference*
Lima	Repair Wharf	NBG Main Base	1945 (1949)	Cold War	A, C	Mason and Weitze 2010
Mike	General Purpose Berthing Wharf	NBG Main Base	1945 (1949)	Cold War	A, C	Mason and Weitze 2010
November	Repair Wharf	NBG Main Base	1945 (1949)	Cold War	A, C	Mason and Weitze 2010

Legend: NBG = Naval Base Guam
Source: NAVFAC Marianas 2015.

Lima Wharf retains the integrity necessary for NRHP eligibility due to important features including two extant gantry cranes and their tracks that complete the functionality of this repair wharf. These elements are important equipment integral to the wharf. Although alterations to the wharf structure have been undertaken, integrity of design, materials, workmanship, feeling, and association are largely retained. Integrity of location is retained and integrity of setting is largely intact (Mason and Weitze 2010; NAVFAC Marianas 2015).

Mike Wharf retains the integrity necessary for NRHP eligibility due to important features including the extant gantry crane and its tracks that complete the functionality of Mike Wharf. These elements are important equipment integral to the wharf. Although alterations to the wharf structure have been undertaken, integrity of design, materials, workmanship, feeling, and association are largely retained. Integrity of location is retained and integrity of setting is largely intact (Mason and Weitze 2010; NAVFAC Marianas 2015).

November Wharf retains the integrity necessary for NRHP eligibility due to important features including the extant gantry crane tracks that complete the functionality of this repair wharf and are important equipment integral to the wharf. Although alterations to the wharf structure have been undertaken, integrity of design, materials, workmanship, feeling, and association are largely retained. Integrity of location is retained and integrity of setting is largely intact (Mason and Weitze 2010; NAVFAC Marianas 2015).

3.3.2.3 Traditional Cultural Properties

NBG was the subject of a traditional cultural properties study in 2010 (Griffin et al. 2010), which identified one such property, Sumay Village, located to the west, outside of the APE, of Inner Apra Harbor. Sumay Village is well known as the first Chamorro village attacked by the Japanese military in

1941. The potential traditional cultural properties include subsurface deposits associated with the village, Sumay Church, and the Sumay Cemetery (Griffin et al. 2010).

3.3.3 Environmental Consequences

Cultural Resources Potential Impacts:

- No significant impacts to archaeological, architectural, or traditional cultural properties would occur.

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. Indirect impacts are those that may result from a change in activity levels or other occurrence that was a byproduct of the Proposed Action, such as the effect of increased vehicular or pedestrian traffic near the resource.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and the wharves could deteriorate over time thus causing the potential for Lima, Mike, and November wharves to fail and collapse into Inner Apra Harbor. Therefore, significant impacts to cultural resources would occur with implementation of the No Action Alternative.

3.3.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

As defined in the implementing regulations for Section 106 of the NHPA, impacts to an undertaking on significant cultural resources are considered adverse if they “diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling or association” (36 CFR 800.5(a)(1)). The Navy consulted with the Guam SHPO regarding the Proposed Action (see Appendix B). The Navy determined the Proposed Action would result in no adverse effect on these NRHP-eligible wharves because the repairs would be conducted in accordance with the Secretary of the Interior Standards. The Navy received Guam SHPO concurrence on this determination via correspondence dated February 21, 2017 (Lizama and Aguon 2017; see Appendix B). In planning for this and future repairs to the historic wharves, the Navy prepared a Level II Historic American Engineering Report and survey of Lima, Mike, and November wharves, which has been provided to the National Park Service and Guam SHPO for donation to the Library of Congress. The original profile of the wharves would be maintained and the existing gantry tracks would be retained (Moon 2017).

There are no archaeological sites within the APE. The traditional cultural properties (Sumay Village) are located outside of the APE and would not be affected by the Proposed Action. In the event there are inadvertent discoveries of historic properties during any ground-disturbing activity, the Standard Operating Procedures (SOPs) listed in the Programmatic Agreement among the Commander, Navy Region Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) would be implemented.

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

3.4 Land Use

This discussion of land use includes current and planned uses and the regulations, policies, or zoning that may control the proposed land use. The term land use refers to real property classifications that indicate either natural conditions or the types of human activity occurring on a parcel. Two main objectives of land use planning are to ensure orderly growth and compatible uses among adjacent property parcels or areas. However, there is no nationally recognized convention or uniform terminology for describing land use categories. As a result, the meanings of various land use descriptions, labels, and definitions vary among jurisdictions.

3.4.1 Regulatory Setting

Through CZMA, Congress established national policy to preserve, protect, develop, restore, or enhance resources in the coastal zone. This Act encourages coastal states to properly manage use of their coasts and coastal resources, prepare and implement coastal management programs, and provide for public and governmental participation in decisions affecting the coastal zone. To this end, CZMA imparts an obligation upon federal agencies whose actions or activities affect any land or water use or natural resource of the coastal zone to be carried out in a manner consistent to the maximum extent practicable with the enforceable policies of federally approved state coastal management programs. 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 uses or resources.” If, however, the proposed federal activity affects coastal uses or resources 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 Navy is required to determine whether its proposed activities would affect the coastal zone. This takes the form of a consistency determination, a negative determination, or a determination that No Further Action (NFA) is necessary.

3.4.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under land use resources at NBG.

3.4.2.1 Land Use Compatibility

The Navy does not have zoning laws or codes, but distinguishes between the working zone (including industrial, waterfront, operational and mission support functions) and living areas that include housing and community support.

Lima, Mike, and November wharves are located at the Former SRF at Inner Apra Harbor, NBG. The Navy has designated the Former SRF as operations and industrial support. Inner Apra Harbor is an industrial harbor for use by military and Coast Guard ships and submarines. There are no recreational activities allowed within the waters of Inner Apra Harbor.

Military and defense areas are generally excluded from the coastal zone. Apra Harbor is unusual in a national context in that there are also DoD-controlled submerged properties that are considered excluded from Guam’s coastal zone. Although NBG is generally excluded from the coastal zone, impacts of the Proposed Action could potentially extend beyond the limits of federally owned and controlled areas. Therefore, the Navy pursued a consistency determination rather than a negative determination. The Guam Bureau of Statistics and Plans is the lead agency for coastal management and is responsible for enforcing Guam’s federally approved coastal management plan. The Navy received Guam Bureau of

Statistics and Plans concurrence on this determination via correspondence dated June 19, 2020 (see Appendix C).

3.4.3 Environmental Consequences

The location and extent of the Proposed Action needs to be evaluated for its potential effects on a project site and adjacent land uses. Factors affecting a Proposed Action in terms of land use include its compatibility with on-site and adjacent land uses, restrictions on public access to land, or change in an existing land use that is valued by the community. Other considerations are given to proximity to a Proposed Action, the duration of a proposed activity, and its permanence.

Land Use Resources Potential Impacts:

- No significant impacts to current Land Use would occur.

3.4.3.1 No Action Alternative

Under the No Action Alternative, the repair of Lima, Mike, and November wharves would not occur and there would be no change to land use. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.4.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

The repair of Lima, Mike, and November wharves would be consistent with operations and industrial support activities in Inner Apra Harbor and the Former SRF. Additionally, there would be no change in the intended use of the wharves. There would be close coordination with PortOps before the start of and during the Proposed Action. Coordination would be conducted to resolve any construction-related and waterborne vehicle access issues. The Former SRF is not currently in use and is considered a "working area;" therefore, construction and repair of Lima, Mike, and November wharves are consistent with industrial activities within the working areas of NBG.

The Navy determined that the Proposed Action would be conducted in a manner fully consistent or consistent to the maximum extent practicable with the federally approved enforceable policies of the Guam Coastal Management Program.

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

3.5 Infrastructure

This section discusses infrastructure such as utilities (including drinking water production, storage, and distribution; wastewater collection treatment and disposal; storm water management, solid waste management, energy production, transmission, and distribution; and communications), and facilities (including airfields, buildings, ranges, training and testing areas, wharves, piers, housing, etc.).

3.5.1 Regulatory Setting

Antiterrorism Force Protection Standards have been adopted by DoD Instruction 2000.16 of October 2006. The standards require all DoD components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats.

3.5.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under infrastructure at NBG.

3.5.2.1 Utilities

Potable Water

The Navy water system services NBG. The existing Navy water system is an island-wide system extending from the Navy Reservoir in southern Guam to the Naval Base Guam Telecommunications Site, North Finegayan near the northern tip of Guam. Water for the system is supplied primarily from the Fena Water Treatment Plant. Water from the treatment plant is transmitted to storage tanks designed to serve different service zones and transfer water to other DoD lands across Guam. Most of the transmission lines from the storage tanks to the distribution systems are 24-inch pipelines. The Navy water transmission system is interconnected with the Guam Waterworks Authority water distribution system at numerous locations throughout the island, allowing the transfer of water between the two systems. This interconnection allows the Navy system to supply water to Guam Waterworks Authority and it provides emergency service capability. Under a 1991 Memorandum of Understanding with the Government of Guam, the Navy system provides up to 4 million gallons per day to the Guam Waterworks Authority water system. Unaccounted for water in the system is estimated at 25%, compared to a recognized acceptable rate of 15% or less.

Primary water supply sources for the Navy's island-wide water system are located in the southern region of Guam and include Almagosa Springs, Bona Springs, and the Fena Reservoir surface water impoundment. Water from these three sources is treated at the Fena Water Treatment Plant and is transmitted through a network of storage tanks, transmission lines, and booster pump stations. A brief description of the water supply sources in each of the Navy service areas is provided below. Groundwater wells are the primary source of potable water at North Finegayan, Naval Computer and Telecommunications Station Barrigada, and Naval Hospital. At the NBG and other Navy areas south of the Piti Power Plant, potable water is supplied entirely by the Fena Water Treatment Plant.

The existing Lima, Mike, and November wharves potable water system is served by two parallel 8-inch water mains that were constructed in the 1980s per record drawings. There are six existing potable water risers that are used to service ships at Lima Wharf. These risers consist of a check valve with isolating gate valves on each side, and a gate valve and threaded nipple with a screw cap. These risers are protected from mooring lines with arched pipe railings. There are no meters on the riser assemblies. There are three existing fire hydrants located along Lima Wharf. These fire hydrants are located approximately 100 feet (30 meters) from the wharf face and spaced at approximately 500 feet (152 meters).

Wastewater

The Apra Harbor wastewater collection and treatment system is Navy owned and operated. It is a secondary treatment plant that services Naval facilities at the NBG, Apra Heights, and Naval Munitions Site. The Apra Harbor wastewater system also collects and treats discharged sludge flow from the Navy's Fena Water Treatment Plant. The existing wastewater collection system includes nine major sewer trunk or subtrunk lines consisting of approximately 35 miles (56 kilometers) of sewer lines ranging from 6 to 36 inches in diameter, and 24 sewer pumping/lift stations.

The Apra Harbor Wastewater Treatment Plant (WWTP) is designed to treat an average daily flow of 4.3 million gallons per day and a peak flow of 9 million gallons per day. The treatment plant currently receives an average daily flow of approximately 2.9 million gallons per day. Treated effluent is discharged through an ocean outfall into Tipalao Bay under NPDES Permit No. GU0110019. This permit authorizes the Apra Harbor WWTP to discharge an average monthly flow of 4.3 million gallons per day and a maximum flow of 6.0 million gallons per day. The Navy-owned outfall also discharges effluent from the Guam Waterworks Authority Agat-Santa Rita WWTP (NPDES Permit No. GU0020222). The Apra Harbor WWTP experiences violations of its permit effluent limits for aluminum, copper, nickel, total residual chlorine, biochemical oxygen demand, and total suspended solids. Compliance problems have been attributed to poor treatment efficiencies, infiltration/inflow, which results in an increase of storm water to the plant that reduces removal efficiencies, metals sources originating from Fena Water Treatment Plant sludge supernatant, and metals from shipboard wastewater. The Navy conducted a study to investigate compliance strategies for the Apra Harbor WWTP (DoD 2010). Concurrently, there are three military construction projects that will address many of the compliance issues associated with the plant. A military construction project at the Fena Water Treatment Plant will eliminate all of the aluminum and some of the copper sources to the Apra Harbor WWTP by rerouting this supernatant to the headworks of the Fena Water Treatment Plant. Biochemical oxygen demand and total suspended solids removal efficiencies will be improved as part of two other military construction projects that will make repairs/upgrades to the sewage collection system and reduce infiltration/inflow, and a project to restore the Apra Harbor WWTP. Facility assessment is currently ongoing for the NBG MS4 Stormwater Management Plan development. Upon completion of this project, the facilities would need to be reassessed. Runoff control measures would be developed in addition to or in conjunction with MSGP measures. In case of overlap, the most stringent BMPs-/-requirements (MS4 permit vs MSGP) will take precedence.

The Navy's compliance strategy study addresses copper and nickel sources in shipboard wastewater treated at the Apra Harbor WWTP. Ship sewer piping is composed primarily of copper and nickel, and the saltwater used for shipboard toilet flushing is highly corrosive to these pipes. This condition results in higher levels of these metals than would typically be found in land-based domestic sewage. The report does not recommend upgrades to the Apra Harbor WWTP because in order to meet the copper limits in the current discharge permit, the wastewater would have to be treated to below drinking water standards using a tertiary treatment process. This upgrade would be too costly and may still not attain the levels required by the permit. Pretreatment of ship sewage was also considered but ruled out because it is not feasible. The primary plan to address the metals non-compliance is to apply for a mixing zone, which has been suggested by both GEPA and USEPA Region 9 federal facilities inspectors. Having a mixing zone calculated into the permit limits would eliminate the non-compliance and the issue of metals in visiting ships sewage. A Federal Facilities Compliance Agreement was signed on 31 March 2011 by the Navy and USEPA Region 9 to globally address all NPDES wastewater compliance issues. The Federal Facilities Compliance Agreement addresses the metals non-compliance through (1) expansion of the internal base instructions into a certificate of discharge control program applied to all copper and nickel sources, and (2) a site-specific receiving water monitoring program to support the application for a mixing zone. The significant copper and nickel sources are not limited to the ships sanitary wastewaters but include the treated oily waters from the Bilge and Oily Wastewater Treatment System units and fuel tank farm. There are numerous other smaller sources as well.

The Apra Harbor WWTP is a Navy-owned Treatment Works as defined by USEPA regulations. Navy-owned Treatment Works are not required by regulation to have pretreatment programs, which control industrial discharges to sewage plants, and may require pretreatment of these waste streams. However, Navy and U.S. Marine Corp facilities typically institute base-wide pretreatment programs to control industrial wastes sources. For the Apra Harbor WWTP, an internal Navy pretreatment program is in place under Instruction 5090.3A "Joint Region Marianas Wastewater Pollutant Minimization and Pretreatment Program" dated January 14, 2003. This instruction covers basic pretreatment requirements, such as a requirement for grease traps for base galley and restaurants wastewater, oil/water separators for industrial wastewaters containing petroleum products, and Navy Bilge and Oily Wastewater Treatment System for shipboard bilge and oily wastes that employ advance oil/water separation and air flotation for oil removal. The current NBG NPDES permit requires the Navy to implement the Industrial Wastewater Discharge Certification Program for all non-domestic discharges.

Storm Water

The Navy maintains and complies with their NPDES MSGP and NBG SWPPP to address storm water management throughout NBG. The project area is covered in Volume 5 of the July 2018 NBG SWPPP as a part of the Former SRF.

The Former SRF is a non-drydock facility that has historically provided repairs to a variety of ocean vessels as requested by the Navy Military Sealift Command. Historically, the Former SRF area hosted several industrial activities. The activities include vessel and equipment cleaning and fluid changes, mechanical repairs, parts cleaning, sanding and blasting, welding, finishing, painting, fueling, and storage of waste materials such as oil, filters, paints, lubrication, adhesives, and solvent. In addition, the facility was also involved in the storage, transport, and off-site disposal of bilge and ballast water, pressure wash water, sanitary waste, and cooling water originating from vessels.

Storm water runoff is directly discharged into Apra Harbor via storm drains and several outlets along the perimeter of Finger Pier and Lima, Mike, and November wharves. A total of 13 storm drains and eight storm drain outlets are located across Lima, Mike, and November wharves. Storm drain outlets along the perimeter of the pier directly discharge and flow in an easterly direction to Apra Harbor. To the north of Building 20 is a network of storm drains connected to a singular storm drain line in front of the facility's main office building. A total of six storm drains are located outside of the facility's office. The following is a list of potential activities and potential pollutants listed in Volume 5 of the July 2018 NBG SWPPP for the Former SRF area:

a. Activity – Material loading and unloading areas. While there are no designated loading and unloading areas, materials for the various service shops are loaded and unloaded into the service bays by using either specialized carts or forklifts.

   Potential Pollutants – Materials that are spilled, leaked, or lost during loading and unloading operations may collect on paved areas and be carried away by storm water runoff.

b. Activity – On-site storage and disposal practices. Significant materials are stored and used throughout the building.

   Potential Pollutants – Leaks, drips, or spills of significant materials or waste could be exposed to rainfall and carried into storm water runoff.

c. Activity – Outdoor activities

   Potential Pollutants – These outdoor activities have the potential to pollute storm water runoff.

d. Activity – Treated wooden pallets with preservatives stockpiled outside the building.

   Potential Pollutants – Preservatives used to treat wooden pallets might leach out of the wood and into the soil, and eventually flow into surface waters during heavy rains.

The following lists the BMPs included in Volume 5 of the July 2018 NBG SWPPP for the Former SRF area:

a) Good Housekeeping Practices – Good housekeeping for this facility should include keeping all storage areas neat so that any spillage is immediately noticeable and can be promptly addressed (see spill section for additional information).

b) Minimizing Exposure – No potential pollutants may be stored outside of this facility to ensure that they are not exposed to precipitation.

c) Preventive Maintenance – A preventive maintenance program involving regular inspections of equipment and storage areas, as well as fuel storage tanks should be implemented. All BMP-related maintenance activities must be documented.

d) Spill Prevention and Response Procedures – Adherence to spill prevention and response procedures. Spill response materials should be stationed at the facility.

e) Routine Inspections – In addition to the inspections performed for preventive maintenance, the integrity of the fuel storage tanks should be inspected monthly as part of the Spill Prevention, Control, and Countermeasure program. Quarterly inspections of the general yard area must be performed. The hazardous materials (HAZMAT) area is inspected weekly as a part of the hazardous material program conducted for hazardous waste (HAZWASTE) satellite accumulation sites. The Former SRF is currently considered inactive and would thus would not have the potential for pollutants from activities on the site. The activities, pollutants, and BMPs are provided as they are the most current description of the storm water program at the Former SRF.

f) Visual Assessments Sampling and Monitoring – The facility is recommended as a sampling site to monitor the water quality of the storm water discharged into Apra Harbor. A quarterly visual assessment will be conducted on a grab sample obtained during a significant rain event.

Solid Waste Management

Construction and demolition waste include products of demolition or removal, excess or unusable construction materials, packaging materials, and other materials generated during the construction process. The Navy Sanitary Landfill is not currently accepting municipal solid waste; therefore, solid waste will be sent to the Layon Municipal Sanitary Landfill approximately 21 miles (35 kilometers) southeast of the project area. A waste management plan will be developed and implemented that requires participation by all subcontractors, vendors, and suppliers. On-site instruction for the appropriate handling and storage of waste, and the appropriate handling, separation, recycling, salvaging, reuse, and return methods to be used by all parties will be provided in the waste management plan.

Energy

The Orote Power Plant, a DoD asset, is operational and can connect to the island-wide power system and generate power to the system. The facility has not generated substantial power to the island-wide power system for years and is not currently suitable to provide extended operation support to the island-wide power system. The site would need system upgrades to provide the necessary reliability to the system and consideration for expanded fuel storage and would need modification to the existing air permit for the site. The Orote facility is not permitted for extended operation and must notify the GEPA before scheduled operation. These permit restrictions would need to change to allow more flexibility and more hours of operation should the Orote facility be used to provide substantial generation capacity to the island-wide power system. The Orote Power Plant has a rated and actual capacity of 19.8 megawatts. The date of construction was not determined.

The existing substation at Lima Wharf is currently de-energized. Power service to Lima, Mike, and November wharves originate from the recently constructed Former SRF substation via pad-mounted switchgear SW-2. There are two existing switchgears (Switchgear L-1 and Switchgear L-2) housed at the Lima Wharf substation building, one for each of the two existing power mounds. A third power mound exists inland and provides industrial power.

Communications

Telephone services to Lima, Mike, and November wharves are provided via existing copper cabling within the concrete bulkhead. Fiber cabling system is not provided at Lima, Mike, and November wharves. Cable television is provided via exposed cabling.

3.5.2.2 Facilities

Facilities in the Former SRF refer to buildings and equipment provided to support industrial and operational activity. The facilities adjacent to Lima, Mike, and November wharves are not currently in use.

Building 21 is divided into a machinery, carpentry, crane and rigging, electrical, and structural area. Along Lima Pier is a double-walled diesel fuel tank with a 4,000-gallon capacity located beside the generator building at the rear side of Building 21. The diesel fuel tank is secondarily contained by a concrete berm and is in compliance with Spill Prevention Control and Countermeasures regulations. Building 20 serves as the facility's 90-day Hazardous Waste Storage Facility. Adjacent to Building 20 is the facility's Satellite Accumulation Site for HAZWASTE materials. A concrete berm is provided for secondary containment of chemical spills and leaks. Past the foundry shop (Building 30) and the 90-day Hazardous Waste Facility (Building 23) is the facility's paint shop (Building 22). Supplies of paint are in a caged area indoors. Activities of Buildings 2057, 2056, and 2078 are unknown. All buildings and activities in the Former SRF are currently considered nonoperational as the facilities appear to be unoccupied and inactive. Buildings 20 and 21 are planned for whole building repair/renovation and modernization as waterfront storage, small craft, and intermediate level ship maintenance support facilities.

3.5.3 Environmental Consequences

This section analyzes the magnitude of anticipated increases or decreases in public works infrastructure demands considering historic levels, existing management practices, and storage capacity, and evaluates potential impacts to public works infrastructure associated with implementation of the alternatives. Impacts are evaluated by whether they would result in the use of a substantial proportion of the remaining system capacity, reach or exceed the current capacity of the system, or require development of facilities and sources beyond those existing or currently planned.

3.5.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to the existing infrastructure at Lima, Mike, and November wharves. Therefore, no significant impacts to transportation, utilities, or facilities would occur with implementation of the No Action Alternative.

3.5.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

The Preferred Alternative would repair and modernize Lima, Mike, and November wharves including the repair of wharf pavement areas, mechanical utilities, electrical power substation, lighting, telecommunications, storm water systems, and fire protection systems. However, no increase in personnel at NBG or population change in the regional area is anticipated as a result of the Preferred Alternative. Implementation of the Preferred Alternative would result in significant improvements to the infrastructure at Lima, Mike, and November wharves.

Potable Water

The Preferred Alternative would replace and improve potable water infrastructure at the wharves. The potable water line serving the wharf risers would be fed by the landside potable water infrastructure. Fire protection improvements would include fire mains, valves, and lead-ins to building sprinklers and hydrants. Utilities and connection points for portable boiler system steam generators including aboveground steam risers would be provided and may be routed underground or in a utility trench in a paved area at Lima Wharf. Furthermore, no substantial increase in potable water load is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the potable water system.

Wastewater

Under the Preferred Alternative, the existing sewer lift station at Lima Wharf would be demolished and the sewer system at Lima, Mike, and November wharves would be renovated to meet wastewater needs. No substantial increase in sewer system load is anticipated under the Preferred Alternative.

Sewage sludge from the Apra Harbor WWTP is disposed of in the Apra Harbor landfill and does not have a history of elevated metals. Plant and collection system capacities at the Apra Harbor treatment plant are sufficient to treat the new wastewater flows from the transient ship population. Military construction projects that are underway would further improve collection system and plant treatment performance. There are no significant impacts anticipated to collection or treatment plant capacities or efficiencies from the sewage resulting in the repair and future use of Lima, Mike, and November wharves. Additionally, these new sewage flows are not expected to contribute significant quantities of metals in sludge at the plant that would impact the ultimate disposal of the sludge. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the wastewater system.

Storm Water

Under the Preferred Alternative, drainage improvements would be provided at Lima, Mike, and November wharves. The wharf deck drainage system would generally maintain the existing drainage flow patterns. Runoff within the wharves would be directed into a longitudinal slotted drain. Slotted drains would be installed for the entire length of the wharf. Drainage manholes or junction structures would be provided to facilitate connection of drainage lines or laterals to the SWQU. The SWQUs would be strategically located between the existing bulkhead wall tie-backs. In addition, the SWQUs would be equipped with a bypass line for excess storm water to flow through during heavy rainfall events. The outfall pipes would be capped at existing wharf outfall pipes to prevent any erosion or sediment from entering Apra Harbor. All drainage system improvements, including SWQUs, would be designed based on the NBG MS4 permit compliant with GEPA storm frequency requirements.

The Preferred Alternative would improve storm water management and control by reducing the number of storm drain outlets at Lima Wharf to four outfalls and preventing silt buildup by redirecting storm water away from the shallow Finger Pier area to the deeper Inner Apra Harbor.

The Former SRF has not been in use for several years. Currently, the Navy is working to include the Former SRF in the 2020 MSGP to properly add and address the Former SRF areas and their activities, and in the NBG SWPPP updates by July 2020. A site-specific SWPPP would be included for the Lima, Mike, and November wharves as part of this plan. The 2020 MSGP and associated SWPPP would include similar BMPs and treatment of storm water through the use of SWQUs. The appropriate BMPs for the activities and potential pollutant sources would be included as part of this site-specific SWPPP. The activities, potential pollutants, and BMPs are anticipated to be similar and more stringent than those referenced in Volume 5 of the July 2018 NBG SWPPP included in Section 3.5.2.1. Compliance with the 2020 MSGP and SWPPP would minimize or avoid adverse impacts to storm water drainage receiving waters associated with the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to the storm water system.

Solid Waste Management

A temporary, short-term increase in solid waste would occur as a result of demolition and construction activities including products of demolition or removal, excess or unusable construction materials, packaging materials, and other materials generated during the construction process. However, no significant long-term change to solid waste management at NBG is anticipated under the Preferred Alternative. Any long-term increase in solid waste as a result of repairing and modernizing Lima, Mike, and November wharves would be negligible compared to the amount of solid waste generated at NBG and would be handled by the current solid waste management practices. Therefore, implementation of the Preferred Alternative would not result in significant impacts to solid waste management.

Energy

Electrical utilities work includes the demolition and replacement of Lima Wharf substation and improvements to power mounds, lighting, and the underground main primary power feeder circuit from the switch station to Lima, Mike, and November wharves. Electrical utilities would be renovated at Lima, Mike, and November wharves, but no significant change to the electrical utilities or load is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to energy use.

Communications

Site telecommunications work includes an underground duct bank system with mains, laterals, communication riser system with associated conduits, cable television system, and a Supervisory Control and Data Acquisition system. The communications systems would be upgraded at Lima, Mike, and November wharves, but no significant change to communications is anticipated under the Preferred Alternative. Therefore, implementation of the Preferred Alternative would not result in significant impacts to communications infrastructure.

3.6 Hazardous Materials and Wastes

This section discusses HAZMAT, HAZWASTE, toxic substances, and contaminated sites. When discussed in this document, HAZMAT includes petroleum, oils, and lubricants (POL), cleaning agents, adhesives, and other products necessary to perform essential functions.

3.6.1 Regulatory Setting

HAZMAT is defined by 49 CFR section 171.8 as “hazardous substances, HAZWASTE, 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 HAZMAT is regulated by the U.S. Department of Transportation regulations.

HAZWASTE is defined by the RCRA, 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 HAZWASTE 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 waste regulations: HAZWASTE batteries, HAZWASTE pesticides that are either recalled or collected in waste pesticide collection programs, HAZWASTE thermostats, and HAZWASTE 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 (ACM), polychlorinated biphenyls (PCBs), and lead-based paint (LBP). USEPA has given authority to regulate special hazard substances by the Toxic Substances Control Act. Asbestos is also regulated by USEPA under the CAA, and the Comprehensive Environmental Response, Compensation, and Liability Act.

GEPA stipulates regulations for the management of HAZMAT on Government of Guam lands. The Guam Code Annotated enforces federal and local regulations for management of hazardous substances. Title 10 Guam Code Annotated 76, Underground Storage of Hazardous Substances Act, establishes requirements for the management of hazardous substances stored underground. DoD operations conducted on Guam must comply with all GEPA hazardous material management requirements.

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 [BRAC], and Formerly Used Defense Sites [FUDS]). The Installation Restoration Program (IRP) and the Military Munitions Response Program (MMRP) are components of the DERP. The IRP requires each DoD installation to identify, investigate, and clean up HAZWASTE disposal or release sites. The MMRP 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.

3.6.2 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 OPNAV instructions and at NBG, Apra Harbor by specific instructions issued by the Base Commander. The Navy continuously monitors its operations to find ways to minimize the use of HAZMAT and to reduce the generation of HAZWASTE.

3.6.2.1 Hazardous Materials

HAZMAT Storage, Use, and Handling

Routine operations at DoD installations require the storage, use, and handling of a variety of HAZMAT. Bulk quantities of fuels and other POLs are stored and distributed in aboveground storage tanks and underground storage tanks, pumps, and pipelines. Fueling operations to support aircraft, watercraft, vehicle operations, and emergency power generation require the storage of these bulk quantities of this POL. These POL storage areas represent potential sources of leaks, releases, or spills. DoD installations have management plans for fuels management, spill containment, and cleanup of POL spills and releases. These plans specify that fuel storage facilities have primary and secondary containment and leak detection features to identify and contain unintended releases, spills, and leaks. In addition, these plans require that the use of HAZMAT be minimized by substituting less toxic products, modifying processes, and designing processes to be more efficient, thus requiring the use of less hazardous substances. Naval Supply Command is responsible for issuing HAZMAT to DoD installations and operations at Guam through the Joint Environmental Material Management Services.

3.6.2.2 Hazardous Waste

Hazardous Waste Generation and Disposal

Operations at DoD installations generate a variety of HAZWASTE, including, but not limited to: medical and dental supplies, adhesives, solvents, lubricants, contaminated absorbents, corrosive liquids, aerosols, herbicides, pesticides, and sludges. In accordance with DoD policies, all facilities must seek to reduce or eliminate HAZWASTE generation by implementing BMPs, SOPs, and best available technologies. DoD 4160.21-M, Defense Material Disposition Manual, August 1997, sets forth DoD policy and prescribes uniform procedures for the disposition of DoD waste, including HAZWASTE. DoD Instruction 4715.4, Pollution Prevention, contains general HAZWASTE policy. By policy, the generation and subsequent disposal of HAZWASTE is considered by DoD to be a means of last resort. There are numerous BMPs and SOPs used by DoD to minimize or eliminate the generation of HAZWASTE.

Disposal of HAZWASTE generated at DoD facilities in Guam is arranged by the Defense Logistics Agency Disposition Services (DLADS), formerly known as the Defense Reutilization and Marketing Office (DRMO). Specifically, licensed HAZWASTE contractors transport and dispose of HAZWASTE at permitted facilities. Under this arrangement, DLADS maintains all HAZWASTE documentation and ensures that all disposal actions are performed in accordance with pertinent federal, state, and local laws and regulations. As part of the DLADS waste management system, centralized accumulation points and satellite accumulation points are utilized at DoD installations on Guam. The accumulation points often contain a variety of wastes, typically stored in 5-gallon pails, 55-gallon drums, and other approved HAZWASTE containers. DLADS arranges for the disposal of HAZWASTE from DoD Guam operations.

The Navy on Guam is a Large Quantity Generator (40 CFR 262.34 [d], [e], and [f]) of HAZWASTE with USEPA identification handler number GU5170022680. Disposal of Navy HAZWASTE is arranged through DLADS and performed by its licensed contractors. DLADS maintains all required HAZWASTE documentation and contracts with licensed contractors for proper off-island disposal of the waste at permitted facilities. The Navy has various waste accumulation points as designated in its approved Hazardous Waste Management Plan.

OPNAV Instruction 5090.1E requires all Navy facilities that generate HAZWASTE to have a Hazardous Waste Management Plan. The Hazardous Waste Management Plan provides guidance for personnel on the proper handling, storage, and disposal of HAZWASTE. Furthermore, the Hazardous Waste Management Plan ensures the proper implementation of the USEPA and Guam Department of Transportation "cradle-to-grave" management requirements for HAZWASTE.

Navy ships are not considered HAZWASTE generators, but rather generate what is termed as "used hazardous material." This material is not considered HAZWASTE until the receiving shore entity declares it "waste" and subjects it to applicable regulations. This policy applies only for material generated aboard ships. When "used hazardous material" is offloaded and determined to have "no further use," it then becomes regulated waste and is subject to all applicable regulations.

3.6.2.3 Special Hazards (Asbestos-Containing Materials, Lead-Based Paint, Polychlorinated Biphenyls)

Toxic Substances Management

Toxic substances associated with DoD operations in Guam include ACM, LBP, PCBs, and radon. LBP and PCBs in Guam are taken by licensed transporters and disposed of in permitted landfill facilities in accordance with applicable federal, state, and local laws and regulations. ACM is disposed of at federal facilities on Guam. Disposal contracts specifically prohibit DoD contractors from the import and use of hazardous or toxic substances.

The collection, transportation, and disposal of these toxic substances are arranged by DLADS.

Asbestos

Asbestos is the name of a group of naturally occurring minerals that may separate into very fine fibers, which are extremely heat-resistant and durable. Asbestos and ACM have been used in a variety of applications, including being used to insulate boilers and pipes, and as a component of various construction and industrial materials. Asbestos becomes a health hazard when microscopic-sized fibers become liberated or released into the air.

DoD facilities scheduled for maintenance, renovation, remodeling, and demolition are inspected for the presence of ACM. When required by law, or as a precautionary measure, ACM is removed by licensed asbestos abatement firms. ACM is disposed of at federal facilities in Guam. DLADS arranges for these ACM disposal actions.

In accordance with DoD policy, ACM-free materials are to be used for new construction and the repair or maintenance of shore facilities. With regard to Navy ships, when suitable substitutes exist, ACM-free substitute materials are to be used during new construction, repair, or renovation activities.

ACMs are present in the Proposed Action area, and include the following examples observed at Building 2078 and the cement gravity sewer at Lima Wharf (NAVFAC Marianas 2019):

- Floor tiles and mastic
- Red brick/tiles
- All gaskets in the piping system
- Cement gravity sewer pipe

LBP

In the past, lead pigments were used to increase the durability of paint and provide added anti-corrosion properties. Exposure to LBP is associated with adverse health effects, including permanent damage to the central nervous system. LBP is identified as having 0.5% or greater lead by weight (U.S. Government Publishing Office 2019a). Lead-containing paint is a paint (or similar surface coating) containing greater than 0.06% of lead by weight (U.S. Government Publishing Office 2019b).

To ensure that DoD employees engaged in the maintenance and repair of surfaces with LBP are adequately protected, personnel involved in these activities where there is a potential exposure to LBP are required to attend annual LBP training. This training is designed to ensure use of appropriate engineering controls and work processes to reduce the risk of lead exposure.

The federal government banned the use of LBP in 1978. Consequently, DoD buildings constructed on Guam prior to 1978 may contain LBP (USEPA 2019). The LBP in these facilities is generally managed in place in accordance with accepted industry guidelines and practices. These guidelines focus upon minimizing the potential for LBP dust creation, direct contact with the LBP surfaces, and contamination of the surrounding environment. The future renovation of DoD facilities or construction of new facilities on Guam would not include the use of LBP.

DoD policy regarding LBP is to manage and dispose of it in a manner that is protective of human health and the environment and to comply with all applicable federal and local laws and regulations. LBP disposal is arranged by the DLADS.

LBP and lead-containing paint are present in the Proposed Action area, and include the following examples of yellow, gray, and blue paint observed at Lima Wharf (NAVFAC Marianas 2019):

- all existing bollards (yellow)
- all existing storm bollards (yellow)
- all existing mooring anchors (yellow)
- all existing cleats (yellow)
- all utility risers (yellow)
- asphalt paint (yellow)
- metal power mounds (yellow or blue)
- all substation exterior and interior paint (gray)

PCBs

PCBs are highly stable organic chemical compounds with low flammability, high heat capacity, and low electrical conductivity. In the past, PCBs were extensively used as a component of many materials, most notably as heat insulating materials and as dielectric fluids used in electrical transformers and capacitors. PCBs are known to cause skin irritation and cancer and are highly persistent in the environment. Since then, effective controls have been mandated related to existing PCB-containing equipment. Until 1979 when the USEPA banned most uses of PCBs, they were commonly present in some building materials, such as concrete, caulk, and paint (USEPA 2015a). Due to these past uses, PCBs are known to exist at various identified waste sites and/or older facilities.

As part of existing DoD waste management plans, fluids that potentially contain PCBs are analyzed to ensure that they are properly disposed of in accordance with all federal, DoD, and local laws and regulations by licensed disposal contractors. DoD would not introduce new sources of PCBs to Guam and is currently addressing existing PCB sources in accordance with federal, local, and DoD laws and regulations. DoD-related PCB disposal on Guam is arranged by DLADS.

PCBs are present in the Proposed Action area, and include the following observed at Lima Wharf (NAVFAC Marianas 2019):

- electrical manholes (EMHs) contain paper insulated, lead covered cables and PCB-containing water and oil in EMHs
- conduits between the EMHs contain paper insulated, lead covered cables
- light ballasts and lamps

Radon

Radon is naturally occurring on Guam and is a colorless, odorless, radioactive gas produced by the decay of uranium in rock and soil. Radon is a known carcinogen, responsible for increasing the risk of lung cancer when inhaled. Typically, outside air contains very low levels of radon (USEPA 2015b), but radon tends to accumulate in enclosed indoor spaces. When present, radon gas typically concentrates in relatively airtight buildings with little outside air exchange. Although there are no federal regulations that mandate an acceptable level of radon exposure, USEPA recommends the voluntary radon action level developed and issued by the American Society for Testing and Materials International, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings, ASTM E-2121.

The USEPA recommended action level for radon is 4 picocuries per liter. According to GEPA, approximately 27% of homes on the island have levels of radon that are higher than the USEPA recommended levels (GEPA 2019). Worse yet, some homes in Guam have tested as high as 300 picocuries per liter (GEPA 2019). Elevated radon levels tend to occur in the northern part of the island where limestone is more prevalent (Denton and Namazi 2013). However, elevated levels have been detected elsewhere including on NBG (Guam Daily Post 2016). As an educational measure, GEPA conducts public radon awareness workshops designed to instruct participants on how to minimize potential radon exposures. As a proactive measure, DoD has ongoing radon monitoring and abatement programs to ensure that its existing facilities meet USEPA radon health recommendations (Agency for Toxic Substances and Disease Registry 2002). In addition, for new facilities, radon-resistant construction techniques, radon testing, and the installation of radon mitigation systems, as appropriate, are employed.

Contaminants of Concern in Soils and Underwater Sediments

With respect to the Proposed Action, soils refer to the terrestrial soils within the project area that would be disturbed by project activities. Contaminated soil is any soil or combination matrix of soil and other material that includes sufficient contaminants of concern (COCs) (e.g., exceeds 85% of the environmental screening levels for the soil matrix) to require treatment as HAZMAT, HAZWASTE, or some other action of removal, disposal, or avoidance. Contaminated soil is present in the Proposed Action area, and includes the following observed at Lima Wharf (NAVFAC Marianas 2019):

- A gross contaminated area at the southern end of the wharf – petroleum impacted
- Building 2078 – soil suspected to contain pesticides, lead, and other COCs

These and other occurrences in the Proposed Project area are discussed further in Section 3.6.3, *Environmental Consequences*.

With respect to the Proposed Action, underwater sediments refer to sediments on the seafloor of Inner Apra Harbor that would be disturbed by project activities. Since modernization of the Inner Harbor during World War II, military (including warzone), heavy industrial, and shipping/dock activities have occurred at and near the Proposed Project area. A legacy of this activity is found in contaminants in the underwater sediments.

A study of underwater sediments in Apra Harbor in 2019 by NAVFAC Pacific, which also summarized an earlier 2016 study, noted (underwater) surface sediment exceedances of screening levels for chemicals of potential concern that included low molecular weight- and high molecular weight-polynuclear aromatic hydrocarbons, total NOAA-18 PCB congeners, four pesticides (total benzene hexachloride, total chlordane, total dichloro-diphenyl-trichloroethane, and dieldrin), and 11 metals (arsenic, chromium, cobalt, copper, lead, manganese, mercury, nickel, tin, vanadium, and zinc) (Figure 3.6-1). Subsurface sediment exceedances were found for the same chemicals of potential concern as above, as well as antimony, barium, cadmium, and silver. The same study noted the completion of a human health risk assessment that determined chemicals of potential concern concentrations in sediments in some parts of the harbor posed an unacceptable risk to human health (NAVFAC Pacific 2019b).

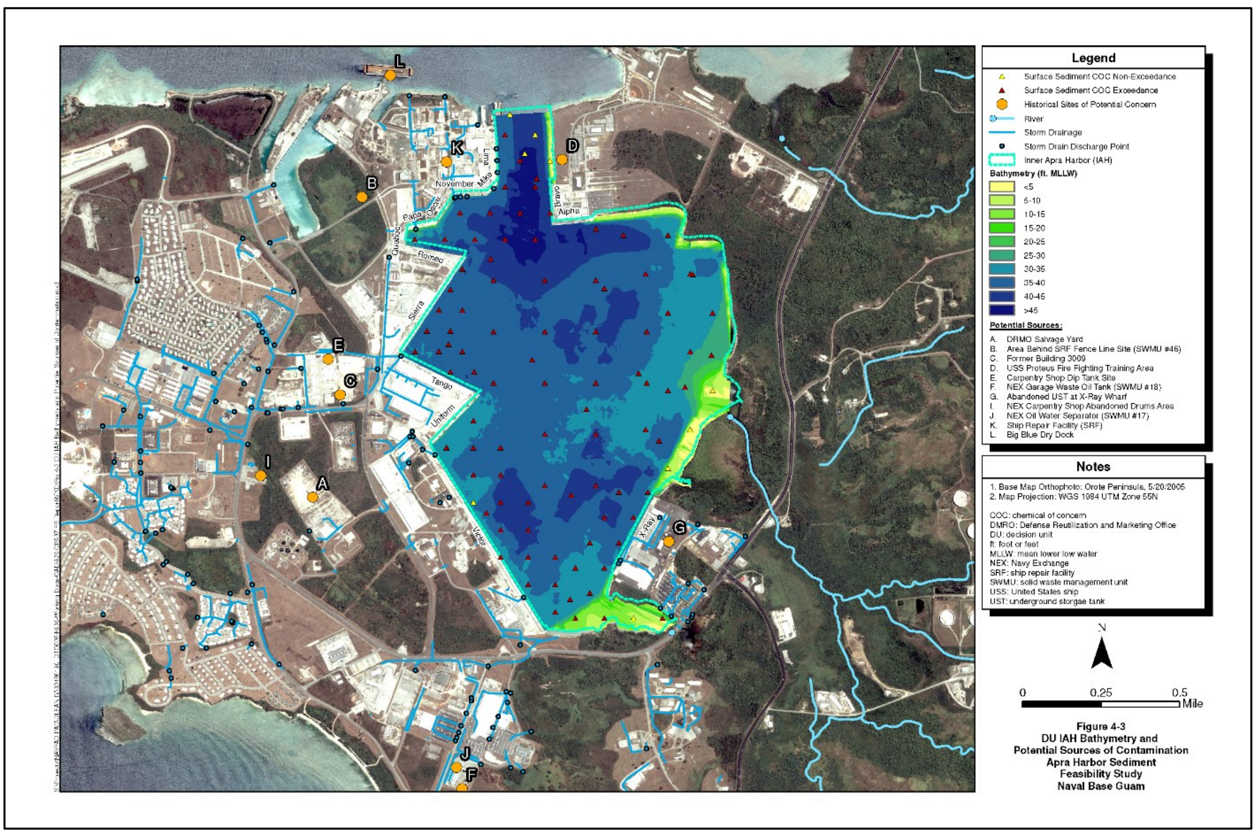

Figure 3.6-1 Chemicals of Potential Concern in Underwater Sediment Identified during Maintenance Dredging of Inner Apra Harbor

Source: NAVFAC Pacific 2019b.

COC are prevalent enough in underwater sediments in the vicinity of the Proposed Action Location (the southern portion of Outer Apra Harbor) that a seafood (i.e., fish, shellfish, and algae or sea grapes) advisory for PCBs, dioxin, and chlorinated pesticides is currently in place. In other parts of the Outer Apra Harbor, fishing activities, other than trolling for pelagic species on the seaward side and bottom fishing outside of the 60-foot depth contour, are prohibited (NAVFAC Pacific 2019b). Table 3.6-1 is modified from the 2019 study to show only Inner Apra Harbor.

Another study conducted south of Proposed Action Location (at the Oscar, Papa, Quebec, and Romeo wharves) also showed that underwater sediment contamination was present in the Inner Apra Harbor (NAVFAC Pacific 2017). Detected concentrations in excess of the effects range low or effects range medium values were found for pesticides, polycyclic aromatic hydrocarbons, metals, and total PCBs. Additionally, the presence of raw petroleum product has been observed in the corner of Quebec and Romeo wharves (NAVFAC Pacific 2020).

In the vicinity of the Proposed Action Location, nonpoint sources of COCs to underwater sediments include contributions from urban and commercial/industrial lands that discharge to the harbor (note the presence of multiple storm drain discharge points along Lima, Mike, November, and other wharves in Figure 3.6-1), as well as exposure during targeted maintenance dredging and erosion of contaminated sediment due to propeller wash. Potential point sources include wharves, releases from ships, and storm drain discharges. In addition, several dockside buildings and sites have been identified as potential or reported sources of sediment contamination that could impact underwater sediments via the storm drain system. The highest potential for COC re-contamination is associated with dredging activities and prop wash from ships that both have the ability to uncover and re-expose contaminated soils just beneath the surface layer of the underwater sediments (NAVFAC Pacific 2019b).

3.6.2.4 Other HAZMAT and HAZWASTE

There are other solid waste items in the Proposed Action Location that do not fit into the categories above that would also be handled as HAZMAT or HAZWASTE depending on where it is in its operational or functional lifecycle. These may include creosote (or other) treated wood utility poles, mercury from electrical ballasts, and other materials to be determined.

3.6.2.5 Defense Environmental Restoration Program

The DERP addresses the identification and cleanup of hazardous substances and military munitions remaining from past activities at DoD installations and FUDS. Within DERP, DoD created two program categories, the IRP and the MMRP. The IRP focuses on cleaning up releases of hazardous substances that pose risks to the public and/or the environment at active, BRAC, and FUDS military sites owned or used by the DoD, including the Navy and U.S. Air Force.

On Guam, Navy and U.S. Air Force have ongoing DERP site cleanup activities with GEPA and USEPA oversight. The Defense and State/Territory Memorandum of Agreement established a program where GEPA staff work closely with DoD representatives to discuss and facilitate environmental restoration and clean-up work on Guam. Under the Defense and State/Territory Memorandum of Agreement program, GEPA maintains regulatory oversight of environmental restoration efforts undertaken on Guam by DoD to ensure compliance with applicable local and federal laws and regulations. The Defense and State/Territory Memorandum of Agreement oversees the following three DoD programs:

Table 3.6-1 Contaminates Identified During Maintenance Dredging of Inner Apra Harbor

	Inner Harbor [a]							
	Recreational Fisher		Recreational User				Subsistence Fisher	
	Fish		Sediment		Surface Water [b]		Fish	
Analyte	ILCR or HQ	%	ILCR or HQ	%	ILCR or HQ	%	ILCR or HQ	%
Cancer Risks (ILCR)								
Adult								
Total NOAA-18 PCBs	1.00E-06	4%	1.E-07	4%	—	—	9.00E-05	4%
Total Dioxin-Like PCB TEQ	3.E-05	96%	5.E-08	2%	8.E-07	91%	**2.00E-03**	96%
Total Dioxin/Furan TEQ	1.E-07	0.30%	1.E-07	5%	2.E-07	9%	8.00E-06	0.30%
Total TEQ	3.E-05	96.30%	2.00E-07	7%	1.00E-06	100%	**2.00E-03**	96.30%
Cumulative Risk of All Chemicals	*3.00E-05*	—	*3.00E-06*	—	*1.00E-06*	—	***2.00E-03***	—
Child								
Total NOAA-18 PCBs	9.E-07	4%	2.E-07	1%	—	—	2.00E-05	4%
Total Dioxin-Like PCB TEQ	2.E-05	96%	1.E-07	1%	—	—	**6.00E-04**	96%
Total Dioxin/Furan TEQ	9.E-08	0.30%	3.E-07	3%	—	—	2.00E-06	0.30%
Total TEQ	2.E-05	96.30%	4.E-07	4%	—	—	**6.00E-04**	96.30%
Cumulative Risk of All Chemicals	*3.00E-05*	—	*1.00E-05*	—	*5.00E-07*	—	***6.00E-04***	—
Non-Cancer Hazards (HQ)								
Adult								
Total NOAA-18 PCBs	0.2	8%	—	—	—	—	**6**	8%
Total Dioxin-Like PCB TEQ	**2**	92%	—	—	—	—	**67**	91%
Total Dioxin/Furan TEQ	—	—	—	—	—	—	0.2	0.30%
Total TEQ	**2**	92%	—	—	—	—	**67.2**	91.30%
Cumulative Hazard of All Chemicals (HI)	***3***	—	*0.06*	—	*0.09*	—	***74***	—
Child								
Total NOAA-18 PCBs	0.5	8%	—	—	—	—	**7**	8%
Total Dioxin-Like PCB TEQ	**6**	92%	—	—	—	—	**77**	92%
Total Dioxin/Furan TEQ	—	—	—	—	—	—	0.3	0.40%
Total TEQ	**6**	92%	—	—	—	—	**77.3**	92.40%
Cumulative Hazard of All Chemicals (HI)	***7***	—	*0.4*	—	*0.1*	—	***84***	—

Note: **Bold shaded** value indicates ILCR >1E-04, or HQ or HI >1. Total TEQ risk and hazard includes the cumulative risk or hazard of total dioxin-like PCB TEQ and total dioxin/furan TEQ combined, while Cumulative Risk and *Cumulative Risk/Hazard of All Chemicals* include the contribution from the risk or hazard for total NOAA-18 PCBs, total dioxin-like PCB TEQ, and total dioxin/furan TEQ combined.

— Chemical not a risk driver, or total percent risk not summed
HI hazard index
ILCR incremental lifetime cancer risk
HQ hazard quotient

[a] Results listed exclude the contribution of background.
[b] Porewater data were used as a surrogate for estimating surface water exposure. Results listed include a standard dilution factor of 10×.

Source: Modified from NAVFAC Pacific 2019b.

- BRAC – A clean-up program to ensure the environmental suitability of DoD properties planned for transfer
- IRP – The main DoD installation environmental restoration program which includes activities, such as investigations and cleanups at the Orote landfill at Commander Naval Forces Marianas, Construction Battalion Landfill at South Finegayan and Landfills # 1 and # 2 at Naval Computer and Telecommunications Station Finegayan, and various sites at Andersen Air Force Base
- FUDS – USACE-managed program designed to clean up military sites that are no longer owned by the U.S. government. To facilitate HAZWASTE site restoration, the DoD has established restoration advisory boards (RABs). RABs are established to improve overall communications between all interested parties and expedite HAZWASTE site cleanup. RABs act as a focal point for information exchange between DoD and the local community. RAB members typically include DoD and regulatory agency representatives and community members and meet to discuss ongoing environmental studies and cleanup activities. RAB members in turn serve as a liaison to the overall local community to address issues of concern. RAB meetings are open to the general public and the community is actively encouraged to participate.

The Proposed Action Location is occurring entirely within government property. Accordingly, there are no BRAC or FUDS sites within or adjacent to the Proposed Action Location.

There are four Installation Restoration (IR) Sites in the vicinity of the Proposed Action Location (Figure 3.6-2):

- IR Fleet Industrial Supply Center Solid Waste Management Unit (SWMU) #12 – DRMO Salvage and Scrap Yard

This site is located east of the proposed Dredge Disposal Area (Figure 3.6-2). IR Fleet Industrial Supply Center SWMU #12 was a DRMO salvage and scrap yard where HAZMAT and HAZWASTE was stored and handled. Site contaminants included waste oils, solvents, PCBs, metals, and total petroleum hydrocarbons. In July 1999, approximately 50 cubic yards of semi-volatile organic compounds, PCBs, and lead contaminated soil (at various locations within the DRMO compound and adjacent drainage swales were removed). Subsequent verification sampling determined that all contamination was removed except PCB hotspots located in adjacent drainage swales.

As of 2010, a removal action was ongoing for the removal of PCBs in surface and subsurface soils within the drainage swales. The current status of IR Fleet Industrial Supply Center SWMU #12 is [to be determined].

- IR Naval Ship Repair Facility (NSRF) Site #24 – Area Behind Naval Ship Repair Facility Fenceline

This site is located southwest of the Lima, Mike, and November Proposed Action Location, on the north side of Fourth Street. IR NSRF Site #24 was a former HAZWASTE disposal area with site contaminants that included total petroleum hydrocarbon, solvents, pesticides, PCBs, and metals. A Removal Action was completed in 2007, a Decision Document was signed in October 2007, and a Land Use Control Work Plan was finalized in March 2008. Twelve-month wetland restoration monitoring was completed in September 2008. As of 2010, long-term monitoring (annual) was in progress with semi-annual and 5-year reviews. The final remedy for the site was implementation of land use controls. The current status of IR NSRF Site #24 remains unchanged: land use controls/5-year reviews (NAVFAC Pacific 2019b).

- IR Site #25 (formerly IR Site #02/SWMU 37) – Plating Shop Leach Field

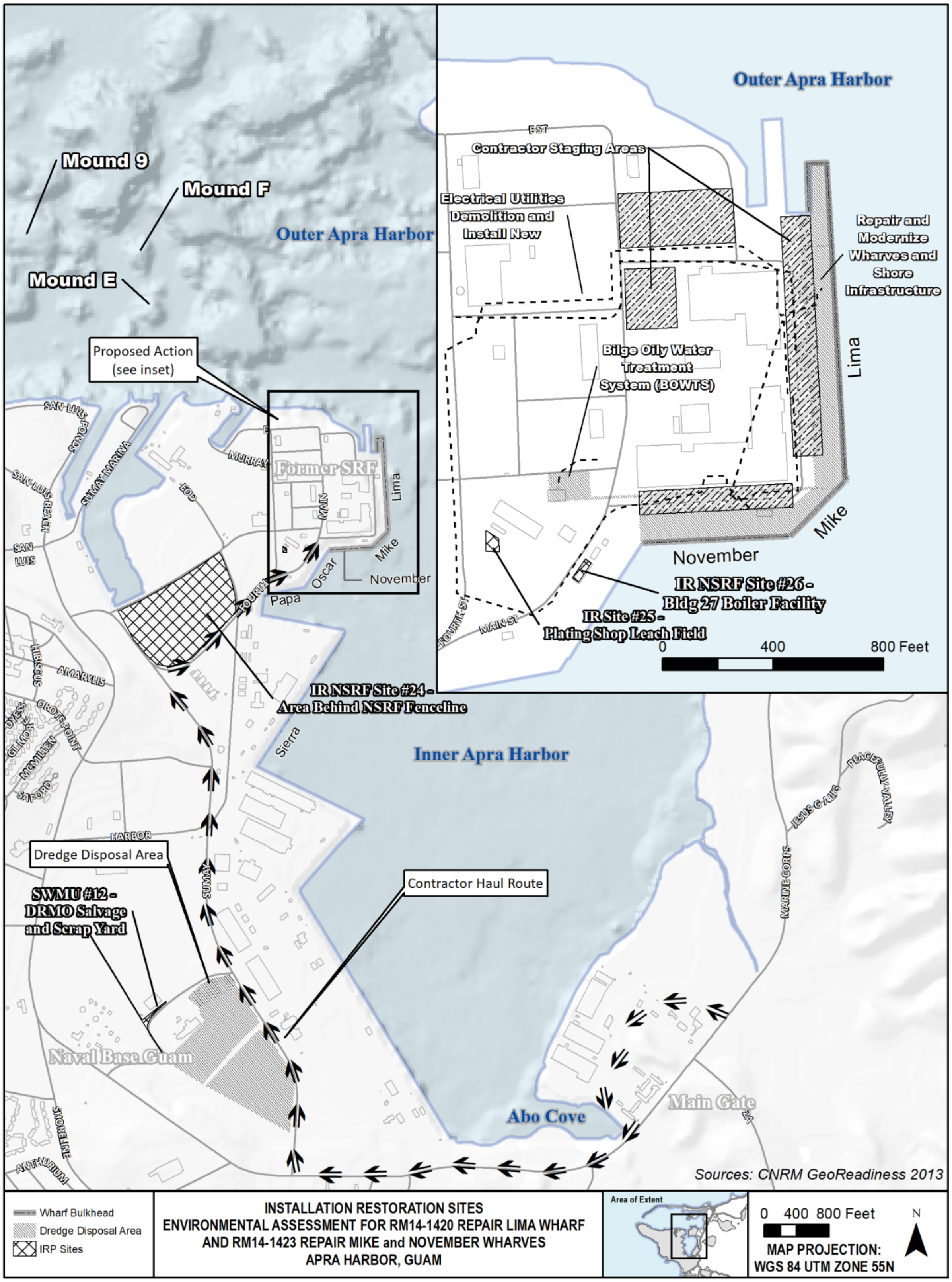

Figure 3.6-2 Location of Installation Restoration Sites at or Immediately Adjacent to the Project Area

This site is located southwest of Building 40 and northeast of the intersection of Fourth Street and Main Street. A former SWMU site (SWMU 37 – Plating Shop Leach Field) that was turned into IR Site 25. A remedial investigation completed for this site in 1995 indicated elevated concentrations of metals (copper, cadmium, nickel, and silver) and cyanide in the soil and groundwater of the leach field. The remedial investigation recommended groundwater monitoring for 3 years. The final remedy for this IR Site, as recorded in a 2005 Decision Document, was NFA. According to the Decision Document, soil from the Plating Shop Leach Field was removed between December 1998 and February 1999, and long-term groundwater monitoring results from April 1999 through July 2003 indicated that concentrations of COCs declined to levels that were no longer harmful to human or ecological receptors. The current status of IR NSRF Site #25 is NFA to industrial use level (NAVFAC Pacific 2019b).

- IR NSRF Site #26 – Building 27 Boiler Facility and Demineralization Units

This site is located just west of November Wharf (see Figure 3.6-2). IR NSRF Site #26 includes a former boiler facility and demineralization unit with petroleum contaminants. As of 2010, a remedial investigation had been scheduled. A final Current Conditions Report recommended NFA for the demineralization units. The current status of IR NSRF Site #26 is NFA to the unrestricted use level (NAVFAC Pacific 2019b).

Former RCRA Cleanup Sites

In 1986, USEPA and GEPA required a RCRA Facility Assessment of the Apra Harbor Naval Complex. Results of the RCRA Facility Assessment identified 50 SWMUs: 18 units requiring NFA, 21 units requiring further evaluation under RCRA, and 11 units continuing under the IR Program. In accordance with the RCRA Part B permit (GUS001) issued in September 1993 by USEPA and GEPA for the Conforming Storage Facility operated by the DRMO and Public Works Center, USEPA/GEPA required a Current Conditions Report and performance of a RCRA Facility Investigation for SWMUs where additional investigation was warranted (NAVFAC Pacific 1998).

SWMUs in the vicinity of the project footprint that underwent additional investigation included:

- SWMU 36: Pipefitting Shop and Dip Tanks and Sump
- SWMU 37: Plating Shop Leach Field
- SWMU 38: Plating Shop Acid Neutralization Tank (Building 2074)
- SWMU 39: Waste Acid Storage Area (Building 2074)
- SWMU 40: Battery Drainage Area (Building 2074)
- SWMU 42: Woodworking Shop Dip Tanks
- SWMU 43: Steam Clean Area and Building 21 Wood Working Shop Dip tanks
- SWMU 45: “Back 40” Lot
- SWMU 51: Building 30 Foundry Shop

The following SWMU descriptions are taken from investigations of the former NSRF by NAVFAC Pacific in 1998, 1999, and 2012 (NAVFAC Pacific 1998, 1999, 2012):

SWMU 36 included dip tanks and a sump located in Building 21 used as a Pipefitting Shop. These tanks were constructed in 1966, and the contents included: carbon removing and degreasing chemicals, rinse water, hydrochloric acid, and sodium hydroxide.

As previously noted, SWMU 37 (Plating Shop Leach Field) was turned into IR Site 25. More information about IR Site 25 is available in the above discussion of IR Sites. The current status of IR NSRF Site #25 is NFA to industrial use level (NAVFAC Pacific 2019b).

SWMU 38 was used for the neutralization of battery acid drained in the adjacent battery change-out area that was SWMU 39. At SWMU 40, an unknown quantity of battery acid was drained to the ground. SWMU 38, 39, and 40 were all co-located at Building 2074.

SWMU 42 included two Woodworking Shop Dip Tanks located in Building 2047 (currently Building 30), which were used from 1945 to 1966. The tanks contained pentachlorophenol and/or copper naphthalene. These tanks were moved to Building 21 in 1967, became SWMU 43, and remained in use until 1972. The tanks were eventually removed in 1976.

SWMU 45 is a large, mostly unutilized area where soil and groundwater sampling occurred to investigate the potential presence of elevated metals concentrations.

SWMU 51 is a 28 foot (8.5 meter) wide by 40 foot (12 meter) long by 3 foot (1 meter) deep unlined sand pit within Building 30 and was used for casting metals from 1980 to 1996. Sand was removed from the pit in 1997.

None of the former SWMU cleanup sites were located entirely within the current project footprint. However, six of the former SWMU sites were located immediately adjacent to the current Proposed Action and in-situ their boundaries may encroach upon, or be encroached by, the boundary of Proposed Action. These include:

- SWMUs 37 (now IR Site 25), 38, 39, and 40, which are located northeast of and immediately adjacent to the southwest corner of the Proposed Action Location designated for the demolition of existing electrical duct bank.
- SWMU 45, which is located west of and immediately adjacent to the northwest corner of the Proposed Action Location designated for the demolition of existing electrical duct bank.
- SWMU 43, which is located west of and immediately adjacent to the upper-north end of the Proposed Action Location designated for the removal of defective paper insulated, lead covered cables.

A RCRA Facility Investigation Report was completed for SMWUs 36, 42, and 43 in 1997. As part of the RCRA Facility Investigation, surface and subsurface soil samples were collected, and groundwater monitoring wells were installed. The results of soil sampling and groundwater monitoring indicated slightly elevated concentrations of copper, lead (dissolved and total), and nickel. These elevated concentrations were determined to be not site-related as there were no identified releases of metals into the soil or water from SWMU 36, 42, or 43; therefore, no corrective measures were recommended for all three sites. The 1997 RCRA Facility Investigation also concluded that no corrective measures were required at SWMUs 38, 39, 40, 45, and 51 as soil and water samples (only sand [verification] samples for SWMU 51) collected from the sites did not pose a threat to human or ecological receptors.

Recent information provided by NAVFAC Pacific (2019) indicates that the project-proximate sites in need of corrective measures have been designated as No Further Action to unrestricted for SWMU 51; NFA to industrial level for SWMU 37/IR 25(02), SWMUs 38, 39, 40, and 45; and NFA to acceptable risk or background level for SWMUs 36, 42 and 43.

MMRP

In September 2001, DoD established the MMRP to address hazards associated with MEC within areas no longer used for operational range activities. These former range training areas are called munitions response areas. Although the Proposed Action area was not used as a range, training/practice rounds have been encountered there. Accordingly, and for the purposes of safety, it should be assumed that MEC and/or MPPEH have the potential to occur anywhere on a military installation. The likelihood of encountering additional munitions on the land portion of the Proposed Action area is low. No Munitions Response Sites have been identified within or adjacent to the Proposed Project area (DENIX 2019).

MEC/MPPEH

It is unlikely that MEC and/or MPPEH will be encountered on the land portion of the Proposed Action. However, MEC and/or MPPEH may be encountered during the in-water work (e.g., dredging and pile driving). World War II-era MEC and/or MPPEH have been encountered in this area, but the likelihood of encountering MEC and/or MPPEH has been substantially reduced due to the extensive post World War II dredging activities. MEC and/or MPPEH risk remains during dredging and transportation and disposal of dredge material. Therefore, exclusion zones based on the primary munition with the greatest fragmentation distance will be established to keep non-essential personnel in the water and on land safe from exposure to potential effects from unintentional detonations (in water and on land).

Screening of dredge material for MEC and/or MPPEH would take place at the approved disposal site. An exclusion zone would be established for screening operations and operators of mechanical equipment would be protected from unintentional detonation by shielding and operator minimum separation distance. Any MEC and/or MPPEH identified during screening would be handled in accordance with procedures approved in the ESS. In addition to being a Health and Safety concern, spent or abandoned munitions may be considered HAZMAT and if allowed to degrade may become HAZWASTE.

3.6.3 Environmental Consequences

The analysis addresses issues related to the use and management of HAZMAT and HAZWASTE as well as the presence and management of specific cleanup sites at NBG.

3.6.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change associated with HAZMAT and HAZWASTE. HAZMAT and HAZWASTE in the wharves would not be removed and properly recycled or disposed of in accordance with applicable federal requirements. The wharves would continue to deteriorate and risk introducing HAZMAT and HAZWASTE directly into the harbor when they failed. Therefore, significant impacts could occur with implementation of the No Action Alternative.

Hazardous Material and Waste Potential Impacts:

- Less than significant impacts to the project, personnel, or environment with HAZMAT and HAZWASTE minimization, construction BMPs, and worker safety measures
- Likely long-term positive impact as a result of the removal and appropriate disposal of HAZMAT and HAZWASTE

3.6.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

There are known HAZMAT and HAZWASTE constituents, components, and cleanup sites within and adjacent to the Proposed Action Location. During construction activities, other forms of HAZMAT and HAZWASTE may also be encountered or generated. HAZMAT and HAZWASTE hazards are meticulously surveyed, documented, and characterized in advance. Handling plans, procedures, and training are developed and completed prior to any construction activities. Potentially significant HAZMAT and HAZWASTE hazards are avoided through the implementation of this approach. The following summary sections explain how this would be accomplished under the Preferred Alternative.

Environmental Protection and Worker Safety Measures

Environmental resources would be protected throughout the duration of the project. All work conducted as part of the project would comply with federal, Guam, and installation regulations pertaining to HAZMAT and HAZWASTE. Project contractors would prepare and submit all necessary environmental protection, HAZMAT and HAZWASTE, and contaminated soil abatement plans as applicable and as indicated in the specifications to the Contracting Officer for review by the government.

All project workers would be informed of the presence of HAZMAT and HAZWASTE (e.g., ACM, LBP/lead-containing paint, PCBs, mercury) and contaminated soil. All work involving HAZMAT and HAZWASTE or contaminated soil would be conducted in a controlled manner protective of the workers, installation personnel, and the work equipment in accordance with applicable federal, Guam, and installation regulations and requirements. Project workers are required be familiar with and at all times conform to applicable federal, Guam, and installation Health and Safety regulations and requirements. All project personnel (including subcontractors) would be provided the necessary hazard communication and other trainings in accordance and compliance with applicable federal, Guam, and installation Health and Safety regulations.

With implementation of the environmental protection and worker safety measures listed above, the Proposed Action Location would not result in a significant impact to the project, personnel, or the environment.

HAZMAT

ACMs, LBP, lead-containing paint, PCBs, and radon at low concentrations are present or assumed present in the Proposed Action Location. Proposed safety measures are summarized below:

- ACMs are present or assumed present in the Proposed Action Location. In areas where the ACM is assumed, such as underground along the gravity sewer pipe, pipe materials would be collected and analyzed for ACM content prior to disturbance or demolition. All ACM disturbance work, abatement, and removal would comply with the requirements in construction specification section 02 82 00 Asbestos Remediation.
- LBP and lead-containing paint are present in the Proposed Action Location. Lead paint disturbance work would comply with the requirements in construction specification section 02 83 00 Lead Remediation. The characterization of waste-containing lead paints would occur through the use of Toxicity Characteristic Leaching Procedure testing prior to disposal to determine the appropriate and corresponding disposal requirements.

- PCBs are present in the Proposed Action Location. Some of the EMHs and conduits in the Proposed Action area would be reused and others would be abandoned in place. For the EMHs and conduits that are to be reused, PCB decontamination and encapsulation would be conducted prior to reuse. All equipment from the EMHs to be abandoned would be removed and disposed. All waste generated from PCB removal and decontamination would be disposed in accordance with 40 CFR 761, the Toxic Substances Control Act, construction specification section 02 84 16 Handling of Lighting Ballasts and Lamps Containing PCB and Mercury, and construction specification section 02 84 33 Removal and Disposal of PCBs. Waste-containing PCB concentration equal to or greater than 2 parts per million (ppm) would be disposed at an off-island disposal facility on the mainland U.S. Prior to PCB removal activities, project contractors would prepare a work plan and site-specific Health and Safety Plan for government review and approval.
- Radon is a significant issue in parts of Guam. However, the Proposed Action Location does not occur in the areas of high concentrations. The radon hazard is most significant when it is able to build up in confined areas such as spaces or buildings with poor ventilation. The Proposed Action would take place outside and the opportunities to encounter confined spaces would be very limited.

With implementation of specific measures described above, the Proposed Action Location would not result in a significant impact to the project or the environment.

COC in Soils and Underwater Sediments

Petroleum-contaminated soil was found at three boring locations at the Lima Wharf in excess of the Environmental Screening Level[1] for unrestricted land use (Myounghee Noh & Associates, L.L.C. 2019). The soil collected from the south end of the wharf (Sampling Point 18LB-08 at 6.5-7.5 feet [2.0-2.3 meters] below ground surface) contained petroleum contamination exceeding the Environmental Screening Level for restricted land use. Also contained in the soil at that sampling Point was Total Petroleum Hydrocarbons-Diesel Range Organics in excess of unrestricted and restricted land uses, Total Petroleum Hydrocarbons-Residual Range Organics equal to the screening level for unrestricted land use, plus the presence of heavy metals and debris containing treated wood. As a consequence, the vicinity of Sampling Point 18LB-08 will be designated as a grossly petroleum-contaminated area. Findings for other areas at Lima Wharf included levels of Total Petroleum Hydrocarbons-Diesel Range Organics and Total Petroleum Hydrocarbons-Residual Range Organics in excess of the screening level for unrestricted land use.

Based on the results of this soil screening survey, it was determined that uncontrolled earthwork could cause potential exposures to the workers and nearby facility users via direct contact or fugitive dust. The routes of exposure of impacted soil as fugitive dust are by inhalation, ingestion, and dermal contact. The following environmental controls were recommended (Myounghee Noh & Associates, L.L.C. 2019):

[1] The analytical results for contaminants were compared to the Hawaii Department of Health, Tropical Pacific Soil Environmental Screening Levels with unrestricted (residential) and restricted (commercial/industrial) land uses above a non-drinking water resource and shallow/deep depth of impacted soil.

- The contractor must use engineering controls such as water misting and wind barriers to control fugitive dust.
- The contractor must prepare a Soil Management Plan including a Health and Safety Plan and a Sampling and Analysis Plan.
- The contractor must provide hazard communication for the workers prior to any soil disturbance.
- Use of BMPs, such as dust and runoff control and erosion control, must be implemented during construction. There shall be no visible emission to the environment.

Excavations in soil deeper than 3 feet (1 meter) below ground surface in the vicinity of Sampling Point 18LB-08 shall be assumed to be grossly contaminated. The excavated soil from this area must be segregated from other soils and disposed of or treated as petroleum-impacted soil. The waste debris shall be separated from the soil and disposed of properly (Myounghee Noh & Associates, L.L.C. 2019).

Excavated soil may be reused on site if the soil meets the geotechnical requirements as fill. Contaminated or potentially contaminated soil excavation and handling would be conducted per construction specification section 02 61 13 Excavation and Handling of Contaminated Material. Soil excavation monitoring and proper soil segregation will be required by using field testing and visual observations. Any excess soil that cannot be reused on site must be disposed of at an off-base disposal facility. The contractor must provide proper soil/waste characterization for disposal. The contractor must coordinate with the Contracting Officer and installation's environmental office for proper handing and management of excess soil. Excess excavated material will become the responsibility of the contractor and must be properly reused or disposed of based on the soil testing results in accordance with applicable federal and Guam regulations.

Erosion control measures such as water misting, wind and soil barriers, stockpile covers, and silt fencing would be implemented to ensure that soil and dust do not migrate away from the stockpile or worksite.

With the implementation of these soil contamination measures, and the environmental protection and worker safety measures listed above, existing contaminated soil in the Proposed Action Location would not result in a significant impact to the project, personnel, or the environment.

Contaminated underwater sediments are present on the harbor floor adjacent to the wharves. During dredging operations and in-water work, silt curtains would be used to minimize the spread of disturbed sediments. Proposed Action activities would include a SWPPP and standard construction BMPs to prohibit construction contributions to underwater sediment contamination.

With implementation of these underwater sediment control measures, existing contaminated underwater sediment in the Proposed Action Location would not result in a significant impact to the Proposed Action or the environment.

Other HAZMAT and HAZWASTE

During construction, other forms of HAZMAT and HAZWASTE are likely to be encountered or generated. Among these are expected to be treated wood utility poles. Treated wood utility poles that cannot be reused would be demolished and disposed of at a permitted off-island disposal facility on the U.S. mainland. No chipping of treated wood materials (e.g., for mulch or ground cover) would be permitted. Work involving mercury-containing light tubes or switches would be conducted in accordance with construction specification section 02 84 16 Handling of Lighting Ballasts and Lamps Containing PCBs and Mercury. Oily water encountered would be containerized and disposed of per the requirements of construction specification section 02 84 33 Removal and Disposal of PCBs. Electrical equipment that can be reused would first be decontaminated.

All HAZWASTE would undergo the requisite sampling and testing needed for characterization and waste manifests would be prepared. Solid and HAZWASTE would be properly packaged and disposed of in accordance with applicable federal, Guam, and installation regulations and requirements. With the implementation of these other HAZMAT and HAZWASTE measures, existing general/non-specific HAZMAT and HAZWASTE in the Proposed Action Location would not result in a significant impact to the Proposed Action or the environment.

DERP

There are four IR Sites adjacent to the Proposed Project area. As of 2019, IR NSRF Site #24 had already completed cleanup action and had been moved to a monitoring phase with land use controls. As of 2019, the status of IR Site #25 was NFA to industrial use level. As of 2019, the status of IR NSRF Site #26 was NFA to the unrestricted use level. As of 2010, IR Fleet Industrial Supply Center SWMU #12 had been cleaned and remaining cleanup of PCB hotspots in adjacent swales was ongoing. Although the current status of Site #12 is unknown, it is unlikely that PCB levels remain at previous levels in the swale hotspots, and moreover the site is not within the project footprint. Additionally, all SWMU sites in need of corrective measures have been designated as NFA to either industrial level or acceptable risk or background level. There are no BRAC, FUDS, MMRP, or any other Navy Active Environmental Restoration Sites in or adjacent to the Proposed Project area.

As a result of cleanup actions already completed or underway, the IR Sites being adjacent to but not within the Proposed Action Location, and the environmental protection and worker safety measures listed above, existing IR Sites and former SWMU sites would not result in a significant impact to the Proposed Action, personnel, or the environment.

MEC/MPPEH

It is unlikely that MEC and/or MPPEH will be encountered on the land portion of the Proposed Action. However, MEC and/or MPPEH may be encountered during the in-water work. The likelihood of encountering MEC, MPPEH, and/or UXO items in the Action Area has been significantly reduced due to extensive post-World War II dredging activities in the Action Area. Procedures will be implemented to remove MEC and /or MPPEH from the dredge spoils. Screening of dredge material for MEC and/or MPPEH would take place at the approved disposal site. An exclusion zone would be established for screening operations and operators of mechanical equipment would be protected from unintentional detonation by shielding and operator minimum separation distance. Any MEC and/or MPPEH identified during screening would be handled in accordance with procedures approved in the ESS. In addition to being a Health and Safety concern, spent or abandoned munitions may be considered HAZMAT and, if allowed to degrade, may become HAZWASTE.

Summary

With the implementation of the preceding HAZMAT and HAZWASTE and environmental protection and worker safety measures listed above, the Preferred Alternative would not result in significant HAZMAT and HAZWASTE impacts to the project, personnel, or the environment. If previously unforeseen suspect materials are encountered, work would cease at the location of the encounter, the situation would be assessed for safety, the occurrence would be documented and reported, and samples of the material would be analyzed at the appropriate time in compliance with applicable laws and regulations.

3.7 Air Quality

This discussion of air quality includes criteria pollutants, standards, sources, permitting, and greenhouse gases (GHGs). 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. The region of influence (ROI) for assessing air quality impacts is the air basin in which the Proposed Action is located on the island of Guam.

3.7.1 Regulatory Setting

3.7.1.1 Criteria Pollutants and National 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 CAA, the 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. Guam also maintains their own ambient air quality standards, which can be found under Title 22 of the Guam Administrative Rules and Regulations, Chapter 1, Section 1302 (Table 3.7-1).

Table 3.7-1 National and Guam Ambient Air Quality Standards

Pollutant		Primary/ Secondary	National Standards			Guam Standards	
			Averaging Time	Level	Form	Level	Form/Averaging Time
CO		primary	8 hours	9 ppm	Not to be exceeded more than once per year	10 mg/m^3 (9 ppm)	Maximum 8-hour average concentration not to be exceeded more than once per year
			1 hour	35 ppm		40 mg/m^3 (35 ppm)	Maximum 1-hour average concentration not to be exceeded more than once per year
Pb		primary and secondary	Rolling 3-month period	0.15 µg/m^3 (1)	Not to be exceeded	1.5 µg/m^3	Maximum arithmetic mean averaged over a calendar quarter
NO_2		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	--	--
		primary and secondary	1 year	53 ppb (2)	Annual mean	100 µg/m^3 (0.053 ppm)	Annual arithmetic mean concentration
O_3		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years	235 µg/m^3 (0.12 ppm)	Maximum 1-hour average concentration not to be exceeded more than once per year
Particle pollution	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	Annual mean, averaged over 3 years	--	--
		secondary	1 year	15.0 µg/m^3	Annual mean, averaged over 3 years	--	--
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years	--	--

Table 3.7-1 National and Guam Ambient Air Quality Standards

Pollutant	Primary/ Secondary	National Standards: Averaging Time	National Standards: Level	National Standards: Form	Guam Standards: Level	Guam Standards: Form/Averaging Time
PM_{10}	primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years	150 μg/m^3 and 50 μg/m^3	Maximum 24-hour average concentration not to be exceeded more than once per year and Annual arithmetic mean
SO_2	primary	1 hour	75 ppb [4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	80 μg/m^3 (0.03 ppm)	Annual arithmetic mean
					365 μg/m^3 (0.14 ppm)	Maximum 24-hour average not to be exceeded more than once per year
	secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year	1300 μg/m^3 (0.5 ppm)	Maximum 3-hour average not to be exceeded more than once per year

Notes: [1] In areas designated nonattainment for the lead standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 micrograms per cubic meter as a calendar quarter average) also remain in effect.

[2]The level of the annual nitrogen dioxide standard is 0.053 parts per million. It is shown here in terms of parts per billion for the purposes of clearer comparison to the 1-hour standard level.

[3]Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

[4]The previous sulfur dioxide standards (0.14 parts per million 24-hour and 0.03 parts per million annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous sulfur dioxide standards or is not meeting the requirements of a SIP call under the previous sulfur dioxide standards (40 CFR 50.4(3)). A SIP call is a USEPA action requiring a state to resubmit all or part of its SIP to demonstrate attainment of the required National Ambient Air Quality Standards.

Legend: μg/m^3 = micrograms per cubic meter; CO = carbon monoxide; mg/m^3 = milligrams per cubic meter; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM_{10} = particulate matter less than or equal to 10 microns; ppb = parts per billion; ppm = parts per million; SO_2 = sulfur dioxide.

Sources: USEPA 2016; GEPA 2013.

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.

In addition to ambient air quality standards for criteria pollutants, GEPA also regulates visible emissions and fugitive dust. Visible emissions are limited to 20% opacity for continuous emissions and 60% for up to 3 minutes in any 60-minute period. Fugitive dust must be controlled using a variety of means related to BMPs, many of which are applicable to demolition and construction activities.

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. USEPA designated areas centered on Piti Power Plant and Tanguisson Power Plant as nonattainment under the 1971 Standard as of November 15, 1990 and the Piti-Cabras area as nonattainment for the 2010 SO_2 standard as of April 9, 2018. The SIP for the 1971 standard nonattainment areas was approved in 1991. The SIP for the 2010 nonattainment area designation was due on October 9, 2019 but no further information is currently available on the status of this submittal.

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants, which are regulated under Section 112(b) of the 1990 CAA Amendments. The National Emission Standards for Hazardous Air Pollutants regulate hazardous air pollutant emissions from stationary sources (40 CFR part 61).

3.7.1.2 Mobile Sources

Hazardous air pollutants emitted from mobile sources are called Mobile Source Air Toxics. Mobile Source Air Toxics 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 Mobile Source Air Toxics Rule, which identified 201 compounds as being hazardous air pollutants that require regulation. More recently, USEPA issued a second Mobile Source Air Toxics 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 hazardous air pollutants. 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.

3.7.1.3 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) 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 Proposed Action itself and are reasonably foreseeable. The federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the federal agency. 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* emission threshold for SO_2 is presented in Table 3.7-2, as it is the only criteria pollutant that has a nonattainment or maintenance designation in Guam.

Table 3.7-2 Applicable General Conformity *de minimis* Levels

Pollutant	*Area Type*	*Tons per year*
SO_2	All nonattainment & maintenance	100

Legend: SO_2 = sulfur dioxide
Source: 40 CFR 93.153.

3.7.1.4 Permitting

New Source Review (Pre-construction Permit)

New stationary sources and modifications at existing stationary sources are required by the CAA to obtain an air pollution permit before commencing construction. This permitting process for stationary sources is called New Source Review and is required whether the source or modification is planned for nonattainment areas or attainment and unclassifiable areas. Because no new and no modifications to existing stationary sources are associated with the Proposed Action, permitting is not carried forward as part of the air quality analysis.

3.7.1.5 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 producing negative economic and social consequences across the globe.

Revised draft guidance from the CEQ, dated December 18, 2014, recommends that agencies consider both the potential effects of a proposed action on climate change, as indicated by its estimated GHG emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected GHG emissions and climate impacts and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. It recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent emissions on an annual basis as a reference point below which a quantitative analysis of GHG is not recommended unless it is easily accomplished based on available tools and data. On June 26, 2019, the CEQ issued a Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions. The public comment period on the draft was extended and closed on August 26, 2019. The draft directs federal agencies to consider GHG emissions in environmental reviews they must complete under NEPA. The draft redefines the process federal agencies would use to evaluate GHG emissions under NEPA. No further activity related to the draft guidance has been initiated to date.

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, methane, nitrogen oxide, 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 carbon dioxide, which has a value of one. The equivalent carbon dioxide 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 are required to submit annual reports to USEPA. NBG is not required to submit any GHG emissions reporting because emissions for the facility fall below any regulatory thresholds. 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. The Navy has established FY 2020 GHG emissions reduction targets of 34% from a FY 2008 baseline for direct GHG emissions and 13.5% for indirect emissions. 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.

3.7.2 Affected Environment

Ambient air quality conditions around Apra Harbor and NBG are affected by a combination of on base emission sources, including vessels and on-road vehicles, as well as power plants in the area that are owned by the Guam Power Authority and other utilities. The area is in attainment for all criteria pollutants except SO_2. Power plants emissions are the main contributors to the SO_2 nonattainment designation (Figure 3.7-1).

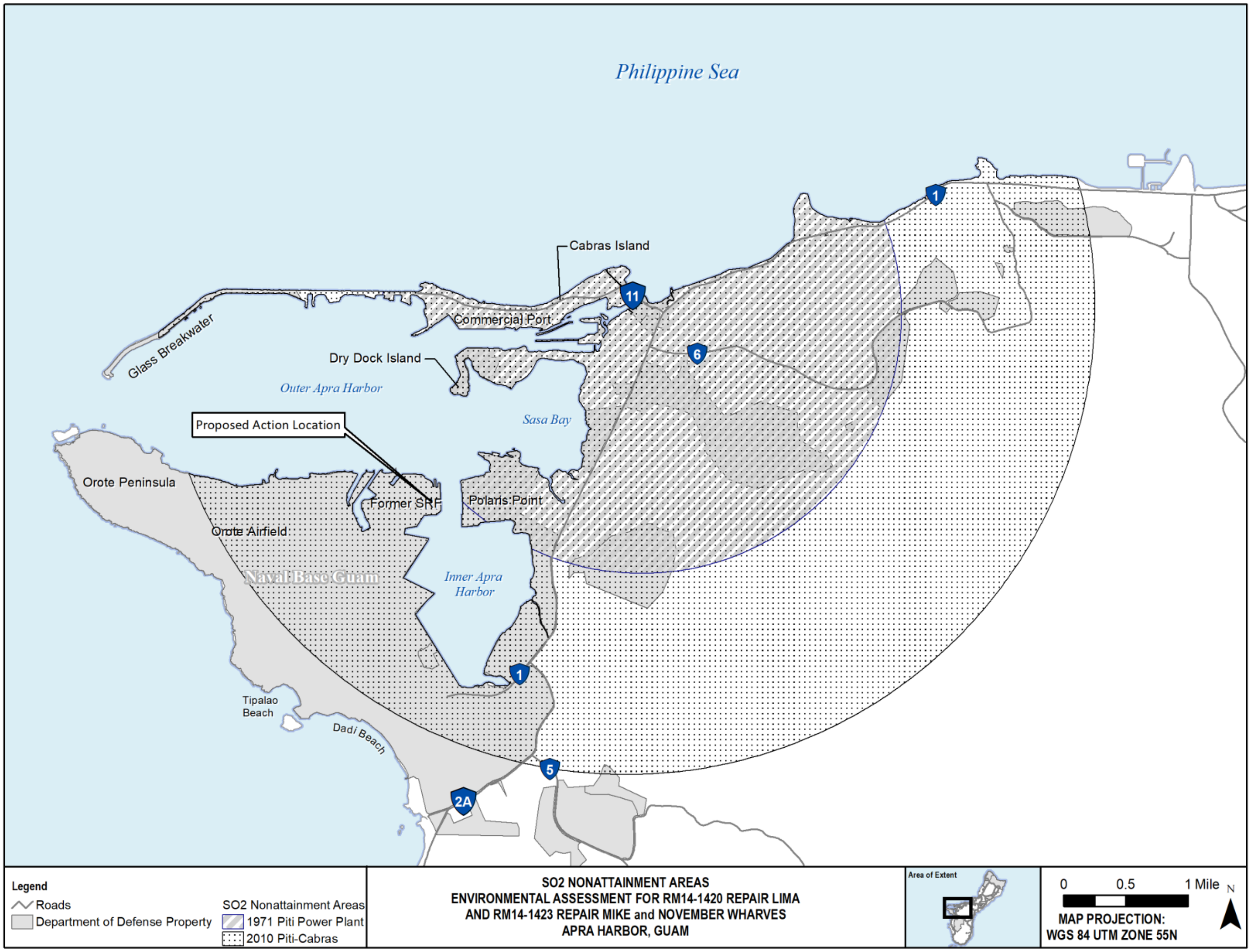

Figure 3.7-1 Boundaries of the SO_2 Nonattainment Areas in Piti Region on Guam

Apra Harbor

In addition to the mobile sources around Apra Harbor, there are several stationary emission sources, including the Guam Power Authority Cabras Power Plant in the Piti Point area with two, 66-megawatt steam turbines and two, slow speed 39.3-megawatt diesel generators. In the same area, the Taiwan Electrical and Mechanical Engineering Services (TEMES) Power Plant operates a 40-megawatt combustion turbine known as Piti #7, and the Marianas Energy Company Power Plant operates two, slow speed diesel generators, each rated at 44-megawatt (also known as Piti #8 and #9). Piti Power Plant also has two units, #4 and #5, previously operated by Guam Power Authority, but currently not in operation. It should be noted that in 2015 an explosion took two of the four Cabras plant turbines off-line. The Guam Power Authority is currently in the process of building a new 180-megawatt baseload power plant near the Dededo-Harmon substation that will replace the Cabras plant and include an additional 130-megawatt from planned solar photovoltaic farms. In 2017, Guam Power Authority also activated decommissioned Dededo Combustion Turbines 1 and 2 (40 megawatts) to help offset the 78.6-megawatt of base load capacity lost by the 2015 explosion (Guam Power Authority 2019).

An emission inventory of the island of Guam is not available; the USEPA National Emission Inventory does not include Guam. USEPA's Technical Support Document for Intended Round 3 Area Designations for the 2010 1-Hour SO_2 Primary NAAQS for Guam reported 2011-2013 actual SO_2 emissions for Cabras (8,891 tons per year), Marianas Energy Company (4,828 tons per year), and TEMES (2 tons per year), which can be used as a reference point for assessing potential impacts from NBG and the proposed alternatives.

Naval Base Guam

NBG has two emergency generators (one 100 kilowatts and one 125 kilowatts). Additionally, the Navy's Orote Point Power Plant has several air permits with combined permitted emissions exceeding 100 tons per year for both nitrogen oxide and volatile organic compounds. The sources covered by these separate air permits under the Orote Point Power Plant include:

- Three 6.6-megawatt emergency diesel generators that can operate up to 1,350 hours per year combined for all three units, one 300-kilowatt black start emergency generator, a 196,000 cubic yard sanitary landfill and shredder. These sources are included in a Title V permit.
- One 10.5-Million British thermal unit per hour boiler, one 6.3-Million British thermal unit per hour boiler, and one 200-kilowatt emergency generator.
- Various portable boilers and emergency diesel generators.

Orote Point Power Plant Title V Permitted Emissions are presented in Table 3.7-3.

Table 3.7-3 Orote Point Power Plant Title V Permitted Emissions

Permitted Annual Emissions (tons per year)				
SO_2	***CO***	***PM_{10}***	***NOx***	***VOC***
23.0	6.1	0.7	96.0	7.4

Legend: CO = carbon monoxide; NO_x = nitrogen oxide; PM_{10} = suspended particulate matter less than or equal to 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

Source: Navy 2010a.

Recent annual criteria pollutant emissions for NBG as reported by the Department of the Navy to GEPA are shown in Table 3.7-4.

Table 3.7-4 NBG Criteria Pollutant Air Emissions Inventory (tons per year)

	NO_x	VOC	CO	SO_x	PM_{10}	$PM_{2.5}$
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

Legend: CO = carbon monoxide; NO_x = nitrogen oxide; $PM_{2.5}$ = fine particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = suspended particulate matter less than or equal to 10 microns in diameter; SO_x= sulfur oxide; VOC = volatile organic compound

Sources: NAVFAC 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, CY 2018. Reported to nearest 1/10 of a ton. Various dates.

3.7.3 Environmental Consequences

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. Potential impacts to air quality are evaluated with respect to the extent, context, and intensity of the impact in relation to relevant regulations, guidelines, and scientific documentation.

Air Quality Potential Impacts:

- Preferred Alternative: Temporary emissions would have less than significant impacts

3.7.3.1 No Action Alternative

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

3.7.3.2 Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative) Potential Impacts

Air quality impacts under the Preferred Alternative were assessed by evaluating the additional emissions associated with the proposed construction (the additional emissions due to the Proposed Action). Under the Preferred Alternative, demolition and repair activities for the three wharves would require construction over two phases, so that construction would extend through 4 years. The deteriorated steel sheet pile including concrete cap, curbs, wall, tie rods, and cathodic protection system would be replaced. The implementation would be phased as two separate projects: FY 2021 RM14-1420 Repair Lima Wharf and FY 2022 RM14-1423 Repair Mike and November Wharves. The construction duration of each of the projects is estimated at 24 months.

For the purposes of this air quality analysis, air emissions were calculated based on equipment associated with demolition, excavation/filling, paving, hauling, piling installation, building construction, infrastructure repair and replacement, maintenance dredging, and removal of materials from NBG for relocation to an off-site landfill. The construction activities were evaluated for each calendar year. For fugitive dust emissions, 10% moisture and 23% silt content were used in the calculations based on Andersen Air Force Base sampling (Andersen Air Force Base 2012).

Air quality impacts would occur from the use of heavy equipment during construction activities, other project-related vehicles, and hauling truck trips. These emissions would primarily be related to fossil fuel combustion from mobile sources such as trucks and construction equipment and fugitive dust from earth-moving equipment and trucks hauling materials on roads. The area of greatest activity is the wharves area. Implementation of the Preferred Alternative would result in temporary increases in criteria pollutant emissions associated with construction and demolition activities. Annual criteria pollutant emissions resulting from the Preferred Alternative are presented in Table 3.7-5.

Table 3.7-5 Air Emissions Estimate: Preferred Alternative Construction Emission Estimates

Year	*Tons per Year*					
	VOCs	*CO*	*NO_x*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
2020	0.66	12.02	14.49	0.08	5.08	1.49
2021	5.34	36.56	15.80	0.04	12.59	3.55
2022	329.18	44.99	14.31	0.03	33.80	11.77
2023	324.28	18.61	3.15	0.008	26.09	9.52
General Conformity Rule de minimis Threshold	NA	NA	NA	100	NA	NA
Exceed *de minimis*?	NA	NA	NA	No	NA	NA

Legend: CO = carbon monoxide; NA = not applicable; NOx = nitrogen oxide; PM2.5 = fine particulate matter less than or equal to 2.5 microns in diameter; PM10 = suspended particulate matter less than or equal to 10 microns in diameter; SO2 = sulfur dioxide; VOC = volatile organic compound

General Conformity

Under the Preferred Alternative, SO_2 emissions would not exceed the general conformity threshold. A Record of Non-Applicability can be found in Appendix D.

Greenhouse Gases

The estimated carbon dioxide emissions attributed to construction operations under the Preferred Alternative is 10,694 tons. Emissions of GHGs from the Preferred Alternative alone would not cause global warming. However, these emissions would increase the atmosphere's concentration of GHGs, and in combination with past and future emissions from all other sources, contribute incrementally to the global warming that is producing the adverse effects of climate change.

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 3.8-1 and 3.8-2, respectively. Table 3.8-2 provides a comprehensive list of all mitigation requirements associated with the Proposed Action.

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
Section 3.1 Marine Biological Resources	Coral would continue to grow on the wharf face, incrementally creating additional habitat for marine fauna. There is long-term potential for wharf disrepair and collapse, that could impact marine resources short term (months-years). This collapse “may affect, would not be likely to adversely affect” ESA species.	ESA, EFH consultation with NOAA required. MMPA not required – no presence of marine mammals. But (possible) see acoustic assessment substantiating minimum potential affect. NMFS concurred with the ESA “may affect, not likely to adversely affect” conclusion (see Appendix A): • Green turtle. Not Likely to Adversely Affect. Unlikely but possible within the primary/secondary impact areas, or the PTS/TTS zones. Turtle-specific monitoring and BMPs may be required. • Hawksbill turtle. No effect. Highly unlikely to be present within the primary/secondary impact areas or the PTS/TTS zones. • Scalloped hammerhead shark. No effect. Exceptionally unlikely to be present within the primary/secondary impact areas, nor the PTS/TTS zones. • Listed corals. No effect. None present. None nearby. NMFS concurred with the EFH “would not adversely affect the quality and/or quantity EFH for management unit species” conclusion (see Appendix A): • Bottomfish Management Unit Species. Two species, unlikely but possible in the impacted areas. Short-term effect to quality of Inner Harbor as habitat. • Pelagic Management Unit Species. Tropical species complex and Shark species complex. No effect. Both species complexes have only weak and peripheral dependencies on inshore waters. Silt curtains and storm drain catch basins implemented for the CWA 401 Water Quality Certification provide value-added benefits for marine resources. Primarily: barrier excludes animals from physical strike and disturbance. Secondary: maximum practical minimization of stress/impact to adjacent habitat. Less than significant impacts after minimization and BMPs. • Existing bio community on wharves is evidence of successful temporary benefit of infrastructure. Recolonization evidence indicates this temporary bio benefit would re-occur in months/years (short term). • Existing bio community on harbor floor in front of wharves is evidence of low-value temporary bio benefit, which is removed at regular intervals

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
		during maintenance dredging. The "best parts" of the harbor floor community were relocated in December 2017 (HDR and CSA 2018). Construction of the new wharf face permanently removes the temporary bio benefits, which had previously been removed at regular intervals. Biosecurity: adhere to base practices. High-risk invasive species in footprint would be removed. Beneficial consequence likely short term (months-years) because non-natives would remain in adjacent areas. Impact analysis will include determination of how to compensate with other projects. It is assumed that avoidance, minimization will be required, which will require OPNAV coordination. Apra Harbor environment unique to other locations. (Anticipated) Less than significant impacts after minimization and BMPs. Avoidance and minimization already have been maximized. Primarily: • Driving the new sheet piles as early as possible in the construction sequence creates a barrier between the harbor and nearly all construction stressors (functions as a coffer dam). Some debris removal and dredging unavoidably occurs outside the new sheet piles, or prior to their installation. Silt curtains, storm drain catch basins, and BMPs are the maximum practical minimization measure for related construction stressors. This also prevents physical strike and disturbance, and it minimizes sedimentation/turbidity.

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
Section 3.2 Water Quality	Failing wharves may impact the water quality due to deterioration of wharves material. Potential leaching of metals. Exposure of contaminated sediment to harbor waters.	Less than Significant Impacts. The Proposed Action would not impact surface water or groundwater resources. The project area does not overlay drinking water sources, so the Proposed Action would not have any effect on the Guam aquifer. The Proposed Action would not significantly impact marine water quality during the construction period. There would be temporary, insignificant adverse water quality impacts during construction (i.e., sediment loading and potential releases of pollutants entrained in dredged materials into the water column) in the areas surrounding the active in-water construction sites. Construction equipment, vessels, and vehicles, fueling of project-related vehicles and equipment, and construction-related debris have the potential to release petroleum products, hydraulic fluids, or other pollutants into marine waters. Silt curtain and storm drain catch basins would be used to prevent unpermitted release of contaminated material into the environment/water. Potential adverse marine water quality impacts would be minimized through implementation of BMPs (see Table 2-1). The Proposed Action would involve in-water construction activities for which a CWA Section 404/Rivers and Harbors Act Section 10 permit from the USACE would be obtained, along with the related Section 401 Water Quality Certification. The Proposed Action would comply with NBG MSGP permit. The Proposed Action would comply with NBG NPDES permit concurrent with USACE permit. Any pumping of water would comply with CWA Section 401 Water Quality Certification and the Spill Prevention, Control, and Countermeasure Plan.

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
Section 3.3 Cultural Resources	Wharves would continue to deteriorate over time, including eligible portions thus causing the potential for the wharves to fail and collapse into Inner Apra Harbor.	Less than Significant Impacts. The Proposed Action would result in no adverse effect on these NRHP-eligible wharves because the repairs and modernization would be conducted in accordance with the Secretary of the Interior Standards. There are no archaeological sites within the APE. Additionally, the existing gantry tracks would be retained. The Navy received concurrence on this determination from the Guam SHPO on February 21, 2017. In planning for this and future repairs to the historic wharves, the Navy prepared a Level II Historic American Engineering Record documentation of Lima, Mike, and November wharves, which has been provided to the National Park Service and Guam SHPO for donation to the Library of Congress.
Section 3.4 Land Use	Wharves are expected to structurally fail without repair. No change to existing land use.	Less than Significant Impacts. Land use at NBG would not change. The Proposed Action would restore capability to this existing Former Ship Repair Facilities area on NBG. Construction and operational activities would not affect recreational or commercial navigation outside Inner Apra Harbor. The Proposed Action would be located entirely on federal property that, by definition, is excluded from Guam's coastal zone. The Navy consulted with the Guam Bureau of Statistics and Plans on all project components and applied for a consistency determination. The Navy received Guam Bureau of Statistics and Plans concurrence on this determination via correspondence dated June 19, 2020 (see Appendix C).

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
Section 3.5 Infrastructure	Wharves are expected to structurally fail without repair.	Less than Significant Impacts. The Proposed Action would replace existing inadequate infrastructure with new infrastructure adequate for current mission. Infrastructure to be replaced includes electrical, potable water, wastewater, storm water, and Bilge and Oily Wastewater Treatment System. The existing fire hydrant coverage and flow pressure at the wharves would be adequate to protect the proposed improvements. The Proposed Action would not significantly impact infrastructure or utility generation or transmission systems. No upgrades to Guam Power Authority's system would be required to supply adequate power, water, wastewater, or solid waste services associated with the Proposed Action.
Section 3.6 Hazardous Materials and Wastes	Area is an industrial area; HAZMAT and HAZWASTE activities are similar to those typically associated with industrial/ship repair function. Negative Impact. HAZMAT and HAZWASTE would not be removed and properly recycled or disposed of in accordance with applicable federal requirements.	Less than Significant Impacts. Prior to construction, all HAZMAT and HAZWASTE would be removed and properly recycled or disposed of in accordance with applicable federal requirements. There is potential for degraded munitions and MEC to be encountered in the water. Dredge spoils will be screened for MEC as part of the repair project. In addition to the petroleum-contaminated soil beneath Lima Wharf, should renovation/demolition activities disturb or impact any identified HAZMAT (e.g., ACM, PCBs, LBP, or mercury), they would be handled, transported, and disposed of in compliance with applicable federal requirements. Any HAZWASTE or containerized hazardous substances and other regulated materials would be removed and properly disposed of in accordance with applicable federal requirements prior to proposed construction. Silt curtain and storm drain catch basins would be used to prevent unpermitted release of contaminated material into the environment/water. The Proposed Action is adjacent to the Oscar, Papa, Quebec, and Romeo wharves restoration site, so there is a potential to encounter contaminated sediments. In the event that suspect contaminated sediments are encountered, it would be analyzed and the Navy would consult with regulatory agencies to develop an appropriate course of action regarding further evaluation and potential remediation.

Table 3.8-1 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)*
Section 3.7 Air Quality	Area is located within SO_2 nonattainment area (see Figure 3.7-1) – current industrial uses and associated emissions.	SO_2 emissions do not exceed General Conformity *de minimis* thresholds. The Proposed Action is located within a nonattainment area for SO_2. The Navy prepared a Record of Non-Applicability. Total construction SO_2 emissions would be below *de minimis* thresholds for CAA general conformity. Therefore, the Proposed Action would not trigger a general conformity determination under Section 176(c) of the CAA. The Proposed Action would involve use of construction equipment and would increase construction-related traffic on and off base during the construction period. The Proposed Action would result in temporary short-term construction-related impacts on air quality primarily due to the operation of gasoline or diesel-powered equipment and activities at the wharves. Fugitive dust emissions would be controlled by: • Using water for dust control during demolition and construction, including grading. • Covering moving open-bodied trucks transporting materials that could release fugitive dust. • Monitoring and prompt removal of soil or other materials from paved streets and roadways left by trucking, earth-moving equipment, erosion or other means. The action would result in a temporary increase in GHGs. Operations would not introduce new air pollution sources. Therefore, no long-term changes to air emissions are anticipated. After the repairs, operations would be similar to current operations.

Legend: ACM = Asbestos-Containing Material; APE = Area of Potential Effects; BMP = Best Management Practice; CAA = Clean Air Act; CWA = Clean Water Act; EFH = Essential Fish Habitat; ESA = Endangered Species Act; GHG = Greenhouse Gas; HAZMAT = Hazardous Materials; HAZWASTE = Hazardous Waste; LBP = Lead-Based Paint; MEC = Munitions and Explosives of Concern; MMPA = Marine Mammal Protection Act; MSGP = Multi-Sector General Permit; NBG = Naval Base Guam; NOAA = National Oceanic and Atmospheric Administration; NPDES = National Pollutant Discharge Elimination System; NRHP = National Register of Historic Places; OPNAV = Chief of Naval Operations; PCB = Polychlorinated Biphenyls; PTS = Permanent Threshold Shift; SHPO = State Historic Preservation Officer; SO_2 = Sulfur Dioxide; TTS = Temporary Threshold Shift; USACE = United States Army Corps of Engineers

Table 3.8-2 Impact Avoidance And Minimization Measures

Measure	*Anticipated Benefit / Evaluating Effectiveness*	*Implementing and Monitoring*	*Responsibility*	*Estimated Completion Date*
Repair and Modernize Lima, Mike, and November Wharves (Preferred Alternative)				
Conformance with SWPPP	Benefits to water quality, marine life and habitat, and potential HAZMAT and HAZWASTE exposure pathways.	Implemented prior to initiation of construction activities and individual measures checked routinely as per the SWPPP.		Upon termination of construction activities.
Silt curtains	Silt curtains and storm drain catch basins implemented for Section 401 water quality provide value-added benefits for marine biology. • Primarily: barrier excludes animals from physical strike and disturbance and reduces sedimentation and turbidity levels in marine environment. • Secondary: maximum practical minimization of stress/impact to adjacent habitat. Benefits to water quality, habitat, turtles, fish, corals, inverts, flora, and all marine species. Minor benefits to underwater noise.	Deployed just prior to dredging/construction. Maintained during construction for wear-and-tear, and positioning. Monitored for damage/failures by looking for turbidity plumes. Monitored for minimization effectiveness by sampling turbidity 'upstream' and 'downstream' of the curtain.		Curtain and curtain anchors removed immediately after in-water construction.
(incidental) Coffer dam/barrier	Benefit of driving the new sheet piles as early as possible in the construction sequence creates a barrier between the harbor and nearly all construction stressors.	Incidental to the construction sequence.		Early in the in-water construction sequence.
Implement coral translocation plan	Completed in advance of construction to minimize loss of coral colonies and the function and services of EFH habitat. Preservation of coral colonies that are not common of Guam per biological	Coral translocation process includes: • Identify # and types of corals suitable for translocation. Identify suitable recipient site(s). • Record baseline demographics of coral colonies being translocated		Completed prior to construction.

Table 3.8-2 Impact Avoidance And Minimization Measures

Measure	*Anticipated Benefit / Evaluating Effectiveness*	*Implementing and Monitoring*	*Responsibility*	*Estimated Completion Date*
	survey results in the Proposed Project Location and consultation with NMFS. Translocation priority will be first for uncommon corals. Enhancement of EFH habitat at the translocation site. Evaluate effectiveness utilizing as guidance, HDR and CSA 2018. Coral Translocation from Northern Inner Apra Harbor, Guam, Final Report. Prepared for Commander, U.S. Pacific Fleet, submitted to NAVFAC Pacific by HDR Environmental, Operations and Construction, Inc.	based on the coral translocation monitoring plan. • A separate ESS Determination Request would be prepared and executed. The ESS Determination Request is for human safety and also serves to protect the corals from an unintentional detonation. • Prepare recipient sites, including staging area within the recipient site. • Manually remove corals from impact area and secure them in the recipient site(s). • Implement and document appurtenant measures to avoid impacts due to the coral translocation process, including physical damage to coral colonies not being translocated, avoid use of toxicopathological agents (i.e., sunscreen that is not reef safe).		
Implement coral translocation monitoring plan	Compare coral transplant demographics of baseline and monitoring data.	Monitoring process concept includes: • Baseline monitoring of translocated corals. • Monitoring of coral condition (i.e.: at TBD months) Co-occurring periodic maintenance of recipient site infrastructure and 'weeding', especially of macroalgae.'		NMFS recommended post-translocation monitoring. The first post-translocation coral monitoring shall occur no sooner than October 2020. The second and third monitoring events shall occur 12 months and 24 months after the first event.

Table 3.8-2 Impact Avoidance And Minimization Measures

Measure	*Anticipated Benefit / Evaluating Effectiveness*	*Implementing and Monitoring*	*Responsibility*	*Estimated Completion Date*
		• Periodic post-translocation monitoring of translocated coral condition (e.g., at 1, 3, 6, 12, 24, and 60 months)		
Conformance with the Programmatic Agreement among the Commander, Joint Region Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office	Inadvertent discoveries of historic properties would be documented per the NHPA and associated regulations 36 CFR 800.	In the event there are inadvertent discoveries of historic properties during any ground-disturbing activity, the SOPs listed in the Programmatic Agreement among the Commander, Joint Region Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) would be implemented.		During construction ground disturbance.
Conformance with Guam Ambient Air Quality Standards, under Title 22 of the Guam Administrative Rules and Regulations, Chapter 1, Section 1302. Fugitive emissions.	Benefits to air quality. Minimization of fugitive emissions.	Use of water or suitable chemicals for control of fugitive dust in the demolition of the wharf structures, construction operations, or excavation processes. Application of water or suitable chemicals on material stockpiles and other surfaces which may allow release of fugitive dust. Installation of appurtenances that provide an enclosure and ventilation for all crushing, aggregate screening, and conveying of material likely to become airborne. Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials.		Post-construction and any earth disturbing activities.

Table 3.8-2 Impact Avoidance And Minimization Measures

Measure	*Anticipated Benefit / Evaluating Effectiveness*	*Implementing and Monitoring*	*Responsibility*	*Estimated Completion Date*
		Reasonable containment methods shall be employed during sandblasting, spray painting, or other similar operations. Covering all moving, open-bodied trucks transporting materials which may release fugitive dust. Identify planned air pollution-generating processes and management control measures (including, but not limited to, spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions). Log hours of operations and track quantities of materials used.		

Legend: % = percent; > = greater than; CFR = Code of Federal Regulations; EFH = Essential Fish Habitat; ESS = Explosives Safety Submission; HAZMAT = Hazardous Materials; HAZWASTE = Hazardous Waste; NAVFAC = Naval Facilities Engineering Command; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; SOP = Standard Operating Procedure; SWPPP = Storm Water Pollution Prevention Plan

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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 NEPA, CEQ regulations, and CEQ guidance. Cumulative impacts are defined in 40 CFR section 1508.7 as "the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

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 timeframe 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 timeframe 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 timeframe 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 EAs, management plans, land use plans, and other planning related studies.

4.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects at and near the Proposed Action Location. 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

Project Name (Lead Agency or Proponent)	*Level of NEPA Analysis Completed*	*Purpose, Scope, and Location*	*Resource Areas with Potential for Cumulative Impacts*
Past Actions			
Ocean Dredged Material Disposal Site Offshore of Guam (USEPA)	FEIS/ROD (2010)	Permanent ocean site for disposing of dredged material originating from Guam, including naval facilities at Apra Harbor. Disposal is limited to 1 million yd^3 (764,555 m^3) per calendar year (Philippine Sea).	Marine biology (including underwater acoustics), water quality, and cultural resources.
Mariana Islands Range Complex (Navy)	FEIS (2010)	Training activities to develop warfighting skills and maintain the constant state of readiness of military forces. The study area includes Guam.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
X-Ray Wharf Improvements (Navy)	FEA/FONSI (2014)	Construction of improvements to the existing main supply wharf within NBG to accommodate two berths for the Navy’s new class of supply ships.	Marine biology (including underwater acoustics) and water quality.

Table 4-1 Cumulative Action Evaluation

Project Name (Lead Agency or Proponent)	*Level of NEPA Analysis Completed*	*Purpose, Scope, and Location*	*Resource Areas with Potential for Cumulative Impacts*
Present and Reasonably Foreseeable Future Actions			
FY15 Apra Harbor Maintenance Dredge (Navy)	RCE	Maintenance dredging in northern Inner Apra Harbor to remove unconsolidated sediment, which has accumulated at the face of selected wharves and a portion of the submarine turning basin. The maintenance dredge will restore the Inner Apra Harbor entrance to operational depth.	Marine biology (including underwater acoustics) and water quality.
Installation Restoration Projects with land use controls or long-term monitoring • SITE 00041 (Apra Harbor) • SWM 001N21 • SWM 40LOT1 • SITE 00025 • SITE 00024 • SITE 00016 • SWMU 00012 • SITE 00019	NA		Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Mariana Islands Test and Training, 2015 (Navy)	FEIS/OEIS/ROD (2015)	Ongoing military readiness training and research, development, testing, and evaluation within the study area, which includes Guam.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Guam and Commonwealth of the Northern Mariana Islands Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Air and Missile Defense Task Force	FEIS/ROD (2010)	Establish operational USMC presence in Guam consisting of approximately 8,600 USMC personnel and 9,000 dependents. Upgrade existing Inner Apra Harbor general purpose wharves and utilities; create embarkation area and amphibious vehicle/small boat laydown area (Inner Apra Harbor).	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.

Table 4-1 Cumulative Action Evaluation

Project Name (Lead Agency or Proponent)	*Level of NEPA Analysis Completed*	*Purpose, Scope, and Location*	*Resource Areas with Potential for Cumulative Impacts*
Guam Military Relocation (2012 Roadmap Adjustments) (Navy)	Final Supplemental EIS/ROD (2015)	Establishment of a main base, family housing area, a live-fire training range complex, and associated infrastructure on Guam in support of the relocation of USMC forces to Guam. Reduction of the originally planned relocation of approximately 8,600 Marines with 9,000 dependents to a force of approximately 5,000 Marines with approximately 1,300 dependents.	Cultural resources, land use (including coastal zone management federal consistency), infrastructure, and air quality.
Oscar, Papa, Quebec, and Romeo Maintenance Dredging	TBD – in progress	Maintenance dredging Oscar, Papa, Quebec, and Romeo wharves in Inner Apra Harbor, NBG. Dredging would be performed to restore the depth of the Oscar, Papa, Quebec, and Romeo wharves to 35 feet below Mean Lower Low Water level as currently constructed.	Marine biology (including underwater acoustics), water quality, and HAZMAT and HAZWASTE.
Finger Pier Dredging	EA	Maintenance dredging of finger piers located to the northwest of Lima Wharf on NBG, Apra Harbor. Maintenance dredging would be performed to restore the depth of the piers to construction design.	Marine biology (including underwater acoustics) and water quality.
Repair/Replace Sewer Lift Station (SLS) 20 SRF	RCE	Repair and replace SLS 20 SRF.	Marine biology and water quality.
Replace Existing P-130 Circuit at SRF	RCE	Replace existing P-130 circuit.	Marine biology, water quality, and infrastructure.
Repair Finger Pier	TBD – in progress	Comprehensive rehabilitation, repair, and modernization of the Finger Pier to support small boats including pilot launches, survey boats, work boats, special service craft, rescue boats, and other small craft. Finger Pier will be structurally repaired to handle weight handling vehicles; required utilities include water, electricity, and boat-fueling.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
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 taking Special Warfare and Coastal Riverine Group (approximately 90-foot craft) out of the water for operations, maintenance, and typhoons to protect boats from heavy weather. A new boat ramp and lift shall be constructed inland from the QUEBEC sheet pile bulkhead.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.

Table 4-1 Cumulative Action Evaluation

Project Name (Lead Agency or Proponent)	*Level of NEPA Analysis Completed*	*Purpose, Scope, and Location*	*Resource Areas with Potential for Cumulative Impacts*
Repair OSCAR, PAPA, and QUEBEC Wharves	TBD – in progress	Restore wharves damaged by inadequate sustainment and return them to fully functional condition as a ship repair and berthing wharves in accordance with DoD and Navy requirements.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Underwater Electromagnetic Measurement System	TBD – in progress	Install sensors on the seafloor of Outer Apra Harbor, NBG, approximately 3,000 feet northwest of Polaris Point. Subsea data transmission cables would be routed from the sensors to Building 4460 located onshore at Polaris Point. Two alternative means of affixing the transmission cables to the sea floor are being considered.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
P-661 Navy-Commercial Fuel Tie-In Hardening	TBD – in progress	Construct a hardened overhead roof structure over and around a new, hardened POL Tie-In Facility along the existing utility access road just south of the Route 18/Route 1 intersection. The new hardened tie-in facility would replace the existing tie-in area consisting of two unhardened open top vaults and tie-in piping. The existing tie-in piping, valve vaults, and visual/security walls will be demolished.	Marine biology, water quality, infrastructure, and land use.
P676, Polaris Point Pier (Navy)	TBD – in progress	Construction of waterfront ship repair and berthing facilities to support arrival of the U.S. Navy Virginia Class Block V submarines to Guam. Project will also provide full cold iron support or complete hotel services including berthing space, mooring, power, and utilities.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Feasibility Study Apra Harbor Sediment Site 41 (Navy)	TBD – in progress	Utilized data from the 2014 Remedial Investigation and 2017 Feasibility Study, and applied site-specific operations information (e.g., maintenance dredging, storm water control measures).	Marine biology (including underwater acoustics) and water quality.
Sasa Bay 7 abandoned derelict vessels	TBD – in progress	GEPA initiative to remove abandoned derelict vessels from Sansa Bay for beneficial environmental impact. [Not enough known for cumulative impact analyses.]	Marine biology (including underwater acoustics), water quality, HAZMAT and HAZWASTE.

Table 4-1 Cumulative Action Evaluation

Project Name (Lead Agency or Proponent)	*Level of NEPA Analysis Completed*	*Purpose, Scope, and Location*	*Resource Areas with Potential for Cumulative Impacts*
Cruise Ship Dredging/Port of Guam Improvements (Hotel Pier), 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 biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Glass Breakwater Repairs, FY2023	RCE	Repair damaged sections of Glass Breakwater at Outer Apra Harbor, NBG. This includes restoring over 1,500 linear feet of slope armor. Work includes 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 repaired slope.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Clipper Cove, FY2023	TBD; not started	Repair/modernize existing boat ramps and sheet pile repair located at Clipper cove in Sumay on NBG.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.
Floating Water Park (Port Authority Guam)	TBD; not started	Develop a water park located off of Route 18 (adjacent to the Port's Family Beach). The water park will include a waiting area on concrete slab sheltered by canopies with a walkway leading to the floaters. The floaters will be anchored approximately 8-10 feet in the water.	Marine biology (including underwater acoustics), water quality, cultural resources, land use (including coastal zone management federal consistency), infrastructure, HAZMAT and HAZWASTE, and air quality.

Legend: DoD = Department of Defense; FEA = Final Environmental Assessment; FEIS = Final Environmental Impact Statement; FONSI = Finding of No Significant Impact; FY = Fiscal Year; GEPA = Guam Environmental Protection Agency; HAZMAT = Hazardous Materials; HAZWASTE = Hazardous Waste; m^3 = cubic meter; NA = Not Applicable; NBG = Naval Base Guam; OEIS = Overseas Environmental Impact Statement; POL = petroleum, oils, and lubricants; RCE = Record of Categorical Exclusion; ROD = Record of Decision; SRF = Ship Repair Facility; SWMU = Solid Waste Management Unit; TBD = To Be Determined; USEPA = United States Environmental Protection Agency; USMC = United States Marine Corps; yd^3 = cubic yard

4.4 Cumulative Impact Analysis

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.

4.4.1 Marine Biological Resources

4.4.1.1 Description of Geographic Study Area

The ROI includes Lima, Mike, and November wharves and waters of Inner Apra Harbor adjacent to those wharves. The Proposed Action will result in the loss of the bottom habitat in front of the existing wharf. Inner Apra Harbor has been significantly altered over time and is now largely made of an artificially built environment that is intensively managed for maritime military and industrial activities, and repeatedly exposed to maintenance dredging and wharf repair and modernization including construction projects listed in Table 4-1.

Inner Apra Harbor is an estuarine environment with soft sediment substrate dominating the area. The substate gradually transitions to a composite of soft sediment, sand, and hard substrate at the boundary with Outer Apra Harbor. Outer Apra Harbor supports an interconnected array of EFH habitats, including multiple patch reefs, shoals and fringing reefs, and the mangrove habitat in Sasa Bay.

4.4.1.2 Relevant Past, Present, and Future Actions

Recently completed projects in Inner Apra Harbor would not contribute to cumulative impacts on marine resources because these projects occurred in the context of the Inner Apra Harbor's artificially built environment, intensively managed for maritime military and industrial activities, and repeatedly exposed to maintenance dredging and wharf repair and modernization.

Each of the construction projects listed in Table 4-1 with potential present and reasonably foreseeable future cumulative impacts to marine biology may result in adverse impacts to marine resources (i.e.: loss of EFH habitat) as well as potential for positive effects in Apra Harbor (i.e.: restoration of the Inner Apra Harbor environment). Additionally, marine resources are tightly linked to water quality and actions with beneficial or adverse impacts to water quality may carry through to marine resources.

Approximately six future projects occurring in Inner Apra Harbor could have impacts that are substantially similar to the Proposed Action (Table 4-1). In all cases, these future projects are planned to occur within the footprint of the Harbor's artificially built environment with essentially zero net-increase or decrease in the artificial hard substrate or soft bottom substrates that provide marine habitat. Future projects occurring in Outer Apra Harbor may negatively impact and permanently degrade the benthic habitat inside of and in the area surrounding the Proposed Project Location given that Outer Apra Harbor supports more complex EFH habitat, including mangrove habitat and coral reefs.

4.4.1.3 Cumulative Impact Analysis

Cumulative biological resource impacts from past, present, and future actions within the Proposed Action Location would be less than significant because they occur within the footprints of Apra Harbor's existing artificially built environment with little net-increase or decrease in the artificial hard substrate or soft bottom substrates that provide marine habitat. Two potential cumulative biological resource impacts may occur with implementation of the Proposed Action:

- One cumulative impact could eliminate an already-rare biological resource that tends to occur on hard substrate harbor infrastructure. Several species known from harbor infrastructure have not yet been found on adjacent natural habitats. None of the BMPs (see Section 2.5) would affect this potential outcome, and the only Impact Avoidance and Minimization Measure (see Table 3.8-2) that could affect this potential outcome is a highly selective implementation of "Coral impact minimization by translocation from wharves."
- Another cumulative impact could adversely affect adjacent marine resources by indirect stressors (e.g., turbidity, water quality, disrupted reproduction) if some of the present and future actions occur at the same time. The likelihood of this impact is substantially reduced by implementation of the BMPs (see Section 2.5) and Impact Avoidance and Minimization Measures (see Table 3.8-2). These would reduce the intensity of potential impacts beyond the immediate Proposed Action Location, reduce the magnitude of indirect stressors, reduce the spatial extent of indirect stressors, and in some cases would reduce the temporal duration of indirect stressors.

The immediate consequences of the Proposed Action and similar present and future actions would cause direct impacts to all marine resources associated with the affected wharf infrastructure. These consequences would be lethal loss for all but the most mobile species, but the artificial hard substrate or soft bottom substrates that provide marine habitat would not be permanently removed. Consequences would not be cumulative because the actions would essentially replace wharf infrastructure in similar quantity and layout, and marine organisms would re-colonize the new harbor infrastructure. This disturb-and-re-colonize process has occurred relatively rapidly after all prior episodes of maintenance dredging and wharf repair and modernization. Most organisms in the dominant fouling community are particularly well-adapted to rapidly colonize new areas (Coles et al. 1999; Paulay 2003; Paulay et al. 1997; Navy 2019c). Consequently, the loss of marine resources would be short term with a duration of months to several years. 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.

4.4.2 Water Resources

4.4.2.1 Description of Geographic Study Area

The ROI includes Lima, Mike, and November wharves and waters of Inner Apra Harbor adjacent to those wharves. Cumulative projects would involve construction activities with potential to temporarily increase turbidity, storm water runoff, erosion, and sedimentation.

4.4.2.2 Relevant Past, Present, and Future Actions

Present and reasonably foreseeable future actions with potential impacts to water quality are detailed in Table 4-1. Past actions include: Ocean Dredged Material Disposal Site Offshore of Guam; Marianas Islands Range Complex; and X-Ray Wharf Improvements. Present and reasonably foreseeable future actions include: FY15 Apra Harbor Maintenance Dredging; Guam and Commonwealth of the Northern Mariana Islands Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Air and Missile Defense Task Force; Oscar, Papa, Quebec, and Romeo Maintenance Dredging; Finger Pier Dredging; Repair/Replace Sewer Lift Station 20 at SRF; Replace Existing P-130 Circuit at SRF; Repair Finger Pier; Repair QUEBEC Quay Wall and Construct Boat Lift; Repair OSCAR, PAPA, and QUEBEC Wharves; P-661 Navy-Commercial Fuel Tie-In Hardening; P676, Polaris Point Pier; Feasibility Study Apra Harbor Sediment Site 41; Cruise Ship Dredging/Port of Guam Improvements (Hotel Pier), 2020; Glass Breakwater Repairs, FY2023; Clipper Cove, FY2023 and Floating Water Park.

Impacts to water resources associated with relevant Navy past, present, and future cumulative projects have been minimized through compliance with NBG MSGP and NGB SWPPP. All in-water construction projects that disturb more than 1 acre of land require USACE permits that address adverse water quality impacts.

Some of the present and reasonably foreseeable future actions listed in Table 4-1 have the potential for positive cumulative impacts, such as the dredging projects, IRP, and wharf and quay wall repair projects. Others, such as the military buildup and training projects may result in adverse impacts to the human and natural environment. Impacts to the natural environment are tightly linked to water quality, marine resources (including marine biology), and fisheries, and may carry back through to the human environment.

Approximately two future projects occurring in Inner Apra Harbor (quay wall and/or wharf repairs at Quebec, Papa, and Oscar) could have impacts that are similar to the Proposed Action (Table 4-1). In all cases, these occur within areas in need of modernization and/or that would likely benefit from water quality control and treatments systems that are design aspects of the project as well as required water BMPs and quality monitoring efforts as designated by the required permits and compliance with NBG MSGP and SWPPP.

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 of compliance with NBG MSGP and NGB SWPPP for Navy projects and USACE permits required for private projects greater than 1 acre in size. The Proposed Action would include SWQUs, which would remove pollutants (such as finer sediment, oils, and grease) from storm water runoff prior to discharge into the harbor. 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.

4.4.3 Cultural Resources

4.4.3.1 Description of Geographic Study Area

The ROI for Cultural Resources includes an area defined as Lima, Mike, and November wharves and their associated wharf pavement areas, mechanical utilities, electrical power substation, lighting, telecommunications, storm water systems, and fire protection systems.

There are no archaeological sites within the ROI; however, in the event there are inadvertent discoveries of cultural resources during any ground-disturbing activity, the SOPs listed in the Programmatic Agreement among the Commander, Navy Region Marianas; Advisory Council on Historic Preservation;

and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) will be implemented.

Mason and Weitze (2010) evaluated the Lima, Mike, and November wharves for NRHP eligibility under Criterion A (associated with the activities of the Former SRF at the Naval Operating Base) and Criterion C (as an example of harbor and wharf design and engineering at Inner Apra Harbor). These wharves were recommended eligible for the NRHP and the Guam SHPO concurred. These three facilities are the only architectural resources located within the ROI (NAVFAC Marianas 2015). In planning for this and future repairs to the historic wharves, the Navy prepared a Level II Historic American Engineering Report and survey of Lima, Mike, and November wharves, which has been provided to the National Park Service and Guam SHPO for donation to the Library of Congress.

4.4.3.2 Relevant Past, Present, and Future Actions

Each of the construction projects listed in Table 4-1 with potential present and reasonably foreseeable future cumulative impacts to cultural resources may result in adverse impacts to cultural resources. However, the Programmatic Agreement for Navy projects on the island of Guam would be implemented; therefore, there would be no significant impacts to cultural resources within the ROI.

4.4.3.3 Cumulative Impact Analysis

Cumulative impacts to cultural resources from past, present, and future actions within the ROI would be less than significant because the Programmatic Agreement among the Commander, Navy Region Marianas; Advisory Council on Historic Preservation; and the Guam Historic Preservation Office regarding Navy Undertakings on the Island of Guam (Navy et al. 2008) would be implemented.

The Programmatic Agreement addresses potential impacts to cultural resources and applies to all ground-disturbing activities, including the Proposed Action. Similarly, as the Programmatic Agreement has likewise guided past, present, and future projects, those projects are also unlikely to significantly impact cultural resources. Therefore, when added to the impacts from potential cumulative actions, implementation of the Proposed Action would not result in significant cumulative impacts to cultural resources. 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 Land Use

4.4.4.1 Description of Geographic Study Area

The ROI includes Lima, Mike, and November wharves located within the Former SRF. The Former SRF has been defined as industrial and operations support. Past, present, and future actions within the Former SRF are consistent with the current land use designations.

4.4.4.2 Relevant Past, Present, and Future Actions

Past, present, or reasonably foreseeable actions are consistent with industrial and operations support land use designations within the Former SRF.

4.4.4.3 Cumulative Impact Analysis

Cumulative land use impacts from past, present, and future actions within the ROI would be less than significant because of conformance with the current land use designation within the Former SRF. The Proposed Action and other projects in the ROI would be consistent with military land use at NBG.

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.

4.4.5 Infrastructure

4.4.5.1 Description of Geographic Study Area

The ROI includes Lima, Mike, and November wharves and the infrastructure that supports those wharves.

4.4.5.2 Relevant Past, Present, and Future Actions

Cumulative projects and the Proposed Action include the modernization of infrastructure within the Former SRF.

4.4.5.3 Cumulative Impact Analysis

Cumulative infrastructure impacts from past, present, and future actions within the ROI would create beneficial impact to infrastructure within the ROI through modernization. No increase in personnel at NBG or population change in the regional area is anticipated as a result of the Proposed Action. Increased infrastructure demands associated with other cumulative projects would largely be addressed by available infrastructure capacity as well as individual utilities improvements incorporated within those projects. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant negative impacts within the ROI.

4.4.6 Hazardous Materials and Wastes

4.4.6.1 Description of Geographic Study Area

The ROI includes Lima, Mike, and November wharves located within the Former SRF. The ROI also includes areas to be dredged adjacent to the wharves as part of the Proposed Action. Additionally, the Proposed Action area includes the wharf-adjacent contractor staging areas, Bilge and Oily Wastewater Treatment System, Building 27 Boiler Facility, and the dredged material disposal area approximately 1 mile south of the wharves, east of the DRMO Salvage Yard and west of Sumay Drive.

4.4.6.2 Relevant Past, Present, and Future Actions

The past actions in Apra Harbor listed in Table 4-1 would not significantly combine with the Proposed Action to contribute to negative cumulative HAZMAT and HAZWASTE impacts. This is because these projects also required HAZMAT and HAZWASTE minimization measures and environmental review as part of project approval and involved the modernization of older and frequently contaminated infrastructure and/or the use of more modern, efficient, and less-polluting craft and vessels. The designation of an offshore disposal site for dredged material has had a positive cumulative effect on HAZMAT and HAZWASTE conditions in Apra Harbor from the removal (and future removal) and disposal of contaminated underwater sediments.

Some of the present and reasonably foreseeable future actions listed in Table 4-1 have the potential for positive cumulative impacts, such as the dredging projects, IRP, and wharf and quay wall repair projects. Others, such as the military buildup and training projects may result in adverse impacts to the human and natural environment. Impacts to the natural environment are tightly linked to water quality, marine resources (including marine biology), and fisheries, and may carry back through to the human environment.

Approximately two future projects occurring in Inner Apra Harbor (quay wall and/or wharf repairs at Quebec, Papa, and Oscar) could have impacts that are similar to the Proposed Action (Table 4-1). In all cases, these occur within areas in need of modernization and/or that would likely benefit from some form of project-related HAZMAT and HAZWASTE material removal and disposal. Future projects occurring on older infrastructure are likely to realize similar benefits.

4.4.6.3 Cumulative Impact Analysis

Cumulative impacts associated with HAZMAT and HAZWASTE from past, present, and future actions within the ROI would be less than significant because very few of the projects occurred, are occurring, or would occur in Inner Apra Harbor. Certain past, present, and foreseeable projects within Inner Apra Harbor (such as dredging and wharf repairs) are having beneficial impacts to existing conditions as they are improving contaminant and HAZMAT and HAZWASTE conditions, not just in the project area, but also in Inner Apra Harbor. For all in-water projects within Inner Apra Harbor, HAZMAT and HAZWASTE hazards are meticulously surveyed, documented, and characterized in advance. Handling plans, procedures, and training are developed and completed prior to any construction activities. Consequently, potentially significant HAZMAT and HAZWASTE hazards are avoided through the implementation of this approach. It should be noted that the application of this approach, project-by-project, has had the beneficial effect of helping to identify and remove legacy World War II-era MEC and/or MPPEH left behind in Apra Harbor. The result is the removal of not only explosive hazards, but also HAZWASTE. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant negative impacts within the ROI.

4.4.7 Air Quality

4.4.7.1 Description of Geographic Study Area

The ROI for cumulative air quality impacts is the island of Guam.

4.4.7.2 Relevant Past, Present, and Future Actions

Each of the construction projects listed in Table 4-1 would result in temporary and localized emission increases. Past projects would not contribute to cumulative air impacts because these projects have been completed and air emissions would have dispersed.

Approximately 10 future projects that have yet to be evaluated would occur after the Preferred Alternative has been completed. None of the listed projects appear to include large stationary sources that could have a continuous and permanent effect on the air quality on the island.

4.4.7.3 Cumulative Impact Analysis

None of the identified projects from past, present, and future actions within the ROI would result in new sources of long-term emissions. The short-term emissions of these projects and the Preferred Alternative itself would be dispersed over time and geographic area. Therefore, cumulative impacts to air quality would not be significant. Because the emissions of these projects and the Preferred Alternative itself would be dispersed over time and area, they are not likely to contribute to cumulative significant impacts on air quality within the ROI.

5 Other Considerations Required by NEPA

5.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 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*
Clean Air Act	Complies
Clean Water Act	Complies
Coastal Zone Management Act	Complies (consultation complete)
Comprehensive Environmental Response and Liability Act	Complies
CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500–1508)	Complies (EA prepared)
Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews	Complies
Emergency Planning and Community Right-to-Know Act	Complies
Endangered Species Act	Complies (consultation complete)
EO 11988, Floodplain Management	Complies
EO 12088, Federal Compliance with Pollution Control Standards	Complies
EO 12114, Environmental Effects Abroad of Major Federal Actions (Navy implementing regulation 32 CFR part 287)	NA
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	NA
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	Complies
EO 13089, Coral Reef Protection	Complies (consultation complete)
EO 13112, Invasive Species	Complies
EO 13175, Consultation and Coordination with Indian Tribal Governments	NA
EO 13751, Safeguarding the Nation from the Impacts of Invasive Species	Complies
Federal Insecticide, Fungicide, and Rodenticide Act	Complies
Federal Water Pollution Control Act, 33 U.S.C. sections 1251–1387	Complies
Guam Air Pollution Control Standards and Regulations	Complies
Magnuson-Stevens Fishery Conservation and Management Act	Complies (consultation complete)
Marine Mammal Protection Act	Complies
Migratory Bird Treaty Act	Complies
Navigable Waters Protection Rule	Complies
NEPA; CEQ NEPA implementing regulations; Navy procedures for Implementing NEPA	Complies (EA prepared)

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 Historic Preservation Act	Complies (consultation complete)
National Invasive Species Act (16 U.S.C. Section 4701)	Complies
Navy regulations for explosive safety review and verification of munitions responses, which provide procedures and reporting requirements to enable oversight of NOSSA	Complies
Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA	Complies (EA prepared)
OPNAV Instruction; OPNAV Instruction 5090.1E; Environmental Readiness Program Manual; OPNAV-M 5090.1	Complies
Resource Conservation and Recovery Act	Complies
Rivers and Harbors Act	Complies
Toxic Substances Control Act	Complies

Legend: CEQ = Council on Environmental Quality; CFR = Code of Federal Regulations; EA = Environmental Assessment; EO = Executive Order; NA = not applicable; NEPA = National Environmental Policy Act; NOSSA = Naval Ordnance Safety and Security Activity; OPNAV = Chief of Naval Operations; U.S.C. = United States Code

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 relatively small amounts of fuel, oil, and lubricants for vehicles; and the use of small amounts of construction materials (e.g., for pier repairs). Implementing the Proposed Action, however, would not result in significant irreversible or irretrievable commitment of resources.

5.3 Unavoidable Adverse Impacts

This EA has determined that the alternatives considered would not result in any significant impacts. Implementing the alternative could result in the following unavoidable environmental impacts:

- minimal, localized, and non-significant disturbance of some marine species and their habitats during implementation of the Proposed Action
- short-term, minor impacts to water quality and air quality associated with repair of Lima, Mike, and November wharves

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 be minimal (see Section 5.3, above). In the long term, there would be beneficial impacts to marine biological resources, water resources, and infrastructure. 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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8.1.1 Federal Agencies

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Appendix A
Essential Fish Habitat and Endangered Species Act Documentation

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DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
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5090
Ser PWD/0137
February 12, 2020

Mr. Michael Tosatto
Pacific Islands Regional Office
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Honolulu, HI 96818

Dear Mr. Tosatto,

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE REPAIR OF LIMA (RM14-1420), MIKE, AND NOVEMBER (RM14-1423) WHARVES, INNER APRA HARBOR, U.S. NAVAL BASE GUAM

The U.S. Navy requests informal consultation with the National Marine Fisheries Service regarding the proposed repair of Lima, Mike, and November Wharves at Inner Apra Harbor, Guam. This request is pursuant to section 7(a)(2) of the *Endangered Species Act of 1973* (ESA) as amended (16 USC§ 153 et seq.). 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.).

The Navy proposes to repair the Lima, Mike, and November Wharves. These wharves are approximately 75 years old and severely deteriorated. The current condition is partially operational and dilapidated in certain areas. The steel sheet pile sectional losses range from 20%–80%, severely limiting the allowable wharf deck loading. The proposed action will repair the existing wharf by replacement, thereby enabling the wharf to accommodate ship repair, ship berthing, and heavy-weather mooring. The action will shift the existing wharf outboard (seaward) up to 10 ft. and will build a new sheet pile bulkhead wharf of approximately 2,315 ft. The in-water actions will be undertaken in daylight hours only and will require approximately 13 months to complete.

Regarding ESA-listed species:

Potential impacts to ESA-listed species may occur from exposure to the following stressors: elevated underwater noise; increased suspended sediments; disturbance from human activity and equipment operation; direct physical contact; vessel collisions; waste and discharge; and entanglement. Based on the best available data and environmental impact analysis described in the 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 determined the proposed action will adversely affect EFH in the marine environment around the wharves but most the effects will be managed and minimized. This determination was based on the proposed action, the quality and quantity of EFH within the action area, and the incorporation of Best Management Practices (BMPs). Potential adverse effects 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. 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 about the consultation documents, please contact Dr. Michelle Bejder at NAVFAC Pacific at (808) 472-1413 or michelle.bejder@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: Lima (RM14-1420), Mike, and November (RM14-1423) Wharves Repair, Inner Apra Harbor, U.S. Naval Base Guam

FINAL
Endangered Species and Essential Fish Habitat Assessment:

Lima (RM14-1420), Mike, and November (RM14-1423) Wharves Repair

Inner Apra Harbor, U.S. Naval Base Guam

Prepared by

Naval Facilities Engineering Command Pacific

Prepared for:

National Oceanic and Atmospheric Administration
Inouye Regional Center
1845 Wasp Blvd., Building 176
Honolulu, HI 96818

February 2020

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4. Acronym List

AIS	aquatic invasive species
BMP	best management practice
BMUS	Bottomfish Management Unit Species
dB	decibel
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973
FEP	Fishery Ecosystem Plan
ft	feet
HAPC	Habitat of Particular Concern
HEA	Habitat Equivalency Analysis
Hz	Hertz
INRMP	Integrated Natural Resources Management Plan
JBPHH	Joint Base Pearl Harbor Hickam
kHz	kilohertz
m	meter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MUS	management unit species
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PMUS	Pelagic Management Unit Species
PTS	permanent threshold shift
µPa	micro Pascal
SEL	sound exposure level
SEL_{cum}	cumulative sound pressure level
SSC	suspended sediment concentration
SPL	sound pressure level
SPL_{cum}	cumulative sound pressure level
SPL_{peak}	peak sound pressure level
SPL_{RMS}	sound pressure level root mean square
TTS	temporary threshold shift
WPRFMC	Western Pacific Regional Fishery Management Council

1. Introduction

The United States (US) Navy (hereinafter referred to as the Navy) proposes to repair and modernize the Lima, Mike, and November Wharves in Apra Harbor, Guam (hereinafter referred to as the "Action"). The goals of this assessment are: 1) to address the potential effects of the Action on 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 Action has the potential to affect the following ESA-listed marine species that may occur in the area: the endangered Central-West Pacific distinct population segment (DPS) green sea turtle (*Chelonia mydas*); the endangered hawksbill sea turtle (*Eretmochelys imbricata*); and the threatened Indo-West Pacific DPS scalloped hammerhead shark (*Sphyrna lewini*). 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 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 and the Pelagic MUS.

Early coordination and pre-consultation with the National Marine Fisheries Service (NMFS) occurred during a series of meetings, and phone conversations, including:

- July 2019 - Pre-consultation with NMFS Habitat Conservation Division & Pre-consultation with NMFS Protected Resources Division
- November 2019 – Pre-consultation with NMFS Habitat Conservation Division to review focused biological survey results
- December 2019 - Pre-consultation with NMFS Habitat Conservation Division to discuss mitigation approach and options
- January 2020 – NMFS Habitat Conservation Division review of draft consultation document.

1.1. Description of the Action Area

On the mid-western shore of Guam, Apra Harbor is a deep lagoon with depths over 150 feet (ft.). It has two recognized major harbor zones: Outer Apra Harbor and Inner Apra Harbor (Figure 1). The majority of submerged land within Apra Harbor is administered by the Navy. Apra Harbor is used for military training and recreational activities, as well as access for civilian vessels and the Government of Guam's Port Authority. The Navy authority over Inner Apra Harbor restricts its use to only military vessels, which includes naval and US Coast Guard (USCG) vessels from allied nations. No recreational uses are permitted in Inner Apra Harbor. Fourteen wharves are located within Inner Apra Harbor to support the Navy and USCG vessels and operations (DON 2019).

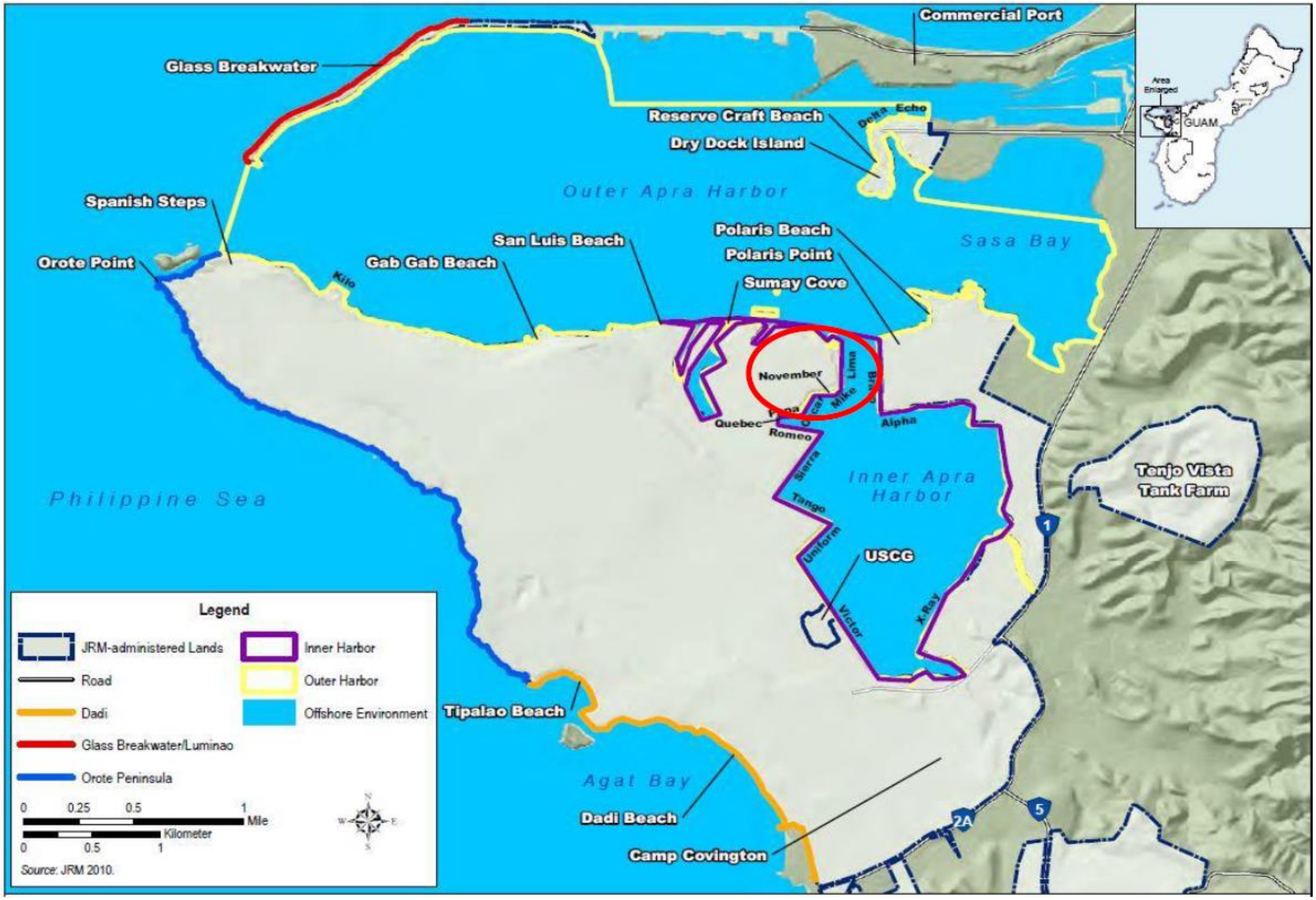


Figure 1. Map of Apra Harbor, Guam, with Action Area (red circle) between Outer and Inner Apra Harbor (Source: DON 2019).

Inner Apra Harbor is defined as the area from the mouth of the channel connecting the inner lagoon to Outer Apra Harbor, and the inner lagoon area from the channel towards the wetland behind X-ray Wharf that flows into Abo Cove (DON 2019; Figure 1). Inner Apra Harbor has a heavily-altered marine environment, and since WWII, has been maintained at depths required by various vessels and submarines (typically 22–40 ft.). The bottom is primarily soft substrate with the exception of the hard substrate near the mouth of the channel to Outer Apra Harbor. Much of the shoreline has been filled and altered to support wharves, with the exception of some of the eastern shoreline inhabited by mangroves and the shoreline south of X-ray Wharf (DoN 2019). Thus, much of the Inner Apra Harbor shoreline contains steep, manmade structures.

1.2. Description of the Proposed Action

The primary functions of the proposed Action are to support the Navy mission, operations, and vessels, and to restore the facilities and waterfront. The repair and modernization of the Lima, Mike, and November Wharves are in accordance with the Navy's intermediate ship repair, ship berthing, and heavy-weather mooring mission requirements for supporting Navy vessels, submarines, cargo ships, and Large Medium-Speed Roll-on/Roll-off ships.

Before in-water construction activities begin, a marine debris survey and removal of interfering debris (e.g. pipes, cables, or any other interfering objects) will be conducted. Divers will identify and assist topside personnel with lifting and removing the debris from the mudline along the entire length of wharves. The in-water construction includes the replacement of the steel sheet pile bulkhead and mooring system, plus the restoration of the fender system. These actions require pre-drilling, pile driving (both sheet piles and concrete fender piles), and pile cutting. After the wharf repairs are complete, additional dredging may be required to provide the required -35-ft. depth up to the face of the wharf and to remove potential high spots left by the previous maintenance dredging.

1.2.1. Wharf Structure

Built in 1945, the Lima, Mike, and November Wharves exceeded their design service life and can no longer be sustained as a fully functional ship repair wharf. The current wharf condition is partially operational and dilapidated in certain areas. The steel sheet pile are severely corroded, with sectional losses ranging from 20%–80%, thus limiting the allowable wharf deck loading. Structural failure of the steel sheet pile bulkhead can block or severely restrict access to the protected harbor. The proposed Action will repair the existing wharf by replacement, thereby enabling the wharf to accommodate ship repair, ship berthing, and heavy-weather mooring. The Action will shift the existing wharf outboard (seaward) up to 10 ft. and will build a new sheet pile bulkhead wharf of approximately 2,315 ft. (Table 1 and Figure 2).

Table 1. Estimated Action Area dimensions for Lima, Mike, and November Wharf repairs in Apra Harbor.

Wharf	Existing Dimensions*		New Dimensions*	
	Length (ft.)	**Depth (ft.)**	**Length (ft.)**	**Depth (ft.)**
Lima (West)	181	7	191	7
Lima (North)	83	12	103	12
Lima (East)	1,159	35	1,169	35
Mike	274	24	286	24
November	566	25	566	25
TOTAL	**2,263**	-	**2,315**	-

Note: *All values are approximate

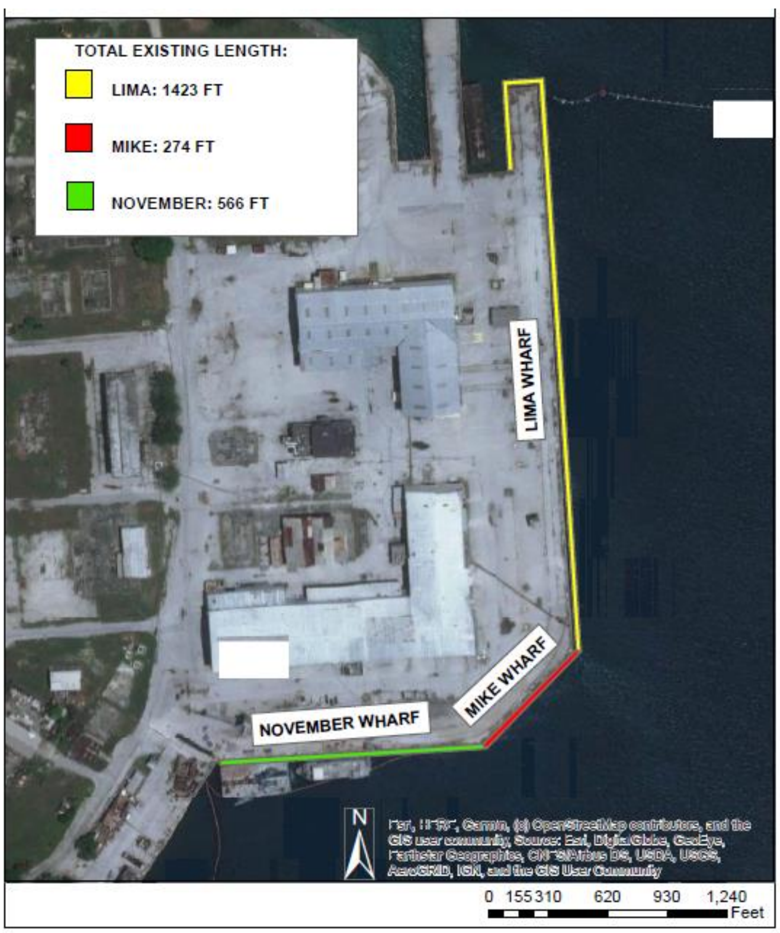


Figure 2. Action Area of Lima, Mike, and November Wharves in Apra Harbor, Guam.

The Action will install two types of piles: sheet piles (both king pile and standard piles); and concrete fender piles. The king pile (or heavy "H" section pile) system consists of a single "H" section (i.e. king piles) welded on both sides to a "Z" infill section (Figure 3). Maximum sheet pile wall depth is 44 in. The new piles will start at about 10 ft. away (seaward) from the existing sheet pile walls. The area between the new and old sheet pile walls will be packed with controlled density fill, and the enclosed land side of the new wharf will be reinforced (improved) with stone columns underground.

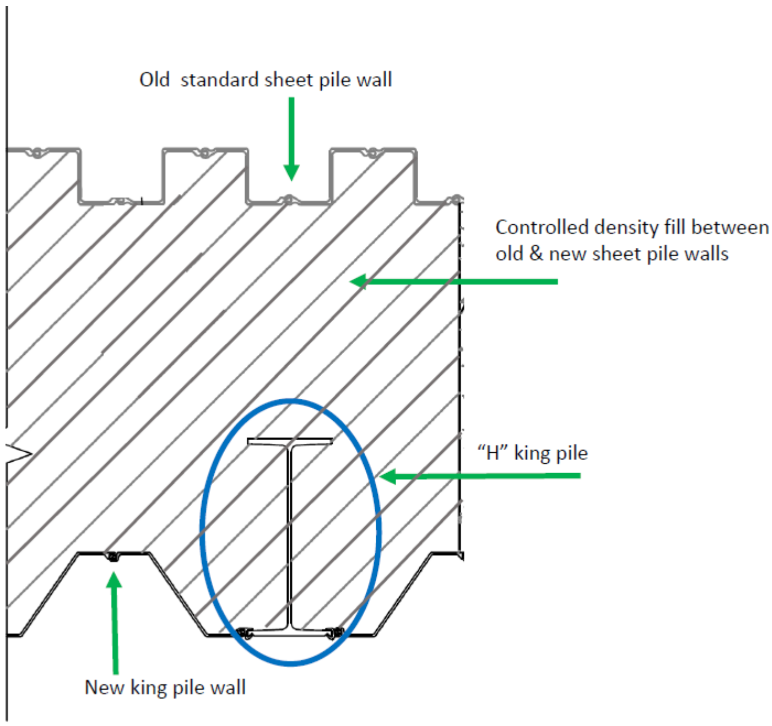


Figure 3. (Top) Engineering plan (top view) of the old sheet pile wall, a new king pile wall, and the controlled density fill between the walls proposed for Lima, Mike, and November Wharves in Apra Harbor, Guam; and (bottom) an example of king pile wall (Source: deepexcavation.com).

The king piles will be driven to a depth of approximately -85 ft., and the walls will be anchored with tie rods, which are round, steel bars that provide lateral stability to the sheet pile wall and anchor the wall approximately 75 ft. on shore (). Tied-back sheet pile wharves are the most widely used (Tsinker 2004). The only exceptions will be at the north end of Lima wharf, where the new king pile wall will be anchored with tie rods to the west wall (i.e. metal rods will connect/support the two walls underground). Also, due to elevation differences, the west wall will be replaced with standard sheet pile sections as opposed to king pile sections.

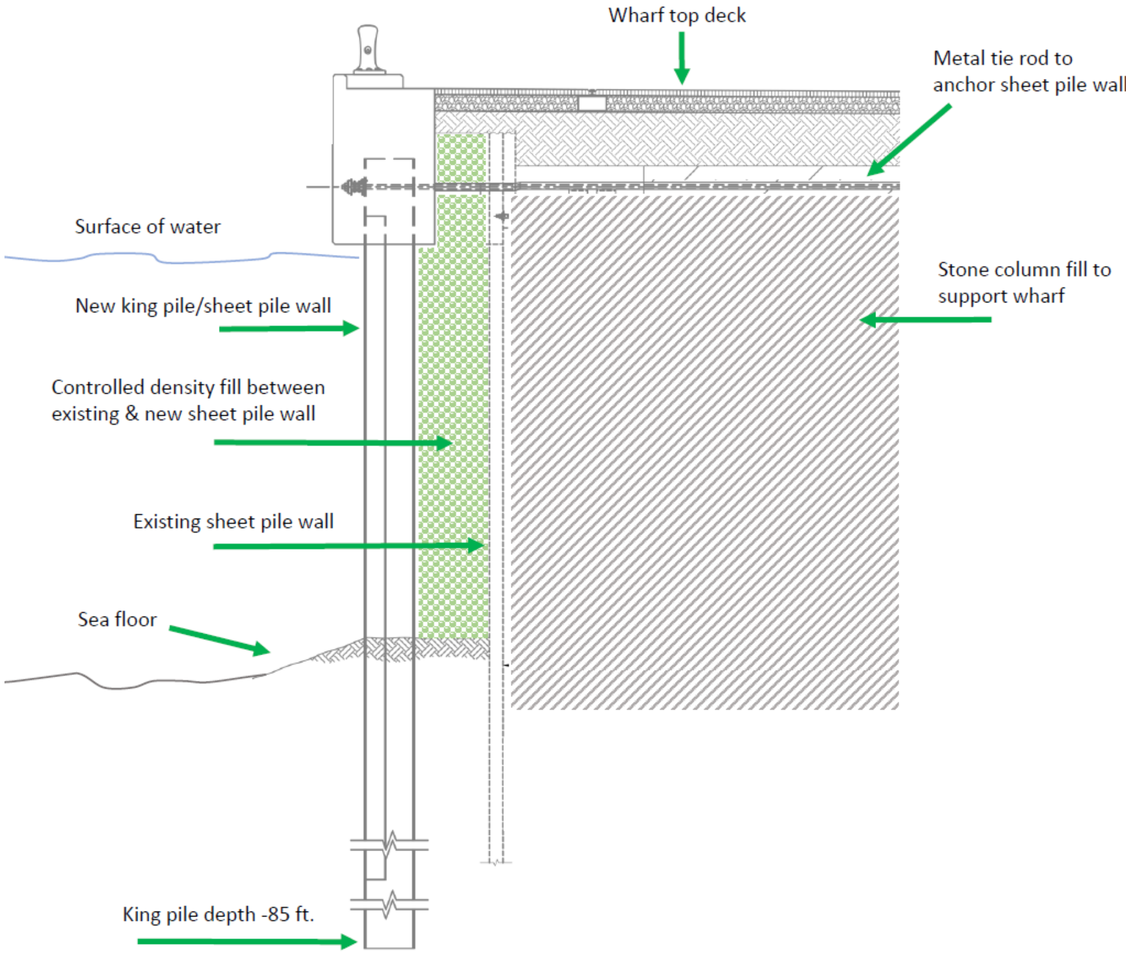


Figure 4. Drawing of side view of old sheet pile wall, new king pile wall, the controlled density fill between and the underground stone columns supporting the new sheet pile wall.

Following the new sheet pile wall construction, four new corner fenders will be installed at each corner of Lima, Mike, and November Wharves (40 total) to protect the vessels and wharf from damage by accidental impact (Figure 5). Corner fenders will consist of 16-in. square concrete piles held together by a steel frame. They will be offset from the wharf face using a series of extruded rubber leg “buckling” fenders

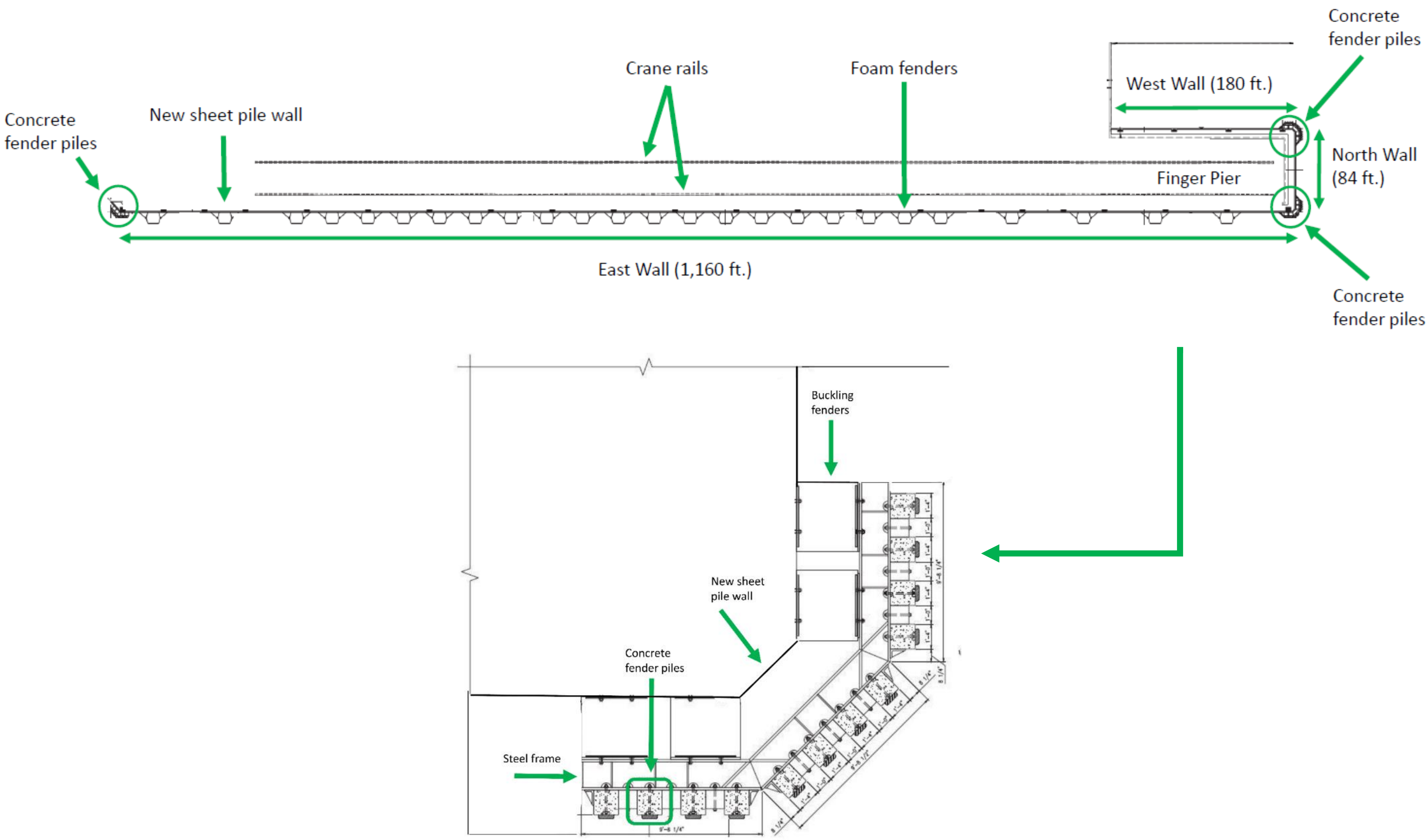


Figure 5. Drawings of Lima Wharf structure showing (top) an overall, top view and (bottom) close-up view of the concrete fender piles.

1.2.2. Pile Installation

Pre-drilling

Holes for each concrete fender pile will be pre-drilled to stabilize pile driving into the natural rock below. Typically, a top-drive drill consists of a hydraulically-powered motor that sits above the water line and activates a 40–50 ft. auger drill. The auger may be equipped with a cutting edge that breaks the soil or rock during rotation, after which the soil cuttings travel up the flights of the auger. The auger is then withdrawn from the hole, bringing cuttings with it, and the cuttings are removed from the auger by spinning the auger. The objective of pre-drilling is to create a hole that will guide the concrete fender pile into the substrate and will yield to driving the pile. Hard substrate, such as rock, would not allow concrete piles to be driven without potential damage to the piles. The drilling will continue until the prescribed depth is reached, and the pre-drilling duration may range from approximately one to several hours per pile, depending on the subsurface conditions encountered in the hole.

Pile Installation Procedures

For the pile installation, hammers shall be steam, air or diesel drop, single-acting, double-acting, differential-acting or hydraulic type. Based on the subsurface conditions in the Action Area (medium dense gravelly soil over very dense limestone; Section 2.1.3), a vibratory hammer will likely have difficulty advancing concrete and steel piles through the limestone, thereby resulting in piles "hanging-up" at insufficient embedment. Previous pile diving projects in Inner Apra Harbor initially and unsuccessfully used vibratory hammers, as the piles quickly encountered the limestone and could not be installed to depth. With similar subsurface conditions, it is highly likely that vibratory hammers would have similar, unsuccessful results if used for the proposed action. The Navy concluded that a vibratory hammer is not feasible to install the piles. Therefore, vibratory hammers will not be used.

All piles will be driven until they reach a sufficient driving resistance and/or specified depth. Depending on several factors (e.g. substrate, inclement weather, equipment conditions, etc.), the time to drill sheet piles through the layered substrate will vary. A pile cap or drive cap will be positioned between the pile and hammer, and a hammer cushion or cap block will be placed between the ram and the pile cap or drive cap. Hammer cushion or cap block will have consistent elastic properties to minimize energy absorption, and transmit hammer energy uniformly and consistently during the entire driving period.

A single, barge crane will be required for pre-drilling and pile driving. A second barge may deliver the piles to the wharf, which would allow the crane operator an easier access during pile installation, less interference from landside operations, and faster overall construction. However, this option would increase the in-water footprint and operations. Alternatively, the piles may be delivered to the wharves by vehicles on land, thereby reducing in-water operations and spatial footprint.

The number of piles per day and the number of blows per pile will vary based on location within the Action Area. On average, approximately six piles will be driven per day, with a maximum of eight sheet piles per pile driving day. The pile driving process begins by placing a choker cable around a pile and lifting it into vertical position with a crane. The pile is lowered into position inside a template and set in place at the mudline (Figure 6). Templates place piles in the correct location and alignment, and are usually sized to cover segments of 5–10 king piles (i.e. 40–80 ft. in length). Impact hammers have guides that hold the hammer in alignment with the pile while a heavy piston moves up and down, striking the top of the pile and driving the pile into the substrate. The number of blows from the impact hammer to drive each pile is estimated at five blows per foot for 15 ft., which equates to an average of 75 blows per pile. This number will vary depending on factors such as soil condition, tip elevation, size of hammer, and final dimensions of the piles. Once all the king piles have been driven, the infill sheet piles will be installed.

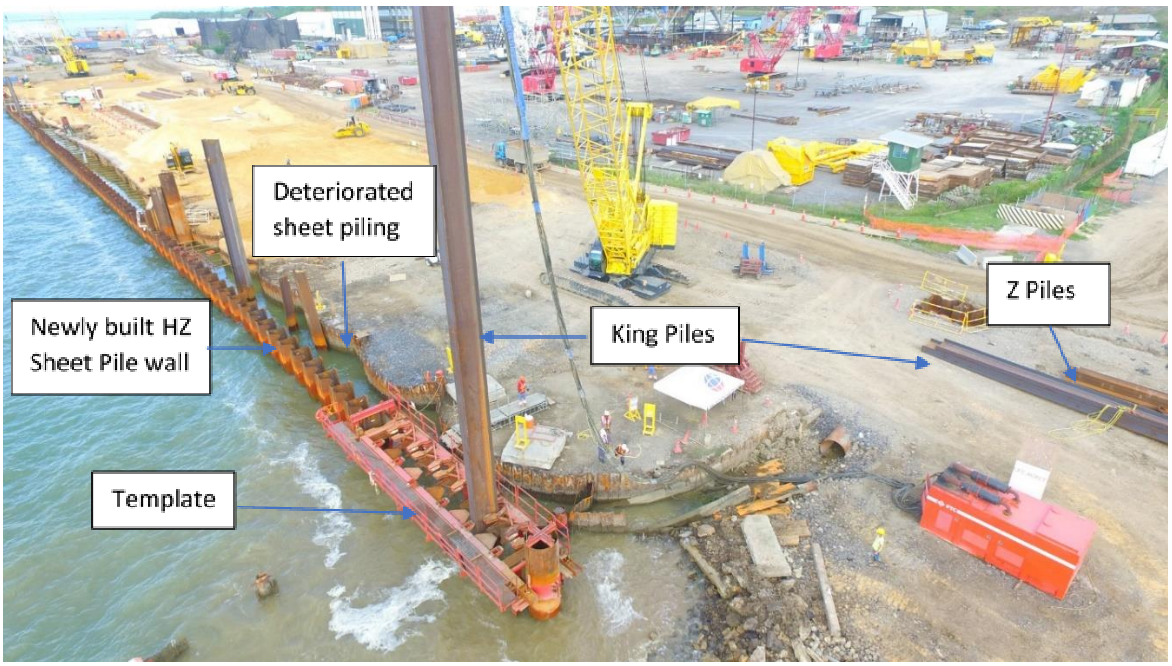


Figure 6. Examples of sheet pile installation equipment and terminology. Note that this photo includes a landside equipment (not a barge mounted crane) and is used for general reference. Photo courtesy of J. Sircar, WSP.

The concrete fender pile installation process is similar to the sheet pile installation, except the concrete fender tip elevations are designated as -67 ft. Only the portion between -35 and -67 ft. will be driven. Once the concrete fender piles are in position, installation typically takes 360-880 blows to reach the required tip elevation, depending on site conditions, driving method, and equipment used. Once all of the piles are driven, closure plates would be attached between the existing adjacent sheet pile walls and new wall end terminations. These are typically welded in place using underwater welding techniques.

Due to the poor condition of the wharves and its inability to support heavy cranes, pile driving at Lima (east), Mike, and November Wharves will be performed by use of a waterside derrick crane mounted barge. The barge crane (both number and size) and the pile delivery methods as discussed above are not confirmed and will not change the implemented best management practices (BMPs; Section 1.3). The barge crane(s) will be anchored at the wharf and away from sensitive benthic habitat (e.g. coral reefs, etc.). The barge crane(s) will be moved, along with any equipment for BMPs to each wharf in phases, and thus restrict the action footprint and duration to one wharf at a time.

The north and west walls of Lima Wharf have shallower water depths that may not accommodate the draft of a barge crane, which is estimated to be 7-10 ft. when fully loaded. If a barge is at risk of coming in contact with coral colonies present at or adjacent to the Action Area, operational modifications will be made or BMPs will be followed, e.g. work will only be conducted at high tide or all pile driving for Lima's north and west walls will be undertaken by cranes on shore and topside of the existing wharf.

Placement of Fill behind New Wharf Structure (Landside Work)

Anchors will be installed or existing tiebacks utilized to reinforce the new wharf face for stability. Following the anchor installation, gravel or concrete fill will be placed into the space behind the wall. The fill material is denser than water, designed to be self-compacting, and will not contain contaminants nor toxic admixtures. Further, if any fill material or concrete wash were to enter the marine environment inadvertently, the amount will be very limited and controlled. Any trapped water behind the wall would be discharged into Inner Apra Harbor in compliance with Section 401 of the Clean Water Act.

Form and Placement of Pile Cap (Landside Work)

After the fill operation, the concrete pile cap will be formed and paced along the top of the new interlocking sheet pile wall. Wood, steel or fiberglass forms will be installed along the top of the wall down to below mean low water elevation. Water will be removed from the forms, and steel reinforcement will be placed in the forms. Concrete will be poured to the required elevations.

1.2.3. Navigational Dredging and Reclamation

After installation of the new sheet pile wharves, the Contractor will commence a reclamation dredge to remove shoals and sediment build-up from the Action and no closer than 5 ft. from new wharf face on the east side of Lima Wharf (Figure 7). No dredging associated with this Action will be performed on the north or west sides of the Lima Wharf. The amount of dredging needed for Mike and November wharves has not yet been determined, but a similar footprint is expected. Inadvertent over dredge will not exceed 2 ft. beyond the maintenance depth. The material to be removed varies from unconsolidated silts, muds, and clays to sand deposits, consolidated clays, and soft rock. The total estimated amount of material to be removed from Lima Wharf within the specified limits, including side slopes, is 5,800 cubic yards.

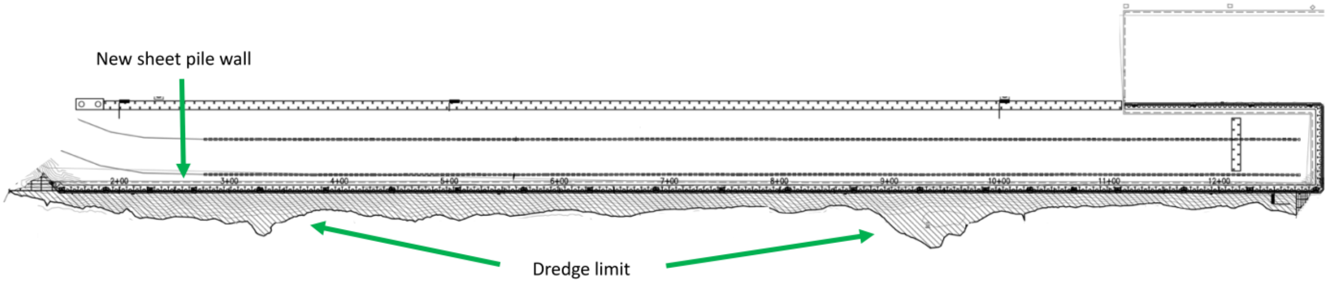


Figure 7. Navigational dredge limit to remove shoals and sediment after the new Lima Wharf construction in Apra Harbor.

Before dredging activities, the Contractor will submit a dredging and disposal operation plan for review and approval by the Navy. The plan will include (but is not limited to) a description of the proposed removal and disposal procedures, a BMP Plan, methods to track and verify the transport and disposal of the dredged material, and an outline of the notification plan. The Contractor is responsible for the verifications of quality and quantity of materials during and after dredging operations, including mitigation for impacts to water quality, coral spawning events, etc. (See Section 1.3 for detailed BMPs).

The Contractor shall remove shoals and sediments that built up during the construction process and in front of the new wharf face (Figure 8). A special barge-mounted, closed bucket excavator will have a sealing-up mechanism, a venting system, and the capability for a horizontal level cut. The special bucket will minimize spillage of dredged sediment and water into the transportation barge. A floating frame beside the crane barge will suspend a silt curtain to contain sedimentation inside the curtain and reduce turbidity in the harbor. Finally, an oil fence or boom will enclose the dredging area, floating equipment, and barges.

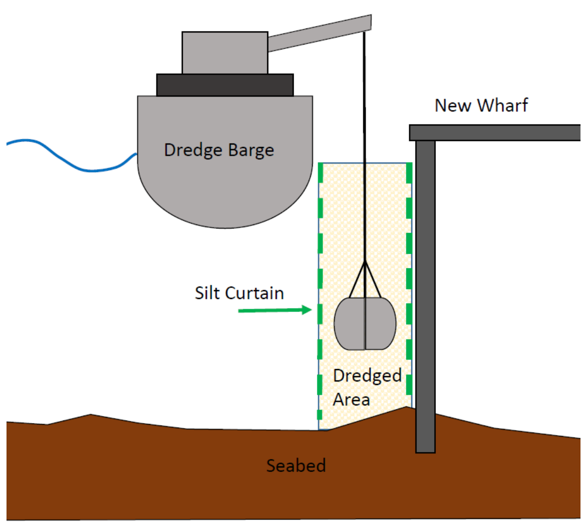


Figure 8. Drawing of the approximate underwater dredge profile at the new Lima Wharf, Apra Harbor (Note: drawing not to scale).

In compliance with the rules and regulations of local port and harbor authorities, the Contractor will provide safe transportation and disposal of dredged materials every day, and ensure that the plant, scows, barges, and associated equipment are maintained to meet these requirements. During transport from the Action Area, the Contractor will ensure that no water or dredged material shall be released from project vessels or other transport vehicles.

Due to the relatively small volumes of dredge material, the dredge material will be placed in an upland confined disposal facility located at Field 5. The dredge material will be located immediately adjacent to the wharf face, lending itself to a landside operation with a long-reach excavator that could load trucks directly from the wharf.

1.2.4. Action Timeline

In-water construction is proposed to begin in August 2021 (Table 2). The total time for in-water work (not including BMPs to stop work during for coral spawning periods) is expected to continue for approximately 13 months. Work will be completed during daylight hours only (i.e. eight-hour workdays), and nighttime activities are not anticipated. The daily construction window for pile removal and driving will begin no sooner than 30 minutes after sunrise (to allow for initial marine mammal monitoring) and will end no later than 30 minutes before sunset (to allow for post-construction marine mammal monitoring).

Table 2. Proposed in-water construction start dates and durations for Lima, Mike, and November Wharves Repairs in Apra Harbor*.

Action	Start Date*	Duration*
Sheet Pile Driving	August 2021	Lima - 5 months
		Mike – 1 month
		November – 2 months
Concrete Fender Pile Driving	March 2022	Lima - 2 months
		Mike – 2 weeks
		November – 3 weeks
Dredging & Reclamation	September 2022	Lima - 1 month
		Mike – 1 week
		November – 2 weeks

Note: *All values are approximate; pile driving does not include time to mobilize, demobilize and move between wharves

1.3. Best Management Practices

The Action will implement a series of BMPs during site preparation and in-water construction work to avoid and minimize adverse impacts to ESA-listed marine species, EFH, and the marine environment. The BMPs have two parts: Part A BMPs avoid and minimize effects from the Action on ESA-listed species; and Part B BMPs avoid and minimize effects from the Action on the marine environment/habitat including EFH. Throughout the duration of their involvement in this Action, all workers associated with this Action, irrespective of their employment arrangement or affiliation (e.g. employee, contractor, etc.), shall be briefed on these BMPs and the compliance requirements.

1.3.1. Part A - BMPS to Avoid and Minimize Impacts to ESA-Listed Species

The following BMPs will be employed to ensure that no adverse effects will occur to ESA-listed species:

A. Constant vigilance will be kept for the presence of ESA-listed marine species during all aspects of the in-water actions, such as boat operations, pile driving, dredging, and deployment of silt curtains, anchors, and mooring lines.
    1. The Contractor will comply with the following monitoring requirements:
        i. From the wharf, a competent observer will monitor for ESA-listed species during all in-water activities (Figure 9).
        ii. While monitoring, the observer will use binoculars to survey the Action Area each day, beginning 30 minutes prior to the start of work and repeated hourly throughout the workday.
            - During the survey period, the observer will record environmental and Action-related information, including but not limited to date, time, weather, action undertaken, status and effectiveness of BMPs, and ESA-listed marine mammals.
            - If no ESA-listed marine animal is seen during the 30-minute survey period, Action activities may commence.
            - If an ESA-listed marine animal is seen during the 30-minute survey period, the observer will notify the Project Manager immediately and monitor the animal. If the animal is within 50 yards (yd.) of the in-water activity, animal behavior observations shall be recorded. Work will not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting.
            - During in-water operations, all in-water work shall stop when an ESA-listed marine animal is within 50 yd. of the proposed work. Work shall 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 shall be recorded.

2. No pile driving or dredging will be conducted after dark.
3. NBG will document and report to NMFS all interactions with ESA-listed species (monthly), including the disposition of any listed species that are inadvertently injured or killed (within 24 hours).

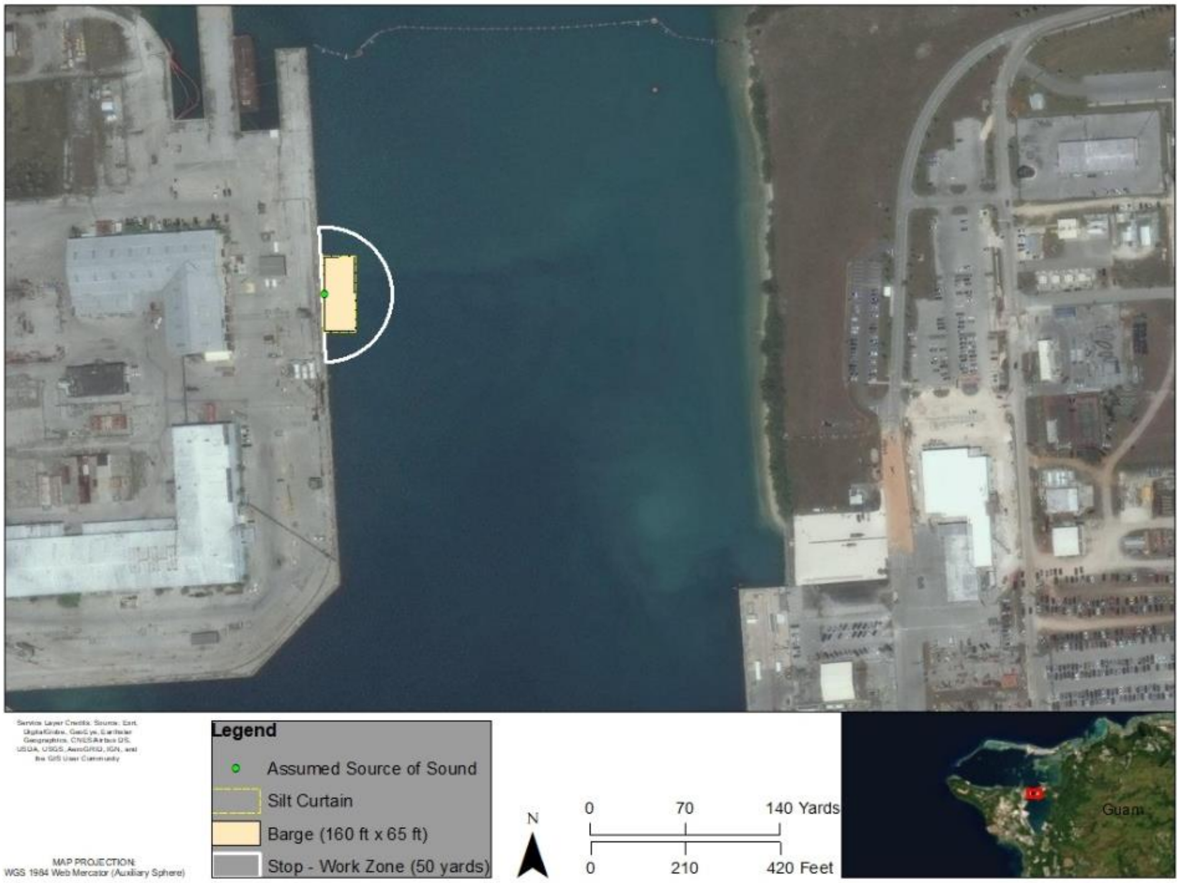


Figure 9. Representation of the in-water Action footprint, including the approximate locations of the barge, silt curtain, and the 50-yard shut-down zone.

B. In-water operations will implement the following BMPs to reduce potential collisions with ESA-listed species:
    1. Vessel operators will halt or alter course to remain at least 50 yd. away from ESA-listed marine animals.
    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.
    3. If approached by an ESA-listed marine animal, the vessel operator will put the engine in neutral until the animal is at least 50 ft. away, and then slowly move to 50 yd. away from the animal.
    4. Vessel operators will not encircle or trap ESA-listed marine animals 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. All personnel will not attempt to disturb, touch, ride, feed or otherwise intentionally interact with any protected species.
    2. All personnel will stay more than 50 yd. away from sea turtles that haul-out on land.
    3. Before any equipment or material enters the water, the Contractor will verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the seabed.
    4. All objects lowered to the bottom will be lowered or installed 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.
    5. 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.
    6. 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 Action Area if not actively being used.

1.3.2. Part B - BMPs to Avoid & Minimize Impacts on Marine Environment & EFH

A. All in-water activities will cease during the primary coral spawning events each year for hard (scleractinian) and soft (octocorallia) corals. The coral spawning period is estimated to be 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 5–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).

B. All construction-related equipment must be operated and anchored to avoid impacting sensitive marine habitat or contacting coral reef resources during in-water construction activities or extreme weather conditions.
1. All anchors (e.g. for vessels and silt curtains) will be set on hard or soft, sandy bottom void of corals and seagrass, and 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.
2. Anchors, anchor chains, wire ropes and associated anchor rigging from construction related vessels must be restricted to designated anchoring areas within the construction footprint (i.e., soft bottom) or within the area that will be permanently impacted.

C. Work platforms will be oriented to minimize shading organisms on natural and manmade substrates to the greatest extent practicable. This may occur by allowing for the path of the sun to 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. All Action-related debris and other waste will be contained and will not enter or remain in the marine environment. The Contractor shall provide a temporary platform or other suitable means of capturing debris from construction, and these structures shall be in-place prior to commencing in-water activities.

E. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the Storm Water Pollution Prevention Plan (SWPPP) and implemented throughout construction of the Action.
1. Fueling of Action-related vehicles and equipment will take place at least 150 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.

2. All Action-related materials and equipment placed in the water will be free of pollutants.
3. 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.
4. Daily pre-work equipment inspections for cleanliness and leaks will be performed. 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.

F. Turbidity and siltation from Action-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.
   1. Full-length silt curtains will be installed immediately adjacent to and around the barge at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable, to maintain water quality and to provide coral protection.
   2. The Contractor must continuously monitor to ensure that control measures are in place and functioning properly
   3. If a visible plume is observed outside the silt curtains, construction activity will be suspended, evaluated, and corrective measures taken.
   4. Activity may resume after problem is corrected.

G. Prevent water quality impacts during the transport of scows to the offloading platform by restricting load volumes to avoid overflow during transport.

H. A contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching tropical storms and typhoons.

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.

J. If the crane barge or any other project vessel is at risk of coming in contact with coral colonies adjacent to the Action Area (i.e. north and west sides of Lima Wharf), work will only be conducted at high tide or all pile driving for Lima's north and west walls will be undertaken by cranes on shore and topside of the existing wharf.

K. 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.

2. Environmental Baseline Conditions

2.1. General Marine Environment

Apra Harbor is located on the western (leeward) side of Guam and is the largest, U.S. deep-water port (depths to 165 ft.) in the Western Pacific and the busiest port in Micronesia (Nelson *et al*. 2016, Marx & Smith 2013). Inner Apra Harbor is defined as the area from the mouth of the channel connecting the inner lagoon to Outer Apra Harbor, and around to the wetland behind X-ray wharf which flows into Abo Cove (DON 2019). Turbidity in Apra Harbor is variable, as highly turbid conditions are common in Inner Apra Harbor, where the current flow pattern is caused by wind-driven wave action and is often less than 0.1 knots (Smith *et al.* 2013).

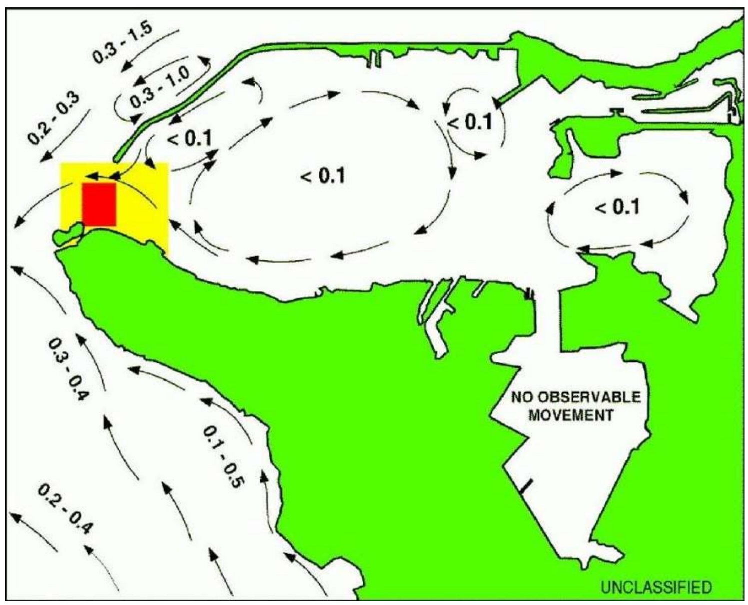


Figure 10. General current circulation of Apra Harbor, Guam: red area indicates where eddies have been reported; yellow area indicates where tides cause current speeds to vary to a degree significantly affecting vessel navigation; speeds are reported in knots (Source: NAVFAC Marianas 2019).

2.1.1. Water Quality

The Apra Harbor Watershed includes the sub-watersheds of Sasa and Atantano, which deliver freshwater inputs into the marine environment on the eastern side of Inner Apra Harbor (DoN 2019). As a result of weak circulation and substantial sediment transport into the marine environment from the watershed, turbidity throughout Inner Apra Harbor is higher than Outer Apra Harbor. Storm water runoff carries large amounts of sediments, most of which originate from the widespread soil erosion that occurs in the highlands and from improperly-managed, construction activities within the drainage basin (DoN 2019). Water quality within Apra Harbor has not been monitored consistently over time, and therefore, no comprehensive spatial or temporal data are available to determine discernable trends.

2.1.2. Sediment Quality

Sedimentation rates in the Inner Apra Harbor are high, with the highest estimated sedimentation rate at 3.2 centimeters per year (DoN 2016, 2018). Higher turbidity in Inner Apra Harbor results from a combination of processes: weak water circulation; substantial sediment transport into the marine environment from the watershed; and long residence time of water (DoN 2018). Dredging and construction in Apra Harbor and the adjacent watersheds likely contribute to the total amount of suspended sediments in Inner Apra Harbor, causing acute exposure of marine resources to increased turbidity levels (DoN 2019). Also, dredging contaminated areas likely mobilized and exposed deeper contaminated sediments. Ship scour causes surficial sediment resuspension, but deeper scouring probably occurs only periodically over small areas during the largest ship movements (DoN 2019).

Chemicals released in the Apra Harbor Watershed and transported to the harbor tend to accumulate in the harbor sediments, which therefore become a natural sink for numerous contaminants of potential concern (COPC) from multiple sources (NAVFAC PAC 2016). Available historical sediment and tissue data collected within Apra Harbor indicated that the sediments have been impacted by contaminants released near the harbor shoreline and in the surrounding watershed. Available upland chemical data, upland activities, and historical information regarding known or suspected releases of contamination all indicate that pathways for transport of COPCs to the harbor sediments are potentially complete (NAVFAC PAC 2016).

The Navy conducted a Remedial Investigation (RI) between 2014 and 2015 and a Feasibility Study in 2018 (AECOM 2018). During the RI, sediment samples collected near Lima and Mike Wharves were analyzed for polynuclear aromatic hydrocarbons (PAHs), PCBs, and pesticides. The Navy developed site-specific, preliminary remediation goals based on the human health and ecological risk assessment results. Within the Action Area, exceedances were observed for several contaminants including PCBs, DDTs, mercury, and other chemical contaminants.

2.1.3. Geology

Sediments in the marine environment of Inner Apra Harbor consist mainly of coral, mud, and sand. The emergent reef faces and Merizo limestone occur in low supratidal to shallow subtidal zones (2-4 m above mean sea level). The most common soil type in the Apra watershed is known as As Ylig, a clay-rich, poorly-drained soil 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, as cited in AECOM 2018).

In 2019, site-specific field investigations analyzed geotechnical data from several boring samples collected throughout the Action Area (Earth Mechanics 2019). The Action Area's subsurface soils consisted of loose to medium dense sandy/gravelly coralline materials Figure 11. The borings first encountered loose to medium dense coralline materials, followed by dense to very dense silty sand to gravel and limestone materials at deeper levels (beginning at -25 ft. MLLW).

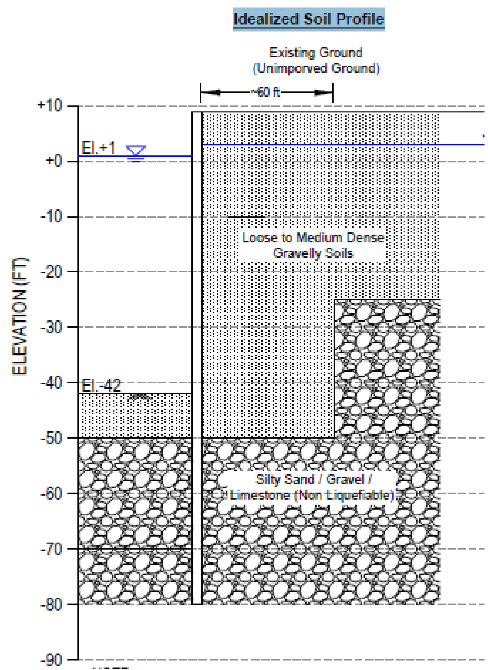


Figure 11. Drawing of existing ground condition soil profile at the Action Area showing loose to medium dense gravity soils over a deeper layer of silty sand/gravel/limestone (Source: Earth Mechanics 2019).

2.1.4. Coastal Habitat

Coastlines in Inner Apra Harbor are predominantly man-made structures (e.g., wharves) with estuarine wetlands on the east side and only limited rocky and/or sandy coastlines present (DoN 2018). The Atantano Wetlands are located along the southeastern shore of Inner Apra Harbor, and constitute the northern boundary of the Atantano River Delta, which discharges into Inner Apra Harbor (DoN 2018). These wetlands begin in the upper reaches of the Atantano River and stretch across the highway via a culvert to the mouth of the Atantano River. Previous studies reported that this area supports one of Guam's most developed mangrove communities, including Asiatic mangrove, Indo-West Pacific stilt mangrove, large-leafed mangrove, and Guam's largest grove of grey mangrove (Moore et al. 1977; Wiles and Ritter 1993). These wetlands are found primarily along the eastern shore of Inner Apra Harbor and outside of the Action Area (DoN 2018).

2.1.5. Benthic and Biological Habitat

Inner Apra Harbor is almost uniformly soft-bottom habitat, with the exception of hard bottom in the channel that connects the Inner and Outer Harbor, and occasional scoured areas near piers or shallow parts of the basin (DoN 2018). Inner Apra Harbor is subject to regular maintenance dredging, and is no deeper than 40 ft. in most locations. Inner Apra Harbor is a highly-altered marine environment that supports coral growth primarily on the perimeter of the harbor on manmade structures and the limited amount of hard substrate found close to the shoreline. Coral reef habitats on Inner Apra Harbor occur on the hard shoreline, occasional debris and rocks in the soft substrate, and artificial structures along the perimeter of the harbor (DoN 2018). There are no coral reefs in the main body of Inner Apra Harbor (Smith *et al.* 2013).

The surfaces of Lima, Mike, and November Wharves and the adjacent substrate were surveyed for biota in September 2019 (NAVFAC 2019). Prior to commencing focused surveys of the wharves, divers performed reconnaissance swims to gain an overview of the biotic composition of the three wharf faces. During the swims, divers noted the points of biotic transitions, and the areas between the transitions were considered “survey zones”: eight zones were identified on Lima Wharf; three on Mike Wharf; and four on November Wharf (). Three main factors dominated the general patterns in macroalgae, invertebrates, and coral distribution and composition:

1) Location from Inner to Outer Apra Harbor: Biotic composition from Inner to Outer Apra Harbor followed a general progression from silty, turbid inner harbor conditions to less silty at the northernmost end of Lima Wharf, and to very little silt inside the Lima Wharf west wall.
2) Depth: The uppermost 3 to 6 ft. (1 to 2 m) of the typical wharf face had about twice the density of coral colonies as the bottommost typical wharf face.
3) Long-term mooring against the wharves: the sole factor causing changes from “high coral” to “low coral” zones that defined the zones. In areas where barges had been moored for long periods, corals occurred in very “low abundance” with predominantly small colony sizes. In areas where long-term mooring did not occur, corals were substantially more abundant, with both higher species abundance and larger size-classes. The likely mechanisms for this effect are shading and dampening the water motion.

Figure 12. Biological survey zones on Lima, Mike, and November Wharves of Inner Apra Harbor (Source NAVFAC 2019).

In the Action Area, the seafloor within four meters of the sheet-piling consists primarily of soft, sandy mud that is easily re-suspended into the water column. Close to the wharf faces, abundant debris (including tires, pipes, hoses, cables, ladders, and assorted metal objects) littered the harbor floor. These items afforded solid surfaces that were raised above the mud floor and thus preferred settling sites for corals. Relatively few corals occurred within the four-meter zone on the natural seafloor, and the corals that did occur were generally isolated small colonies (Figure 13).

Between the Lima Wharf Finger Piers (i.e. north end; Figure 5), the bottom is composed of a harder sand substrate with a lower component of easily suspended, fine-grained material (NAVFAC 2019). Compared to the sediment surface within Inner Apra Harbor, a substantially different coral community colonized the outer harbor floor in this survey area. *Pocillopora damicornis* dominated the number of colonies on the inner harbor floor next to Lima Wharf (55% of corals counted), but that species was notably less present on the Finger Piers' outer harbor floor (3.5% of colonies). There was overlap in the species observed in the two locations from the most common species/groups, especially the Porites massive species complex. The average size (in two-dimensional area) of colonies on the outer harbor floor of the Finger Piers was about 1.7 times greater than colonies on the inner harbor floor in front of Lima Pier (i.e. 163 vs. 94 cm^2). The coral colony density was about the same (3.7 vs. 3.9 colonies/m^2) between the two areas. *Leptastrea purpurea*, a low profile species, was the most abundant coral on the floor of the outer harbor adjacent to the Finger Piers, comprising 43% of the corals counted. Besides coral, small patches of seagrass were observed on the sand substrate between the Lima Wharf Finger Piers, but outside of the Action Area.

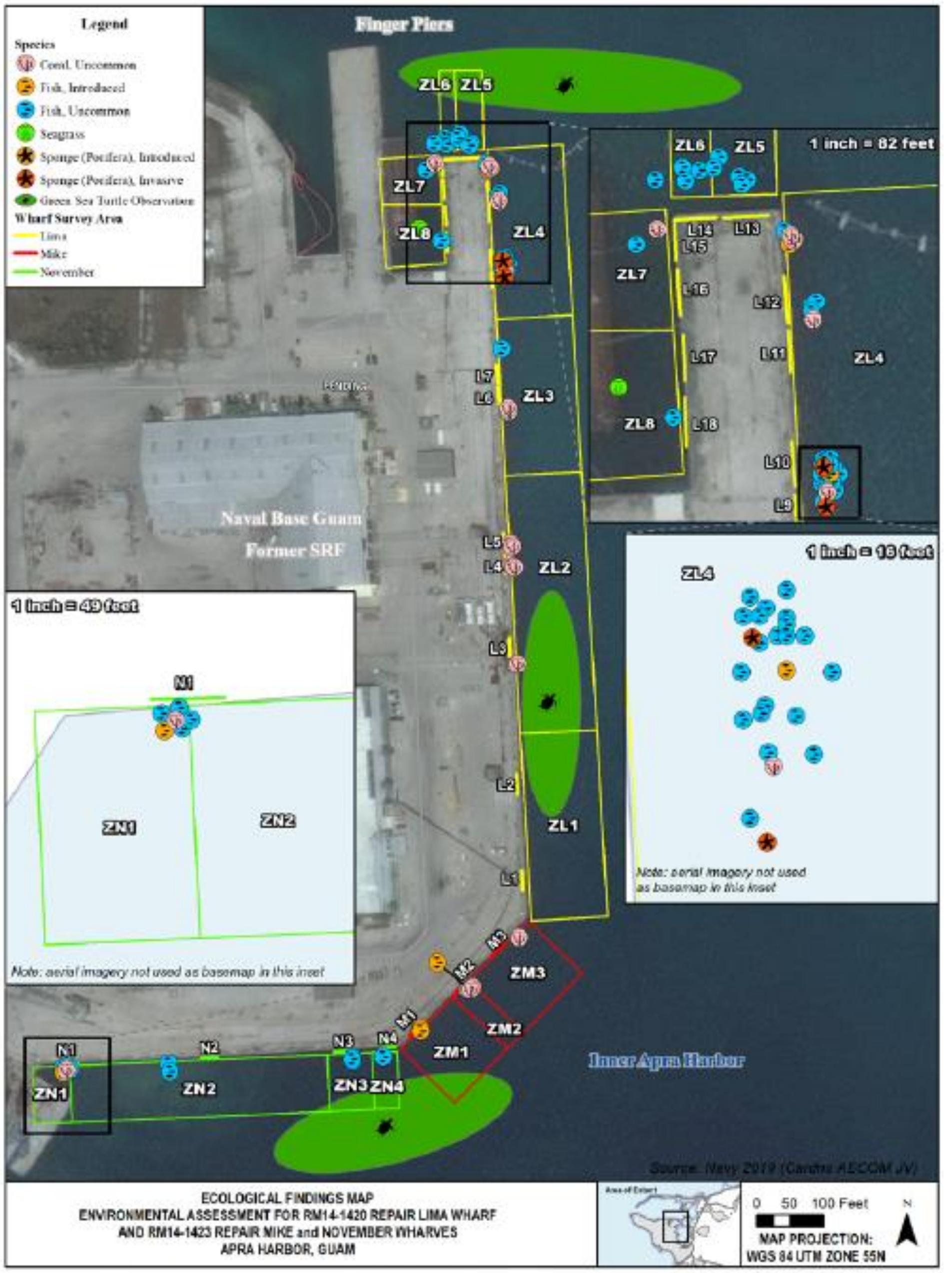


Figure 13. Habitat map of the Lima, Mike, and November Wharves in Inner Apra Harbor (Source NAVFAC 2019).Note that ZL5–ZL8 are outside but adjacent to the Action Area.

2.1.6. Unexploded Ordnances

There is no documented evidence of past munitions and explosives of concern (MEC) use in the Action Area, and MEC activities are not performed currently in the Action Area. However, MEC, material potentially presenting an explosive hazard (MPPEH) or unexploded ordnances (UXO) may be present in Apra Harbor as a result of World War II-era activities MEC items have found in Inner Apra Harbor including at least one MEC item in the vicinity of Lima Wharf. Also, the extensive dredging required to change the depth profile of the Inner Harbor from an average of -22 ft. to the current average of -35 ft. occurred post World War II, and would have been reasonably expected to remove any potential MEC from the sediments within Inner Apra Harbor. Furthermore, a maintenance dredge of Inner Apra Harbor is expected to occur before the proposed Action takes place, further reducing the probability of encountering MEC, MPPEH and/or UXO items.

2.2. Marine Fauna

2.2.1. Corals

In September 2019, the survey methods used for coral analysis were photogrammetric orthomosaics, *in situ* quadrat surveys of percent cover, condition and coral demographics, and species richness surveys (NAVFAC 2019; see the A for details). From orthomosaic images of the wharf faces, the overall dominant biotic cover is macroalgae (64%), followed by non-coral invertebrates (19%), and then coral (15%). Considering each wharf, average coral cover was highest on Mike (23%), followed by Lima (15%), and then November (10%). The highest coral cover of 35% occurred on the north end of Lima Wharf; while the lowest coral cover (between 3 to 4%) occurred in the central zone of Lima Wharf in an area that appeared to be a long-term berthing site.

Table 3. Summary of percent cover from orthomosaic images of each section from Lima, Mike, and November Wharves in Inner Apra Harbor, Guam (Source: NAVFAC 2019)

ZONE	SECTION	SURFACE COVER (%)				
		Algae	Coral	Invertebrate	Sediment	Other
ZL1	L01	82.0	12.9	2.6	2.6	-
	L02	79.0	4.0	15.5	1.5	-
ZL2	L03	75.8	4.2	20.0	-	-
	L04	75.9	3.0	20.1	1.0	-
	L05	72.6	4.5	22.3	0.6	-
ZL3	L06	78.3	10.1	11.6	-	-
	L07	70.5	8.5	20.5	0.5	-
ZL4	L09	68.0	11.0	18.5	1.0	1.5
	L10	63.6	14.9	21.0	0.5	-
	L11	61.5	20.5	16.5	1.5	-
	L12	51.5	27.5	21.0	-	-
ZL5	L13	57.1	11.9	30.5	-	0.6
ZL6	L14	51.6	19.8	26.6	1.6	0.5
ZL7	L15	82.0	12.9	2.6	2.6	-
	L16	52.6	34.9	7.8	3.1	1.6
ZL8	L17	60.0	22.6	14.2	3.2	-
	L18	45.4	27.3	11.3	13.4	2.6
AVE. LIMA		66.3	14.7	16.6	1.9	0.4
M01	M01	37.7	30.2	32.2	-	-
M02	M02	57.9	15.7	26.4	-	-
M03	M03	52.4	23.0	24.1	0.5	-
AVE. MIKE		49.3	23.0	27.5	0.2	-
N01	N01	68.3	9.7	22.0	-	-
N02	N02	70.9	4.0	25.1	-	-
N03	N03	61.1	12.1	26.8	-	-
N04	N04	66.9	14.6	18.5	-	-
AVE. NOVEMBER		66.8	10.1	23.1	-	-
AVE. LMN		64.3	15.0	19.1	1.4	0.3
ZL5	L13HF	35.5	11.3	6.5	36.6	10.2
ZL6	L14HF	23.7	9.6	5.1	38.4	23.2
ZL7	L15HF	17.2	10.1	1.0	56.6	15.2
	L16HF	9.6	19.2	-	69.2	2.0
ZL8	L17HF	7.0	14.0	-	73.5	5.5
	L18HF	7.8	5.2	-	85.0	2.1
AVE. LIMA FLOOR		16.8	11.6	2.1	59.9	9.7

2.2.2. Fish

Smith *et al.* (2008) recorded 62 species of fish on transects surveyed in Inner Apra Harbor, 59 of which are native to Guam. They noted that while this number indicates an impoverished fish fauna, the species seem representative of protected, turbid lagoons or bays of Guam. Donaldson *et al.* (2009) found results that were very similar to Smith *et al.* (2008), overall species richness greater on or adjacent to mid-wall and top-wall transects at Oscar and Papa Wharves, where corals, hanging debris, and oyster shells provided shelter for various species, especially damselfish, cardinalfish, and juvenile butterflyfish species. Bottom-transects at both wharves had the lowest number of species and individuals (Donaldson *et al.* 2009).

Besides benthic invertebrates, fishes and other mobile vertebrates were recorded in the surveys of Lima, Mike, and November wharves during September 2019 (NAVFAC 2019; see the Appendix A for details). Those species were surveyed using stationary point count, belt transect, and timed swim methods. Fish species were identified *in situ* and by review of photos and video footage collected during the surveys. Fish species richness from focused *in situ* surveys recorded a total of 97 species identifications within 28 families (Table 4). Three identifications could only be made to the family taxon, and some species were uncertain and identified with notations *affinis* (*aff.*), confer (*cf.*), and species (sp.). Gobiidae and Blenniiddae were underrepresented in the survey data. These families contain species that are small, cryptic, and are difficult to identify. General observations of the bottom habitat indicate that the survey area is rich with many goby and blenny species that live in borrows potentially with symbiotic species, such as shrimp.

Table 4. Fish species richness at Lima, Mike, and November Wharves in Apra Harbor, Guam.

Acanthuridae	**Chaetodontidae**	**Labridae**	**Pomacentridae**
Acanthurus blochii	*Chaetodon bennetti*	*Bodianus axillaris*	*Chrysiptera* aff. *traceyi*
Acanthurus maculiceps	*Chaetodon*	*Cheilinus fasciatus*	*Chrysiptera cyanea*
Acanthurus nigrofuscus	*ephippium*	*Cheilinus trilobatus*	*Chrysiptera traceyi*
Acanthurus nigroris	*Chaetodon lunula*	*Cheilinus undulatus*	*Dascyllus aruanus*
Acanthurus xanthopterus	*Chaetodon ulietensis*	*Halichoeres*	*Neopomacentrus*
Aff. *Acanthurus nubilis*		*biocellatus*	*violascens*
Ctenochaetus marginatus	**Cirrhitidae**	*Hemigymnus*	*Plectroglyphydodon*
Ctenochaetus sp.	*Paracirrhites*	*melapterus*	*phoenixensis*
Naso unicornis	*forsteri* or	*Labroides dimidiatus*	*Pomacentrus*
Acanthuridae sp.	*Pleurosicya micheli*		*aboinensis*
Zanclus cornutus		**Lethrinidae**	*Pomacentrus coelestis*
Zebrasoma scopas	**Clupidae**	*Gymnocranius euanus*	*Pomacentrus pavo*
	Spratelloides	*Lethrinus harak*	*Pomachromis*
Apogonidae	*delicatulus*	*Lethrinus olivaceus*	*guamensis*
Apogon angustatus		*Monotaxis*	*Pomacentridae* sp.
Apogon lateralis	**Dasyatidae**	*grandoculus*	
Apogon leptacanthus	*Urogymnus*		**Scaridae**
Cheilodipterus aff. *macrodon*	*asperimmus* or	**Lutjanidae**	*Chlorurus bleekeri*
Cheilodipterus artus	*Himantura*	*Lutjanus fulvus*	*Hipposcarus longiceps*
Cheilodipterus	*granulate*	*Lutjanus vitta*	*Scarus sordidus*
quinoquelineatus			*Canthigaster valentini*
Rhabdamia aff. *cypselurus*	**Engraulidae**	**Microdesmidae**	
Rhabdamia cypselurus	Engraulidae sp.	*Ptereleotris* aff.	**Serranidae**
		microlepis	*Cephalopholis argus*
Balistidae	**Fistulariidae**		*Plectropomus*
Balistoides viridescens	*Fistularia*	**Mullidae**	*areolatus*
Pseudobalistes	*commersonii*	*Parupeneus* aff.	*Plectropomus laevis*
flavimarginatus		*cyclostomus*	
Rhinecanthus aculeatus	**Gobiidae**		**Sphyraenidae**
	Amblybogius	**Muraenidae**	*Sphyraena barracuda*
Blenniidae	*phaelena*	*Gymnothorax*	
Ecsenius bicolor	*Amblyeleotris* sp.	*javanicus*	**Syngnathidae**
Meiocanthus atrodorsalis	*Amblygobius* aff.		*Corythoichthys* sp.
	sphynx	**Nemipteridae**	
Caesionidae	*Amblygobius*	*Scolopsis trileata*	**Synodontidae**
Caesio caerulaurea	*nocturnus*		*Synodus variegatus*
	Eviota sp. or	**Pomacentridae**	
Carangidae	*Cryptocentrus*	*Abudefduf sexfasciatus*	**Tetraodontidae**
Carangoides ferdau	*strigilliceps*	Aff. *Stegastes*	*Canthigaster solandri*
Caranx melampygus	*Gnatholepis*	*fasciolatus or*	*Canthigaster* sp.
Caranx sexfasciatus	*caurensis*	*Pomacentrys*	
	Istigobius sp.	*amboinensis*	
Carcharhinidae	*Paragobion*	*Amblyglyphidodon*	
Carcharhinus melanopterus	*lacunicolus*	*curacao*	
		Amblyglyphidodon	
Chaetodontidae		*ternatensis*	
Chaetodon lunulatus		*Chromis viridis*	
Chaetodon auriga			

There were notable species observed during the 2019 survey, including juvenile Napoleon wrasse (*Cheilinus undulata*) and three species of adult groupers (Serranidae). These observations suggested that the habitat around Lima, Mike, and November Wharves may offer enough trophic structure to support these predators for at least part of their life cycle. In addition, an endemic damselfish, *Pomachromis guamensis* (Allen & Larson 1975) was observed at Mike Wharf. The greatest number of species were observed near the part of Lima Wharf that extends out toward outer Apra Harbor (zones ZL4 and ZL5 in Figure 13), although a large number of species were also observed at the innermost end of November Wharf (section N1 i and Table 5).

Table 5. Fish species identification per survey section (Source NAVFAC 2019).

Wharf	Section	Number of Species
November	1	23
	2	6
	3	8
	4	13
November Sub Total		**31**
Mike	1	19
	2	7
	3	9
Mike Sub Total		**22**
Lima	1	6
	2	1
	3	0
	45	6
	6	0
	7	10
	8	4
	9	25
	10	30
	11	10
	12	13
Lima Sub total		**59**
Lima Wharf Finger (Outer Apra harbor)	13	22
	13/14	23
	14	29
Outer Lima-Finger Sub total		**44**
Lima-Finger Pier	15	3
	16	16
	17	3
Lima-Finger Sub Total		**23**
Grand Total		**97**

2.2.3. Other Marine Species

Within the Action Area, the 2019 biological surveys identified macroalgae and non-coral invertebrate species, most of which were *Porifera* with trace amounts (i.e. <5%) of tunicates and bivalves (Figure 13;Table 6). The results of a point count analysis of orthomosaics from the wharf faces estimated the dominant biotic cover as macroalgae (64%), and quadrat survey results identified approximately 45 macroalgae species, including green algae, red algae, brown algae, and cyanobacteria (NAVFAC 2019; see Appendix A for more details). On the seafloor in the Action Area, point count data from orthomosaics at the northern end of Lima Wharf contained the highest percentage of macroalgae cover (17%), while quadrat survey data from the seafloor of all wharves resulted with 3% macroalgae cover.

Table 6. Percent cover estimates of macroalgae and non-coral invertebrates from both orthomosaic photographic and quadrat survey data (Source NAVFAC 2019).

Category	Percent Cover - Wharf			Percent Cover - Seafloor	
	Orthomosaic	Quadrat Survey (Shallow)	Quadrat Survey (Bottom)	Orthomosaic	Quadrat Survey
Macroalgae	64	40	28	17	3
Non-coral invertebrates	19	29	33	2	5

Invertebrates such as sponges, bivalves, and tunicates were observed throughout the Action Area, and the preliminary richness (i.e. the most prominent and readily-identified) of these non-coral invertebrates comprised 119 individual counts (NAVFAC 2019; see the Appendix A for details). No protected species of non-coral invertebrates were recorded, although these species could not be identified, as well as corals and fishes (NAVFAC 2019). Species identification was sometimes limited by low light, turbidity, and blurred focus, and a lack of photos of the organism from different perspectives. In addition, the biological survey identified one introduced invertebrate species: the elephant ear sponge, *Ianthella basta,* which is established and observed only in Apra Harbor, provides habitat for fishes, is not invasive, and is popular for recreational divers (NAVFAC 2019).

2.3. ESA-Listed Species and Critical Habitat

Table 7 lists the marine, ESA-listed species that may occur in Apra Harbor, Guam.

Table 7. ESA-listed species that are likely to occur in Apra Harbor, Guam

Scientific Name	Common Name	Status
MARINE MAMMALS		
Balaenoptera musculus	Blue whale	Endangered
Balaenoptera physalus	Fin whale	Endangered
Megaptera novaeangliae	Humpback whale	Endangered
Balaenoptera borealis	Sei whale	Endangered
Physeter microcephalus	Sperm whale	Endangered
Dugong dugong	Dugong	Endangered
SEA TURTLES		
Chelonia mydas	Green sea turtle, Central West Pacific Distinct Population Segment (DPS)	Endangered
Eretmochelys imbricata	Hawksbill sea turtle	Endangered
Dermochelys coriacea	Leatherback sea turtle	Endangered
Caretta caretta	Loggerhead sea turtle, North Pacific DPS	Endangered
Lepidochelys olivacea	Olive ridley sea turtle	Threatened
FISHES		
Sphyrna lewini	Scalloped hammerhead shark, Indo-West Pacific DPS	Threatened
Manta birostris	Giant manta ray	Threatened
Carcharhinus longimanus	Oceanic whitetip shark	Threatened
CORALS		
Acropora globiceps	---	Threatened

Based on historical records and results from biological surveys of Apra Harbor (NAVFAC 2019), only three species have reasonable potential to occur within the Action Area. No ESA-listed coral species were observed within the Action Area. Thus, this consultation document will assess potential impacts to these three species:

- Green sea turtle (Central West Pacific Distinct Population Segment [DPS]), *Chelonia mydas*
- Hawksbill sea turtle, *Eretmochelys imbricata*
- Scalloped hammerhead shark, Indo-West Pacific DPS, *Sphyrna lewini.*

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* (NMFS & USFWS 2007a), the *Green Sea Turtle Status Review* (NMFS 2015), 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).

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 emergencies (also known as nesting attempts or false crawls) 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, Sumay, San Luis, Polaris Point and Tipalao.

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.

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 (NMFS & USFWS 2007 Martin *et al.* 2016, as cited in DON 2018). The *Recovery Plan* (NMFS &USFWS 1998b) and the *5-year Status Review* (NMFS & 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). 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, a biological survey of the Action Area did not observe a hawksbill sea turtle during approximately 40 hours of survey effort (NAVFAC 2019).

As with green sea turtle, 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 (NMFS & USFWS 2007b). However, nesting by hawksbill turtles have not been observed on NBG since 1995 (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.

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 on Guam was in 1968 but confirmed sightings are rare today (Kami 1971; NMFS 2014; Adams 2018). Adult scalloped hammerhead sharks have been observed 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 (NMFS 2015; 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 (NMFS 2015).

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). 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). 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. Furthermore, no scalloped hammerhead sharks were observed during the 2019 biological survey of the Action Area, which included approximately 40 hours of survey effort (NAVFAC 2019).

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 Management Unit Species (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 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 m from shoreline to the outer boundary of the EEZ (i.e. 5,150 km; 200 nautical miles; 230 miles), and 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’s 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’s Archipelago include eggs, larvae, juveniles, and adults for Bottomfish and Pelagic MUS (Table 8). No Habitat Areas of Particular Concern (HAPCs) 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	Bottomfish, Shallow- (0-100 m, 0-330 ft.) and 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, and 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

Recent changes to the ESA defined "effects of the action" as all effects on the listed species or critical habitat that are caused by the proposed action, including the effects of other activities that are caused by the proposed action (50 CFR § 402.02). An effect or activity 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 effects occurring outside the immediate area involved in the action. 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 (FWS & 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 in-water actions (not including BMPs to stop work during for coral spawning periods) are expected to continue for approximately 13 months (beginning August 2021). The in-water work also requires the use of heavy machinery and equipment (both staged on land and atop a floating barge) and divers using hydraulic hand tools (Section 1.2). All such activities have the potential to impact ESA-listed species in the marine environment of Inner Apra Harbor. This section includes an impacts and risks assessment of the effects of the proposed Action on ESA-listed species.

The proposed Action requires informed decisions and effective environmental risk assessments to ensure success. 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. The environmental risk management process is a continuous, systematic decision-informing process that consists of five primary steps:

1. Identify the risk
2. Assess the risk
3. Develop controls and make decisions
4. Implement controls
5. Supervise and evaluate.

The proposed Action Area represents a small portion of the geographic range of ESA-listed species. As the green sea turtle and hawksbill sea turtle do not breed in the Action Area, the Action will have discountable effects on the reproductive success of these animals. 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 Action design (Section 3). Green and hawksbill sea turtles have regular but low-level occurrences within the Action Area, and thus, the proposed in-water activities may affect these species, which will be evaluated in the subsequent sections. A discussion of each potential effect is described in the following subsections.

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 3.1.1)	Near Certainty	Negligible	Moderate	• Marine fauna observers • Shut-down zone	Insignificant
Increased suspended sediments (Section 3.1.2)	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 3.1.3)	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. Elevated Underwater Noise Levels

The proposed activities that will produce elevated noise levels underwater include pre-drilling, pile driving, and navigational dredging. Of these activities, only pile driving is likely to generate noise levels with the potential to cause adverse impacts to ESA-listed species. Apra Harbor is a working harbor with a likely ambient sound pressure level (SPL) >100 decibels (dB) re 1 micro-Pascal (µPa). Marine fauna residing in this environment function and thrive within an acoustic background of relatively high, ambient sound levels. The potential environmental effects of elevated noise levels may include:

- Direct, physiological effects – serious injury or mortality
- Direct, behavioral effects - disruptions to feeding, mating, breeding or nursery activities in such a way that impacts the survival or abundance of populations
- Indirect effects - disruptions to the abundance and behavior of prey species; long-term change to population survival.

The direct, physiological effects from acoustic impacts include hearing damage, injury or mortality. Permanent threshold shifts (PTS) occur when an animal experiences a shift in their hearing threshold caused by prolonged or repeated exposure to high sound levels that results in permanent and irreversible damage (Richardson *et al.* 1995). Temporary threshold shifts (TTS) occur when an animal's hearing threshold is temporarily increased (i.e. temporarily less sensitive to sound) during and immediately after exposure to a loud sound source (Richardson *et al.* 1995). TTS may have a duration of minutes to days to weeks, after which time full recovery is expected. Both TTS and PTS can result from a single pulse, from accumulated effects of multiple pulses from an impulsive sound source (e.g. impact pile driving) or from accumulated effects of non-pulsed sound from a continuous sound source. TTS and PTS occur only in the sound frequencies to which an animal is exposed.

Although there are no known studies on the auditory sensitivity of scalloped hammerhead sharks, 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). Unlike many bony fishes, sharks do not possess swim bladders or other structures that can convert acoustic pressure into a displacement stimulus and, therefore, respond only to the particle motion component of sound (e.g. 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 sound at all frequencies compared to teleosts fishes. This is 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). Thus, acoustic impacts to scalloped hammerhead sharks are discountable.

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 2012, Popper *et al.* 2014). Underwater audiograms for six sub-adult and two juvenile green sea turtles showed hearing sensitivities that were specialized for low-frequencies levels (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 2012). The green sea turtles had lower SPL thresholds in air than underwater at (relatively) higher frequencies (i.e. >400 Hz). 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 PTS has not been investigated. 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, and although a seismic sound source is different from an impact hammer for pile driving, both are impulse noises defined by high peak sound pressure, short duration, fast rise-time, and broad frequency content (NOAA 2016).

Acoustic Effects to Sea Turtles from Pile Driving

During pile driving, the sound intensity depends on the type and size of the pile, installation method, and the substrate. The environmental effects from these elevated sound levels also depend on several acoustic factors, including the source level (i.e. acoustic pressure measured at standard reference distance, usually 1 m), propagation or transmission loss (i.e. loss of sound power with increasing distance from the source), the duration of the activity, and the effective hearing range of the receiving species. Transmission loss varies according to environmental factors, such as water depth, substrate, surface condition, salinity, and the amount of suspended solids in the water. Sound energy will dissipate through mechanisms such as spreading, scattering, and absorption and typically more rapidly in shallow, turbid water over soft substrates (Au & Hastings 2008).

From the scientific literature, the response of marine fauna to pile driving sounds ranged from no effect to various behavioral changes. Immediate, physiological impacts were restricted to very close ranges and high sound intensities and were unlikely to occur for the majority of marine species, as most free-swimming animals avoided areas of disturbance. NMFS provides technical guidance for marine mammal species only. *The 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. As the best available scientific data, these guidelines presented a set of numerical thresholds or 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. This guidance provided reasonable, precautionary threshold values upon which potential effects to green and hawksbill turtles from pile driving noise (Table 10) are assessed in this document.

Table 10. Pile driving sound exposure guidelines for sea turtles (Source: Popper *et al*. 2014).

Effect of Action		Threshold Value
Mortality & potential mortal injury		(SEL_{cum}) 210 dB re 1 μPa^{2}·s*
		($SPL_{pk,flat}$) 207 dB re 1 μPa
Impairment	Recoverable injury (PTS)	(Near**) High*** (Intermediate) Moderate (Far) Low
	TTS	
	Masking	
Behavior		

Notes: *SEL_{cum} derived from 960 pile strikes (Halvorsen *et al.* 2012)
**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.

Acoustic Effects to Sea Turtles from Dredging

Underwater noise from dredging operations have lower sound pressure levels than noise produced from pile driving or in-water construction (Wenger *et al.* 2017). Scientific measurements of underwater sound levels exist for four types of dredging vessels (Figure 14; WODA 2016). 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).

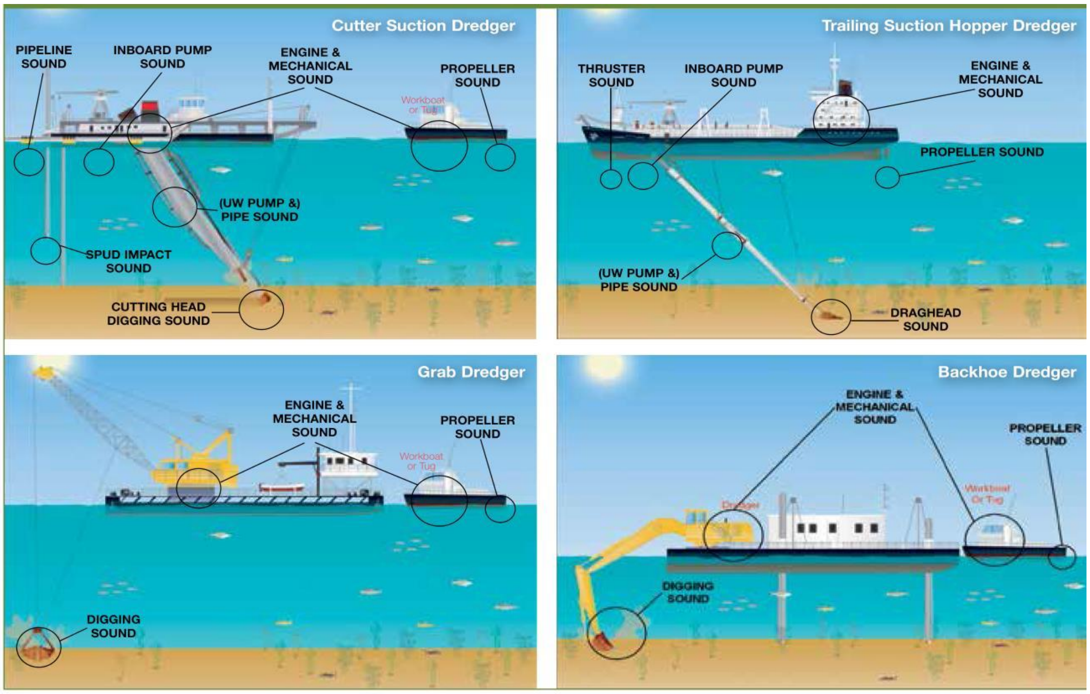


Figure 14. Sound sources for four main dredge types (Source: WODA 2013).

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 Hz; Reine & Dickerson 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. However, 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.

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 Inner Apra Harbor are not expected to exceed SPL_{RMS} of 124 dB re 1 µPa from the impact sound (Table 11). 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 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. Also, implemented BMPs (Section 1.3) will require that all work stop when an ESA-listed marine species is observed within 50 yds. 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 sea turtles or marine mammals.

Table 11. 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

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, and 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 1.3), in-water Action activities may 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.

Estimated Range of Underwater Sound

Among the proposed actions, only pile driving has the potential to generate sound levels loud enough to cause injury or harm to the marine fauna species likely to be in the Action Area. The size of acoustic injury zones depends on different aspects of pile driving, such as the number of piles driven per day and the number of strikes per pile. Impact pile driving has an average rate of 35 strikes per minute, and one pile may require approximately 15 minutes to drive, with a pause of up to an hour before the next pile is driven (U.S. DoN 2017).

Underwater sound levels generated by a single strike from the proposed pile driving are not expected to exceed the levels recorded in previous acoustic investigations (e.g. SPL_{peak} 205 dB re 1 µPa, SPL_{RMS} of 190 dB re 1 µPa, SEL 180 dB re 1 µPa^2·s; CALTRANS 2015). Based on these published values, practical spreading estimated a received sound level of approximately 165 dB re 1 µPa at 50 yards away, which is not likely to cause direct, physiological effects (e.g. serious injury or mortality) to nor behavioral responses from green or hawksbill turtles (Table 10; Popper *et al.* 2014).

The relative risk of PTS for a sea turtle is higher if the animal is within tens of meters from the sound source. However, the implemented BMPs (Section 1.3) will require that all work will stop when an ESA-listed marine species is observed within 50 yards of the proposed work (i.e. Shut-down Zone), and shall only resume after the animal departed the area voluntarily or until 30 minutes passed since the previous sightings, thereby ensuring that should no acoustic impairment (i.e. PTS, TTS or masking) will occur to sea turtles. Also, the full-length silt curtain surrounding the barge crane will present a physical barrier that prevents sea turtles from approaching the pile driving sound source. Furthermore, the rigid external anatomy of a sea turtle may protect them from impulsive sound effects, at least with regard to pile driving (Popper *et al.* 2014). Therefore, any behavioral disturbance to a green or hawksbill turtle exposed to elevated noise levels will be temporary and recoverable, and thus insignificant.

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 inhomogenetities (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).

Therefore, underwater sound levels generated by a single strike from impact pile driving is not expected to exceed the levels recorded in the acoustic investigations summarized above, and thus, are not likely to cause direct, physiological effects (e.g. PTS injury or mortality) to sea turtles. With implemented BMPs, the pile driving sound levels will not be loud enough to exceed acoustic impact thresholds for TTS, PTS, or mortality in sea turtles.

Determination

The Navy determined that exposure to elevated underwater noise levels from the proposed action may affect but is not likely to adversely affect green sea turtles and hawksbill sea turtles. 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 restricted to daylight hours for approximately 13 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, 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.

3.1.2. Increased Suspended Sediments

The proposed action involves dredging (i.e. excavating the seafloor using an environmental 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.

Action-generated, elevated turbidity levels will be contained to the greatest extent practicable using turbidity curtains to encircle each discrete work area. Dredging will result in *de minimis* discharges into the marine environment incidental to the in-water dredge operation. As work progresses throughout the Action Area, elevated turbidity levels would be temporary and are expected to naturally settle and to restore to ambient upon completion, with no persistent or permanent effect.

Turbidity from the proposed in-water activities will be further mitigated by a silt curtain. 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. However, if the curtains are not secured properly, their effectiveness in containing re-suspended sediments may not be complete, as water may pass below or around the curtains (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).

If not mitigated, elevated turbidity levels will reduce light penetration throughout the water column and limit visibility. As the listed species that may occupy the harbor breathe air, their respiratory processes should not be affected by the elevated turbidity. If Action-related turbidity is not controlled or if an ESA-listed species approaches the Action Area, the during-dredging degradation of water quality may behaviorally affect the ESA-listed species by creating an unwelcoming environment and causing listed species to avoid the area, in favor of clearer waters, or due to limited visibility, interfere with foraging. The potential displacement of individuals out of the harbor as a result of the Action activities 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.

Proposed implementation of in-water, perimeter sediment-containing devices (e.g., full-surround silt curtain) will help to minimize the spread and settling of suspended sediments beyond the dredge area. A monitoring and assessment plan to minimize construction and operation-related degradation of water quality will be developed and implemented. 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.

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, Action-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 activities will be restricted to daylight hours for approximately 13 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 will be insignificant to ESA-listed marine species.

3.1.3. 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 Action. Increased, Action-related activity in Apra Harbor will increase human presence, ambient noise levels, and potential for interactions 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 in Apra Harbor. 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 have a regular presence in Apra Harbor, although their occurrence is expected to be low. It is expected that they will avoid human activity throughout the duration of heightened nearshore and in-water activity. As scalloped hammerhead sharks have not been sighted in Apra Harbor in over a decade, it is unlikely that individual sharks will be disturbed by the Action's activities and equipment operations.

Further, no impacts to sea turtles or scalloped hammerhead sharks are expected to occur, provided that the following BMP is implemented: if any marine fauna are sighted within 50 yd. of the construction vessels/equipment, all construction activities will be suspended until the marine fauna (e.g. sea turtles) voluntarily leaves the area or disappears and is not sighted for a period of 30 minutes. The implemented BMPs will prevent intentional interactions with ESA-listed species and will minimize unintentional interactions to the greatest extent practicable. Biological observers will remain vigilant of ESA-listed species within a distance that could be impacted (50 yards) and of the effectiveness of in-water BMP measures. They will visually observe the marine waters at all times, i.e. 30 minutes before, during and 30 minutes after in-water construction activities. All personnel are 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 ESA-listed species and the 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 Action-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. 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, potential disturbance from human activities and equipment operations are expected to be discountable to ESA-listed species.

3.1.4. Direct Physical Contact

The proposed action involves the use of heavy machinery, barge and accessory vessels, and handheld machinery. All Action activities occurring in-water have the potential to result in direct physical contact with or strikes to ESA-listed marine species. A physical impact or strike by in-water equipment 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 escape without further injury. Injuries may include bruising, laceration, broken bones/carapace, amputation or injury-induced, immediate death. From pile driving and dredging operations, an animal could be pinned to the seafloor, causing drowning or immediate death. Environmental dredges produce the least amount of water disturbance compared to other dredgers, and the impacts are localized to relatively small areas. Also, environmental 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.

However, direct physical impact of ESA-listed marine species will be avoided to the greatest extent practicable through implemented BMP measures, which will prevent intentional interactions with ESA-listed marine species. Observers will actively survey marine waters for presence of ESA-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 the NMFS has resolved the concern (e.g., by reinitiating consultation).

Hawksbill sea turtles and scalloped hammerhead sharks are expected to have rare sightings in the Action Area. Thus, potential impacts from direct physical contact to these species are expected to be discountable. For green sea turtles, a regular but low-occurrence is expected within the Action Area, and thus there is a low likelihood that the proposed actions may contact a green sea turtle. However, the Action Area is not a foraging, nesting, nor basking habitat of known importance. The proposed activities are of short duration (i.e. 13 months in water) and during daylight hours only. Furthermore, implemented Shut-down Zones of 50 yd. will not allow green sea turtles (and any marine ESA-listed marine species) to be close enough to the activities to cause direct, physical contact during pile driving. If a turtle or shark approached the in-water, construction activities undetected, full-length silt curtains will surround the crane barge and prevent animals from close approaches to construction activities. Thus, potential impacts from direct physical contact with an individual green sea turtle are discountable, particularly with the BMPs implemented to avoid direct physical contact to marine fauna.

Determination

The Navy determined that with the implementation of BMPs, 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, marine fauna will not be close enough to the activities to cause 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 13 months, thus having a short-term duration for potential impact. Implemented BMP measures (particularly full-surround silt curtain and marine observers) will aid to avoid and/or minimize potential for direct physical impacts with ESA-listed species. Therefore, based on the low occurrence of listed species within Apra Harbor and implementation of BMPs, the potential for direct physical contact with an ESA-listed species are 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 Action Area, while the smaller accessory vessels will be used to monitor for marine fauna and to install temporary, in-water BMP measures (e.g. silt curtains). When surfacing to breathe or rest, marine fauna is at risk of being struck by moving vessels. The type and severity of injury depends 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. Depending on these factors, collision with a small vessel has the potential to cause serious injury or death.

Vessels have the potential to impact turtles and sharks while at the Action Area. Hawksbill sea turtles and scalloped hammerhead sharks are expected to have rare sightings in the Action Area. Thus, during the proposed wharf repairs, potential impacts from vessel collisions to hawksbill turtles and scalloped hammerhead sharks are expected to be discountable.

For green sea turtles, a regular but low-level occurrence is expected within the Action Area, and thus there is a low likelihood for collisions with vessels, which is considered a major threat for green sea turtles (NMFS & FWS 1998a). Research suggested that sea turtles may not consistently detect and avoid vessels traveling at speeds over 2 knots, and higher vessel speeds were more likely to cause impacts, particularly in shallow waters where turtles were abundant and in turbid waters (Hazel *et al.* 2007). Therefore, the success of avoiding a vessel strike is dependent on the speed of the approaching vessel and the prevailing water clarity, rather than vessel type. In accordance with the BMPs listed in Section 1.3, when piloting vessels at or within 50 yards from 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.

Determination

The Navy determined that with the implementation of BMPs, vessel collisions may affect but are not likely to adversely affect ESA-listed marine species. Based on low number of vessels in the water, the rare to low occurrence of ESA-listed species in the Action Area, and the implemented BMPs (e.g. slow vessel speeds), the risk of collision with vessels associated with the proposed action is discountable.

3.1.6. Wastes and Discharges

The Proposed Action will not generate wastes that will enter the water. However, in the unlikely event that Action-related wastes and debris unintentionally and accidentally enter the water, the debris may entangle or be ingested by a marine species, which could be a major, anthropogenic threat to the recovery of ESA-listed species that results in both lethal and non-lethal effects (NMFS 2016, NMFS & FWS 1998). 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).

In an unlikely worst case scenario, accidental spills and discharges could contain petroleum and/or other hazardous chemicals that can expose protected species to toxic substances. Some spills could occur when small containers of chemicals are used in open areas, creating a risk of entering the sea. If released in large quantities, the toxic substances may cause avoidance of the affected area, serious injury or in some severe cases, death. However, if a chemical is discharged or spilled accidentally during the proposed Action, the realistic worst case would be a small quantity or volume (e.g. <25 L).

No debris will 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 Action 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.

In addition, a contingency plan to control and contain accidental, toxic spills will be developed for the Action and include protective measures for all construction vehicles and heavy machinery. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be implemented throughout construction of the Action, with BMPs such as vehicle fueling at least 150 ft. away and pre-work inspections of heavy equipment for cleanliness and leaks. Petroleum spill-containment devices (e.g. absorbent pads, containment booms, etc.) will be located on-site, in sufficient quantity, and available and accessible for immediate deployment at all times. The Action-specific BMPs (Section 1.3) 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 discountable, because accidental spills or discharge will be of small amounts and cleaned quickly. Furthermore, a contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching tropical storms and hurricanes.

Hawksbill sea turtles and scalloped hammerhead sharks are expected to have rare sightings in the Action Area. For green sea turtles, a regular but low-level occurrence is expected within the Action Area, and thus, there is a low likelihood for exposure to accidental release of waste and discharge. Implementation of BMPs (Section 1.3) will prevent accidental release of waste and discharge and have discountable effects to ESA-listed species.

Determination

The Navy determined that with the implemented BMPs, 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 rare to low level occurrence of ESA-listed species and implemented BMPs (e.g. equipment maintenance, contingency plans, fueling restrictions), potential effects from exposure to accidental release of waste and discharges are discountable.

3.1.7. Entanglement

In the Action Area, marine fauna could be entangled inadvertently by two different elements of the proposed action: 1) trash and debris (see Section 3.1.6); and 2) equipment (e.g. silt curtains, rope or barge anchor chains) in the Action Area. Materials could be accidentally 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 also 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.

In the worst case scenario of severe entanglement, 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, and may suffer temporary hindrance to movement before it frees itself or they may remain entangled (DoN 2017). Entangled individuals may suffer minor injuries but recover fully or may die as a result of the entanglement.

Dredging activities will be encircled by silt curtains, which will be used extensively throughout the Action Area to minimize turbidity. The enclosures will be adaptively managed (opened, closed, re-located, re-sized) to minimize spread of suspended sediments to adjacent marine waters. Constant visual surveys for listed species throughout the Action Area will ensure that any species entangled in a silt curtain are immediately freed. Entanglement from equipment and gear typically used in dredging and construction is not commonly observed and unlikely to occur. Action 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 Action 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.

Determination

The Navy determined that with implemented BMPs, entanglement from the proposed action may affect but is not likely to adversely affect ESA-listed species, which are expected to have a rare to low-level of occurrence in the Action Area. The proposed activities will be restricted to daylight hours for approximately 8 months, thus having a short-term duration for potential impact. The silt curtain will be a barrier for animals approaching the Action Area, where the in-water construction work will occur. BMPs will be implemented, such that the risk of entanglement of an ESA-listed species from the proposed action is discountable.

3.1.8. Unexploded Ordnances

As described in Section 2.1.6, the extensive dredging activities in the Action Area post-World War II reduced the probability of encountering MEC, MPPEH, and/UXO items in the Action Area. The material that will be dredged resides in locations that have been dredged previously and has been moved there through natural water movement. Therefore, intentional in-place (underwater) detonations are not expected to impact ESA-listed species.

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 listed species are within 50 yards of the Action Area. The Navy will also surround the use 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 history of previous dredging and construction in the harbor, as well as 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 defined 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 referred to 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.

As described in Section 2.4, EFH has been designated in the Action Area for BMUS and PMUS. All life stages of some species from those two MUS could occur in the Action Area. The Navy understands that even if the results of recent brief surveys do not show that a particular species was observed, that is not conclusive evidence that the species is not there in some life stage. Field surveys discussed in Section 2.1 and 2.2 revealed a modest community of sessile invertebrates and algae on the wharves and debris on the harbor floor within 4 m (13 ft.) of the wharf faces. In addition, a diverse assemblage of fish was observed in the area. The fish represented life stages from juveniles to adults of species typically found on coral reefs, as well as from genera named in the Mariana Archipelago FEP (*Lethrinus*, *Lutjanus*, *Caranx*, and *Variola*) for shallow-water complex bottomfish. None of the specific species listed in the Mariana or Pelagic FEP were observed at the Action site, but some closely related species were seen. Ecologically, species that represented a range of trophic levels were present, including higher order predators such as the blacktip reef shark (*Carcharhinus melanopterus*) and giant barracuda (*Sphyraena barracuda*) observed at Lima Wharf and mesopredators such as the giant moray eel (*Gymnothorax javanicus*) observed at November Wharf and the several juvenile Napoleon wrasse (*Cheilinus undulatas*) observed at Lima Wharf. Although the surveys of the wharves are a brief snapshot in time, it is presumed the results are representative of the invertebrate and fish community regularly found around these wharves. The fish represent an assemblage that is attracted and sustained to some degree by the prey species and other ecosystem components, (i.e. coral, sponges, vegetation, and structure of surfaces and substrate) on and around the wharves.

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, and removal or occlusion of wharf surfaces) are expected to continue for approximately 13 months (beginning August 2021). All such activities have the potential to impact EFH in the marine environment of Inner 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 9), particularly due to temporary nature of the Action and the BMPs implemented into the Action design (Section 3). A discussion of each potential effect is described in the following subsections.

Table 12. 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 (new wharf face)
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 new wharf faces of Lima, Mike, and November Wharves will replace the existing walls and extend approximately 10 ft. (3 m) away from the current position of the wharf faces. 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 wharf faces, debris, and harbor floor, 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 harbor floor is primarily soft sediment and poor habitat for juvenile and adult BMUS to rest or forage. In contrast, the corals and biofouling community that will be removed may be refuge where prey for later life stages of BMUS may reside.

The 2019 biological survey of the Action Area determined that the wharves had an average biotic cover of macroalgae (64%), non-coral invertebrates (19%), and coral (15%; NAVFAC 2019). The average cover of the harbor floor within 13 ft. (4 m) of the wharf face was approximately 56% silt, 12% debris, 10% sand, and 8% coral, with minor contributions of sponges, turf, macroalgae, tunicates, and bivalves (less than 5% each). Installation of new sheet pile walls at Lima, Mike, and November Wharves will result in the physical removal of approximately 5,127 m^2 (55,187 ft^2) of existing wharf area and 2,673 m^2 (28,772 ft^2) of harbor floor for a combined marine environment area of 7,800 m^2 (83,959 ft^2). More than 5,127 m^2 (55,187 ft^2) will be replaced by new wharf face, and will be available again as a surface for EFH recruitment.

Corals

Physical removal of the Action Area's coral community will result in a reduction of quantity of habitat that supports MUS and prey species. On the wharf faces only, photomosaic documentation and analysis estimated 25,700 coral colonies (NAVFAC 2019). This estimation is based on an extrapolation of survey data from 27% of the entire Action Area. Of these colonies (wharf faces only), approximately 52% are in the smallest size class (0–10 cm). Additionally, photomosaic documentation and direct counts estimated approximately 4,700 coral colonies on the debris and the harbor floor within 4 m (13 ft.) from the wharf. Of these colonies (harbor floor and debris only), approximately 58% are in the smallest size class (0–10 cm). Of the combined 30,400 coral colonies (wharf faces, harbor floor and debris), approximately 53% are in the smallest size class (0–10 cm) of the Action Area's total coral community (NAVFAC 2019).

Corals that have an encrusting growth form (such as *L. purpurea* and *Favia favus*) provide a nominal contribution to the functionality of EFH at a site of a manmade structure, as they do not provide habitat complexity, rugosity, nor refuge for predators or prey. These species cover artificial surfaces with living coral tissue, thus providing filtering functions and preventing macroalgae from establishing in locations where corals may thrive. However, that function is not essential to manmade structures because those structures are not intended to be vibrant, coral-dominated habitat. In contrast, for locations with significant water movement and friable or partitioned substrate, encrusting corals provide stability to growing surfaces and may be resilient to environmental change, such as storms and/or bleaching events (for example Halford *et al.* 2004, Denis *et al.* 2017). Once again, that function is unnecessary on manmade structures. Encrusting growth forms are also difficult to avoid damaging because they cannot be removed from a site easily unless they are on a rock or piece of debris that is easy to transport. Therefore, the Navy does not consider the loss of encrusting coral colonies from the Action Area to represent a notable loss in EFH quality for PMUS or BMUS. Nonetheless, these colonies are considered as EFH in the analysis and for offset mitigation (see below), but not considered for coral translocation.

From orthomosaic images, coral species that were observed in the strictly encrusting growth form represented 28.5% of the colonies counted at the Action Area (NAVFAC 2019). For the purposes of this analysis, the species found in the encrusting growth form were *L. purpurea*, *F. favus, Pavona frondifera*, *Pavona varians*, and *Porites* encrusting colonies that were less than 7.9 in (20 cm) in diameter (larger colonies could also take on the laminar growth form). The Navy's conservative estimate of encrusting colonies excluded species that occur in several growth forms that could include encrusting. Two of the encrusting species (*L. purpurea* and *Porites* encrusting colonies that were less than 7.9 in (20 cm) in diameter) were among the most numerous corals counted in the survey area of the project footprint (14.1% and 13.8% colonies, respectively). The other encrusting coral species comprised the remaining 0.6%.

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, Miller *et al*. 2014). Small colonies are difficult to remove and relocate because of their small size and relative delicacy. In the Action Area, the smallest colonies represented the greatest number of individual coral colonies across species on the wharves or on the harbor floor and their removal is not considered to represent a significant net loss of quality or quantity to EFH. Therefore, these colonies will not be included in the calculations for relocation, but are considered in this analysis as making a contribution to EFH as habitat.

Coral species identified from the Poritidae Family in the massive category (>10 cm; 3.9 in) comprised 17% of the corals observed on the shallow waters along the wharf faces. Considering diversity and habitat value, these massive *Porites* spp. are less likely to survive coral translocation, exhibit the highest rate of partial mortality and stress, and display too large of growth morphologies to physically relocate with ease. All *Porites* spp. will be considered as EFH in the analysis for offset mitigation, but not considered a priority for coral translocation. However, several massive *Porites* spp. colonies growing freely on the outer harbor floor of the Action Area are more likely to survive coral translocation and exhibited less signs of adverse health. These colonies would likely be capable of surviving translocation, as exhibited by prior relocation activities in the area (HDR *et al.* 2019). Therefore, the massive *Porites* spp. colonies on the outer harbor floor will be considered for coral translocation.

Throughout all sizes and morphologies of coral colonies observed, an average of 6.4% displayed bleaching, disease, and/or partial mortality (NAVFAC 2019). Bleaching and disease incidence with partial mortality was highest in the shallow zones, predominately within the Poritidae Family, and averaged 1.6% of all colonies observed. Partial mortality averaged 4.8% of all corals observed, with greatest incidence at the inner harbor floor near the wharf face and was directly attributable to silt smothering (NAVFAC 2019). In addition, the presence of recent mortalities were attributed to the boring sponges *Cliona vastifica* and *Cliona cf. lampa* for the Omega-stage, when the sponge rapidly dissolves after reproduction and the bored coral skeleton collapses. The recent mortalities due to these sponges were not specifically quantified for this analysis, but the observations were considered indicators of the health and status of corals experiencing partial mortality in the Action Area. There were no other indications of coral predation causing tissue loss from other corallivores, (e.g. crown-of-thorns starfish, *Drupella* or corallivorous fishes), and thus, it was assumed that predation was an unlikely cause of any significant portion of bleaching, disease, and/or partial mortality. All coral displaying adverse health conditions still contribute towards the EFH analysis. However, 1.2% of all corals exhibited visual signs of disease and are thus considered to be unhealthy and providing lesser services and functions to EFH. Therefore, all colonies displaying adverse health will be considered within the total coral area as EFH but a slightly lower quality of the services (1.2%) diseased corals will be reflected in the analysis for offset mitigation (see below). All colonies displaying adverse health conditions (bleaching, disease or partial mortality) will not be considered for coral translocation.

Photomosaic analysis examined the two-dimensional surface area of corals along the longest colony diameter. The perimeter area was also generated for comparison, and the ratio of the total diameter area to perimeter area for each wharf is about 2:1. Such a ratio suggests that estimating coral cover based on the longest colony diameter, and assuming circular shape will double the actual coral cover result. For this analysis, a circular shape for coral colonies was conservatively assumed based on the maximum diameter. The Navy extrapolated that the total area of coral cover along the wharf faces in the Action Area was 760 m^2 (8,227 ft^2; 15.0%). Combined photomosaic analysis (i.e. using the longest colony diameter and averaging the size frequency data of colonies when mosaics were not available) generated a total area of coral cover of the harbor floor in the Action Area to 310 m^2 (3,337 ft^2; 11.6%). Therefore, the total area of coral cover for the entire Action Area was 1,070 m^2 (11,517 ft^2; 13.7%). This area will be the primary focus of avoidance, minimization, and offset mitigation proposed for this Action.

Biofouling Community

The biofouling community comprised suspension feeders that exploit the planktonic community and contribute to the biomass and energy transport of the marine ecosystem in the Action Area. Sponges 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). Sponges feed primarily on picoplankton (<2 µm) with up to 99% efficiency rate. Therefore, the filter-feeding ability to actively uptake particles and plankton allows sponges and other suspension feeders to participate in large-scale repair of water quality and regulation of the marine ecosystem (Ostroumov 2005).

The impact to filtration services associated with the removal of the biofouling community on the existing wharves will adversely affect the quality of EFH through a minor and temporary reduction in water quality. The biofouling community comprised 980 m^2 (10,549 ft^2) that is approximately 19% of the total existing wharf faces, 2.1% of the total area on the harbor floor and debris (Table 6), and provided little to no structure or habitat. This area will also be the focus of avoidance, minimization, and offset mitigation proposed for this Action.

Furthermore, the new sheet pile wharves will replace the existing wharf faces entirely, and will support the growth of a new biofouling community, including macroalgae and filter-feeding invertebrates. Thus, the unavoidable loss of the ecosystem functions and services provided by the biofouling community is temporary, and the species will be able to recruit and recover on the new wharf structures. Scientific evidence documented that biofouling 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). Therefore, it is reasonable to conclude that the biofouling community and ecosystem functions and services would appear within a short time (as little as two weeks) on the new wharf surfaces. Based on these findings, adverse effects to the biofouling community within the Action Area will be temporary and recoverable.

Infauna and Benthic Community

With the exception of the northern and western sides of Lima wharf, the Action Area seafloor (i.e. the seafloor extending from the bottom of the sheet piling to 4 m from the sheet piling) consisted of soft, sandy mud with scattered anthropogenic debris (i.e., pipes, hoses, cables, ladders, and assorted metal objects) and isolated small coral colonies, which were more abundant on the debris than the seafloor (NAVFAC 2019). The anthropogenic debris afforded solid surfaces raised above the mud floor and provided preferred settling sites for corals compared to the natural substratum. Divers found, during the most recent biological survey, that the natural substratum was easily re-suspended into the water column, limiting visibility. As a result, the natural seafloor habitat is not suitable for recruitments of coral or other EFH. Additionally, dredging or other construction activities of the Action Area footprint 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. Also, after the 100% design specifications were developed for the Action, Navy engineers further avoided impacts to corals on the harbor floor by redesigning the wharf structure and restricting all dredging at the north end of Lima Wharf.
- ***Minimization*** – Effects from the Action will be minimized by implementing BMPs and natural resource

management actions. In addition, the Navy will move coral (suitable for translocation) and other invertebrates from the 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 avoidance 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

After completing the Action's 100% engineering plans, the Navy assessed potential impacts from the Action and determined that the quality of EFH (particularly coral reef habitat) at the north end of Lima Wharf would be adversely affected by extending the wharf by 3 m (10 ft). To avoid these losses, the Navy reduced the distance of the new north and west walls of Lima Wharf to 2.1 m (7 ft) from the existing wharf face. This change in the Action avoids impacts to approximately 79.2 m^2 (852 ft^2) of EFH on the harbor floor.

In addition, the orthomosaics demonstrated that the substrate at the north end of Lima Wharf contained more sand and coarse sediment, as opposed to the muddy sediment along Lima Wharf's east wall in the Inner Harbor (NAVFAC 2019. Coral cover at the north end of Lima Wharf was 12%, with larger coral colonies than the other harbor floor sites surveyed. It was also the only location where seagrass was observed adjacent to the Action Area. Therefore, to avoid impacts to this EFH habitat, the Navy redesigned the Action and will not dredge the harbor floor in front of the north and west walls of Lima Wharf.

Finally, based on 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

Of the 30,400 corals estimated on wharf faces, harbor floor, and debris, about 24,600 colonies are not candidates for translocation. They were too small, exhibited adverse health conditions and/or had a growth form that cannot be safely transported (i.e. encrusting, branching, columnar, and some laminar forms). The Navy will strive to minimize loss of the remaining 5,800 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 15). 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). The 1.5–2 acre area on top of Mound 9 is predominately comprised of rock rubble and sand-covered bottom (NAVFAC 2019).

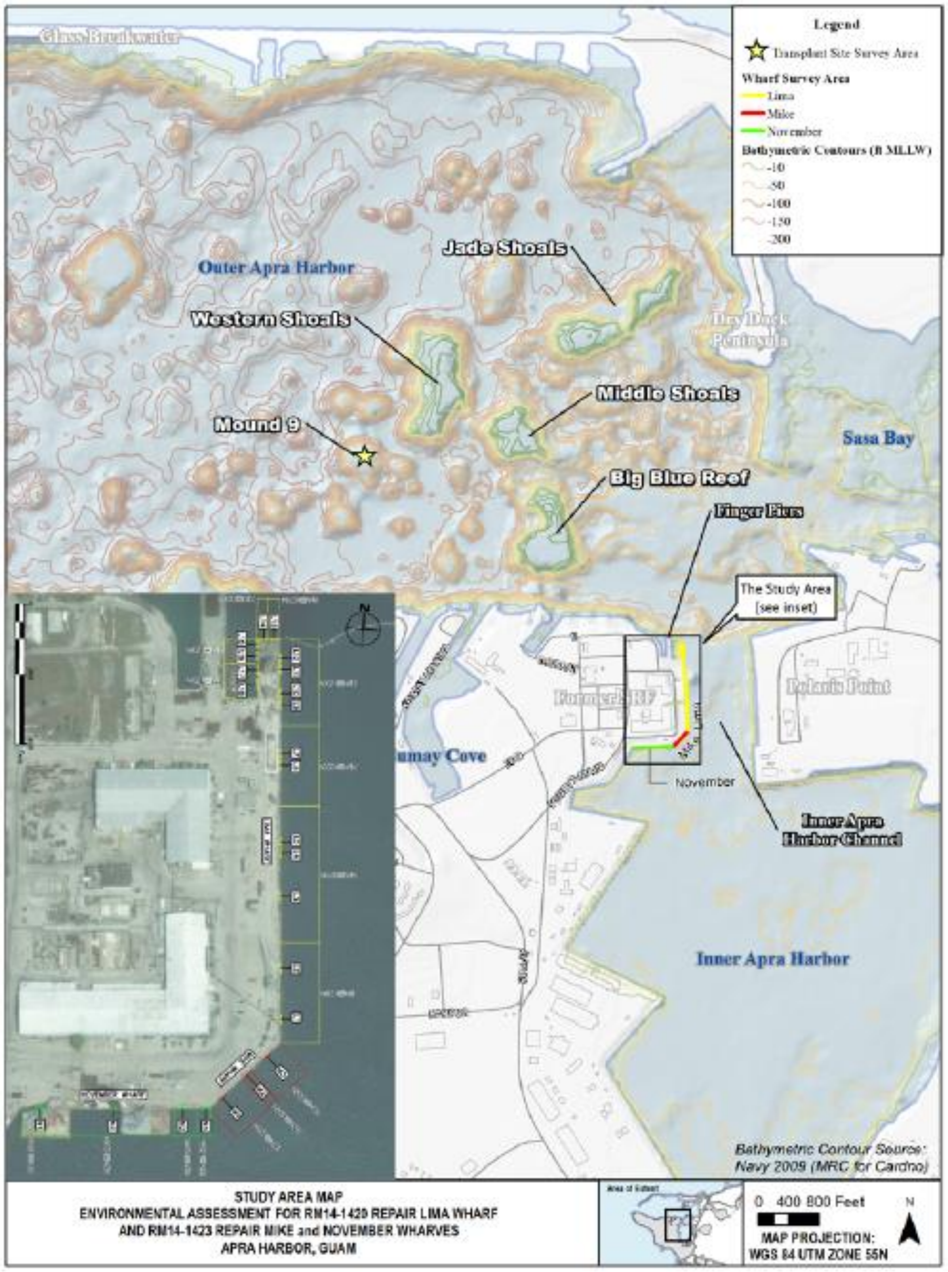


Figure 15. Map of Action Area and Mound 9 in Apra Harbor, Guam (Source: NAVFAC 2019)

The Navy does not expect to successfully translocate all 5,800 corals to Mound 9. Some corals have a growth form that is too delicate to move because of fragility or sheer mass, and these delicate forms include the branching, columnar, and some laminar forms. The Navy defined the following criteria for the appropriate candidates for coral translocation:

1. At least one dimension is greater than 10 cm.

   a. Colonies that were <10 cm (3.9 in) in diameter represented 53% of the colonies counted at the Action Area (NAVFAC 2019) and are <u>not suitable for translocation</u>.
   b. The survey data contained an overlap of coral colonies with encrusting growth forms and <10 cm (3.9 in) in diameter, and those two values cannot be added. When the encrusting colonies that were <10 cm (3.9 in) in diameter were removed from the encrusting colony group, the remaining value represented 8.1% of the total counted colonies.
   c. The survey data also contained an overlap in the group of colonies that were *Porites* massive growth forms and <10 cm (3.9 in) in diameter, and those two values cannot be added. When the *Porites* massive colonies that were <10 cm (3.9 in) in diameter were removed from the *Porites* massive colonies group, the remaining number value was 17.1% of the total counted colonies.
2. Colonies in good health (i.e. no signs of bleaching, wounds, disease or parasites).
   a. Throughout the Action Area and in all size classes, 6.4% of all coral colonies displayed some form of adverse health conditions from disease, bleaching or partial mortality, and thus are not suitable for translocation.
   b. Coral disease was highest in the colonies near the water surface. Translocation should avoid colonies with signs of coral disease (to prevent spreading disease further and to increase survival at Mound 9), and intervene if disease is observed at Mound 9.
   c. Colonies that were not included in the <10 cm diameter or encrusting growth forms but showed adverse health conditions comprised 2.7% of the total coral population. Combined, encrusting growth forms, colonies that were <10 cm (3.9 in) in diameter, and colonies that showed signs of disease, bleaching or partial mortality represented 80.9% (53% + 17.1 % + 8.1% + 2.7%) of all corals that were counted at the Action Area.
3. Morphology that could be removed with minimal damage, in particular:
   a. No finely-branching growth forms, such as *Pocillopora damicornis*
   b. No flat-encrusting growth forms, such as *L. purpurea*.

Realistically, the Navy expects that approximately 29% of the possible candidate corals (approximately 1,700) will not meet the translocated criteria, including the majority of coral colonies that were found attached/growing on anthropogenic debris. These coral colonies would be immoveable due to the type of debris, form of attachment, and/or requirements to relocate portions of the debris (e.g. sawing off debris). These corals will be unavoidably lost based on the type of debris found and coral attached. Furthermore, of the 5,800 corals, several 'rare' species were observed, including *Lobophyllia hatai, Pectinia paeonia, Pectinia alcicornis, Symphyllia hassi*, and *Coscinaraea exesa*. Preserving 'rare' species will be a priority and ecologically meaningful to the EFH. To preserve their genetic and ecological functions, translocation effort will prioritize the relocation of rare coral species, regardless of growth form or size, and with the following considerations:

1. To preserve or enhance microhabitat for fish and other animals:
   a. *Porites horizontalata*
   b. *Porites monticulosa*
   c. Similar morphologically complex species that can be translocated relatively intact.

   d. The branching morphology of *Porites rus* is also high-value but with a lower probability of most colonies remaining intact.
2. To maintain habitat diversity value
   a. species that seem to prefer vertical surfaces: *Pachyseris*, *Symphillia*, etc.
   b. massive *Porites* spp. to create/enhance vertical surfaces at Mound 9.

Therefore, the Navy will attempt to move 13.5% of the total estimated coral colonies (i.e. the remaining 4,100 corals) to Mound 9, along with large sponges and mobile invertebrates that can be collected in the Action Area. 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 80% of translocated coral will survive, with only partial mortality within five 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 20% more corals (i.e., 820 of 4,100 corals) that may be unavoidably lost, with the overall EFH benefit that 80% (i.e. 3,280 corals) are expected to survive and grow on Mound 9.

At the mitigation site, 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 (SSC PAC 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 (NAVFAC 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 (NAVFAC 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 16). 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.

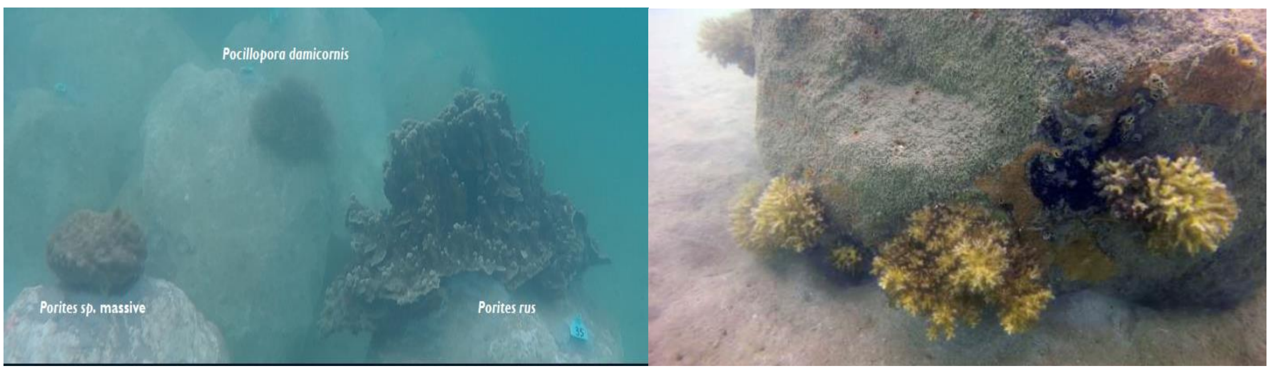


Figure 16. (Left) Corals translocated onto limestone boulders in Inner Apra Harbor in 2015; (Right) recruited coral colonies of *Pocillopora damicornis* growing along lower edges of a boulder at translocation site in 2018 (center colony approximately 15 cm diameter; Source HDR *et al*. 2019).

Offset

The most notable ecosystem functional loss to EFH from this Action is the community and habitat complexity on the surface of the wharf, which allows for recruitment, refuge, and habitat for BMUS and PMUS species. Based on the recent biological survey analysis (NAVFAC 2019), the area of coral (1,070 m^2) and biofouling community (980 m^2) that are functioning collectively as EFH in the Action Area that is expected to be unavoidably lost is estimated to be 2,050 m^2 (22,066 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, (NAVFAC 2019) as feasible. By restoring the site at Mound 9, the Navy will be performing habitat conversion from the invertebrate community on manmade structures 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. Also, these and other BMUS species could inhabit Mount 9 as juveniles and adults.

For the proposed Action, the Navy performed a 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 B) in the HEA analysis produced 848.4 m^2 (9,132 ft^2) of replacement habitat to offset the loss of coral cover, and 28.8 m^2 (310 ft^2) of replacement habitat to offset the temporary and permanent loss of EFH. In total, the HEA analysis indicated a replacement project of 877.2 m^2 (9,442 ft^2) will provide the service gains equal to the services temporarily lost (see Appendix B).

The Navy understands that the percent cover used for analysis of corals and biofouling community is limited in its three-dimensional evaluation of habitat, even though at least one-third of all corals observed had an encrusting morphology and thereby lacked significant three-dimensional structure. The small corals (<10 cm) and the encrusting corals 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 longest colony diameter - as many corals do not grow in a circular growth form, it is apparent that the calculation of area based on only the longest colony diameter is greater than the area based on actual colony shape.
    b. a circular shape for all colonies. A secondary method that calculates the area within the polygon prescribed by the outline of the perimeter of each colony was also calculated.

   Based on the LMN survey reports, the ratio of the total diameter area to perimeter area averaged for each wharf is about 2:1, which suggested 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.

2. The HEA analysis of coral cover included all coral species, regardless of encrusting morphology, small size, adverse health or translocation from the Action Area.
    a. 64% of all corals observed fell into these categories, but their EFH services and functions are acknowledged (despite being variable and often minimal). The Navy conservatively avoided omitting any percentage of these criteria and considered all coral cover in its HEA analysis.
    b. While some corals are precluded from translocation, the HEA analysis included all prospective translocated corals, which were essentially mitigated twice - in both the minimization and offset mitigation.
    c. The Navy accounted for lesser services provided from diseased corals by lowering the total service level at the project site and restoration site to 98.8% for both pre-injury and in perpetuity.

3. The coral and biofouling community HEA analysis included a ratio of 1:1 for the pre-injury site (Action Area at LMN wharves) versus the recovery site (Mound 9). The Navy conservatively accepted that a vertical manmade structure inside an active military installation was equivalent to a natural coral reef mound in the outer harbor, which has suffered previous adverse impacts. Realistically, conditions and quality at Mound 9 are expected to be substantially more optimal for coral survivorship and recruitment, especially after habitat restoration is executed and further complemented with regular maintenance and monitoring.

4. Finally, the Navy is also proposing to provide more replacement habitat (1,075 m^2; 11,571 ft^2) than the HEA analysis indicated as necessary (877.2 m^2 ; 9,442 ft^2) to provide service gains equal to the services temporarily lost over time in the Action Area.

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 400 m^2 (4,306 ft^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 150 locally-sourced, limestone boulders or concrete blocks 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 16 and Figure 17; 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 17. Limestone boulders from a quarry on Guam were transported to a coral translocation site by barge and placed underwater at the selected site (Source: NAVFAC 2018).

- The Navy expects to procure limestone boulders from the same source and of the same approximate size for the proposed habitat restoration. Therefore, 150 boulders will add approximately 675 m^2 (7,266 ft^2) of hard surface area to the top of Mound 9.
- 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.
- baseline survey of existing coral community adjacent to the restoration site at Mound 9.
- Monitor (i.e. quantify and assess the resource conditions) fish, algae, and transplanted coral at the Mound 9 restoration site at pre-determined intervals over five years after translocation (e.g. at the time of completed translocation, and at 6, 12, 24, and 60 months thereafter).
- after each monitoring event, provide a status report to NMFS on the condition of coral, macroalgae, and fish at the Mound 9 restoration site.
- manage macroalgae and sponge populations that threaten to overgrow transplanted corals at Mound 9, (including “weeding” and removing algae and sponges at 3-6 month intervals up to five years after translocation).
- manage corallivore species populations (e.g. crown-of-thorns starfish) at the 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.

With the execution of the above steps, the Navy expects to stabilize and/or add more than the original 5,200 m^2 (55,972 ft^2) of exposed wharf face and approximately 1,075 m^2 (11,571 ft^2) of new surface area at Mound 9. Not all of this surface area will be available to marine species for habitat use. The area of the stabilized substrate occupied by the placed boulders is estimated between 54 and 216 m^2 (581 and 2,315 ft^2). Therefore, the approximate surface area of the proposed habitat conversion available for translocation and species recruitment at Mound 9 will be between 805 and 1,021 m^2 (8,665 and 10,990 ft^2), which is between 0.95 and 1.20 times the replacement habitat size calculated by the HEA. However, some boulders will have a smaller size, and some boulders may be stacked, thereby covering a smaller section of the stabilized habitat area. Once translocation is complete, Mound 9 will be populated with a community of approximately 4,100 corals along with other invertebrates, more than 80% of which are expected to persist and grow when properly managed.

Determination

The Navy determined that the direct physical removal of coral and other marine species will adversely affect EFH for BMUS and PMUS. Of the coral and biofouling community in the Action Area, approximately 2,050 m^2 (22,066 ft^2) is contributing to EFH that warrants avoidance, minimization, and offset measures (Table 13). The Navy will avoid this impact by revising the Action at the north end of Lima Wharf (i.e. reducing wharf size and avoid dredging the north end) and by implementing BMPs (e.g. safe equipment and vessels use). The Navy will also minimize losses by translocating approximately 13.5% 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 five 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 13. Summary of mitigation actions other than BMPs proposed to address the removal of the marine invertebrate community on Lima, Mike, and November Wharves

Mitigation Action	Type	Quantity
Reduce location of new wharf face from 3 m (10 ft.) to 2.1 m (7 ft.) on north and west side of Lima Wharf	Avoidance	Construction footprint reduced by 79.2 m^2 (852 ft^2)
Translocate coral and other benthic invertebrates	Minimization	Target moving approximately 4,100 colonies; about 3,280 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
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 400 m^2 of rubble stabilized for invertebrate attachment and recruitment

Mitigation Action	Type	Quantity
Boulder placement at Mound 9	Compensatory mitigation – habitat conversion	150 boulders - about 675 m^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.

Inner Apra Harbor is subject to daily vessel traffic and regular maintenance dredging (at an interval of roughly 5–8 years). Therefore, during maintenance dredging, corals in Inner Apra Harbor are exposed to suspended sediment and oxygen depleted water as a result of the movement of large quantities of sediment by dredging equipment. DON employs BMPs to reduce negative effects to corals from dredging. In addition to dredging, wharf maintenance regularly impacts coral that is grown on the man-made structures. Because there are long intervals between major wharf repairs, coral can grow to become large and can represent significant ecological function as EFH.

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. Thus, the following assessment evaluates potential impacts for EFH of all life stages of the BMUS and PMUS.

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 sediment 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). 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*. 2015; 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.* 2015). 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*. 2015). 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).

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 of the silt curtain and caused by the proposed repairs, the contractor shall stop the activity and take corrective action immediately. Work will resume after the cause of the excess turbidity is corrected.

Furthermore, the 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. <u>Phase One – Synchronization / Fertilization (Day 1-8)</u>: 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, Jokiel 1985, 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 5–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.

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.* 2015). 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.

Particle Tracking Model for Apra Harbor

The Naval Facilities Engineering Command Pacific (NAVFAC PAC) requested assistance from the U.S. Army Corps of Engineers (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 alternative berthing sites. 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 impact and risk assessments.

The PTM, a Lagrangian particle tracker, 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).

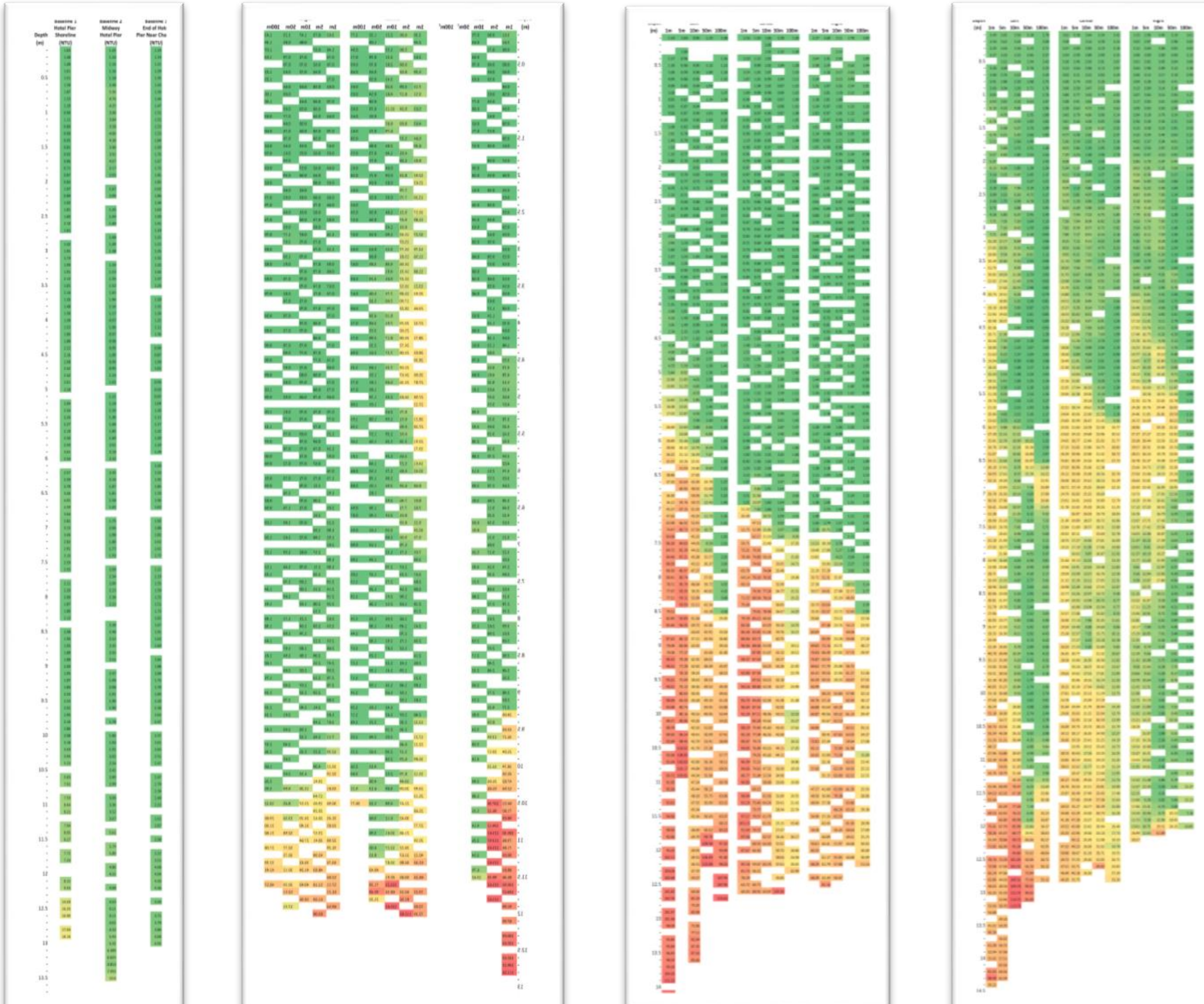
Further, the model results demonstrated that sediment dredged at each site generally remained near the dredge site. It was concluded that lateral transport was nominal because of the small velocities within Apra Harbor (Gailani *et al.* 2017). The model also indicated that sediment tends to deposit shortly 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 dredging would have similar but 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

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 Nephelometric Turbidity Unit (NTU), which measures scattered white light at 90 degrees from an incident light beam.

During a recent maintenance dredge of Pearl Harbor’s Southeast Loch (SE Loch) in 2018, heat maps suggested that turbidity levels close to or above 20 NTU mostly occurred within a meter or less of the bottom (Figure 18). 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. From this Pearl Harbor maintenance dredging data, the overall impression 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 18).



(a) (b) (c) (d)

Figure 18. 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).

Determination

The Navy determined that suspended sediment may adversely affect EFH. However, any effects from suspended sediment would be temporary and last only as long as the Action 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. Implemented BMPs (e.g. silt curtains) will reduce effects of increased suspended sediments to EFH to minimum levels. Therefore, based on 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 Underwater Noise Levels

The proposed Action will produce elevated underwater noise levels from: pre-drilling, pile driving new sheet piles, and reclamation marine dredging after new wharf construction. These in-water actions are likely to generate underwater noise levels with the potential to cause adverse impacts to fish, particularly for species identified within the BMUS and PMUS. See Section 3.1.2 for more information about the acoustic properties of pile driving sounds.

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 influences 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:

1. Fish with no swim bladder or other gas chamber – these fish are less susceptible to physical trauma and injury from exposure to noise.
2. 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.
3. 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 kHz), which is higher than marine dredging sounds (Table 11). 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 from Pile Driving

Direct impacts from exposure to pile driving operations include behavioral avoidance, TTS, PTS, serious injury (e.g. barotrauma) or mortality. The types and frequency of injury are influenced by the presence or absence of a swim bladder, as well as the type of swim bladder. When exposed to low-frequency impulsive sounds, the swim bladder may vibrate with sufficient magnitude to cause damage to tissues and organs, including the swim bladder itself (Halvorsen *et al.* 2012a). Fish with physostomous swim bladders have the ability to expel air quickly, to reduce tension on the swim bladder, and to prevent further damaging effects during noise exposure. In contrast, fish with a physoclistous swim bladder decrease the volume of gases slowly and thus may sustain more severe injuries. Spiny-rayed fish such as Pomacentridae, Ostraciidae, and Sciaenidae are physoclistous examples. Finally, 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. In the water around the Action Area, fish species are predominantly spiny-rayed teleost fish (Section 2.2.2). While the type of swim bladder was not identified for all species, it is reasonable and precautionary to presume that these fish are have physoclistous swim bladders, which are typical for spiny-rayed teleost fish such as those from the Families Pomacentridae, Ostraciidae, Sciaenidae, Zanclidae and Zeidae (UCSD 2009). Of these Families, fish from Pomacentridae, Ostraciidae and Zanclidae were identified in the nearby benthic habitat survey of the Action Area (Carilli *et al.* 2018).

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. These guidelines provided reasonable, precautionary threshold values upon which potential effects to fish from pile driving noise (Table 14) will be assessed in this document.

Table 14. Pile driving sound exposure guidelines for fish (Source: Popper *et al*. 2014).

<table>
<tr><th colspan="2">Effect of Action</th><th>Threshold Value - No swim bladder</th><th>Threshold Value - Physostomous swim bladders</th><th>Threshold Value - Physoclistous swim bladders</th></tr>
<tr><td colspan="2" rowspan="2">Mortality & potential mortal injury</td><td>219 dB re 1 μPa^{2}s (SEL_{cum})</td><td>210 dB re 1 μPa^{2}s (SEL_{cum})</td><td>207 dB re 1 μPa^{2}s (SEL_{cum})</td></tr>
<tr><td>213 dB re 1 μPa ($SPL_{pk,flat}$)</td><td>207 dB re 1 μPa ($SPL_{pk,flat}$)</td><td>207 dB re 1 μPa ($SPL_{pk,flat}$)</td></tr>
<tr><td rowspan="4">Impairment</td><td rowspan="2">PTS</td><td>216 dB re 1 μPa^{2}s (SEL_{cum})</td><td colspan="2">203 dB re 1 μPa^{2}s (SEL_{cum})</td></tr>
<tr><td>213 dB re 1 μPa ($SPL_{pk,flat}$)</td><td colspan="2">207 dB re 1 μPa ($SPL_{pk,flat}$)</td></tr>
<tr><td>TTS</td><td colspan="3">186 dB re 1 μPa^{2}s (SEL_{cum})</td></tr>
<tr><td>Masking</td><td colspan="3" rowspan="2">(Near*) High** / (Intermediate) Moderate / (Far) Low</td></tr>
<tr><td colspan="2">Behavior</td></tr>
</table>

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 documented underwater sound levels generated by a single strike from pile driving, the estimated sound source level will not exceed the threshold levels likely to induce mortality/mortal injury or PTS for the fish (Table 14). Only at very close distances may a fish be exposed to sound levels greater than the TTS threshold of 186 dB re 1 μPa^{2}s (SEL_{cum}), which is only likely during the brief periods of driving a steel pipe pile with an impact hammer. However, with the implemented BMP of a full-length silt curtain, no fish are expected to encounter the pile-driving sound source. 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. Furthermore, the surrounding substrate is covered by a relatively featureless, sandy-mud seabed and 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.

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.

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 15) will be assessed in this document.

Table 15. 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		(Near*) High**/(Intermediate) Moderate/(Far) Low		

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 11), which is below the threshold levels likely to induce mortality/mortal injury, PTS, TTS or masking for fish from a continuous sound (Table 15). 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, underwater noise levels will adversely affect the quality of EFH, particularly for BMUS and PMUS species, which may be more sensitive to sound. However, the acoustic effects will be short-term (daytime hours only for approximately 3 weeks) and minimal (i.e. predicted sound levels from dredging will not exceed thresholds likely to cause TTS, PTS or mortality). Fish may respond behaviorally to 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 (e.g. full-length silt curtain), potential acoustic effects from exposure to elevated, underwater noise levels from in-water activities 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 unintentionally and 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 Action 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 Action 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, Action-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.

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 commercial vessels and equipment used in construction represent a pathway/vector for potential AIS introductions (Ruiz & Zabin, 2014). The Navy implements prevention and control measures to reduce the risk of introduction and spread of invasive species and includes these measures in contract specifications. 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 may 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. the Environmental Readiness Program Manual, RBP, and INRMP) and implemented BMPs, potential impacts from exposure to AIS will be unlikely to occur.

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 exhibited 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 16). 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 16. Main contaminants, sources and concerns in regards to tropical coral reefs (van Dam *et al*. 2011).

Contaminant Group	Representatives	Sources	Main Concerns for 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 a remedial investigation (RI) of Apra Harbor identified the nature and extent of chemicals of potential concern (COPCs) in the Apra Harbor sediments, evaluated sediment transport processes, and assessed 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 the Action's in-water activities (e.g. pile driving and dredging) could have negative impacts on EFH. These activities 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. 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. 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 chemical contaminants within the sediments from the proposed Action would adversely affect EFH for all MUS likely to occur in the Action Area, and these 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 small 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 hypoxic conditions in the marine environment will not occur during the proposed Action and thus not adversely affect EFH for all MUS likely to occur in the Action Area.

3.2.1. Unexploded Ordnances

As described in Section 2.1.6, the likelihood of encountering MEC, MPPEH, and/or UXO items in the Action Area has been significantly reduced due to extensive post-World War II dredging activities in the Action Area. The material that will be dredged resides in locations that have been dredged previously and has been moved there through natural water movement. Therefore, intentional in-place (underwater) detonations are not expected to impact EFH.

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 will 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 history of previous dredging and construction in the harbor, as well as 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.

4. Summary of Determinations

4.1. ESA Determination

This assessment considered the potential environmental impacts resulting from the Proposed Action on the following ESA-listed species that may occur within the ESA Action Area: the green sea turtle (Central West Pacific DPS), the hawksbill sea turtle, and the scalloped hammerhead shark (Indo-West Pacific DPS). Action 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 the Action Area. Therefore, the indirect adverse effect to EFH from Action-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 translocation plan. Due to the containment of impacts to the Action Area, 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 Action, and compensatory mitigation for unavoidable loss (i.e. coral translocation and habitat conversion), the Navy determined that the anticipated adverse effects 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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APPENDIX A: Final Report Biological and Benthic Habitat Surveys in Support of RM14-1420 Repair Lima Wharf and RM14-1423 Repair Mike and November Wharves, Apra Harbor, Guam

APPENDIX B: Habitat Equivalency Analysis for Lima, Mike, and November Wharves, Apra Harbor, Guam

Habitat Equivalency Analysis for Lima, Mike, and November Wharves

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 (Pioch *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 (Pioch *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).

For this HEA, the Navy based the input parameters on assumptions of the ecological function 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 (Table 1 and Table 2) produced 848.4 m^2 (9,132 ft^2) of replacement habitat to offset the temporary and permanent losses of coral colony area, and 28.8 m^2 (310 ft^2) of replacement habitat to offset the temporary loss of the ecological functions and services provided by the biofouling community. In total, the HEA analysis indicated that a replacement of 877.2 m^2 (9,442 ft^2) of habitat will provide the ecological service gains that are equal to the ecological services temporarily lost. Below is a detailed description of each parameter used in this HEA.

Coral Community HEA

- Claim Year: Assumed construction activities would commence only after the restoration and coral relocation have been completed in late 2020.
- Injured Units: The total coral cover in the Action Area (injured site) was estimated to be 1,070 m^2 (11,517 ft^2) and conservatively included all coral communities regardless of their health, morphology, size or function.
- Value Injured/Value restored*:* The Action Area is a manmade structure at an active installation with various stressors. The recipient site is a native coral mound with less stressors and improved conditions. However, the recipient site requires restoration and maintenance in order to sustain the planned habitat. 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 historic value of 3% according to the

Coral Reef Task Force (USCRTF) guidelines (2016) and (Pioch *et al.* 2017).

- Pre-Injury Service Level (%): The Navy used a 98.8% level of services provided by the injured area prior to injury, due to 1.2% of all coral colonies in all size classes displayed some form of disease throughout the whole of the Action Area.
- Pre-Restoration Service Level (%): Due to the lack of consolidated hard substrate and constant shift of rubble preventing natural coral recruitment, a value of 25% was used for the level of services provided by the restoration area prior to restoration at Mound 9. The additional lack of complexity and rugosity prevented other coral reef community species cover and recruitment that benefits the overall health of the restoration site. There is also an unknown amount of anthropogenic debris at the restoration site that will be removed before habitat restoration commences.
- Units: The smaller unit for habitat area, square meters (m^2) was used.
- Time Units: Years were the unit used.
- Service Loss Displayed Years: Considering the action and estimated time to full recovery, the years 2020 to 2070 were used as the time span of service loss analysis to be displayed.
- Service Gain Displayed Years: Considering the restoration and time to full recovery, the years 2020 to 2070 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 98.8%, but it was anticipated that the Action Area will lose all service level between relocation and construction activities in 2020. Therefore, a service level node of 0% was assigned to 2020.
- 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 its current condition of 98.8% service within 50 years naturally. Therefore, a service level node of 98.8% was assigned to 2070.
- 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 gained upon debris removal, habitat restoration (stabilization and boulders) and coral translocation in 2020. Therefore, a service level node of 35% was assigned to 2020.
- Service Level At the Recovery Site Node: After 5 years of maintenance and monitoring, it is assumed that the restoration area will have stabilized and begun recruitment of new coral colonies. Therefore, a service level node of 50% was assigned to 2025.
- Service Level At the Recovery Site Node: After 15 years, it was assumed that the restoration area will nearly be recovered through natural recruitment of corals and reef community. Therefore, a service level node of 95% was assigned to 2035.
- Service Level At the Recovery Site Node: After 30 years, it was assumed that the restoration area will reach 98.8% service level. Therefore, a service level node of 98.8% was assigned to 2050.
- Results: The analysis indicated that a compensatory replacement project of 848.4 m^2 (9,132 ft^2) will provide service gains equal to the services temporarily lost over time in the injured area.

Table 1. Habitat Equivalency Analysis Software Units used to Facilitate Calculation of Compensatory Restoration of Coral Cover (Pioch *et al*. 2017, Kohler *et al.* 2006).

Claim Year	2020
Injured Units	1070
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	2020-2070
Service Gain Displayed Years	2020-2070
Service Level At the Injury Site Node	2020 0%
Service Level At the Injury Site Node	2070 100%
Service Level At the Recovery Site Node	2020 35%
Service Level At the Recovery Site Node	2025 50%
Service Level At the Recovery Site Node	2035 95%
Service Level At the Recovery Site Node	2050 100%
Total Discounted Service Unit Years (SUYs) Lost	17548.584
Total Discounted SUYs Gained	22095.781
Discounted SUYs gained per unit	20.65
Replacement Habitat Size (sq. m)	849.8

Biofouling Community HEA

- Claim Year: Assuming construction activities would commence only after the restoration and coral relocation have been completed in late 2020.
- Injured Units*:* The total biofouling community cover in the Action Area (injured area) was estimated to be 980 m^2 (10,549 ft^2) and conservatively included all non-coralline invertebrates.
- Value Injured/Value restored*:* The Action Area is a manmade structure at an active installation with various stressors. The recipient site is a native coral mound with less stressors and improved conditions, but it will require restoration and maintenance in order to sustain the planned habitat. 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 historic value of 3% based on Coral Reef Task Force (USCRTF) guidelines (2016) and (Pioch *et al.* 2017).

- Pre-Injury Service Level (%): The Navy conservatively assigned a 100% level of services provided by the injured area prior to injury.
- Pre-Restoration Service Level (%): The lack of consolidated hard substrate and constant shift of rubble prevents natural coral recruitment, but benefits the biofouling community. Therefore, a value of 50% was used for the level of services provided by the restoration area prior to restoration at Mound 9. The additional lack of complexity and rugosity prevents other coral reef community species cover and recruitment that benefits the overall health of the restoration site. There is also an unknown amount of anthropogenic debris at the restoration site that will be removed before habitat restoration commences.
- *Uni*ts: The smaller unit for habitat area, square meters (m^2) was used.
- Time Units: Years were the unit used.
- Service Loss Displayed Years: Considering the action and assuming a short time frame to full recovery, the years 2020 to 2025 were used as the time span of service loss analysis to be displayed.
- Service Gain Displayed Years: Considering the restoration and assuming a short time frame to full recovery, the years 2020 to 2025 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 conservatively set to 100%, but it was anticipated that the Action Area will lose all service level between relocation and construction activities in 2020. Therefore, a service level node of 0% was assigned to 2020.
- Service Level At the Injury Site Node: It was assumed that the pre-injury service level will recover to 100% service within 1 year naturally at the Action Area based on scientific evidence that biofouling communities recover within 6–8 months (Newell et al. 1998). Therefore, a service level node of 100% was assigned to 2021.
- Service Level At the Recovery Site Node: The pre-restoration service level at the restoration site was 50%. It was anticipated that 25% of services will be gained upon debris removal, habitat restoration (stabilization and boulders) and coral translocation in 2020 based on scientific evidence that biofouling communities in tropical reef habitats recover within two weeks to one year (Bailey-Brock 1989). Therefore, a service level node of 75% was assigned to 2020.
- Service Level At the Recovery Site Node: After 1 year, it was assumed that the restoration area will be 100% recovered through natural recruitment of the biofouling community. Therefore, a service level node of 100% was assigned to 2021.
- Results: The analysis indicated that a compensatory replacement project of 28.75 m^2 (309.5 ft^2) will provide service gains equal to the services temporarily lost over time in the injured area. Therefore, it was reasonable to conclude that the biofouling community and ecosystem functions and services would appear within a short time (as little as two weeks) on the new wharf surfaces and restoration area.

Table 2. Habitat Equivalency Analysis Software Units used to Facilitate Calculation of Compensatory Restoration of Biofouling Community (Pioch *et al*. 2017, Kohler *et al.* 2006).

Claim Year	2020
Injured Units	980
Value Injured/Value Restored	1
Discount Rate per time unit (%)	3
Pre-Injury Service Level (%)	100
Pre-Restoration Service Level (%)	50
Units	sq. m
Time Units	year
Service Loss Displayed Years	2020-2025
Service Gain Displayed Years	2020-2025
Service Level At the Injury Site Node	2020 0%
Service Level At the Injury Site Node	2021 100%
Service Level At the Recovery Site Node	2020 75%
Service Level At the Recovery Site Node	2021 100%
Total Discounted Service Unit Years (SUYs) Lost	490.0
Total Discounted SUYs Gained	16700.833
Discounted SUYs gained per unit	17.042
Replacement Habitat Size (sq. m)	28.753

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Edward Moon
Installation Environmental Program Director
Naval Base Guam
PSC 455 Box 195
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March 13, 2020

Dear Mr. Moon:

The National Marine Fisheries Service, Pacific Islands Regional Office (NMFS), received the Naval Facilities Engineering Command Pacific's (Navy) essential fish habitat (EFH) consultation initiation request for the repair of Lima, Mike, and November wharves in Apra Harbor, Guam (Navy Project Numbers: RM14-1420 and RM14-1423). We have reviewed the Final Endangered Species and Essential Fish Habitat Assessment: Lima (RM12-1420), Mike, and November (Rm14-1423) Wharves Repair document and agree that there will be unavoidable and substantial adverse effects to sensitive and hard-to-replace EFH due to project activities. 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 transplantation of corals, and offset via the creation of new habitat area, is a viable approach to conserving EFH. We have provided two 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 the proposed conservation recommendations and all the proposed BMPs will ensure that expected and potential adverse effects to EFH are avoided, minimized, offset for, or otherwise mitigated.

Project Description

Navy proposes to repair and modernize Lima, Mike, and November wharves, which occur along the west bank at the mouth of Inner Apra Harbor on Guam. The wharves were built in 1945 and are currently experiencing structural failure due to corrosion, limiting the functionality of the facilities. The proposed action will completely resurface the wharves through the installation of 2,315 feet (ft) of new sheet pile bulkhead, replacing walls that currently measure up to 35-ft deep and have up to 35% coral cover. King piles will be driven to a depth of 85 ft approximately 10-ft seaward of the existing wharf faces; these will be supported by anchored tie rods for lateral stability and linked together by a new sheet pile wall. A total of 40 concrete fender piles will also be installed at the corners of each wharf to an estimated depth of 67 ft. Piles will be installed from a barge crane using steam, air, diesel drop or hydraulic hammers. Vibratory hammers have been ruled out because they lack the power to penetrate the underlying limestone substrates. Full-length silt curtains will be installed immediately adjacent to and around the barge at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. Once all piles are driven, closure plates will be welded to the adjacent sheet pile walls and new wall end terminations. Anchors will be installed to reinforce the new wharf face for stability and gravel or concrete self-compacting fill will be placed into the space behind the wall. After construction of the new sheet pile wharves is completed, a barge-mounted, closed bucket excavator will be used to dredge the area in front of each new wharf face. Dredging activities will occur between the new wharf and the silt curtain to remove shoals and sediment build-up from construction and ensure maintenance depth, impacting an estimated 4,700 coral colonies within the combined dredge footprint. The Navy estimates 5,800 cubic yards of material will be removed as part of the dredging process.

In total, the project proposed to replace 55,187 ft^2 of wharf area and 28,772 ft^2 of harbor floor; killing or displacing more than 30,000 coral colonies in the process. The Navy will be conducting coral transplantation activities to minimize potential adverse effects to corals; habitat restoration activities will also be conducted to offset expected unavoidable losses to corals. A description of these in-water activities is provided below (see sections on Navy-proposed Avoidance, Navy-proposed Minimization, and Navy-proposed Offset).

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 (5,150 kilometers/200 nautical miles/230 miles), 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

The supporting document titled: Final Report – Biological and Benthic Habitat Surveys in Support of RM14-129 Repair Lima Wharf and RM14-1423 Repair Mike and November Wharves, includes a considerable amount of detailed information regarding the current status of benthic and fish communities in the project area. NMFS greatly appreciates being included throughout the survey design and implementation process and we have found the quality and detail of the combined orthomosaic and *in situ* quadrat surveys to be invaluable in expediting our project review. The wharf faces and adjacent benthic habitats have not undergone any documented maintenance since being built, resulting in 75 years of settlement and growth for the benthic communities in areas where vessel activities have been limited. Surveys identified approximately 50 coral species and an estimated 30,000 coral colonies within the project footprint. The most common corals were *Leptastrea purpurea, Pocillopora damicornis, Porites rus, Lobophyllia spp.* and *Porites* massive forms with no Endangered Species Act (ESA) corals observed within the project footprint. Data from the orthomosiac surveys indicated that 52% of corals were small (e.g., 0-10 centimeters (cm) in diameter), while less than 3% of corals were greater than 80 cm in diameter. Coral cover varied between the different wharf faces, with 23% coral cover on Mike, 15% coral cover on Lima, and 10% coral cover on November. Macroalgae was the dominant biotic cover, 64% on average, across the entire project area, with non-coral invertebrates making up 19% of the remaining benthic cover. This illustrates the relative dominance of the marine successional and filter feeding community as part of EFH within this area.

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 pile driving and back filling, dredging, and diver activities; turbidity and sedimentation from pile driving and dredging, the potential for introduction of invasive species and chemical contamination from equipment, 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 and artificial surfaces. In total, the project proposes to replace or remove 55,187 ft^2 of wharf area and 28,772 ft^2 of harbor floor for a total impact of 83,959 ft^2.

The project activities will also result in unavoidable and substantial long-term to permanent adverse effects (i.e., unavoidable) to sensitive and hard-to-replace EFH due to project activities, including the loss of corals and non-coral invertebrates (e.g., successional community, filter feeders, etc.), and their ecosystem services and functions. Thirty four percent of the project area is currently covered by non-coral invertebrates or corals, totaling approximately 22,000 ft^2; this area also consists of more than 30,000 individual coral colonies.

Physical Damage/Removal (physical stressor): Physical damage to principle benthic organisms from dredging and transplantation 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 (Rützler 2001). Reduction of topographic complexity in the habitats of the coral reef ecosystem reduces biodiversity and productivity (Alvarez-Filip et al. 2009).

Sedimentation (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, Philipp and Fabricius 2003). Coral reef organisms are easily smothered by sediment (Golbuu et al. 2003), and rates >100 milligrams/centimeter^2/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). Sedimentation and turbidity caused by dredging should be minimal and temporary if the proposed BMPs and monitoring efforts are being followed to ensure that the silt curtains are functioning properly.

Invasive Species (biological stressor): Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Species can be introduced to new biogeographies, typically via transport on vessel hulls or in ballast water. Invasive species rapidly increase in abundance to the point that they come to dominate their new environment, creating adverse ecological effects to other species of the ecosystem and the functions and services it may provide (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.

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. 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).

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 even 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.

Applicant-proposed Avoidance

Navy has proposed a variety of BMPs within the EFH Assessment that should help avoid adverse effects to EFH during project activities including:

- 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.
- Submission of a dredging and disposal operation plan for review which will include: a description of the proposed removal and disposal procedures, a BMP Plan, methods to track and verify the transport and disposal of the dredged material, and an outline of the notification plan.
- Turbidity and siltation from action-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.

- Full-length silt curtains will be installed immediately adjacent to and around the barge at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable, to maintain water quality and to provide coral protection.
- The Navy will continuously monitor to ensure that control measures are in place and functioning properly
- If a visible plume is observed outside the silt curtains, construction activity will be suspended, evaluated, and corrective measures taken.
- Activity may resume after problem is corrected.

- A monitoring and assessment plan to minimize construction and operation-related degradation of water quality will be developed and implemented.
- 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.
- All in-water activities will cease during the primary coral spawning events each year for hard (scleractinian) and soft (octocorallia) 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 contingency plan will be in place for the removal and adequate securing of equipment in the event of approaching tropical storms and typhoons.
- An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the Storm Water Pollution Prevention Plan (SWPPP) and implemented throughout construction of the Action.
- Prevent water quality impacts during the transport of scows to the offloading platform by restricting load volumes to avoid overflow during transport.
- 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.
- Work platforms will be oriented to minimize shading organisms on natural and manmade substrates to the greatest extent practicable. This may occur by allowing for the path of the sun to 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.
- All action-related debris and other waste will be contained and will not enter or remain in the marine environment. The Contractor shall provide a temporary platform or other suitable means

of capturing debris from construction, and these structures shall be in-place prior to commencing in-water activities.

- If the crane barge or any other project vessel is at risk of coming in contact with coral colonies adjacent to the Action Area (i.e. north and west sides of Lima Wharf), work will only be conducted at high tide or all pile driving for Lima's north and west walls will be undertaken by cranes on shore and topside of the existing wharf.

Applicant-proposed Minimization

Navy is proposing to transplant 5,800 of the near 30,000 total coral colonies that fall within the preferred size, morphology, and observed health range from the project area to a nearby restoration area in Outer Apra Harbor called Mound 9. Specifically, the corals prioritized for transplantation include:

- Colonies with one dimension greater than 10 cm in diameter.
- Colonies that exhibit good health (i.e., no signs of bleaching, wounds, disease, or parasites).
- Morphologies that could be removed with minimal damage, excluding finely branching (e.g., *Pocillopora damicornis*), flat-encrusting (e.g., *Leptastrea purpurea*), and extremely large (*Porites sp.*) growth forms.

NMFS considers this a minimization measure because the corals that survive transplantation are not unavoidably lost and don't require direct offset. Based on the previous performance of similar outplanting efforts within Apra Harbor, the Navy expects about 4,100 colonies to survive the relocation effort, indicating that approximately 1,700 corals are not expected to survive transplantation (i.e., unavoidable loss).

Applicant-proposed Offset

Navy has proposed to offset the 22,000 ft^2 of EFH substrate and ecosystem services and function that will be unavoidably lost through the generation of new habitat by removing anthropogenic debris, stabilizing substrate, and deploying limestone boulders at Mound 9 in Outer Apra Harbor. Collectively these measures will generate area for coral settlement and regrowth, increase rugosity, and increase benthic complexity in an area where corals have historically flourished. The Navy worked with NMFS through early coordination to generate parameters for a Habitat Equivalency Analysis (HEA) to quantify the interim loss of ecosystem services and function associated with the adverse effects of this project, and develop a quantifiable mitigation strategy focusing on EFH area replacement. The Navy built in three conservative assumptions into the HEA to account for the lack of three-dimensionality in the area metric, which helped to generate a more robust result within the Visual_HEA software tool. First, coral diameter estimates were based on the longest measure taken from the orthomosaic images. Second, the total coral area from the construction and dredge footprints were used regardless of morphology, health or potential for transplantation. Third, the area making up the marine successional and filter feeding community was included within the model. These three assumptions, plus the Visual_HEA parameters developed jointly by Navy and NMFS regarding the expected injury, service levels, discount rate and years to recover, indicated that the Navy will need to provide 9,442 ft^2 of alternative habitat area to effectively offset the ecosystem services that will be unavoidable lost.

To further address uncertainties in this process, the Navy has offered to provide more than 20% additional offset and deploy a total of 150 limestone boulders resulting in 11,517 ft^2 of new settlement area at Mound 9. The Navy also proposes to monitor the transplanted coral at Mound 9 and provide status reports after each monitoring event to NMFS for 5 years after translocation.

NMFS Concerns

We are 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 and chemical contamination from equipment, and introduction of toxicopathological contaminants during transplantation and habitat restoration activities. Some of these specific concerns are further described below.

i. *Permanent loss of natural hard bottom reef substrate.*

Extending the wharf faces out 7-10 ft from the existing structure will result in the permanent removal and replacement of approximately 20,000 ft^2 of benthic habitat.

ii. *Long-term to permanent loss of corals, non-coral invertebrates, and their ecosystem services and function.*

Construction and dredging activities associated with this project will directly impact an estimated 83,959 ft^2 of EFH, including more than 30,000 coral colonies. Minimization measures are expected to protect approximately 4,100 of the 5,800 coral colonies proposed for transplantation, leaving more than 25,000 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 both Mound 9 and on the new sheet piling at Lima, Mike, and November wharves to replace the lost habitat area and demonstrate a return to current coral densities, and ecosystem function, over the next 30 to 50 years. If unforeseen factors prevent the new boulders or wharf surface areas from returning to a reasonable facsimile of the coral diversities and densities that are being lost, effective offset of EFH would have failed. HEA has proven to be an effective tool in developing the theoretical offset, but should be supported by monitoring and adaptive management to ensure that the expected level of offset occurs.

The mitigation projects proposed as minimization and offset for the construction and dredging impacts also have the potential to adversely affect EFH through boating (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 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 Navy, the project action could still have long-term to permanent adverse effects to EFH associated with implementation of the proposed mitigation strategies or resulting from delays in coral recovery and/or recruitment at Mound 9 and along the new sheet piles at Lima, Mike, and November wharves.

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 and locations within and nearby the dredge footprint. 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 these out year monitoring activities within the next update to the JRM INRMP.

Conservation Recommendation 2: Coral transplantation, limestone boulder deployment, and benthic survey activities (e.g., diving, anchoring, staging of materials, work with tools and transects) should avoid physical contact with organisms that are not actively being transplanted, especially coral. If rugosity is measured, alternatives to the classic chain approach should be considered and any materials being staged on the bottom should be thoroughly stabilized and secured to avoid movement, especially during time periods of elevated typhoon risk. Divers should also avoid exposing corals directly or indirectly to toxicopathological agents.

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 EFH Assessment and related information for the proposed repair of Lima, Mike, and November wharves in 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 transplantation 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

cc by e-mail:
Claudine Camacho, DCA Guam
Malia Chow, NMFS

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DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0416
April 09, 2020

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 REPAIR OF LIMA (RM14-1420), MIKE, AND NOVEMBER (RM14-1423) WHARVES, INNER 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 13 March 2020. The EFH consultation is for proposed repairs of Lima, Mike, and November Wharves in Inner Apra Harbor, U.S. Naval Base Guam (Navy Project Numbers: RM14-1420 and RM14-1423). 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 13 February 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 EFH 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 and locations within and nearby the dredge footprint. 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 Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (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 these out year monitoring activities within the next update to the JRM INRMP.

Navy Response to Conservation Recommendation 1: The Navy understands that while the HEA is 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. Currently, the Navy's subject matter experts are developing a plan for long-term monitoring and quantification of the coral community at Mound 9. In response to this conservation recommendation, the Navy will plan to revisit the HEA analysis or an equivalent and improved model analysis (if existent) for the impact area at Lima, Mike, and November Wharves and Mound 9. The Navy will set a goal of evaluating the coral community at the impact site and the mitigation site through the HEA or another model analysis approximately five years after the coral transplantation has been performed.

Furthermore, the Navy agrees with this Conservation Recommendation, that the monitoring plan for Mound 9 should consider aligning with the 2019 JRM INRMP. Also, 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 EFH Conservation Recommendation 2: Coral transplantation, limestone boulder deployment, and benthic survey activities (e.g., diving, anchoring, staging of materials, work with tools and transects) should avoid physical contact with organisms that are not actively being transplanted, especially coral. If rugosity is measured, alternatives to the classic chain approach should be considered and any materials being staged on the bottom should be thoroughly stabilized and secured to avoid movement, especially during time periods of elevated typhoon risk. Divers should 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 and habitat restoration, including avoidance of physical contact with organisms not transplanted (especially coral). Also, if rugosity is measured, then the Navy will consider alternatives to rugosity measurements with the classic chain approach, and 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. Those divers are knowledgeable about the risk of disease to damaged corals. To the best of their ability, the divers will avoid exposing corals directly or indirectly to toxicopathological agents.

The Navy appreciates NMFS's effort and careful deliberation invested in evaluating the proposed actions and providing these two EFH conservation recommendations. Should you have any questions or concerns about the consultation documents, please contact me at (671) 339-8203 or edward.moon@fe.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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April 8, 2020

Edward Moon
Installation Environmental Program Director
Department of the Navy
U.S. Naval Base Guam
PCS 455 Box 152
FPO AP 96540-1000

RE: Request for Informal ESA Consultation on the Repair of Lima, Mike, and November Wharves, Inner Apra Harbor, U.S. Naval Base Guam (I-PI-20-1815-AG, PIR-2020-00424)

Dear Mr. Moon:

On February 12, 2020, NOAA's National Marine Fisheries Service (NMFS) received your written request for concurrence that the Navy's proposed action to repair the Lima, Mike, and November wharves in Inner Apra Harbor, Guam, is not likely to adversely affect (NLAA) the following endangered or threatened species or designated critical habitat under NMFS' jurisdiction: endangered Central West Pacific and threatened Central North Pacific green turtles; endangered hawksbill, leatherback, and loggerhead turtles; threatened olive ridley sea turtle; threatened Indo West Pacific scalloped hammerhead and oceanic whitetip sharks; endangered Hawaiian monk seal; endangered blue, fin, sei, sperm and Main Hawaiian Island insular false killer whales (MHI IFKW); and the giant manta ray, as well as critical habitat for the Hawaiian monk seal and MHI IFKW. On March 2, 2020, we requested confirmation that transiting to and from the repair site was part of this action. On March 4, 2020 you provided this information, and informal consultation began on this date. This response to your request was prepared by NMFS pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), 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.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019 [84 FR 44976]. We are applying the updated regulations to this consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this letter of concurrence in light of the updated regulations and conclude the letter is fully consistent with the updated regulations.

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 action consists of repairing and modernizing the Lima, Mike, and November wharves in Apra Harbor, Guam. The current wharf condition is partially operational and dilapidated in certain areas. The steel sheet piles are severely corroded with some section losses ranging from 20-80%. The upgrades will enable the wharf to accommodate ship repair, berthing, and heavy-weather mooring. The action will shift the existing wharf seaward up to 10 feet and build a new sheet pile bulkhead wharf approximately 2,315 feet long. In-water work is expected to begin in August 2021 and continue for 13 months. Pile driving will occur during daylight hours only, beginning 30 minutes after sunrise and ending no later than 30 minutes before sunset to allow for protected species monitoring.

Pre-work activities. Before in-water construction begins, debris will be removed from the mudline along the entire length of the wharves. Debris includes trash, pipes, cables, and other interfering objects.

In-water construction. This includes replacement of the steel sheet pile bulkhead and mooring system, as the restoration of the fender system. These activities require pre-drilling, pile driving of both sheet piles and concrete fender piles, and pile cutting. The piles being installed are king and standard sheet piles, and concrete fender piles. The maximum sheet pile wall depth is 44 inches. New piles will start approximately 10 feet seaward from the existing sheet pile walls. The area between the old and new sheet pile walls will be packed with controlled density fill. The enclosed land-side of the new wharf will be reinforced with stone columns underground. King piles will be driven to approximately 85 feet; walls will be anchored with tie rods – round steel bars that provide lateral stability and anchor the wall approximately 75 feet on shore except at the north end of the Lima wharf, where the new king pile wall will be anchored to the west wall. The west wall will be replaced with standard sheet pile sections instead of king pile sections due to elevation differences. Sheet pile driving is expected to take 5 months for the Lima wharf, 1 month for the Mike wharf, and 2 months for the November wharf.

After sheet pile wall construction, four new corner fenders will be installed at each corner of Lima, Mike, and November wharves for a total of 40 fenders. Fenders will consist of 16 inch square concrete piles held together by a steel frame. Holes will be pre-drilled using a 40-50 foot auger, potentially equipped with a cutting edge to break the soil and rock, which will take one to several hours per pile. The concrete piles will then be driven into the holes. Concrete fender pile driving is anticipated to take 2 months for the Lima wharf, 2 weeks for the Mike wharf, and 3 weeks for the November wharf.

Impact hammers will be steam, air, or diesel drop, single-acting or double-acting or differential acting, or hydraulic. Vibratory hammers will not be used. The time to drive sheet piles through the substrate will vary depending on substrate, inclement weather, equipment, etc. A pile cap or drive cap will be between the pile and hammer and a hammer cushion or cap block will be between the ram and pile cap or drive cap.

A single barge crane will be required for drilling and pile driving. A second barge may deliver the piles to the wharf. Piles may alternatively be delivered to the wharves on land, thereby reducing in-water operations. On average, approximately six piles will be driven per day with a maximum of eight sheet piles per day. Five blows per foot for 15 feet is estimated for the impact hammer to drive each pile, for an average of 75 blows per pile. Once the king piles have been driven, the infill sheet piles will be installed with the same methodology.

Concrete fenders will be driven from 35 to 67 feet. Installation typically takes 360-880 blows to reach the required tip elevation. Closure plates will then be attached between the existing adjacent sheet pile walls and new wall end terminations using underwater welding.

From land, anchors will be installed or existing tiebacks utilized to reinforce the new wharf face. After anchor installation, gravel or concrete fill will be placed in the space behind the wall. The fill is denser than water, designed to be self-compacting, and will not contain contaminants. Subsequent to the filling, a concrete pile cap will be placed along the top of the new interlocking sheet pile wall. Wood, steel, or fiberglass forms will be installed along the top of the wall to below the mean low water elevation. Water will be removed from the forms and steel reinforcement will be placed in the forms. Concrete will then be poured to the required elevations.

Post-construction. Dredging may be required to provide the necessary 35-foot depth up to the face of the wharf and to remove high spots left by previous maintenance dredging. No dredging will occur on the north or west sides of Lima wharf. Dredging will occur no closer than five feet from the new wharf face of the east side of the Lima wharf. A similar footprint for the Mike and November wharves is expected. Inadvertent over dredge will not exceed two feet beyond the maintenance depth. The total estimated amount of material to be removed from Lima wharf is 5,800 cubic yards. Dredging will be done using a barge-mounted closed bucket excavator within the confines of a silt curtain. An oil fence or boom will enclose the dredging area, floating equipment, and barges. Dredge material will be placed on land in a disposal facility.

Action Area

The action area encompasses inner and outer Apra Harbor, Sasa Bay, and the high seas route as yet undetermined because there is a high likelihood that an additional barge will be brought in from another place such as the Commonwealth of the Northern Mariana Islands or Hawaii. The proposed activity is specifically located at the channel between outer and inner Apra Harbor on Guam (Figure 1; Figure 2).

Figure 1. Inner and Outer Apra Harbor and Sasa Bay. The project area is in the red box.

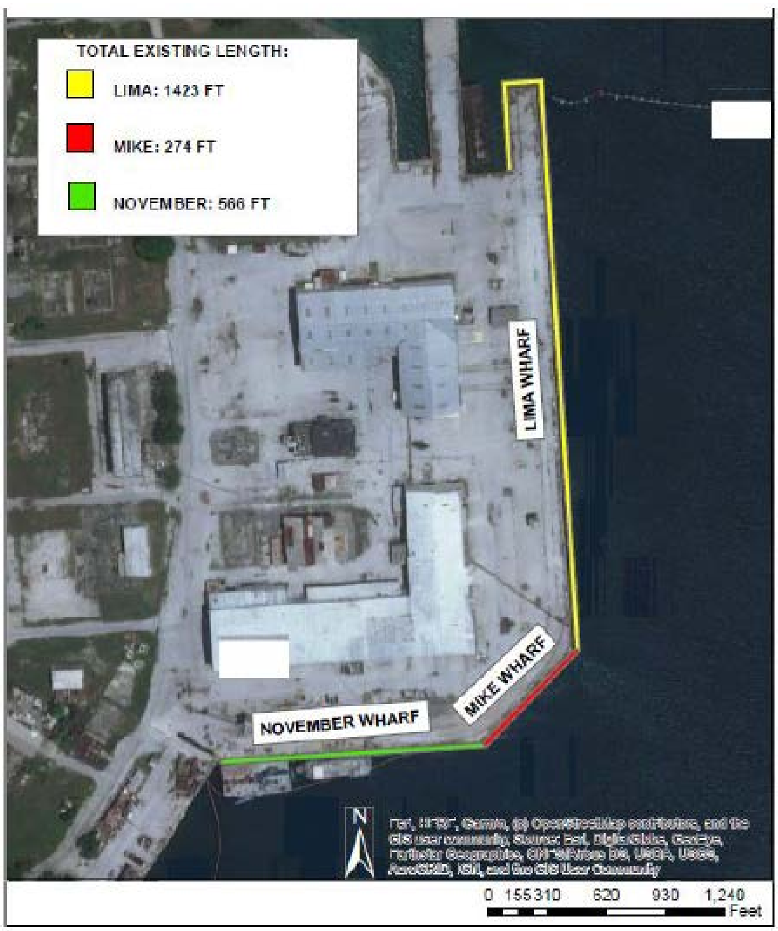

Figure 2. The project area, showing the Lima, Mike, and November Wharves on which the work will be performed.

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 https://www.fisheries.noaa.gov/topic/endangered-species-conservation.

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
Green Sea Turtle Central North Pacific	*Chelonia mydas*	Threatened	5/06/2016	81 FR 20057
Central West Pacific Green Sea Turtle	*Chelonia mydas*	Endangered	05/06/2016	81 FR 20057
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	06/03/1970	35 FR 8491
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened	08/27/1978	43 FR 32800
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
North Pacific Loggerhead Sea Turtle	*Caretta caretta*	Endangered	10/24/2011	76 FR 58868
Hawaiian Monk Seal[1]	*Neomonachus schauinslandi*	Endangered	11/23/1976	41 FR 51612
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 macrocephalus*	Endangered	12/02/1970	35 FR 18319
Main Hawaiian Island Insular[2] False Killer Whale	*Pseudorca crassidens*	Endangered	11/28/2012	77 FR 70915
Indo West Pacific Scalloped Hammerhead Shark	*Sphyrna lewini*	Threatened	09/02/2014	79 FR 38213
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened	03/01/2018	83 FR 4153
Giant Manta Ray	*Manta birostris*	Threatened	02/21/2018	83 FR 2916

[1]Critical Habitat was designated for Hawaiian monk seals on 5/26/1988 (53 FR 18990) and revised on 8/21/2015 (80 FR 50925).
[2]Critical Habitat was designated for Main Hawaiian Island Insular false killer whales on 7/24/2018 (83 FR35062).

The original species included were the Central West Pacific green sea turtle, hawksbill sea turtle, and Indo West Pacific scalloped hammerhead shark. The action agency does not know if support vessels will originate from Guam or from elsewhere in the Pacific (M. Bedjer, pers. comm., 3/4/20). Thus, NMFS has included additional species to the consultation for an assessment of potential vessel strikes. The Navy concluded that the activity of bringing a support vessel from outside Guam to support the action is not likely to adversely affect the protected species listed above (M. Bedjer, pers. comm., 3/23/20).

Seagrass beds and macroalgae in Agat Bay, Sasa Bay, and Apra Harbor provide important foraging and resting areas for green turtles (DON 2020). Tagging research showed high site fidelity and limited movements for both green and hawksbill turtles while in Apra Harbor (Martin and Jones 2017). Inner Apra Harbor has limited habitat for green turtles and few recorded sightings. In 2019, three surface observations of green sea turtles occurred within the action area over 40 hours of observation time (DON 2020). Hawksbill turtles have been seen within all area of Apra Harbor; at least three were observed during surveys (DON 2020).

Adult scalloped hammerhead sharks have been observed in Outer Apra Harbor, Sasa Bay, and the southernmost part of Inner Apra Harbor; however, no anecdotal sightings or scientific evidence of scalloped hammerhead sharks have been reported since 2004 in Apra Harbor (DON 2020). This may be due to the high level of human activity and lack of quality habitat (DON 2019). There were no sightings of scalloped hammerhead sharks during the 2019 biological survey of the action area (DON 2020).

Analysis of Effects

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 joint USFWS-NMFS Endangered Species Consultation Handbook, 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[1]. Discountable effects are those extremely unlikely to occur. 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 assessment. Only activities that have the potential to adversely affect ESA-listed species are discussed here.

The Navy identified the following stressors that have the potential to affect listed marine species in the action area (Table 2):

- Elevated underwater noise

[1] Take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. 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." 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.

- Increased suspended sediments
- Disturbance from human activity
- Direct physical contact
- Entanglement
- Vessel strikes
- Wastes and discharges

Table 2. Locations where species are expected to occur and the stressors assessed.

<table>
<tr><th>Species</th><th>Expected Activity Location</th><th>Stressors assessed</th></tr>
<tr><td>Green Sea Turtle</td><td rowspan="2">Inner Apra Harbor, High seas</td><td rowspan="3">• Elevated underwater noise
• Increased suspended sediments
• Disturbance from human activity
• Direct physical contact
• Entanglement
• Vessel strikes
• Wastes and discharges</td></tr>
<tr><td>Hawksbill Sea Turtle</td></tr>
<tr><td>Indo West Pacific Scalloped Hammerhead Shark</td><td>Inner Apra Harbor</td></tr>
<tr><td>Olive Ridley Sea Turtle</td><td rowspan="11">High seas / Hawaii</td><td rowspan="11">• Vessel strikes
• Wastes and discharges</td></tr>
<tr><td>Leatherback Sea Turtle</td></tr>
<tr><td>Loggerhead Sea Turtle</td></tr>
<tr><td>False Killer Whale</td></tr>
<tr><td>Monk Seal</td></tr>
<tr><td>Blue Whale</td></tr>
<tr><td>Fin Whale</td></tr>
<tr><td>Sei Whale</td></tr>
<tr><td>Sperm Whale</td></tr>
<tr><td>Oceanic Whitetip Shark</td></tr>
<tr><td>Giant Manta Ray</td></tr>
</table>

Elevated Underwater Noise

Several activities proposed for this action will generate elevated underwater noise. These activities include pre-drilling, pile driving, and dredging. Apra Harbor is a working harbor with a likely ambient sound pressure level of more than 100 dB re 1 μPa (DON 2020). ESA-listed species residing in this environment function within this acoustic background. Elevated underwater noise can lead to direct physiological effects including serious injury and mortality, and disruption to feeding, mating, breeding, or nursery activities, or indirect effects such as disruptions to abundance and behavior of prey species. Sea turtles and scalloped hammerhead sharks have hearing sensitivity up to about 1 kH and are most sensitive to frequencies below 100 Hz (Myrberg 2001, Popper 2014). Scalloped hammerhead sharks are not anticipated to be seen in the action area due to no observations of them for several years.

Pre-Drilling. For continuous sound, behavior disturbance for sea turtles is estimated at 160 dB re 1μPa. Average SPL for auger drilling has been estimated at 152 dB re 1 μPa at 1 m (Dazey et al. 2012). Another estimate for auger drilling is a mean sound pressure level root-mean-square (SPL$_{RMS}$) of 133 dB re 1 μPa, however no distance was provided for the measurement (Denes et al. 2016). Thus NMFS uses 152 dB re 1 μPa at 1 m as a proxy using cylindrical spreading, which results in potential behavioral disturbance at 0.2 meters. This distance is easily monitored by an observer for ESA-listed sea turtles.

Pile Driving with impact hammer. Received sound levels from pile driving are contingent on the type and size of pile, installation method, substrate, topography, water depth, and shape of the area (in this case, enclosed Inner Apra Harbor, the small channel that connect Inner and Outer Apra Harbor, and Outer Apra Harbor, which is mostly enclosed). Mortality and potential mortal injury to sea turtles from pile driving occurs at a SEL_{cum} of 210 db re 1 μPa; behavioral disturbance occurs at 175 dB re 1μPa. Impairment such as masking and temporary threshold shifts occur within tens of meters to the source (Popper et al. 2014). Pile driving source levels for king piles, or H piles, have been estimated at an SPL_{RMS} ranging from 156 dB re 1 μPa at 70 meters in 3-5 meters deep water, to 175 dB re 1 μPa at 10 meters in 5-6 meters deep water, to 166 dB re 1 μPa in 14 meters deep water in a drifting boat (assumed to be 40 meters from the source; CALTRANS 2015); Apra Harbor is up to 40 feet, or 12 meters deep. This range of source levels results in a range of 3.8-10 meters to the behavior disturbance level of 175 dB re μPa for sea turtles. The upper distance is easily monitored by an observer for ESA-listed sea turtles.

Dredging. Dredging typically produces low frequencies less than 500 Hz (Reine and Dickerson 2014). Bucket dredges make a repetitive sequence of sounds generated by winches, buckets impacting the substrate, bucket closing, and bucket emptying. The sound level generated by this activity is not anticipated to be loud enough to create permanent harm or injury to ESA-listed species in the action area. The sound level is not expected to exceed an SPL_{RMS} of 124 dB re 1 μPa because the surrounding substrate is soft silt-covered rubble and sandy seabed. 124 dB re 1 μPa at 1 meter results in 1.8 meters to the behavioral disturbance level. This distance is easily monitored by an observer for ESA-listed sea turtles.

Conclusion. Sounds generated from these activities are not expected to leave the Inner or Outer Apra Harbor area due to the confining nature of the harbor. Thus the effects of sound will not propagate to deeper water where it could impact marine mammals. Scalloped hammerhead sharks are not anticipated to be seen in the action area due to no observations of them for several years. The distances to behavioral disturbance are easily monitored by an observer for green and hawksbill sea turtles and scalloped hammerhead sharks. Implemented BMPs (BMP A1-3) further reduce the potential effects of construction-related noise on ESA-listed sea turtles and scalloped hammerhead sharks by requiring repeated monitoring by an observer throughout the work day, shutting down work if an ESA-listed animal is within 50 yards (50 meters) of the proposed works (which is greater than the distances to behavior disturbance), and not resuming work until the ESA-listed animal has departed the area voluntarily. Thus, NMFS concludes that the effects of increased sound levels to be discountable for scalloped hammerhead sharks and insignificant for green and hawksbill sea turtles.

Increased suspended sediments

Increased suspended sediments are anticipated to occur during pile driving and dredging activities within the immediate action area. Elevated turbidity is expected to be temporary in nature, settling naturally back to the bottom with no persistent or permanent effect. Elevated turbidity reduces the light penetration in the water column and limits visibility, which can interfere with foraging, navigation, and breathing (in the case of sharks). BMP F states explicitly that turbidity and siltation from action-related work will be minimized and contained through use of silt containment devices. Specifically, DOD states that silt curtains and turbidity curtains will be used to contain sediments to the extent practicable. Given the implementation of BMPs, the rare occurrence of scalloped hammerhead sharks, that turtles breathe air, and the short duration that increased suspended sediments and increased turbidity will occur, NMFS concludes that the effects of increased suspended sediments are insignificant.

Disturbance from human activity

Increased human activity will occur with this proposed action. This includes during pre-construction diving to remove debris, during construction, and post-construction dredging. Exposure to human activity can result in responses ranging from attraction to a human activity, general disregard, or panicked flight. However, the ESA-listed sea turtles are assumed to be habituated to a high level of human activity because of their ongoing use of Apra Harbor with high site fidelity (Martin and Jones 2017). Since scalloped hammerheads have not been observed in Apra Harbor in more than 15 years, it is unlikely they will be disturbed by increased human activity due to this action. Given the habituation of sea turtles, lack of scalloped hammerhead sharks present, and BMP A regarding halting construction if an ESA-listed species is sighted within 50 yards until the species has voluntarily departed the area, NMFS concludes that the effects of disturbance from human activity on sea turtles is insignificant, and is insignificant and discountable for scalloped hammerhead sharks.

Direct physical contact

This action includes the use of heavy machinery, barges, accessory vessels, and handheld machinery, as well as divers in the water. ESA-listed species could be struck by in-water equipment, which could result in injuries ranging from bruising or lacerations, to broken bones or carapaces, to immediate death. Pile driving and dredging could pin an animal to the sea floor, resulting in immediate death. This project will utilize environmental dredges, which are the least likely of the common dredge methods to cause direct physical impact to ESA-listed species because they are stationary and impact a small area with each grab, but could grab an ESA-listed species. BMPs will be implemented that will reduce the likelihood of direct physical contact. BMP A requires an observer to monitor for ESA-listed species during all in-water activities and BMP C prohibits personnel from disturbing, touching, riding, feeding, or otherwise intentionally interacting with any protected species. Contractors will verify no ESA-listed species are in the water prior to putting any equipment or material into the water, and equipment will be lowered into the water in a controlled manner. Due to the BMPs that will be implemented for this action that highly reduce the likelihood of direct physical contact with an ESA-listed species, NMFS concludes that the effects of direct physical contact on sea turtles and scalloped hammerhead sharks to be discountable.

Entanglement

Entanglement can occur from trash or debris, or from equipment such as the silt curtains or barge anchor chains. Entanglement of the ESA-listed species in this consultation primarily occurs with fishing gear, with no documented cases of entanglement in construction equipment in Guam (Miller et al. 2014; NMFS and USFWS 2013; Seminoff et al. 2015). Scalloped hammerheads are typically fished for or are the bycatch of fishing targeting other species (Miller et al. 2014); entanglement is not a risk factor of concern. Hawksbill sea turtles are susceptible to entanglement in fishing gear, particularly gill nets (NMFS and USFWS 2013). Fishery bycatch are a threat to the western central Pacific green sea turtle (Seminoff et al. 2015). In addition to no documented cases of scalloped hammerhead sharks or green or hawksbill sea turtles being entangled in construction equipment, BMPs will be implemented to reduce the likelihood of entanglement occurring. BMP C5 requires that in-water tethers and mooring lines for vessels and marker buoys will be kept to minimum lengths necessary and remain deployed only as long as is necessary to accomplish the task. BMP C6 mandates that anchor lines from construction vessels be deployed with appropriate tension to avoid entanglement with ESA-listed species and that construction related equipment that may pose an entanglement hazard are removed from the action area if not being actively used. Based on no documented cases of scalloped hammerhead sharks or green or hawksbill sea turtles being entangled in construction equipment and implemented BMPs, NMFS concludes that the effects of entanglement on scalloped hammerhead sharks or green or hawksbill sea turtles to be discountable.

Vessel strikes

This action requires barges and accessory vessels in Apra Harbor. There is also potentially a need to bring in an additional barge from outside Guam (e.g., from Hawaii or CNMI) with one vessel transit from and to its origin. Thus in addition to the green and hawksbill sea turtles and scalloped hammerhead sharks, there is the potential for vessel strikes outside Apra Harbor on the vessel track to and from the barge's origin on ESA-listed marine mammals, including the false killer, blue, fin, sei, and sperm whales; olive ridley, loggerhead and leatherback sea turtles and a second DPS of green sea turtle; oceanic whitetip shark; and the giant manta ray. Collision can cause injuries ranging from bruising to broken bones or carapaces, lacerations, or even death.

Green turtles have been documented occasionally being hit by boats in Guam (Seminoff et al. 2015). Hawksbill sea turtles and scalloped hammerhead sharks have not been documented being struck by vessels in Guam (Miller et al. 2014; NMFS and USFWS 2013). Turtles cannot consistently notice and avoid vessels traveling greater than two miles per hour (Hazel et al. 2007), thus vessel operators must be responsible for watching out for and avoiding sea turtles. Oceanic white tip sharks and giant manta rays have not been studied with respect to vessel avoidance. Both species are highly mobile. Giant manta rays are frequently found traveling just below the surface (Deakos 2010).

Hawaiian monk seals and whales could be exposed to ship strikes. Data suggest that the probability of vessel collisions between whales and vessels associated with this action is low. Over the 2007-2016 ten-year period, 11 blue whale ship strikes were observed on the US West Coast, however none were reported for Hawaii or the Marianas (Carretta et al. 2019). No ship strikes of other threatened or endangered cetaceans were recently reported (Carretta et al. 2019). The severity of vessel strike is directly related to speed, with the probability of lethal injury increasing from 21% at 8.6 knots to over 79% at 15 knots or greater (Vanderlaan and Taggart 2007). False killer whales are known to travel in pods, approaching vessels to ride their bow wake. Seals are known to be highly agile. However, vessels have been known to infrequently injure monk seals, including one probable boat strike in 2015 (NMFS 2007; Carretta et al. 2019).

BMPs B 1-4 require that vessel operators halt or alter course to remain at least 50 yards away from ESA-listed marine mammals, and that vessel operators will reduce their vessel speed to 10 knots or les when piloting vessels in the proximity of marine mammals, and 5 knots or less when piloting vessels in areas of known or suspected turtle activity. Operators will be particularly vigilant watching for turtles at or near the surface. Additionally, if approached by an ESA-listed marine animal, the vessel will be put in neutral until the animal is at least 50 feet away, and then slowly move to 150 feet (50 yards).

Due to the low speeds at which vessels will be operating within Apra Harbor, the low number of transits expected to occur outside Apra Harbor (one transit to and from a barge's origin), the low number of recorded ship strikes on ESA-listed marine mammals, turtles, sharks, and rays in the Western Pacific, and the proposed BMPs, NMFS concludes that the potential effect of vessel strikes is discountable.

Wastes and discharges

Although this action is not anticipated to generate waste that will enter the water, waste and debris, such as plastic bags and candy wrappers, could potentially do so. ESA-listed animals may view these as sources of food and ingest them, which can cause blockage of their digestive systems, internal injuries, and starvation. Green and hawksbill sea turtles are documented consuming marine debris (Seminoff et al. 2015; NMFS and USFWS 2013), although scalloped hammerhead sharks have not been documented consuming marine debris (Miller et al. 2014). DON (2020) states that no debris will be allowed to enter the water. Waste will be controlled and disposed into trash dumpsters or roll-off bins in the action area base yard or storage area. BMP D states that all action-related debris and other waste will be contained and will not enter or remain in the marine environment, a temporary platform or other suitable means will be implemented as a means of capturing construction debris, and these structures will be in place prior to starting in-water work.

During transit from port of origin to Guam, as well as within Apra Harbor, while highly unlikely, accidental discharges and fuel spills could occur. These accidental discharges or spills could lead to poisoning of ESA-listed animals, in some cases resulting in death. However, these spills, should they occur, are expected to be very small (realistic worst case less than 25 liters (DON 2020)) and quickly and easily contained in Apra Harbor, or should quickly disperse on the high seas. Wastewater from demolition work will be disposed of at an off-site approved disposal facility. Prior to commencing daily activities, all equipment and vehicles will be maintained and checked to reduce the risk of leaks or discharge; hydraulic equipment will be maintained properly to prevent leaks. BMP E states that an oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be implemented through the storm water pollution protection plan. Fueling will occur at least 150 feet from the water unless the equipment (e.g. crane on barge) cannot be fueled on land. In this case, booms will be deployed to contain spills and all spills will be cleaned immediately.

Implemented BMPs will reduce the risk to sea turtles, seals, rays, sharks, and cetaceans. Should a small spill occur, which is highly unlikely, it is expected to be very small in nature and quick to disperse on the high seas or be cleaned up in Apra Harbor. Therefore NMFS concludes that the effect of small spills, discharges, and waste to be discountable.

Critical Habitat

Should the extra support vessel be brought from Hawaii to Guam, the transit route would most likely be in and out of Honolulu, which is excluded from Hawaiian monk seal critical habitat. Therefore NMFS concludes that this proposed action is not likely to adversely affect Hawaiian monk seal designated critical habitat and the effects are discountable.

Critical habitat for MHI IFKW associated with the proposed action potentially includes the transit route to and from Honolulu, Hawaii should the support vessel be brought from off Guam. BMPs associated with this action should prohibit any pollutants from entering the marine environment. The sound associated with the vessel will be transient in nature. Therefore, NMFS concludes that the proposed action is not likely to adversely affect any essential feature of MHI IFKW critical habitat in any meaningful way, and the effects are therefore discountable.

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 following ESA-listed species: endangered Central West Pacific and threatened Central North Pacific green turtles; endangered hawksbill, leatherback, and loggerhead turtles; threatened olive ridley sea turtle; threatened Indo West Pacific scalloped hammerhead and oceanic whitetip sharks; endangered Hawaiian monk seal; endangered blue, fin, sei, sperm and Main Hawaiian Island insular false killer whales; and the giant manta ray, as well as critical habitat for the Hawaiian monk seal and MHI IFKW.

This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. Consultation regarding Essential Fish Habitat will be completed by NMFS' Habitat Conservation Division in a separate communication.

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 Sarah Pautzke at Sarah.Pautzke@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: 2020.04.08 14:27:19 -10'00'

Ann M. Garrett
Assistant Regional Administrator
Protected Resources Division

Cc: Edward Moon (Edward.Moon@fe.navy.mil), Jeffery Lambrecht (Jeffrey.Lambrecht@fe.navy.mil), Andrea Vonburg-Hall (andrea.vonburg-hall@navy.mil), and Kyle Fujimoto (kyle.fujimoto@navy.mil)
NMFS File No.: PIR-2020-1815

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APPENDIX A

BEST MANAGEMENT PRACTICES TO AVOID AND MINIMIZE IMPACTS TO ESA-LISTED SPECIES

The following BMPs were provided by DON and will be employed to ensure that no adverse effects will occur to ESA-listed species:

A. Constant vigilance will be kept for the presence of ESA-listed marine species during all aspects of the in-water actions, such as boat operations, pile driving, dredging, and deployment of silt curtains, anchors, and mooring lines.
   1. The Contractor will comply with the following monitoring requirements:
      i. From the wharf, a competent observer will monitor for ESA-listed species during all in-water activities (Figure 3).
      ii. While monitoring, the observer will use binoculars to survey the Action Area each day, beginning 30 minutes prior to the start of work and repeated hourly throughout the workday.
         - During the survey period, the observer will record environmental and Action-related information, including but not limited to date, time, weather, action undertaken, status and effectiveness of BMPs, and ESA-listed marine mammals.
         - If no ESA-listed marine animal is seen during the 30-minute survey period, Action activities may commence.
         - If an ESA-listed marine animal is seen during the 30-minute survey period, the observer will notify the Project Manager immediately and monitor the animal. If the animal is within 50 yards (yd.) of the in-water activity, animal behavior observations shall be recorded. Work will not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting.
         - During in-water operations, all in-water work shall stop when an ESA-listed marine animal is within 50 yd. of the proposed work. Work shall 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 shall be recorded.

Figure 3. Lima, Mike, and November Wharves with the 50 meter monitoring and shutdown zone. Apra Harbor, Guam.

2. No pile driving or dredging will be conducted after dark.
3. NBG will document and report to NMFS all interactions with ESA-listed species (monthly), including the disposition of any listed species that are inadvertently injured or killed (within 24 hours).

B. In-water operations will implement the following BMPs to reduce potential collisions with ESA-listed species:
   1. Vessel operators will halt or alter course to remain at least 50 yd. away from ESA- listed marine animals.
   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.
   3. If approached by an ESA-listed marine animal, the vessel operator will put the engine in neutral until the animal is at least 50 ft. away, and then slowly move to 50 yd. (50 meters) away from the animal.

4. Vessel operators will not encircle or trap ESA-listed marine animals 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. All personnel will not attempt to disturb, touch, ride, feed or otherwise intentionally interact with any protected species.
   2. All personnel will stay more than 50 yd. away from sea turtles that haul-out on land.
   3. Before any equipment or material enters the water, the Contractor will verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the seabed.
   4. All objects lowered to the bottom will be lowered or installed 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.
   5. 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.
   6. 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 Action Area if not actively being used.

D. All Action-related debris and other waste will be contained and will not enter or remain in the marine environment. The Contractor shall provide a temporary platform or other suitable means of capturing debris from construction, and these structures shall be in-place prior to commencing in-water activities.

E. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the Storm Water Pollution Prevention Plan (SWPPP) and implemented throughout construction of the Action.
   1. Fueling of Action-related vehicles and equipment will take place at least 150 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.
   2. All Action-related materials and equipment placed in the water will be free of pollutants.
   3. 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.
   4. Daily pre-work equipment inspections for cleanliness and leaks will be performed. 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.

F. Turbidity and siltation from Action-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.
   1. Full-length silt curtains will be installed immediately adjacent to and around the barge at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the phasing limits. Silt curtains will completely enclose dredging and pile driving operations to the maximum extent practicable, to maintain water quality and to provide coral protection.
   2. The Contractor must continuously monitor to ensure that control measures are in place and functioning properly
   3. If a visible plume is observed outside the silt curtains, construction activity will be suspended, evaluated, and corrective measures taken.
   4. Activity may resume after problem is corrected.

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Appendix B
National Historic Preservation Act Section 106 Documentation

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DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0031
January 23, 2017

Ms. L. B. Aguon
State Historic Preservation Officer
Department of Parks & Recreation
490 Chalan Palayso
Agana Heights, Guam 96910

Dear Ms. Aguon,

SUBJECT: REHABILITATION AND MODERNIZATION OF LIMA, MIKE AND NOVEMBER WHARVES, NAVAL BASE GUAM

Naval Base Guam (NBG) requests your review of a proposed project for structural and operational improvements of Lima (L), Mike (M) and November (N) Wharves, located within Apra Harbor. Pursuant to Section 106 of the National Historic Preservation Act (NHPA), we have reviewed the proposed project and determined it is an undertaking as defined in 36 CFR 800.16(y).

Project Description

This project proposes to rehabilitate and modernize the existing L, M, and N Wharves so that they can remain operational. The structural piles are badly deteriorated and require replacement to maintain these wharves. Concrete caps on the wharves are damaged and there are severe cracks throughout the wharves presumably from earthquakes and typhoons. Other components of the wharves: anodes, fenders, moorings, bumpers, anchor plates, bollards, cleats, and heavy mooring anchor have deteriorated beyond their useful life. Additionally, the utilities and fire protection system serving the wharves are outdated and do not meet current requirements.

This project will require a geotechnical boring survey in order to evaluate the structural integrity of the existing internal pilings. The proposed repairs would also include new sheet piles in front of the existing face. The space between the existing piles and new sheet piles will be dredged and filled with concrete and capped with a concrete topping which will extend the wharves out a couple of feet at their perimeter. Cracks in the concrete decking will be repaired with new concrete. The original profile of the wharves will be maintained and the gantry tracks will be retained.

Area of Potential Effects

The Area of Potential Effects (APE) is depicted on the maps in Enclosure (1) and the location of the geotechnical borings is shown on Enclosure (2).

Identification of Historic Properties

The wharves were built in 1949 and are eligible for the National Register of Historic Places (NRHP). They are significant under Criterion A for its essential presence in the Pacific that supported Pacific Fleet's mission during the Cold War; and, under Criterion C as an example of post WWII wharf construction. Two gantry portal cranes and track were added in 1952. The wharf design, concrete bulkhead, former gantry cranes[1] and track were identified as character defining features of this wharf. Numerous additions and multiple repairs to the decking and fender system have taken place. In 1959 a concrete curb capping the top of the sheet piling was added along with a wood fender system that was later replaced with rubber bumpers. The wharves were evaluated by Weitze and Cosson in 2010 for a study: *Cold War Historic Context and Architectural Inventory for Naval Base Guam*. The study found that the wharves retain sufficient integrity to be considered eligible for the National Register of Historic Places (NRHP).

The wharves were constructed on fill lands created from mid-20th century dredge materials (Welch 2010:361; Welch et al. 2009:253). There are no archaeological sites or submerged resources in the vicinity of the wharves that would be affected by the proposed repairs (Carrell 1991; Welch et al. 2009). The Inner Apra Harbor was constructed after World War II and required massive earth moving and dredging to establish its current water depths (Welch et al. 2009:160; Yoklavich and Reinman 1997:29). Subsequent maintenance dredging of the harbor has occurred continuously over the years.

Determination of Effect

The Navy has determined the undertaking would have **"no adverse effect"** on these NRHP eligible wharves because repairs and rehabilitation will be conducted in accordance with the

[1] The two gantry cranes were owned and operated by the Ship Repair Facility since the 1980s. The Ship Repair Facility recently removed the gantry cranes.

Secretary of the Interior Standards and there are no archaeological sites within the APE.

In planning for this and future repairs to the historic wharves, Naval Base Guam is preparing a Level II Historic American Engineering Report (HAER) and survey of Lima, Mike and November Wharves which will be donated to the Library of Congress via the National Park Service and Guam SHPO.

In accordance with 36 CFR 800.4 (d)(1), if we receive no response from your office within 30 days of receipt of this letter, we may proceed with carrying out the undertaking in accordance with applicable law. Should you have any questions or require additional information about this proposed project, our point of contact is Mr. Lon Bulgrin, Archaeologist, NAVFAC Marianas at (671) 339-2093 or email: Lon.Bulgrin@fe.navy.mil

Sincerely,

Ed Moon

E.E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure:

1. Location Map and Vicinity Plan
2. Boring Location at Lima Wharf

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1. 2010 Weitze, Karen and Cosson, Polly, *Cold War Historic Context and Architectural Inventory for Naval Base Guam.* Mason Architects Incorporated and Weitze Research.

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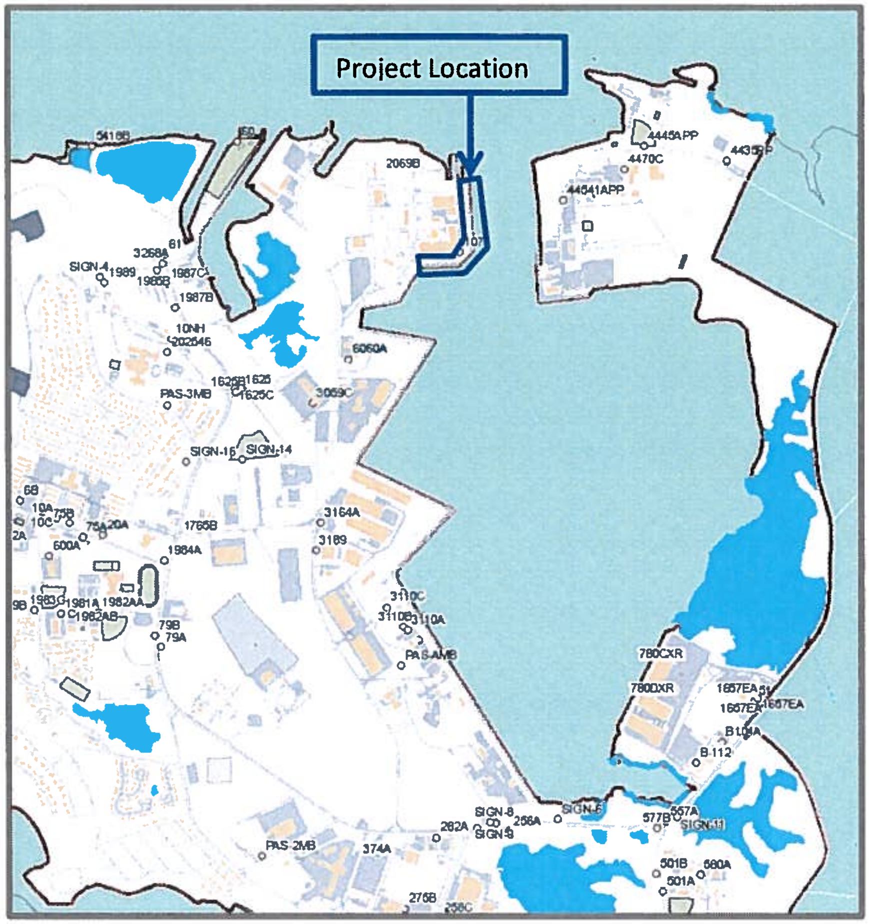
5. 1991 Carrell, Toni *Micronesia Submerged Cultural Resources Assessment.* Submerged Cultural Resources Unit, National Park Service. Santa Fe, New Mexico.

Copy to:
NAVFAC MAR PWD (L. Bulgrin, W. Arnold)
NAVFAC PAC EV21 (K. Fujimoto)

Blind copy to:
NAVFAC PAC EV23 (J. Sanehira)



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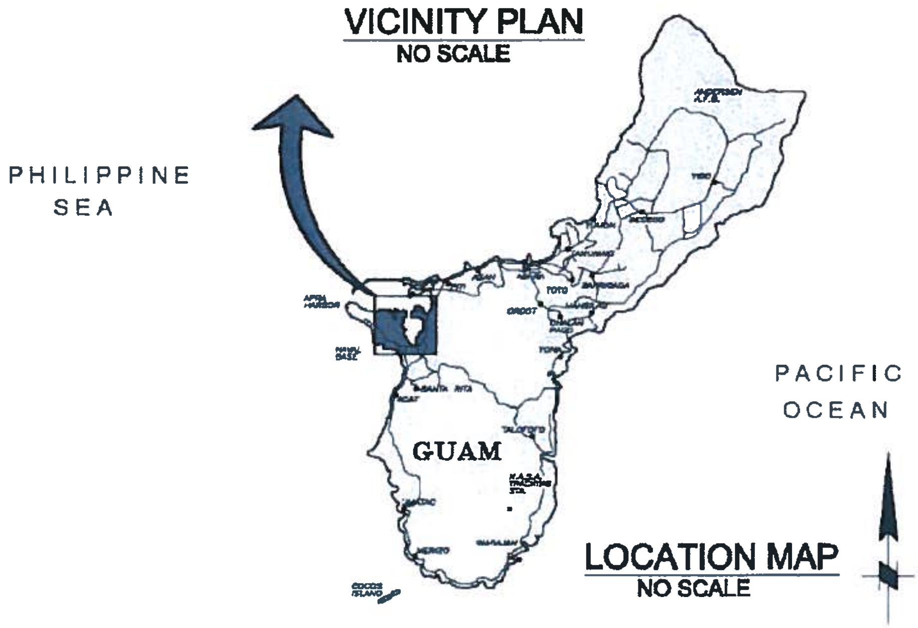
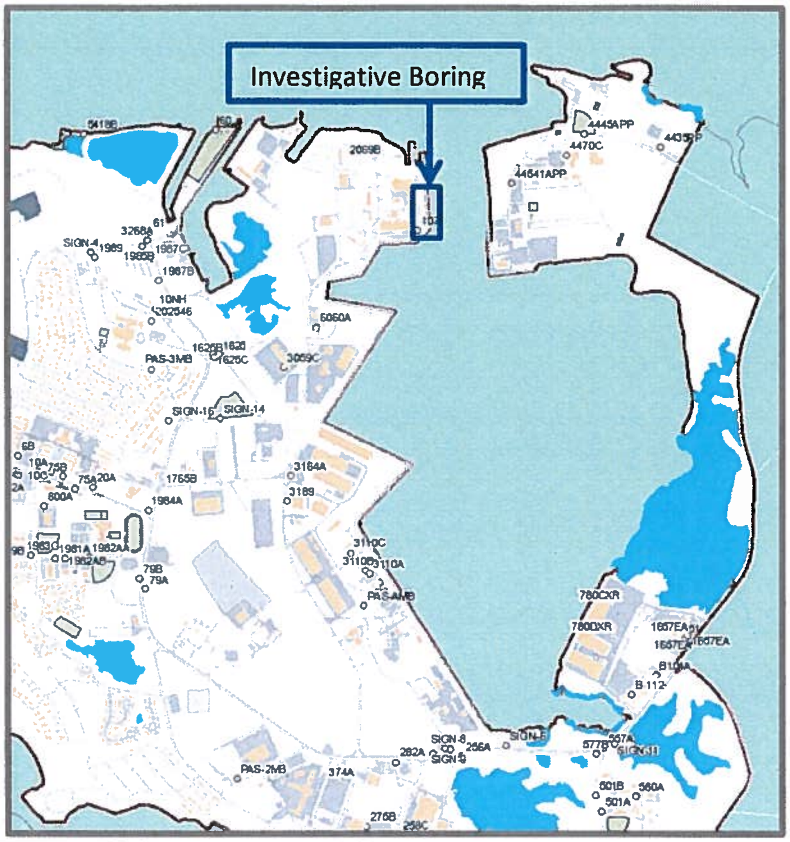
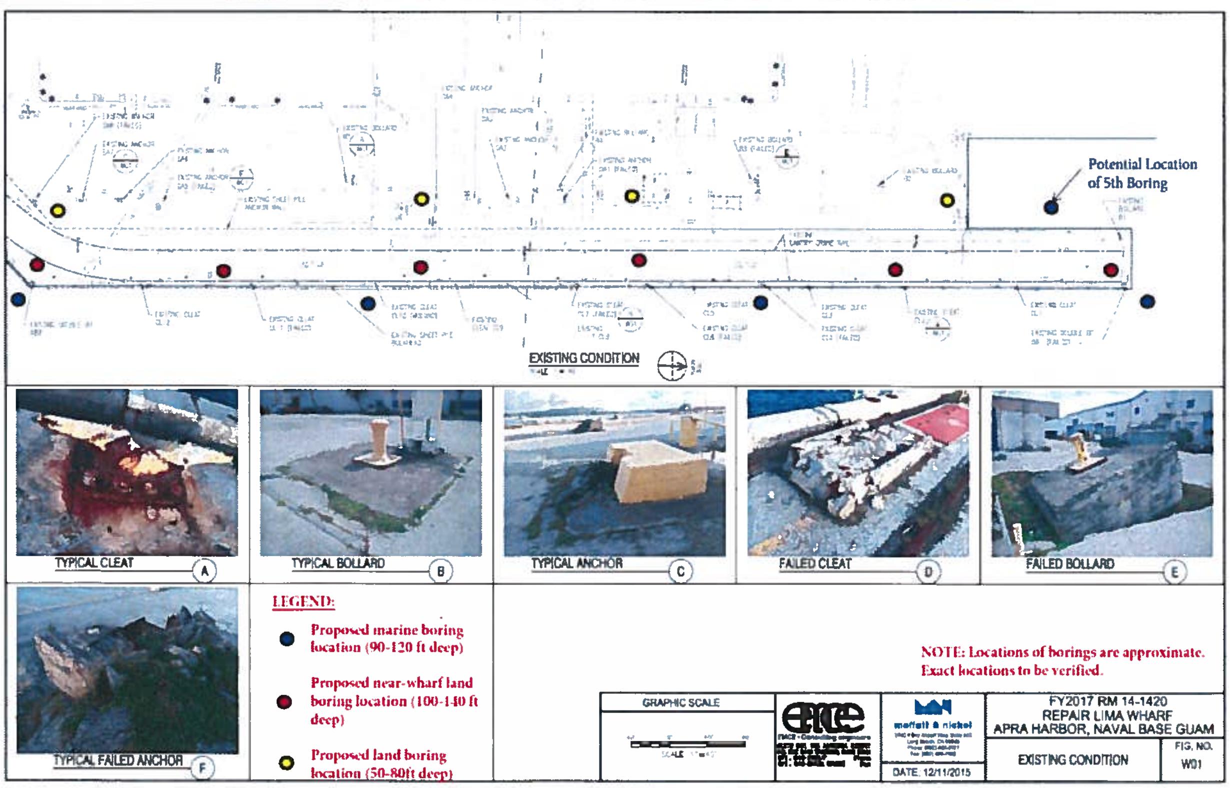


LOCATION MAP
NO SCALE

ENCLOSURE (1)





BORING LOCATION AT LIMA WHARF

ENCLOSURE (2)

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo, Agana Heights, Guam 96910
Director's Office: (671) 475-6296/7; Fax (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822

Eddie B. Calvo
Governor

Ray Tenorio
Lt. Governor

Robert S. Lizama
Director

William N. Reyes
Deputy Director

In reply refer to:
RC2017-0109

February 21, 2017

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: 5090 Ser EV/0031 January 23, 2017
Rehabilitation and Modernization of Lima, Mike and November Wharves, Naval Base Guam

Dear Mr. Moon,

We reviewed the subject undertaking and concur with the Navy determination of "no adverse effect" for the proposed project for structural and operational improvements of the subject wharves located within Apra Harbor. As the Naval Base Guam (NBG) indicated, based on 2010 *Weize and Cosson: Cold War Historic Context and Architectural Inventory for Naval Base Guam,* the wharves are considered eligible for the National Register of Historic Places (NRHP).

We agree with the NBG's position that in planning for the subject undertaking and future repairs to the historic wharves, a Level II Historic American Engineering Report (HAER) and survey of Lima, Mike, and November will be conducted. We look forward to the submission of the HAER and study for our review.

As to the project improvement activities, in accordance with *36 CFR Sec. 800.13 Post review discoveries*, in the event that historic properties are encountered within the APEs of subject project, the work must stop and our office notified immediately for further consultation.

If you have any questions, please don't hesitate to contact our office.

Sincerely,

Robert S. Lizama
Director

Lynda Bordallo Aguon
State Historic Preservation Officer

Cc: Lon Bulgrin, Archaeologist, NAVFAV Marianas
Lon.Bulgrin@fe.navy.mil

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Appendix C
Coastal Consistency Determination

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DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/0850
April 20, 2020

Tyrone J. Taitano
Director
Guam Coastal Management Program
P.O. Box 2950
Hagåtña, Guam 96932

Subject: NOTIFICATION OF CONSISTENCY DETERMINATION FOR THE LIMA, MIKE, AND NOVEMBER WHARF REPAIR AND MODERNIZATION AT NAVAL BASE GUAM, APRA HARBOR

Dear Mr. Taitano,

U.S. Naval Base Guam is proposing to repair and modernize Lima, Mike, and November Wharves at Apra Harbor, Guam starting in Fiscal Year 2021 to ensure the wharves continue to fulfill waterfront infrastructure needs and meet assigned operational mission requirements. 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 930.35.

Lima, Mike, and November wharves were built in 1945 and serve as berthing and ship repair wharves. Concrete caps on the wharves are damaged and there are cracks in the concrete throughout the wharves due to damage from natural disasters (e.g., earthquakes and typhoons). The anodes, fenders, moorings, bumpers, wall anchor plates, ship tie downs, and heavy-weather mooring anchor are damaged and beyond their useful life. The telecommunication, utilities, storm water, and fire protection systems serving the wharves are old, outdated, and do not meet current code requirements.

Lima, Mike, and November wharves are located at the entrance of Inner Apra Harbor, which is connected to the Atantano River and to the estuarine and marine environments of the Outer Apra Harbor. Although Inner Apra Harbor was naturally formed, it has been extensively modified by construction, dredging, and filling beginning around 1944. Most of the modern Inner Apra Harbor is an artificially built environment that is intensively managed and used for maritime military and industrial activities.

The purpose of the Proposed Action is to repair and restore the existing wharves to working condition and to ensure structural integrity. The need for the Proposed Action is to ensure that Lima, Mike, and November wharves fulfill waterfront infrastructure needs and meet assigned operational mission requirements to enable combat capable naval forces to be ready for deployment worldwide. In this regard, the Proposed Action furthers the Navy's execution of its congressionally mandated roles and responsibilities under 10 U.S. Code (U.S.C.) section 5062.

The Navy conducted consultation with National Marine Fisheries Service (NMFS) to make a final determination of the effects to endangered species and essential fish habitat (EFH). 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 agreed with the Navy's conclusion that there will be unavoidable and substantial adverse effects to sensitive and hard-to-replace EFH due to project activities. NMFS also agreed with the mitigation plan put forward by the Navy and provided two additional EFH conservation recommendations for consideration. The Navy also conducted consultation under Section 106 of National Historic Preservation Act in February 2017. This consultation indicated that there would be no adverse effect to sites eligible for the National Register of Historic Places. The Guam State Historic Preservation Officer (SHPO) concurred with the Section 106 request.

The Navy prepared a Draft Environmental Assessment (EA) (enclosed) and has completed an "effects" test per 15 CFR Part 930 Section 930.33(a)(1). The Navy assessed reasonably foreseeable direct and indirect effects on Guam's coastal use or resources, reviewed relevant management program enforceable policies, and determined that the project has foreseeable coastal effects to Guam's defined coastal zone per 15 CFR 930, Section 930.35. This notification of consistency determination is based on:

1. 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); however, there is a potential for spillover effects to mobile in-water resources (e.g., fisheries, marine mammals, etc.) that can cross-over and extend into Guam's coastal zone per 15 CFR 923, Section 923(b).
2. The proposed federal development is consistent with existing land uses as military mission support.
3. The use of Best Management Practices would be implemented to minimize potential environmental effects.
4. The proposed activities are similar to previous Navy activities that have been determined to be either consistent with, or have no effects, on coastal resources.

We are hopeful that a response from Bureau of Statistics and Plans can occur 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 16 CFR Section 930.35(c).

Subject: NOTIFICATION OF CONSISTENCY DETERMINATION FOR THE LIMA, MIKE, AND NOVEMBER WHARF REPAIR AND MODERNIZATION AT NAVAL BASE GUAM, APRA HARBOR

Should you have any questions or require additional information about this proposed project, please contact me, Mr. Jeffrey Lambrecht, Environmental Planner, NAVFAC Marianas at (671) 339-2587 or email: jeffrey.lambrecht@fe.navy.mil.

Sincerely,

Ed Moon

Edward Moon
By direction of the Commanding Officer
Installation Environmental Program Director

Enclosures:
1. Proposed Action Location Map
2. Typical Lateral View of Wharf Bulkhead Replacement
3. Guam CZM Program Assessment Form
4. Draft EA, Lima, Mike, and November Wharf Repair and Modernization at Naval Base Guam, Apra Harbor
5. NMFS Response Letter, Endangered Species Act Consultation (4-8-20)
6. NMFS Response Letter, Endangered Species Act and Essential Fish Habitat Assessment Consultation (3-13-20)
7. Guam Department of Parks and Recreation Section 106 Review Letter (2-21-17)
8. Biological and Benthic Habitat Surveys at LMN Wharves Final Report (December 2019)

GUAM COASTAL MANAGEMENT PROGRAM
ASSESSMENT FORM

DATE OF APPLICATION: April 16, 2020
NAME OF APPLICANT: Jeffrey Lambrecht, Environmental Planner for Naval Base Guam
ADDRESS: Naval Facilities Engineering Command Marianas ATTN: EV Jeff Lambrecht PSC 455, Box 195, FPO AP 96540-2937
TELEPHONE NUMBER: (671) 339-2587 Fax No.______________ Cell No.____________________
E-MAIL ADDRESS: Jeffrey.lambrecht@fe.navy.mil

TITLE OF PROJECT:
Lima, Mike, and November Wharf Repair and Modernization at Naval Base Guam, Apra Harbor

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. ____
6. ____

DATE REVIEW COMPLETED:____

DEVELOPMENT POLICIES (DP):

DP1. 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 that 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: The proposed project is consistent with DP1. The proposed project area is not in a Seashore Reserve; it is located within a developed area along a developed shorefront that has changed little over the past 80 years. The proposed project is to repair the existing developed shorefront and would not substantially change it. The repairs would improve the appearance and function of the existing shorefront. Because it is a repair action, the proposed project can only occur at the location of the existing shorefront and thus, there is no feasible alternative site. New construction at a different location would fail to address the deterioration of the Navy wharves.

DP2. URBAN DEVELOPMENT

Intent: To cluster high-impact uses to ensure coherent community design, function, infrastructure support, and environmental compatibility.

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: DP2 is not applicable. The proposed project is located within the "Military/Federal" generalized existing land use area and does not involve the development of commercial, multi-family, industrial, and resort-hotel zone uses and uses requiring high levels of support facilities.

DP3. RURAL DEVELOPMENT

Intent: To provide a development pattern compatible with environmental and infrastructure support suitability and that 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: DP3 is not applicable. The proposed project is not in a rural development area nor does it involve residential development or agricultural uses.

DP4. 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: DP4 is not applicable. The proposed project does not involve the siting of major utilities, fuel, or transport facilities. The national interest is served through the Naval Base Guam (NBG) Lima, Mike, and November (LMN) wharf repair and modernization. This project would fulfill waterfront infrastructure needs and meet assigned operational mission requirements to enable combat capable naval forces to be ready for deployment worldwide.

DP5. 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 DP5. The proposed project area is at the waterfront of Inner Apra Harbor, an area that is vulnerable to tsunami inundation, seiche, earthquakes, and typhoons. However, the proposed project would not involve new development and would not pose an unreasonable risk to the health, safety, or welfare of the people of Guam. The proposed project would improve conditions by preventing the potential for hazards due to the failure of bulkheads and the disintegration of existing shore infrastructure.

DP6. 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 man-made hazards, and recognize the limitations of the island's resources to support historical patterns of residential development.

Discussion: DP6 is not applicable. The proposed project does not include residential development.

DP7. 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: DP7 is not applicable. The proposed project does not include the development of transportation systems.

DP8. 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 percent or greater slope by requiring strict compliance with erosion, sedimentation, and land use districting guidelines, as well as other related land use standards for such areas.

Discussion: The proposed project is consistent with DP8. The project location is in a level area. Best management practices (BMPs) include the use of silt containment devices, implementation of a construction debris disposal plan, use of a closed clamshell bucket excavator to reduce sediment re-suspension, implementation of a Water Quality Monitoring Plan, and protection of storm drain inlets and other drainage facilities.

Turbidity and siltation from in-water construction activities would be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains would completely enclose dredging operations to the maximum extent practicable. Turbidity would be monitored using a Guam Environmental Protection Agency-approved Water Quality Monitoring Plan.

With these BMPs and water quality monitoring measures, the proposed project would be in compliance with erosion, sedimentation, and land use districting guidelines.

RESOURCES POLICIES (RP):

RP1. AIR QUALITY

Intent: To control activities to ensure good air quality.

Policy: All activities and uses shall comply with all local air pollution regulations and all appropriate federal air quality standards to ensure the maintenance of Guam's relatively high air quality.

Discussion: The proposed project is consistent with RP1. A comprehensive air quality impact analysis of the proposed project is presented in Section 3.7 of the Draft Environmental Assessment (Enclosure 4) and is summarized below.

The proposed project would create temporary increases in criteria pollutant emissions during construction and demolition activities; however, the construction emissions are intermittent and not permanent. The proposed project is located within a nonattainment area for sulfur dioxide. The Navy prepared a Record of Non-Applicability. Total construction sulfur dioxide emissions would be below *de minimis* thresholds for Clean Air Act general conformity. Therefore, the proposed project would not trigger a general conformity determination under Section 176(c) of the Clean Air Act.

The action would result in a temporary increase in greenhouse gas emissions; however, operations would not introduce new air pollution sources. Fugitive dust emissions would be controlled by:

- using water for dust control during demolition and construction, including grading;
- covering moving open-bodied trucks transporting materials that could release fugitive dust; and
- monitoring and prompt removal of soil or other materials from paved streets and roadways left by trucking, earth-moving equipment, erosion, or other means.
- The combined effects are considered minimal with regards to any foreseeable direct or indirect effect on uses and other resources of the Guam coastal zone.

RP2. WATER QUALITY

Intent: To control activities that may degrade Guam's drinking, recreational, and ecologically sensitive waters.

Policy: Safe drinking water shall be ensured 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, reefs, and aquifer areas.

Discussion: The proposed project is consistent with RP2. A comprehensive water quality impact analysis of the proposed project is presented in the Draft Environmental Assessment (Enclosure 4) and is summarized below.

The proposed project would not impact surface water or groundwater resources. The project area does not overlay drinking water sources, so the proposed project would not have any effect on the Guam aquifer.

The proposed project would involve in-water construction activities for which a Clean Water Act Section 404/Rivers and Harbors Act Section 10 permit from the United States Army Corps of Engineers would be obtained, along with the related Section 401 Water Quality Certification. The proposed project would comply with NBG Multi-Sector General Permit and the NBG National Pollutant Discharge Elimination System Permit, concurrent with United States Army Corps of Engineers permit. Runoff control measures will be developed in addition to or in conjunction with Construction General Permit, National Pollutant Discharge Elimination System Permit, and Multi-Sector General Permit requirements. In case of overlap, the most stringent BMPs and requirements will take precedence. Any pumping of water would comply with Clean Water Act Section 401 Water Quality Certification and with the Spill Prevention, Control, and Countermeasure Plan.

There would be temporary, insignificant adverse water quality impacts during construction (i.e., sediment loading and potential releases of pollutants entrained in dredged materials into the water column) in the areas surrounding the active in-water construction sites. Construction equipment, vessels, and vehicles, fueling of project-related vehicles and equipment, and construction-related debris have the potential to release petroleum products, hydraulic fluids, or other pollutants into marine waters. Silt curtain and storm drain catch basins would be used to prevent unpermitted release of contaminated material into the environment/water. Potential adverse marine water quality impacts would also be minimized through implementation of BMPs such as:

- fugitive dust control (i.e., water-down material stockpiles, cover stockpiles and vehicles carrying stockpiles);
- protection of storm drain inlets and other drainages;
- filtration or frequent cleaning and maintenance of catch basins to remove accumulated sediments;
- maintain hazardous materials under shelter and behind containment;
- keep the work site clear of refuse and construction debris;
- prohibit fueling of equipment and vehicles within 50 feet of water;
- maintain and have readily available spill kits and booms as in work areas;
- turbidity curtains (in water); and
- use of clamshell bucket excavator to reduce sediment re-suspension.

- Dredging would have visual monitoring for plumes. Trained observers will be designated to visually survey the marine areas within and adjacent to the project footprint for protected species. Additionally, all project-related materials and equipment placed in the water would be free of pollutants. The project manager and 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. Operations would not proceed until the leak is repaired and equipment cleaned.

  Turbidity would be monitored using a Guam Environmental Protection Agency-approved Water Quality Monitoring Plan.

RP3. 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, shall be regulated to protect their unique character.

- Historical and archaeological 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 Impact Avoidance and Minimization Measures. The individual fragile areas specifically identified in RP3 are further addressed below.

Historical and archaeological sites. The proposed LMN wharves improvement areas are located in areas where no archaeological resources have been discovered. Archaeological predictive modeling, reflected in current NBG archaeological probability maps, indicate the proposed project would be entirely within an area designated as having no/low archaeological probability due to its location on fill lands created from mid-20th century dredged materials. Inner Apra Harbor, including the areas proposed for dredging in this project, is a post-World War II man-made facility constructed through massive earth-moving and dredging to establish its current water depth. Therefore, submerged World War II resources and intact archaeological deposits are not expected. A Section 106 review of the project was submitted to the Guam State Historic Preservation Officer in January of 2017, and Guam State Historic Preservation Officer concurred with the Navy's determination of "no adverse effect" in February of 2017 (Enclosure 7).

Wildlife habitats. The proposed project is consistent with RP3 to the maximum extent practicable with the implementation of BMPs and Impact Avoidance and Minimization Measures. These BMPs and Impact Avoidance and Minimization Measures are outlined in the National Marine Fisheries Service (NMFS) consultations (Enclosure 6), Draft Environmental Assessment (Enclosure 4), and Biological and Benthic Habitat Surveys Final Report (Enclosure 8). Marine mammals are not known to be common in Apra Harbor, particularly not in Inner Apra Harbor, and the proposed project would have less than significant impacts to marine mammals. In addition, the Navy will implement measures determined during the Endangered Species Act (ESA) consultation and Marine Mammal Protection Act (MMPA) permit processes with the NMFS. Therefore, the proposed project and associated construction activities are consistent to the maximum extent practicable with the enforceable policy on living marine resources of the Guam Coastal Management Program.

Pristine Marine and Terrestrial Communities. As noted above in both the hard bottom and soft bottom discussions of wildlife habitats, the native hard bottom habitat has been completely removed from Inner Apra Harbor. The dominant hard bottom habitats are anthropomorphic structures with littered native rubble and debris. Inner Apra Harbor is subject to regular maintenance dredging, and it is the wharf faces and other man-made structures that support fish communities. Therefore, marine communities are not pristine.

Regarding terrestrial communities, the entire proposed project location and most of the surrounding area has been extensively modified by construction, dredging, and landfills since approximately 1943. The terrestrial portion of the proposed project consists almost entirely of manufactured hardscape. There is no fragile terrestrial community within the proposed project location, and if it were, it would not be considered pristine.

Limestone Forests, Mangrove Stands, and Other Wetlands. Impacts on mangrove stands and other wetlands are covered under the discussion for estuarine/wetland habitats above. Limestone forests are not present within or adjacent to the proposed project area.

Coral Reefs. Impacts on coral reefs are covered under the discussion for coral reef habitat above.

The reasonably foreseeable direct and indirect effects from impacts to fragile areas from the proposed project and construction activities to the uses and resources of the Guam coastal zone would be minimal; these activities would occur within the boundaries of the military installation, and more importantly they would not occur within the six fragile area types listed in the bullet points above. Stressors, physical disturbances, and strike potential from the proposed project and construction activities within federally owned lands would not diminish the ability of soft bottoms or hard bottoms to function as non-fragile habitat.

RP4. 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 overharvesting and, in the case of corals, sea turtles, and marine mammals, from any taking whatsoever.

Discussion: The proposed project is consistent with RP4. The Draft Environmental Assessment (Enclosure 4) provides detailed analyses of impacts on fish, corals, sea turtles, and marine mammals. The impacts analyses are summarized below.

The proposed project would cause direct impacts to abiotic marine resources, marine habitats, marine vegetation, non-coral benthic invertebrates, coral, and fish associated with wharf infrastructure within the proposed project location. The impacts would be lethal loss for all but the most mobile species. Because the proposed project would replace the wharf infrastructure in similar quantity and layout, the adjacent marine resources would rapidly re-colonize the new wharf infrastructure. This disturb-and-re-colonize process has occurred relatively rapidly after all prior episodes of maintenance dredging and wharf repair and modernization. Most organisms in the dominant fouling community are particularly well-adapted to rapidly colonize new areas. Therefore, the loss of the fouling community would be short term with a duration of months to several years for non-coral invertebrates.

With the implementation of BMPs and Impact Avoidance and Minimization Measures (listed in Appendix A in Enclosure 4), and Mitigation Measures through coral translocation, impacts to habitat and marine species would not be significant. These BMPs and measures would reduce the intensity of indirect stressors, reduce the spatial extent of indirect stressors, and in some cases would reduce the temporal duration of indirect stressors. The Navy concluded Section 7 ESA consultation with NMFS (Enclosure 5) and is in consultation with NMFS for Essential Fish Habitat (EFH) (Enclosure 6).

ESA Species. The proposed project may affect but is not likely to adversely affect three 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*). There are no reports of ESA-listed corals in the vicinity of the proposed project location, and there are no reports from Inner Apra Harbor. Marine mammals are not known to be common in Apra Harbor, particularly not in Inner Apra Harbor, and have been excluded from prior agency consultations for substantially similar actions. The three ESA-listed species have been reported in the proposed project location, but little suitable habitat exists within the proposed project location for those species. Impacts to ESA-listed species may occur from exposure to the following stressors: elevated underwater noise, direct physical contact, vessel collisions, waste and discharge, and entanglement. Given the rarity of these species' presence in the proposed project area, the Navy has determined that the potential for impacts is less than significant. 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. The NMFS concurrence is applicable to the following ESA-listed species, endangered Central West Pacific and threatened Central North Pacific green turtles (*Chelonia mydas*), endangered hawksbill (*Eretmochelys imbricate*), leatherback (*Dermochelys coriacea*), and loggerhead turtles (*Caretta caretta*), threatened olive ridley sea turtle (*Lepidochelys olivacea*), threatened Indo West Pacific scalloped hammerhead (*Sphyrna lewini*) and oceanic whitetip sharks (*Carcharhinus longimanus*), endangered Hawaiian monk seal (*Neomonachus schauinslandi*), endangered blue (*Balaenoptera musculus*), fin (*B. physalus*), sei (*B. borealis*), sperm (*Physeter macrocephalus*), and Main Hawaiian Island insular false killer whales (MHI IFKW) (*Pseudorca crassidens*), and the giant manta ray (*Manta birostris*), as well as critical habitat for the Hawaiian monk seal and MHI IFKW (Enclosure 5).

NMFS acknowledged the unavoidable loss of EFH from the Proposed Action, the potential for long-term impacts on EFH even with BMPs implemented, and the potential for the proposed mitigation strategies to impede coral recovery or recruitment (Enclosure 6). NMFS provided two conservation recommendations in support of the efforts by the Navy to effectively avoid, minimize, offset, or mitigate impacts to EFH by the Proposed Action. First, the Habitat Equivalency Analysis should be remodeled based on quantitative data collected as part of the coral translocation monitoring to determine the modelled and actual results reflect the effective offset of the ecosystem function. Second, the coral translocation process should avoid physical damage to organisms that are not being transplanted, especially coral, and that the translocation process avoid both direct and indirect exposure of coral to toxicopathological agents. The Navy is currently in the process of evaluating these additional recommendations.

Fish. The Proposed Action does not involve the harvesting of fish. However, stressors to fish include acoustic (in-water construction noises), physical disturbance and strike (vessels and in-water devices), and secondary (from impacts on sediments and water quality). Most of the construction activities that involve these stressors would be conducted intermittently. Impacts from stressors to fish would be localized. Although potential impacts on individuals of certain fish species from the proposed project may include injury or mortality, impacts are not expected to decrease the overall fitness of any given population. Therefore, the reasonably foreseeable direct and indirect effects to the uses and resources of the Guam coastal zone from impacts to fish from construction activities would be minimal.

Corals. Acoustic stressors (in-water construction noises), physical disturbance and strike stressors (vessels and in-water devices), and secondary stressors (from impacts on sediments and water quality), will adversely affect corals. There are no ESA-listed species of coral present in the project area, and BMPs would be implemented to avoid impacts via disturbance, strike, or secondary stressors to non-ESA corals present. The reasonably foreseeable direct and indirect effects from impacts to corals to the uses and resources of the Guam coastal zone from the proposed project would be minimal. With the implementation of BMPs and mitigation measures, the proposed project is consistent to the maximum extent practicable with RP4.

Sea Turtles. Stressors to sea turtles from the proposed project include acoustic (in-water construction noises and vessel noise), physical disturbance and strike (vessels and in-water devices), and secondary (from impacts on sediments and water quality).

With the implementation of stressor-avoidance mitigation measures, the proposed project is consistent to the maximum extent practicable with the enforceable policies of the Guam Coastal Management Program.

Marine Mammals. Stressors to marine mammals from the proposed project include acoustic (construction noise and vessel noise), physical disturbance and strike (vessels and in-water devices), and secondary (habitat – sediments and water quality, air quality, prey availability).

Marine mammals are protected under the MMPA, while species of marine mammals that are endangered or threatened are further protected under the ESA. For this reason, impacts on marine mammals are analyzed separately under each law for each stressor, as discussed below.

Acoustic stressors. Pursuant to the ESA, construction noise and vessel noise may affect but are not likely to adversely affect certain ESA-listed marine mammals. However, marine mammals are not known to be common in Apra Harbor, and particularly not in Inner Apra Harbor. A trained observer will be present during construction activities and will have the authority to halt activities in the event a marine mammal is observed approaching within 50 yards of the proposed project area. Based on above, and pursuant to the MMPA, the impacts would not be anticipated to rise to the level of take.

Physical Disturbance and Strike Stressors. Pursuant to the MMPA, the use of vessels is not expected to result in harassment that would rise to the level of a take. Pursuant to the ESA, vessel use may affect and is likely to adversely affect certain ESA-listed species if they are present.

Secondary Stressors. Pursuant to the MMPA, secondary stressors are not expected to result in harassment of any marine mammal. Pursuant to the ESA, secondary stressors may affect but are not likely to adversely affect certain ESA-listed marine mammals if they are present. Although there are reasonably foreseeable direct and indirect effects from impacts to marine mammals to the uses and resources of the Guam coastal zone, the Navy will implement mitigation measures identified during the ESA consultation. Pursuant to the MMPA, because the impacts would not be anticipated to rise to the level of take, the Navy is not required to obtain a permit through MMPA processes with the NMFS. The Navy will implement mitigation measures to minimize these effects. Based on the above analysis, the Navy finds that the proposed project and construction activities are consistent to the maximum extent practicable with the enforceable policy on living marine resources of the Guam Coastal Management Program.

RP5. 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 RP5. The proposed project would not degrade the site's existing visual qualities, nor would it affect the natural scenic features of the area. The proposed project would restore/improve the visual quality of the decaying wharves and bulkhead.

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 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.

Discussion: RP6 is not applicable. The proposed project is located in Inner Apra Harbor where recreational activities such as diving, fishing, jet skiing, etc. are prohibited.

RP7. 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: RP7 is not applicable. The proposed project is located within a military facility and is part of NBG. Access to the project site is restricted and only personnel with base access are allowed at the site. No non-federally owned beach areas, territorial recreation areas, parks, scenic overlooks, designated conservation areas, or other public lands would be affected by the Proposed Action. There would be no reasonably foreseeable direct or indirect effects to the uses and resources of the Guam coastal zone from the proposed project.

RP8. 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: Not applicable. The proposed project does not involve development on agricultural land.

FEDERAL CONSISTENCY SUPPLEMENTAL INFORMATION FORM

Date: April 16, 2020

Project/Activity Title or
Description: Lima, Mike, and November Wharf Repairs and Modernization

Location: Naval Base Guam wharves including nearshore and in-water

Other applicable area(s) affected, if appropriate:

____

Est. Start Date: July 2021 Est. Duration: 24 months construction duration

APPLICANT

Name & Title: Jeffrey Lambrecht, Environmental Planner for Naval Base Guam

Agency/Organization: Naval Facilities Engineering Command Marianas

Address: ATTN: EV Jeffery Lambrecht 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: Jeffrey.Lambrecht@fe.navy.mil

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 Permit or License
( ) III Grants & Assistance

TYPE OF STATEMENT (check one only)

(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:

A/C (____) ______________________
A/C (____) ______________________
Fax (____) ______________________

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

Date of: ____

Agency	Type of Approval	Date of Application	Status
____________	____________	____________	____________
____________	____________	____________	____________
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____________	____________	____________	____________
____________	____________	____________	____________
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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

JUN 19 2020

Edward Moon
Installation Environmental Program Director
Department of the Navy
U.S. Naval Base Guam
PSC 455 Box 152
FPO AP 96540-1000

RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for the Department of the Navy's proposed Repair and Modernization of the Lima, Mike, and November Wharfs at Naval Base Guam *(GCMP FC No. 2020-0007)*

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 the Department of the Navy. The Department of the Navy ("the federal agency") has submitted its consistency determination relative to its proposed Repair and Modernization of the Lima, Mike, and November Wharfs at Naval Base Guam.

The Bureau coordinated this review with partnering agencies, provided Public Notice, and received comments from the Department of Parks and Recreation indicating no adverse effect. 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) and will be conducted in a manner consistent with the program. Our 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.

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 Consistency Coordinator 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

TYRONE J. TAITANO
Director

Cc: DoAgr-DAWR
DLM
DPR-SHPO
DPW
GEPA
NOAA-OCM

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Appendix D

Air Quality Methodology and Calculations

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Record of Non-Applicability for Clean Air Act Conformity

Naval Base Guam
Repair and Modernization of Lima, Mike, and November Wharves

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: Repair and Modernization of Lima, Mike, and November Wharves

Proposed Action and Emissions Summary:

The proposed action includes repair and modernization of Lima, Mike, and November Wharves and appurtenances at Naval Base Guam Apra Harbor. The work includes replacement of the steel sheet pile bulkhead, replacement of the mooring system, restoration of the heavy weather mooring system, fender system restoration, replacement of the existing electrical substation, replacement of wharf utilities (potable water, bilge oily water, sewer, steam, drainage, electrical, telecommunications), construction of wharf lighting, pavement and other appurtenances. The work also includes construction of a bilge oily water treatment system (BOWTS) to process BOW offloaded by vessels berthing at Lima for repairs. The proposed action includes transplantation of corals to a suitable receptor site prior to construction.

The deteriorated steel sheet piles at the wharves would be replaced and the space between the replacement and existing sheet pile would be dredged and filled. The mooring system including hardware and foundations would be replaced and repairs made to wharf paving and drainage. Areas within and immediately adjacent to the wharves would be dredged to achieve a -35 foot Mean Lower Low Water navigational depth. Dredged material would be disposed of at a suitable upland disposal site.

The purpose and need for this proposed action is to maintain the existing wharf in working condition and to ensure structural integrity, fulfillment of shore infrastructure needs, and meet assigned operational mission requirements.

The proposed action would be implemented over a three year period starting in 2020.

Estimated Emissions for Proposed Action

Project Year	Sulfur Dioxide (ton per year)
2020	0.08
2021	0.04
2022	0.03
2023	<0.01
General Conformity de minimis Threshold (tpy)	*100*

Affected Air Basin: Piti-Cabras, Guam

Date RONA Prepared: November 15, 2019

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 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: Ed Moon ______________________________

Name/Rank: _Edward E. Moon________________________ Date: _13 Dec 2019___________

Position: Installation Environmental Program Director, By Direction of the Commanding Officer

Activity Data

Equipment	Fuel Type	Power (hp)	Operating Hours				No. of Trips	Vehicle Miles Traveled (mi)				Onsite Idling (hr)			
			2020	2021	2022	2023		2020	2021	2022	2023	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES															
Passenger Truck	GASOLINE	200	-	-	-	-	3032	1159	5758	8392	3793	92	457	666	301
CORAL TRANSPLANTATION															
Excavator	DIESEL	1200	200	-	-	-	-	-	-	-	-	-	-	-	-
Flat Bed Truck	DIESEL	280	-	-	-	-	200	4240	-	-	-	100	-	-	-
Tugboat	DIESEL	1475	400	-	-	-	-	-	-	-	-	-	-	-	-
Twin Engine Large Dive Boat	DIESEL	330	280	280	-	-	-	-	-	-	-	-	-	-	-
Twin Engine Medium Dive Boat	DIESEL	250	140	448	448	112	-	-	-	-	-	-	-	-	-
CONSTRUCTION															
100-T Crawler Crane	DIESEL	230	254	2346	2092	-	-	-	-	-	-	-	-	-	-
150-T Crane Barge	DIESEL	700	-	1571	1571	-	-	-	-	-	-	-	-	-	-
Air Compressor	DIESEL	145	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Asphalt Paver	DIESEL	142	-	12	1067	1056	-	-	-	-	-	-	-	-	-
Backhoe	DIESEL	80	124	285	8981	8820	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	80	973	1460	487	-	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	36	1674	2511	837	-	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	275	254	1472	1218	-	-	-	-	-	-	-	-	-	-
Concrete Finisher	DIESEL	70	-	383	730	346	-	-	-	-	-	-	-	-	-
Concrete Mixer	GASOLINE	18	-	46	462	415	-	-	-	-	-	-	-	-	-
Concrete Pump	DIESEL	380	-	1988	3248	1259	-	-	-	-	-	-	-	-	-
Concrete Saw	GASOLINE	8	822	1232	411	-	-	-	-	-	-	-	-	-	-
Concrete Saw	GASOLINE	18	-	2	55	54	-	-	-	-	-	-	-	-	-
Concrete Slipform Paver	DIESEL	250	-	-	38	38	-	-	-	-	-	-	-	-	-
Concrete Truck	DIESEL	235	-	1988	3248	1259	8276	-	25755	43261	17506	-	205	345	140
Dewatering Pump	DIESEL	70	-	762	1702	941	-	-	-	-	-	-	-	-	-
Dozer	DIESEL	285	1262	1893	631	-	-	-	-	-	-	-	-	-	-
End Dump Truck	DIESEL	400	1827	4874	6394	3347	12088	25254	91280	98412	32387	103	372	401	132
Excavator	DIESEL	148	977	1464	487	-	-	-	-	-	-	-	-	-	-
Excavator	DIESEL	71	-	814	1786	972	-	-	-	-	-	-	-	-	-
Excavator Dredge/Generator Set	DIESEL	513/200	-	-	328	328	-	-	-	-	-	-	-	-	-
Flat Deck Barge	N/A	400	-	1571	1571	-	-	-	-	-	-	-	-	-	-
Flatbed Truck	DIESEL	380	-	9	88	79	24	-	13	125	113	-	0.1	1	1
Forklift Truck	DIESEL	78	4	3855	8942	5090	-	-	-	-	-	-	-	-	-
Generator	GASOLINE	27	1674	6197	6912	2389	-	-	-	-	-	-	-	-	-
Generator	DIESEL	400	254	1472	1218	-	-	-	-	-	-	-	-	-	-
Generator	GASOLINE	8	-	826	1725	899	-	-	-	-	-	-	-	-	-
Handheld Vibratory Compactor	GASOLINE	5	-	971	7797	6826	-	-	-	-	-	-	-	-	-
Impact Hammer	DIESEL	180	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Jet Pump	DIESEL	300	254	1552	1298	-	-	-	-	-	-	-	-	-	-
Loader	DIESEL	200	1594	3875	2501	220	-	-	-	-	-	-	-	-	-
Motor Grader	DIESEL	145	-	298	595	298	-	-	-	-	-	-	-	-	-
On-Hwy Truck Tractor	DIESEL	380	76	76	-	-	38	1140	1140	-	-	6	6	-	-
Pickup Truck	DIESEL	310	3405	5922	8784	6267	-	-	-	-	-	-	-	-	-
Roller Compactor - drum	DIESEL	96	-	12	1067	1056	-	-	-	-	-	-	-	-	-
Roller Compactor - tire	DIESEL	134	-	12	1067	1056	-	-	-	-	-	-	-	-	-
Roofing Kettle	GASOLINE	8	-	2	16	14	-	-	-	-	-	-	-	-	-
Rough Terrain Crane	DIESEL	105	569	4675	9680	5575	-	-	-	-	-	-	-	-	-
Skid Steer Loader	DIESEL	49	-	179	179	-	-	-	-	-	-	-	-	-	-
Towing Tug (Generator)	DIESEL	400	80	80	-	-	-	-	-	-	-	-	-	-	-
Towing Tug (Main Engine)	DIESEL	4000	48	48	-	-	-	-	-	-	-	-	-	-	-
Trailer Mounted Coring Drill	DIESEL	55	1611	2416	805	-	-	-	-	-	-	-	-	-	-
Truck Crane	DIESEL	350	-	35	355	319	-	-	-	-	-	-	-	-	-
Truck-Mounted Striper	DIESEL	200	-	-	831	831	-	-	-	-	-	-	-	-	-
Vibratory Compactor	DIESEL	163	-	412	836	424	-	-	-	-	-	-	-	-	-
Vibratory Hammer & Power Pack	DIESEL	375-630	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Vibroprobe	ELECTRIC	135	254	2346	2092	-	-	-	-	-	-	-	-	-	-
Water Truck	DIESEL	150	718	1077	359	-	-	-	-	-	-	-	-	-	-
Welder	DIESEL	47	80	2534	2535	81	-	-	-	-	-	-	-	-	-
Work Tug / Generator Set	DIESEL	750/150	-	3142	3142	-	-	-	-	-	-	-	-	-	-

Emissions

Equipment	Category	SO_2 Emission Factor					SO_2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.03	0.03	0.02	0.02	g/hr	0.01	0.07	0.10	0.04
	Passenger Truck - 25 mph[1]	0.003	0.003	0.003	0.003	g/mi				
	Passenger Truck - start[1]	0.002	0.002	0.002	0.001	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	4.10	-	-	-	g/hr	1.81	-	-	-
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	Harbor Tug (Tier 0)[3]	0.09	-	-	-	g/kWh	129	-	-	-
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	0.38	g/hr	0.23	0.75	0.75	0.19
CONSTRUCTION										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	0.39	0.38	0.38	-	g/hr	0.22	1.97	1.74	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	0.68	0.67	-	g/hr	-	2.35	2.32	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	0.21	0.21	0.21	-	g/hr	0.04	1.17	1.12	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	0.30	0.29	0.29	g/hr	-	0.01	0.69	0.68
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	0.10	0.10	0.10	0.09	g/hr	0.03	0.06	1.89	1.81
Compressor	Air Compressors (75 < hp <= 100)[2]	0.15	0.15	0.15	-	g/hr	0.33	0.49	0.16	-
Compressor	Air Compressors (25 < hp <= 40)[2]	0.06	0.06	0.06	-	g/hr	0.22	0.32	0.11	-
Compressor	Air Compressors (175 < hp <= 300)[2]	0.40	0.39	0.39	-	g/hr	0.22	1.28	1.04	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	0.20	0.20	0.20	g/hr	-	0.17	0.32	0.15
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	0.07	0.07	0.07	g/hr	-	0.01	0.07	0.06
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	0.72	0.71	0.70	g/hr	-	3.18	5.12	1.96
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	0.04	0.04	0.04	-	g/hr	0.08	0.11	0.04	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	0.10	0.10	0.10	g/hr	-	0.0004	0.01	0.01
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	0.51	0.51	g/hr	-	-	0.04	0.04
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	0.07	0.07	0.07	g/hr	-	0.69	1.15	0.46
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.01	0.01	0.01	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.003	0.002	0.002	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	0.13	0.12	0.12	g/hr	-	0.21	0.47	0.25

Equipment	Category	SO_2 Emission Factor					SO_2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	0.52	0.51	0.51	-	g/hr	1.44	2.13	0.70	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	0.07	0.07	0.07	0.07	g/hr	1.06	3.79	4.07	1.30
	Combination Short-Haul Truck - 25 mph[1]	0.02	0.02	0.02	0.02	g/mi				
	Combination Short-Haul Truck - start[1]	0.003	0.003	0.003	0.003	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	0.30	0.30	0.29	-	g/hr	0.65	0.96	0.32	-
Excavator	Excavators (50 < hp <= 75)[2]	-	0.15	0.15	0.14	g/hr	-	0.27	0.57	0.31
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	0.90	0.90	g/hr	-	-	0.48	0.48
	Generator Sets (175 < hp <= 300)[2]	-	-	0.43	0.42	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	0.76	0.75	-	g/hr	-	2.65	2.61	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	0.07	0.07	0.07	g/hr	-	0.0003	0.003	0.003
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.01	0.01	0.01	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.003	0.002	0.002	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	0.22	0.21	0.21	0.21	g/hr	0.002	1.83	4.18	2.36
Generator	Generator Sets (16 < hp <= 25)[2]	0.09	0.09	0.09	0.09	g/hr	0.33	1.23	1.37	0.47
Generator	Generator Sets (300 < hp <= 600)[2]	0.78	0.76	0.75	-	g/hr	0.43	2.48	2.02	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	0.04	0.04	0.04	g/hr	-	0.07	0.15	0.08
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	0.02	0.02	0.02	g/hr	-	0.04	0.31	0.27
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	0.53	0.52	0.52	-	g/hr	0.09	2.92	2.81	-
Jet Pump	Pumps (175 < hp <= 300)[2]	0.45	0.44	0.44	-	g/hr	0.25	1.52	1.25	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	0.52	0.51	0.50	0.50	g/hr	1.82	4.35	2.78	0.24
Motor Grader	Graders (100 < hp <= 175)[2]	-	0.31	0.30	0.30	g/hr	-	0.20	0.40	0.20
On-Hwy Truck Tractor	Combination Short-Haul Truck - idle[1]	0.07	0.07	-	-	g/hr	0.05	0.05	-	-
	Combination Short-Haul Truck - 25 mph[1]	0.02	0.02	-	-	g/mi				
	Combination Short-Haul Truck - start[1]	0.003	0.003	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	0.05	0.05	0.05	0.04	g/hr	0.35	0.60	0.88	0.61
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	0.21	0.21	0.21	g/hr	-	0.01	0.49	0.48
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	0.29	0.29	0.29	g/hr	-	0.01	0.69	0.67
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	0.05	0.05	0.05	g/hr	-	0.0002	0.002	0.001
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	0.24	0.23	0.23	0.23	g/hr	0.30	2.42	4.95	2.82
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	0.05	0.05	-	g/hr	-	0.02	0.02	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	2.55	2.55	-	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	21.6	21.6	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	0.13	0.12	0.12	-	g/hr	0.45	0.66	0.22	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	0.68	0.67	0.66	g/hr	-	0.05	0.52	0.47

Equipment	Category	SO₂ Emission Factor 2020	2021	2022	2023	units	SO₂ Emissions (lb/yr) 2020	2021	2022	2023
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	0.07	0.06	g/hr	-	-	0.13	0.12
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	0.29	0.29	0.29	g/hr	-	0.27	0.54	0.27
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	1.76	1.73	1.69	-	g/hr	0.31	9.63	9.12	-
Vibroprobe	N/A (electric)	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	0.07	0.07	0.07	-	g/hr	0.11	0.17	0.06	-
Welder	Welders (40 < hp <= 50)[2]	0.05	0.05	0.05	0.05	g/hr	0.01	0.29	0.29	0.01
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	1.15	1.15	-	g/hr	-	4.86	4.85	-
	Generator Sets (100 < hp <= 175)[2]	-	0.25	0.24	-	g/hr				
					TOTAL (lb/yr)		165	81.3	63.9	16.8
					TOTAL (tpy)		0.08	0.04	0.03	0.008

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'
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).

[2] Nonroad - U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 2014b; Weekdays, All Months; Virgin Islands St. Thomas; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

LMN Wharves Repair and Modernization - Emissions Summary

Year	Emissions (tpy)									
	CO	NOx	PM10	PM2.5	SO2	VOC	CO2	CH4	N2O	CO2e
2020	12.02	14.49	5.08	1.49	0.08	0.66	1396	0.11	0.02	1403.79
2021	36.56	15.80	12.59	3.55	0.04	5.34	3851	0.14	0.003	3855.49
2022	44.99	14.31	33.80	11.77	0.03	329.18	4267	0.16	0.0002	4271.31
2023	18.61	3.15	26.09	9.52	0.008	324.28	1162	0.06	0.0001	1163.86
Total	112.19	47.75	77.56	26.32	0.16	659.46	10676.03	0.49	0.02	10694.44

Equipment	Category	CO Emission Factor					CO Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	11.82	9.77	8.05	6.61	g/hr	30.16	136.34	181.44	74.51
	Passenger Truck - 25 mph[1]	4.63	4.27	3.95	3.63	g/mi				
	Passenger Truck - start[1]	19.64	17.94	16.44	14.97	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	462.03	-	-	-	g/hr	203.72	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	15.15	-	-	-	g/hr	32.91	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	2.06	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	7.86	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	2.50	-	-	-	g/kWh	3730.00	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	139.20	138.70	-	-	g/hr	171.85	171.24	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	80.23	79.94	79.64	79.34	g/hr	49.52	157.90	157.32	39.18
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	21.86	18.52	15.93	-	g/hr	12.24	95.79	73.49	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	54.92	46.34	-	g/hr	-	190.23	160.50	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	16.54	13.81	12.12	-	g/hr	2.92	76.91	65.34	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	28.31	25.06	21.85	g/hr	-	0.72	58.96	50.85
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	63.26	56.36	48.00	38.46	g/hr	17.29	35.41	950.31	747.82
Compressor	Air Compressors (75 < hp <= 100)[2]	27.67	23.01	20.04	-	g/hr	59.38	74.08	21.50	-
Compressor	Air Compressors (25 < hp <= 40)[2]	7.30	5.94	5.23	-	g/hr	26.95	32.88	9.64	-
Compressor	Air Compressors (175 < hp <= 300)[2]	24.12	19.68	17.00	-	g/hr	13.51	63.87	45.65	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	43.34	39.04	35.08	g/hr	-	36.63	62.81	26.79
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	3124.52	3087.19	3054.75	g/hr	-	317.97	3141.71	2797.83
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	141.40	126.68	113.41	g/hr	-	619.73	907.00	314.90
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	1881.06	1881.25	1881.28	-	g/hr	3407.22	5111.35	1703.80	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	4229.24	4229.00	4228.91	g/hr	-	16.69	516.52	499.82
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	34.16	29.20	g/hr	-	-	2.82	2.41
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	13.90	12.75	11.71	g/hr	-	196.85	311.35	119.15
	Single Unit Short-Haul Truck - 25 mph[1]	-	1.87	1.69	1.53	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	7.77	7.69	7.640	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	45.32	41.47	38.03	g/hr	-	76.10	155.63	78.87
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	29.54	23.26	18.15	-	g/hr	82.19	97.10	25.27	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	19.08	17.74	16.46	15.27	g/hr	290.11	988.66	1004.74	312.10
	Combination Short-Haul Truck - 25 mph[1]	3.59	3.29	3.01	2.76	g/mi				
	Combination Short-Haul Truck - start[1]	15.83	15.85	15.86	15.876	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	17.66	14.20	11.59	-	g/hr	38.05	45.84	12.44	-
Excavator	Excavators (50 < hp <= 75)[2]	-	15.31	12.23	10.56	g/hr	-	27.46	48.16	22.62
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	59.15	49.17	g/hr	-	-	45.73	39.58
	Generator Sets (175 < hp <= 300)[2]	-	-	67.33	60.31	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	147.23	131.91	-	g/hr	-	509.96	456.91	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	13.90	12.75	11.71	g/hr	-	0.10	0.90	0.77
	Single Unit Short-Haul Truck - 25 mph[1]	-	1.87	1.69	1.53	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	7.77	7.69	7.640	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	54.26	47.26	40.64	35.24	g/hr	0.48	401.71	801.03	395.51
Generator	Generator Sets (16 < hp <= 25)[2]	3919.31	3902.17	3887.01	3875.42	g/hr	14464.43	53315.07	59231.11	20407.28
Generator	Generator Sets (300 < hp <= 600)[2]	164.71	147.23	131.91	-	g/hr	92.24	477.79	354.22	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	1652.08	1651.10	1650.45	g/hr	-	3008.50	6278.02	3270.03
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	498.64	498.75	498.50	g/hr	-	1067.17	8572.97	7501.82
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	43.21	38.54	34.68	-	g/hr	7.62	214.57	186.94	-
Jet Pump	Pumps (175 < hp <= 300)[2]	87.15	77.46	69.33	-	g/hr	48.80	265.04	198.40	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	39.55	32.70	27.77	22.84	g/hr	138.97	279.41	153.15	11.06
Motor Grader	Graders (100 < hp <= 175)[2]	-	16.98	13.77	11.36	g/hr	-	11.14	18.06	7.45
	Combination Short-Haul Truck - idle[1]	19.08	17.74	-	-	g/hr				

LMN Wharves Repair and Modernization - CO Emissions

Equipment	Category	CO Emission Factor					CO Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	3.59	3.29	-	-	g/mi	10.60	9.85	-	-
	Combination Short-Haul Truck - start[1]	15.83	15.85	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	15.31	13.28	11.50	9.99	g/hr	114.91	173.35	222.68	137.97
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	40.31	34.66	27.40	g/hr	-	1.03	81.55	63.76
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	23.73	20.77	16.94	g/hr	-	0.61	48.87	39.43
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	2063.67	2063.66	2063.69	g/hr	-	7.10	70.97	63.88
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	16.38	14.12	12.52	10.74	g/hr	20.56	145.49	267.27	131.99
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	13.67	12.16	-	g/hr	-	5.39	4.79	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	2.50	2.50	-	-	g/kWh	73.65	73.65	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	2.50	2.50	-	-	g/kWh	623.40	623.40	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	45.81	42.13	39.22	-	g/hr	162.65	224.41	69.64	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	54.92	46.34	40.46	g/hr	-	4.30	36.25	28.49
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	12.75	11.71	g/hr	-	-	23.36	21.46
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	23.73	20.77	16.94	g/hr	-	21.55	38.29	15.84
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	511.20	453.57	385.33	-	g/hr	90.16	2525.20	2077.29	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	15.15	13.90	12.75	-	g/hr	23.99	33.01	10.09	-
Welder	Welders (40 < hp <= 50)[2]	30.14	26.37	22.64	18.85	g/hr	5.32	147.35	126.55	3.37
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	242.57	241.68	-	g/hr	-	1009.32	988.16	-
	Generator Sets (100 < hp <= 175)[2]	-	48.83	43.61	-	g/hr				
					TOTAL (lb/yr)		24046	73125	89980	37227
					TOTAL (tpy)		12.02	36.56	44.99	18.61

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; All Processes; Maximum Monthly;

Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;

Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

LMN Wharves Repair and Modernization - NOx Emissions

Equipment	Category	NOx Emission Factor					NOx Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	1.20	0.99	0.81	0.66	g/hr	2.01	8.53	10.66	4.12
	Passenger Truck - 25 mph[1]	0.33	0.28	0.24	0.20	g/mi				
	Passenger Truck - start[1]	1.12	0.98	0.86	0.76	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	2936.88	-	-	-	g/hr	1294.95	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	35.14	-	-	-	g/hr	58.92	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	4.56	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.92	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	13.00	-	-	-	g/kWh	19395.98	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	687.71	669.85	-	-	g/hr	849.05	826.99	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	392.37	381.77	371.50	361.55	g/hr	242.21	754.12	733.84	178.55
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	95.13	80.56	68.53	-	g/hr	53.27	416.68	316.10	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	229.91	194.42	-	g/hr	-	796.32	673.40	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	78.15	66.50	58.31	-	g/hr	13.78	370.21	314.35	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	94.16	84.79	75.47	g/hr	-	2.41	199.50	175.63
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	64.77	59.18	52.41	44.75	g/hr	17.71	37.18	1037.78	870.21
Compressor	Air Compressors (75 < hp <= 100)[2]	73.14	65.41	60.34	-	g/hr	156.95	210.56	64.75	-
Compressor	Air Compressors (25 < hp <= 40)[2]	41.10	39.11	38.11	-	g/hr	151.68	216.50	70.32	-
Compressor	Air Compressors (175 < hp <= 300)[2]	112.82	93.48	80.34	-	g/hr	63.17	303.35	215.72	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	87.83	83.04	78.57	g/hr	-	74.23	133.60	60.01
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	21.72	21.20	20.76	g/hr	-	2.21	21.58	19.02
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	474.46	431.10	391.24	g/hr	-	2079.50	3086.48	1086.33
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	12.33	12.34	12.34	-	g/hr	22.34	33.52	11.17	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	27.07	27.07	27.06	g/hr	-	0.11	3.31	3.20
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	108.43	93.46	g/hr	-	-	8.96	7.73
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	31.30	27.93	24.95	g/hr	-	255.20	385.83	140.85
	Single Unit Short-Haul Truck - 25 mph[1]	-	4.07	3.65	3.27	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.92	0.92	0.93	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	112.82	108.47	104.55	g/hr	-	189.46	407.09	216.82
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	91.81	71.25	54.24	-	g/hr	255.46	297.40	75.50	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	57.31	52.27	47.89	43.81	g/hr	629.28	2057.82	2024.15	606.78
	Combination Short-Haul Truck - 25 mph[1]	11.07	10.01	9.13	8.32	g/mi				
	Combination Short-Haul Truck - start[1]	0.00	0.00	0.00	0.00	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	62.94	47.79	35.57	-	g/hr	135.62	154.24	38.16	-
Excavator	Excavators (50 < hp <= 75)[2]	-	96.00	94.56	93.78	g/hr	-	172.20	372.23	200.94
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	162.41	133.73	g/hr	-	-	151.20	132.38
	Generator Sets (175 < hp <= 300)[2]	-	-	255.78	232.40	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	499.58	453.93	-	g/hr	-	1730.39	1572.27	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	31.30	27.93	24.95	g/hr	-	0.12	1.12	0.91
	Single Unit Short-Haul Truck - 25 mph[1]	-	4.07	3.65	3.27	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.92	0.92	0.93	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	97.34	90.55	84.39	78.34	g/hr	0.86	769.66	1663.65	879.11
Generator	Generator Sets (16 < hp <= 25)[2]	26.71	25.90	25.18	24.63	g/hr	98.57	353.86	383.68	129.69
Generator	Generator Sets (300 < hp <= 600)[2]	548.99	499.58	453.93	-	g/hr	307.42	1621.24	1218.91	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	10.30	10.26	10.24	g/hr	-	18.75	39.00	20.28
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	5.09	5.09	5.08	g/hr	-	10.88	87.48	76.45
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	142.41	126.29	112.75	-	g/hr	25.12	703.13	607.84	-
Jet Pump	Pumps (175 < hp <= 300)[2]	316.26	287.87	261.80	-	g/hr	177.10	984.96	749.18	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	120.18	101.12	85.20	68.66	g/hr	422.29	863.94	469.79	33.25
Motor Grader	Graders (100 < hp <= 175)[2]	-	64.14	49.20	36.75	g/hr	-	42.07	64.54	24.10
	Combination Short-Haul Truck - idle[1]	57.31	52.27	-	-	g/hr				

LMN Wharves Repair and Modernization - NOx Emissions

Equipment	Category	NOx Emission Factor					NOx Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	11.07	10.01	-	-	g/mi	28.62	25.89	-	-
	Combination Short-Haul Truck - start[1]	0.00	0.00	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	25.41	22.27	19.32	16.87	g/hr	190.76	290.70	374.10	233.14
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	84.88	78.45	70.84	g/hr	-	2.17	184.57	164.86
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	87.16	76.12	63.12	g/hr	-	2.23	179.10	146.89
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	13.52	13.52	13.52	g/hr	-	0.05	0.46	0.42
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	81.73	71.96	63.43	53.89	g/hr	102.59	741.70	1353.68	662.27
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	30.58	29.81	-	g/hr	-	12.06	11.75	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	13.00	13.00	-	-	g/kWh	382.99	382.99	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	13.00	13.00	-	-	g/kWh	3241.70	3241.70	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	118.83	114.18	110.34	-	g/hr	421.95	608.17	195.91	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	229.91	194.42	170.90	g/hr	-	17.99	152.09	120.32
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	27.93	24.95	g/hr	-	-	51.17	45.71
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	87.16	76.12	63.12	g/hr	-	79.18	140.34	59.02
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	994.81	875.80	746.45	-	g/hr	175.46	4875.89	4024.10	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	35.14	31.30	27.93	-	g/hr	55.64	74.33	22.11	-
Welder	Welders (40 < hp <= 50)[2]	39.75	37.78	35.79	33.74	g/hr	7.01	211.10	200.06	6.03
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	1171.49	1141.21	-	g/hr	-	4671.13	4511.77	-
	Generator Sets (100 < hp <= 175)[2]	-	177.10	161.37	-	g/hr				
					TOTAL (lb/yr)		28980	31595	28614	6305
					TOTAL (tpy)		14.49	15.80	14.31	3.15

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; All Processes; Maximum Monthly;

Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;

Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

LMN Wharves Repair and Modernization - PM10 Emissions

Equipment	Category	PM10 Emission Factor					PM10 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.02	0.02	0.02	0.02	g/hr	0.21	1.05	1.52	0.68
	Passenger Truck - 25 mph[1]	0.08	0.08	0.08	0.08	g/mi				
	Passenger Truck - start[1]	0.02	0.01	0.01	0.01	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	74.84	-	-	-	g/hr	33.00	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.77	-	-	-	g/hr	6.97	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.56	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.26	-	-	-	g/kWh	389.41	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	14.27	14.02	-	-	g/hr	17.62	17.31	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.68	8.57	8.46	8.34	g/hr	5.36	16.93	16.71	4.12
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	4.13	3.49	3.02	-	g/hr	2.31	18.04	13.94	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	8.35	7.12	-	g/hr	-	28.92	24.68	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	4.02	3.37	2.97	-	g/hr	0.71	18.75	16.02	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	6.80	6.08	5.33	g/hr	-	0.17	14.31	12.40
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	10.65	9.48	8.00	6.30	g/hr	2.91	5.95	158.33	122.45
Compressor	Air Compressors (75 < hp <= 100)[2]	4.60	3.89	3.42	-	g/hr	9.86	12.53	3.67	-
Compressor	Air Compressors (25 < hp <= 40)[2]	1.13	0.77	0.59	-	g/hr	4.17	4.27	1.10	-
Compressor	Air Compressors (175 < hp <= 300)[2]	4.93	4.02	3.47	-	g/hr	2.76	13.04	9.31	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	7.23	6.56	5.93	g/hr	-	6.11	10.55	4.53
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	1.11	1.13	1.14	g/hr	-	0.11	1.15	1.04
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	22.12	19.78	17.68	g/hr	-	96.95	141.64	49.10
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	0.90	0.90	0.90	-	g/hr	1.63	2.45	0.82	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	1.89	1.89	1.89	g/hr	-	0.01	0.23	0.22
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	6.81	5.84	g/hr	-	-	0.56	0.48
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	3.39	3.04	2.72	g/hr	-	31.43	48.99	18.46
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.52	0.48	0.45	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.05	0.04	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	7.85	7.08	6.41	g/hr	-	13.18	26.59	13.30
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	5.54	4.57	3.80	-	g/hr	15.41	19.10	5.28	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	4.85	4.49	4.15	3.82	g/hr	63.88	214.97	217.58	67.33
	Combination Short-Haul Truck - 25 mph[1]	1.12	1.04	0.98	0.92	g/mi				
	Combination Short-Haul Truck - start[1]	0.07	0.06	0.06	0.06	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	4.49	3.62	2.96	-	g/hr	9.68	11.69	3.18	-
Excavator	Excavators (50 < hp <= 75)[2]	-	1.63	1.29	1.08	g/hr	-	2.92	5.06	2.32
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	9.82	8.54	g/hr	-	-	8.55	7.57
	Generator Sets (175 < hp <= 300)[2]	-	-	13.84	12.39	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	22.32	19.96	-	g/hr	-	77.31	69.12	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	3.39	3.04	2.72	g/hr	-	0.02	0.14	0.12
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.52	0.48	0.45	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.05	0.04	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	8.74	7.70	6.71	5.86	g/hr	0.08	65.43	132.22	65.78
Generator	Generator Sets (16 < hp <= 25)[2]	1.53	1.54	1.54	1.53	g/hr	5.66	21.03	23.41	8.05
Generator	Generator Sets (300 < hp <= 600)[2]	25.04	22.32	19.96	-	g/hr	14.02	72.43	53.59	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	0.68	0.67	0.67	g/hr	-	1.23	2.57	1.33
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	0.78	0.78	0.78	g/hr	-	1.68	13.49	11.75
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	8.57	7.69	6.93	-	g/hr	1.51	42.80	37.37	-
Jet Pump	Pumps (175 < hp <= 300)[2]	18.19	16.30	14.63	-	g/hr	10.18	55.78	41.86	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	7.51	6.23	5.36	4.56	g/hr	26.38	53.22	29.55	2.21
Motor Grader	Graders (100 < hp <= 175)[2]	-	4.31	3.50	2.88	g/hr	-	2.82	4.59	1.89
	Combination Short-Haul Truck - idle[1]	4.85	4.49	-	-	g/hr				

LMN Wharves Repair and Modernization - PM10 Emissions

Equipment	Category	PM10 Emission Factor					PM10 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	1.12	1.04	-	-	g/mi	2.89	2.69	-	-
	Combination Short-Haul Truck - start[1]	0.07	0.06	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	1.22	1.06	0.92	0.80	g/hr	9.17	13.85	17.84	11.12
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	6.68	5.81	4.65	g/hr	-	0.17	13.67	10.83
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	5.84	5.18	4.26	g/hr	-	0.15	12.19	9.91
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	0.99	0.99	0.99	g/hr	-	0.00	0.03	0.03
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	4.07	3.50	3.11	2.67	g/hr	5.10	36.03	66.45	32.81
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	2.20	1.95	-	g/hr	-	0.87	0.77	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.26	0.26	-	-	g/kWh	7.69	7.69	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.26	0.26	-	-	g/kWh	65.08	65.08	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	9.22	8.44	7.82	-	g/hr	32.75	44.95	13.89	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	8.35	7.12	6.30	g/hr	-	0.65	5.57	4.43
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	3.04	2.72	g/hr	-	-	5.57	4.99
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	5.84	5.18	4.26	g/hr	-	5.31	9.55	3.98
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	56.14	49.33	42.21	-	g/hr	9.90	274.63	227.53	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	3.77	3.39	3.04	-	g/hr	5.97	8.06	2.41	-
Welder	Welders (40 < hp <= 50)[2]	5.22	4.59	3.95	3.27	g/hr	0.92	25.67	22.09	0.58
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	24.52	24.07	-	g/hr	-	121.28	116.18	-
	Generator Sets (100 < hp <= 175)[2]	-	10.50	9.48	-	g/hr				
CONSTRUCTION - FUGITIVE DUST										
Backhoe	Bulldozing[4]	2.47	2.47	2.47	2.47	lb/hr	306.29	703.90	22184	21787
Concrete Mixer	Material Handling[4]	-	0.0003	0.0003	0.0003	lb/ton	-	0.0005	0.005	0.004
Dozer	Bulldozing[4]	2.47	2.47	2.47	-	lb/hr	3117	4677	1559	-
End Dump Truck	Material Handling[4]	0.0003	0.0003	0.0003	0.0003	lb/ton	7.96	21.23	27.85	14.58
Excavator	Bulldozing[4]	2.47	2.47	2.47	2.47	lb/hr	5963	13897	13863	5930
Excavator Dredge	Material Handling[4]	-	-	0.0003	0.0003	lb/ton	-	-	0.69	0.69
Handheld Vibratory Compactor	Bulldozing[4]	-	2.47	2.47	2.47	lb/hr	-	2398	19259	16861
Loader	Material Handling[4]	0.0003	0.0003	0.0003	0.0003	lb/ton	6.63	16.13	10.41	0.91
Motor Grader	Grading[4]	-	0.57375	0.57375	0.57375	lb/mi	-	853.45	1707	853.45
Roller Compactor - drum	Bulldozing[4]	-	2.47	2.47	2.47	lb/hr	-	28.65	2636	2607
Roller Compactor - tire	Bulldozing[4]	-	2.47	2.47	2.47	lb/hr	-	28.65	2636	2607
Vibratory Compactor	Bulldozing[4]	-	2.47	2.47	2.47	lb/hr	-	1018	2065	1048
					TOTAL (lb/yr)		10165	25178	67601	52183
					TOTAL (tpy)		5.08	12.59	33.80	26.09

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

[4] U.S. EPA AP-42 Chapter 13.2.3 Heavy Construction Operations: Bulldozing (Table 11.9-1), material silt content (s) = 23%, moisture content (M) = 10%; Grading (Table 11.9-1), mean vehicle speed (S) = 5 mph; Material Handling (13.2.4, equation 1), k(PM10) = 0.35, k(PM2.5)=0.053, moisture content (M) = 10%, mean wind speed (U) = 10.2 mph.

LMN Wharves Repair and Modernization - PM2.5 Emissions

Equipment	Category	PM2.5 Emission Factor					PM2.5 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.02	0.02	0.02	0.02	g/hr	0.05	0.25	0.36	0.16
	Passenger Truck - 25 mph[1]	0.01	0.01	0.01	0.01	g/mi				
	Passenger Truck - start[1]	0.01	0.01	0.01	0.01	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	72.60	-	-	-	g/hr	32.01	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	3.47	-	-	-	g/hr	4.77	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.34	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.25	-	-	-	g/kWh	369.94	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	13.84	13.60	-	-	g/hr	17.09	16.79	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	8.42	8.31	8.21	8.09	g/hr	5.20	16.42	16.21	4.00
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	4.01	3.38	2.93	-	g/hr	2.25	17.50	13.52	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	8.10	6.91	-	g/hr	-	28.05	23.93	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	3.90	3.27	2.88	-	g/hr	0.69	18.18	15.54	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	6.59	5.90	5.17	g/hr	-	0.17	13.89	12.03
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	10.33	9.19	7.76	6.11	g/hr	2.82	5.78	153.58	118.78
Compressor	Air Compressors (75 < hp <= 100)[2]	4.46	3.78	3.32	-	g/hr	9.57	12.16	3.56	-
Compressor	Air Compressors (25 < hp <= 40)[2]	1.10	0.75	0.58	-	g/hr	4.05	4.15	1.06	-
Compressor	Air Compressors (175 < hp <= 300)[2]	4.78	3.90	3.36	-	g/hr	2.68	12.65	9.03	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	7.02	6.36	5.75	g/hr	-	5.93	10.23	4.40
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	1.02	1.04	1.05	g/hr	-	0.10	1.06	0.96
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	21.46	19.19	17.15	g/hr	-	94.04	137.39	47.63
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	0.83	0.83	0.83	-	g/hr	1.50	2.25	0.75	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	1.74	1.74	1.74	g/hr	-	0.01	0.21	0.21
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	6.60	5.66	g/hr	-	-	0.55	0.47
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	3.12	2.80	2.50	g/hr	-	18.99	28.49	10.30
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.30	0.27	0.24	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.04	0.04	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	7.61	6.87	6.22	g/hr	-	12.78	25.79	12.90
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	5.37	4.44	3.68	-	g/hr	14.94	18.52	5.12	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	4.46	4.13	3.81	3.51	g/hr	43.07	141.06	139.17	41.88
	Combination Short-Haul Truck - 25 mph[1]	0.75	0.68	0.62	0.57	g/mi				
	Combination Short-Haul Truck - start[1]	0.06	0.06	0.06	0.05	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	4.36	3.51	2.87	-	g/hr	9.38	11.34	3.08	-
Excavator	Excavators (50 < hp <= 75)[2]	-	1.58	1.25	1.05	g/hr	-	2.84	4.91	2.25
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	9.53	8.29	g/hr	-	-	8.30	7.34
	Generator Sets (175 < hp <= 300)[2]	-	-	13.42	12.02	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	21.65	19.36	-	g/hr	-	74.99	67.05	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	3.12	2.80	2.50	g/hr	-	0.01	0.08	0.07
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.30	0.27	0.24	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.04	0.04	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	8.47	7.47	6.51	5.69	g/hr	0.07	63.47	128.25	63.80
Generator	Generator Sets (16 < hp <= 25)[2]	1.41	1.42	1.41	1.41	g/hr	5.21	19.35	21.54	7.40
Generator	Generator Sets (300 < hp <= 600)[2]	24.29	21.65	19.36	-	g/hr	13.60	70.26	51.98	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	0.62	0.62	0.62	g/hr	-	1.13	2.36	1.23
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	0.72	0.72	0.72	g/hr	-	1.54	12.41	10.81
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	8.31	7.46	6.72	-	g/hr	1.47	41.51	36.25	-
Jet Pump	Pumps (175 < hp <= 300)[2]	17.64	15.81	14.19	-	g/hr	9.88	54.11	40.60	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	7.28	6.04	5.20	4.42	g/hr	25.59	51.63	28.67	2.14
Motor Grader	Graders (100 < hp <= 175)[2]	-	4.18	3.39	2.80	g/hr	-	2.74	4.45	1.84
	Combination Short-Haul Truck - idle[1]	4.46	4.13	-	-	g/hr				

LMN Wharves Repair and Modernization - PM2.5 Emissions

Equipment	Category	PM2.5 Emission Factor					PM2.5 Emissions (lb/yr)			
		2020	**2021**	**2022**	**2023**	**units**	**2020**	**2021**	**2022**	**2023**
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	0.75	0.68	-	-	g/mi	1.95	1.77	-	-
	Combination Short-Haul Truck - start[1]	0.06	0.06	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	1.12	0.98	0.85	0.74	g/hr	8.44	12.74	16.41	10.23
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	6.48	5.64	4.51	g/hr	-	0.17	13.26	10.51
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	5.67	5.02	4.13	g/hr	-	0.14	11.82	9.61
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	0.91	0.91	0.91	g/hr	-	0.00	0.03	0.03
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	3.94	3.39	3.02	2.59	g/hr	4.95	34.94	64.46	31.82
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	2.13	1.89	-	g/hr	-	0.84	0.75	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.25	0.25	-	-	g/kWh	7.30	7.30	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.25	0.25	-	-	g/kWh	61.83	61.83	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	8.95	8.19	7.59	-	g/hr	31.77	43.60	13.47	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	8.10	6.91	6.11	g/hr	-	0.63	5.41	4.30
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	2.80	2.50	g/hr	-	-	5.13	4.59
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	5.67	5.02	4.13	g/hr	-	5.15	9.26	3.86
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	54.46	47.85	40.94	-	g/hr	9.60	266.39	220.70	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	3.47	3.12	2.80	-	g/hr	5.49	7.41	2.22	-
Welder	Welders (40 < hp <= 50)[2]	5.06	4.46	3.83	3.17	g/hr	0.89	24.90	21.43	0.57
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	23.78	23.35	-	g/hr	-	117.65	112.70	-
	Generator Sets (100 < hp <= 175)[2]	-	10.18	9.19	-	g/hr				
CONSTRUCTION - FUGITIVE DUST										
Backhoe	Bulldozing[4]	0.97	0.97	0.97	0.96872	lb/hr	120.12	276.06	8700	8544
Concrete Mixer	Material Handling[4]	-	0.00004	0.00004	0.00004	lb/ton	-	0.0001	0.001	0.001
Dozer	Bulldozing[4]	0.97	0.97	0.97	-	lb/hr	1223	1834	611.59	-
End Dump Truck	Material Handling[4]	0.00004	0.00004	0.00004	0.00004	lb/ton	1.20	3.22	4.22	2.21
Excavator	Bulldozing[4]	0.97	0.97	0.97	0.97	lb/hr	917.15	2137	2132	912.05
Excavator Dredge	Material Handling[4]	-	-	0.00004	0.00004	lb/ton	-	-	0.10	0.10
Handheld Vibratory Compactor	Bulldozing[4]	-	0.97	0.97	0.97	lb/hr	-	940.39	7553	6612
Loader	Material Handling[4]	0.00004	0.00004	0.00004	-	lb/ton	1.00	2.44	1.58	-
Motor Grader	Grading[4]	-	0.05	0.05	0.05	lb/mi	-	77.33	154.67	77.33
Roller Compactor - drum	Bulldozing[4]	-	0.97	0.97	0.97	lb/hr	-	11.24	1034	1023
Roller Compactor - tire	Bulldozing[4]	-	0.97	0.97	0.97	lb/hr	-	11.24	1034	1023
Vibratory Compactor	Bulldozing[4]	-	0.97	0.97	0.97	lb/hr	-	399.18	810.04	410.86
					TOTAL (lb/yr)		2970	7099	23542	19031
					TOTAL (tpy)		1.49	3.55	11.77	9.52

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

[4] U.S. EPA AP-42 Chapter 13.2.3 Heavy Construction Operations: Bulldozing (Table 11.9-1), material silt content (s) = 23%, moisture content (M) = 10%; Grading (Table 11.9-1), mean vehicle speed (S) = 5 mph; Material Handling (13.2.4, equation 1), k(PM10) = 0.35, k(PM2.5)=0.053, moisture content (M) = 10%, mean wind speed (U) = 10.2 mph.

LMN Wharves Repair and Modernization - SO2 Emissions

Equipment	Category	SO2 Emission Factor					SO2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.03	0.03	0.02	0.02	g/hr	0.01	0.07	0.10	0.04
	Passenger Truck - 25 mph[1]	0.003	0.003	0.003	0.003	g/mi				
	Passenger Truck - start[1]	0.002	0.002	0.002	0.001	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	4.10	-	-	-	g/hr	1.81	-	-	-
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]	0.09	-	-	-	g/kWh	129	-	-	-
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	0.38	g/hr	0.23	0.75	0.75	0.19
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	0.39	0.38	0.38	-	g/hr	0.22	1.97	1.74	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	0.68	0.67	-	g/hr	-	2.35	2.32	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	0.21	0.21	0.21	-	g/hr	0.04	1.17	1.12	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	0.30	0.29	0.29	g/hr	-	0.01	0.69	0.68
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	0.10	0.10	0.10	0.09	g/hr	0.03	0.06	1.89	1.81
Compressor	Air Compressors (75 < hp <= 100)[2]	0.15	0.15	0.15	-	g/hr	0.33	0.49	0.16	-
Compressor	Air Compressors (25 < hp <= 40)[2]	0.06	0.06	0.06	-	g/hr	0.22	0.32	0.11	-
Compressor	Air Compressors (175 < hp <= 300)[2]	0.40	0.39	0.39	-	g/hr	0.22	1.28	1.04	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	0.20	0.20	0.20	g/hr	-	0.17	0.32	0.15
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	0.07	0.07	0.07	g/hr	-	0.01	0.07	0.06
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	0.72	0.71	0.70	g/hr	-	3.18	5.12	1.96
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	0.04	0.04	0.04	-	g/hr	0.08	0.11	0.04	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	0.10	0.10	0.10	g/hr	-	0.0004	0.01	0.01
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	0.51	0.51	g/hr	-	-	0.04	0.04
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	0.07	0.07	0.07	g/hr	-	0.69	1.15	0.46
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.01	0.01	0.01	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.003	0.002	0.002	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	0.13	0.12	0.12	g/hr	-	0.21	0.47	0.25
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	0.52	0.51	0.51	-	g/hr	1.44	2.13	0.70	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	0.07	0.07	0.07	0.07	g/hr	1.06	3.79	4.07	1.33
	Combination Short-Haul Truck - 25 mph[1]	0.02	0.02	0.02	0.02	g/mi				
	Combination Short-Haul Truck - start[1]	0.003	0.003	0.003	0.003	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	0.30	0.30	0.29	-	g/hr	0.65	0.96	0.32	-
Excavator	Excavators (50 < hp <= 75)[2]	-	0.15	0.15	0.14	g/hr	-	0.27	0.57	0.31
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	0.90	0.90	g/hr	-	-	0.48	0.48
	Generator Sets (175 < hp <= 300)[2]	-	-	0.43	0.42	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	0.76	0.75	-	g/hr	-	2.65	2.61	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	0.07	0.07	0.07	g/hr	-	0.0003	0.003	0.003
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.01	0.01	0.01	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.003	0.002	0.002	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	0.22	0.21	0.21	0.21	g/hr	0.002	1.83	4.18	2.36
Generator	Generator Sets (16 < hp <= 25)[2]	0.09	0.09	0.09	0.09	g/hr	0.33	1.23	1.37	0.47
Generator	Generator Sets (300 < hp <= 600)[2]	0.78	0.76	0.75	-	g/hr	0.43	2.48	2.02	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	0.04	0.04	0.04	g/hr	-	0.07	0.15	0.08
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	0.02	0.02	0.02	g/hr	-	0.04	0.31	0.27
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	0.53	0.52	0.52	-	g/hr	0.09	2.92	2.81	-
Jet Pump	Pumps (175 < hp <= 300)[2]	0.45	0.44	0.44	-	g/hr	0.25	1.52	1.25	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	0.52	0.51	0.50	0.50	g/hr	1.82	4.35	2.78	0.24
Motor Grader	Graders (100 < hp <= 175)[2]	-	0.31	0.30	0.30	g/hr	-	0.20	0.40	0.20
	Combination Short-Haul Truck - idle[1]	0.07	0.07	-	-	g/hr				

LMN Wharves Repair and Modernization - SO2 Emissions

Equipment	Category	SO2 Emission Factor					SO2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	0.02	0.02	-	-	g/mi	0.05	0.05	-	-
	Combination Short-Haul Truck - start[1]	0.003	0.003	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	0.05	0.05	0.05	0.04	g/hr	0.35	0.60	0.88	0.61
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	0.21	0.21	0.21	g/hr	-	0.01	0.49	0.48
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	0.29	0.29	0.29	g/hr	-	0.01	0.69	0.67
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	0.05	0.05	0.05	g/hr	-	0.0002	0.002	0.001
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	0.24	0.23	0.23	0.23	g/hr	0.30	2.42	4.95	2.82
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	0.05	0.05	-	g/hr	-	0.02	0.02	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	2.55	2.55	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	21.6	21.6	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	0.13	0.12	0.12	-	g/hr	0.45	0.66	0.22	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	0.68	0.67	0.66	g/hr	-	0.05	0.52	0.47
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	0.07	0.07	g/hr	-	-	0.13	0.13
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	0.29	0.29	0.29	g/hr	-	0.27	0.54	0.27
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	1.76	1.73	1.69	-	g/hr	0.31	9.63	9.12	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	0.07	0.07	0.07	-	g/hr	0.11	0.17	0.06	-
Welder	Welders (40 < hp <= 50)[2]	0.05	0.05	0.05	0.05	g/hr	0.01	0.29	0.29	0.01
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	1.15	1.15	-	g/hr	-	4.86	4.85	-
	Generator Sets (100 < hp <= 175)[2]	-	0.25	0.24	-	g/hr				
					TOTAL (lb/yr)		165	81.3	63.9	16.9
					TOTAL (tpy)		0.08	0.04	0.03	0.008

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb); scaled for fuel sulfur content = 1000 ppm (0.1%)

LMN Wharves Repair and Modernization - VOC Emissions

Equipment	Category	VOC Emission Factor					VOC Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
	GOVERNMENT FLEET VEHICLES									
Passenger Truck	Passenger Truck - idle[1]	1.64	1.45	1.30	1.16	g/hr	2.59	11.37	14.74	5.92
	Passenger Truck - 25 mph[1]	0.21	0.19	0.17	0.15	g/mi				
	Passenger Truck - start[1]	2.12	1.87	1.65	1.46	g/start				
	CORAL TRANSPLANTATION									
Excavator	Excavators (1200 < hp <= 2000)[2]	103.73	-	-	-	g/hr	45.74	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	7.66	-	-	-	g/hr	9.69	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.67	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.05	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.27	-	-	-	g/kWh	402.84	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	41.63	42.12	-	-	g/hr	51.40	52.00	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	19.73	19.73	19.73	19.73	g/hr	12.18	38.98	38.98	9.74
	CONSTRUCTION - TAILPIPE									
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	6.18	5.14	4.35	-	g/hr	3.46	26.58	20.07	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	11.67	9.91	-	g/hr	-	40.41	34.31	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	4.94	4.02	3.41	-	g/hr	0.87	22.40	18.39	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	5.40	4.67	3.98	g/hr	-	0.14	10.98	9.25
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	12.34	10.86	9.10	7.12	g/hr	3.37	6.83	180.16	138.53
Compressor	Air Compressors (75 < hp <= 100)[2]	4.32	3.45	2.89	-	g/hr	9.28	11.11	3.10	-
Compressor	Air Compressors (25 < hp <= 40)[2]	2.03	1.76	1.61	-	g/hr	7.49	9.73	2.96	-
Compressor	Air Compressors (175 < hp <= 300)[2]	7.75	6.33	5.39	-	g/hr	4.34	20.53	14.48	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	4.93	4.29	3.72	g/hr	-	4.17	6.90	2.84
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	113.26	109.77	106.85	g/hr	-	11.53	111.71	97.86
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	30.95	27.76	24.91	g/hr	-	135.65	198.76	69.18
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	41.15	41.17	41.17	-	g/hr	74.54	111.85	37.29	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	83.95	83.93	83.92	g/hr	-	0.33	10.25	9.92
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	7.55	6.43	g/hr	-	-	0.62	0.53
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	6.81	6.05	5.36	g/hr	-	37.60	56.32	20.31
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.60	0.53	0.47	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.05	0.05	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	9.96	9.04	8.24	g/hr	-	16.72	33.93	17.09
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	5.34	4.36	3.64	-	g/hr	14.85	18.18	5.07	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	8.59	7.83	7.15	6.48	g/hr	38.94	128.53	127.68	38.17
	Combination Short-Haul Truck - 25 mph[1]	0.66	0.61	0.56	0.51	g/mi				
	Combination Short-Haul Truck - start[1]	0.00	0.00	0.00	0.00	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	2.63	2.12	1.75	-	g/hr	5.67	6.85	1.88	-
Excavator	Excavators (50 < hp <= 75)[2]	-	2.79	2.45	2.25	g/hr	-	5.00	9.63	4.82
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	8.81	7.61	g/hr	-	-	11.03	9.84
	Generator Sets (175 < hp <= 300)[2]	-	-	21.71	19.62	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	32.52	29.17	-	g/hr	-	112.62	101.02	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	6.81	6.05	5.36	g/hr	-	0.02	0.16	0.13
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.60	0.53	0.47	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.05	0.05	0.05	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	5.02	4.26	3.60	3.02	g/hr	0.04	36.17	70.91	33.89
Generator	Generator Sets (16 < hp <= 25)[2]	108.97	106.13	103.57	101.51	g/hr	402.15	1450.09	1578.19	534.55
Generator	Generator Sets (300 < hp <= 600)[2]	36.48	32.52	29.17	-	g/hr	20.43	105.52	78.32	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	47.56	47.43	47.35	g/hr	-	86.61	180.35	93.82
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	20.98	21.00	20.95	g/hr	-	44.90	360.92	315.32
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	10.04	8.82	7.81	-	g/hr	1.77	49.09	42.09	-
Jet Pump	Pumps (175 < hp <= 300)[2]	27.30	24.62	22.25	-	g/hr	15.29	84.25	63.67	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	7.90	6.48	5.45	4.52	g/hr	27.77	55.33	30.07	2.19
Motor Grader	Graders (100 < hp <= 175)[2]	-	2.55	2.06	1.72	g/hr	-	1.67	2.71	1.13
	Combination Short-Haul Truck - idle[1]	8.59	7.83	-	-	g/hr				

LMN Wharves Repair and Modernization - VOC Emissions

Equipment	Category	VOC Emission Factor					VOC Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	0.66	0.61	-	-	g/mi	1.79	1.63	-	-
	Combination Short-Haul Truck - start[1]	0.00	0.00	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	3.16	2.70	2.29	1.95	g/hr	23.75	35.22	44.32	26.94
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	3.33	2.75	2.12	g/hr	-	0.09	6.47	4.93
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	3.98	3.37	2.67	g/hr	-	0.10	7.93	6.21
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	47.57	47.57	47.57	g/hr	-	0.16	1.64	1.47
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	4.04	3.36	2.86	2.34	g/hr	5.07	34.60	61.02	28.80
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	3.35	2.97	-	g/hr	-	1.32	1.17	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.27	0.27	-	-	g/kWh	7.95	7.95	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.27	0.27	-	-	g/kWh	67.33	67.33	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	10.70	9.77	9.07	-	g/hr	37.99	52.04	16.10	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	11.67	9.91	8.70	g/hr	-	0.91	7.75	6.12
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	6.05	5.36	g/hr	-	-	11.08	9.82
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	3.98	3.37	2.67	g/hr	-	3.62	6.21	2.49
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	52.82	47.03	40.37	-	g/hr	9.32	261.83	217.63	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	7.66	6.81	6.05	-	g/hr	12.13	16.18	4.79	-
Welder	Welders (40 < hp <= 50)[2]	6.98	6.08	5.21	4.36	g/hr	1.23	33.98	29.14	0.78
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	73.66	74.47	-	g/hr	-	308.53	306.12	-
	Generator Sets (100 < hp <= 175)[2]	-	15.42	13.91	-	g/hr				
CONSTRUCTION - FUGITIVE										
Asphalt Paver	Asphalt Paving[4]	-	0.26	0.26	0.26	% by wt.	-	7111	654176	647066
					TOTAL (lb/yr)		1321	10679	658355	648568
					TOTAL (tpy)		0.66	5.34	329.18	324.28

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; All Processes; Maximum Monthly;

Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;

Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

[4] U.S. EPA AP-42 Chapter 4.5 Asphalt Paving Operations; Table 4.5-1, assume medium cure, 45% by volume of diluent in cutback: asphalt density = 140 lb/ft^3.

LMN Wharves Repair and Modernization - CO2 Emissions

Equipment	Category	CO2 Emission Factor					CO2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	3961	3845	3730	3595	g/hr	2196	10606	15015	6551
	Passenger Truck - 25 mph[1]	471	457	443	427	g/mi				
	Passenger Truck - start[1]	234	231	227	223	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	559686	-	-	-	g/hr	246780	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	8268	-	-	-	g/hr	16196	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	1315	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	297	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	690	-	-	-	g/kWh	1029479	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	71828	71827	-	-	g/hr	88678	88677	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	41409	41409	41410	41410	g/hr	25562	81798	81798	20450
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	54261	54264	54266	-	g/hr	30385	280680	250304	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	94046	94051	-	g/hr	-	325747	325764	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	29489	29491	29493	-	g/hr	5201	164188	158996	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	41571	41573	41575	g/hr	-	1063	97813	96755
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	12705	12709	12714	12720	g/hr	3473	7985	251747	247346
Compressor	Air Compressors (75 < hp <= 100)[2]	21276	21279	21280	-	g/hr	45656	68491	22832	-
Compressor	Air Compressors (25 < hp <= 40)[2]	8498	8499	8500	-	g/hr	31364	47049	15684	-
Compressor	Air Compressors (175 < hp <= 300)[2]	55535	55539	55542	-	g/hr	31098	180237	149143	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	28441	28443	28445	g/hr	-	24038	45763	21725
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	11147	11126	11107	g/hr	-	1134	11322	10173
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	90702	90711	90719	g/hr	-	397535	649450	251897
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	6951	6951	6951	-	g/hr	12591	18887	6296	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	15828	15828	15828	g/hr	-	62	1933	1871
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	72890	72893	g/hr	-	-	6026	6026
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	8220	8174	8136	g/hr	-	81134	135514	54576
	Single Unit Short-Haul Truck - 25 mph[1]	-	1307	1300	1293	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	295	293	292	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	15807	15809	15812	g/hr	-	26545	59335	32791
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	74575	74577	74580	-	g/hr	207496	311304	103804	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	8373	8349	8327	8304	g/hr	122177	440222	473202	155287
	Combination Short-Haul Truck - 25 mph[1]	2129	2123	2116	2110	g/mi				
	Combination Short-Haul Truck - start[1]	316	315	314	314	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	43575	43576	43577	-	g/hr	93889	140645	46755	-
Excavator	Excavators (50 < hp <= 75)[2]	-	21553	21554	21554	g/hr	-	38659	84844	46184
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	130024	130028	g/hr	-	-	66639	66642
	Generator Sets (175 < hp <= 300)[2]	-	-	54284	54290	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	95652	95662	-	g/hr	-	331311	331346	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	8220	8174	8136	g/hr	-	40	393	352
	Single Unit Short-Haul Truck - 25 mph[1]	-	1307	1300	1293	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	295	293	292	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	30094	30096	30098	30100	g/hr	265	255802	593317	337783
Generator	Generator Sets (16 < hp <= 25)[2]	14759	14756	14756	14757	g/hr	54470	201616	224853	77707
Generator	Generator Sets (300 < hp <= 600)[2]	95641	95652	95662	-	g/hr	53557	310413	256877	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	6276	6276	6277	g/hr	-	11429	23865	12436
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	2981	2981	2981	g/hr	-	6379	51234	44858
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	73991	73995	73997	-	g/hr	13050	411955	398920	-
Jet Pump	Pumps (175 < hp <= 300)[2]	55456	55463	55470	-	g/hr	31054	189773	158734	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	72825	72829	72832	72835	g/hr	255889	622232	401614	35271
Motor Grader	Graders (100 < hp <= 175)[2]	-	44588	44590	44591	g/hr	-	29245	58491	29246
	Combination Short-Haul Truck - idle[1]	8373	8349	-	-	g/hr				

LMN Wharves Repair and Modernization - CO_2 Emissions

Equipment	Category	CO2 Emission Factor					CO2 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	2129	2123	-	-	g/mi	5495	5478	-	-
	Combination Short-Haul Truck - start[1]	316	315	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	5559	5458	5358	5256	g/hr	41728	71256	103767	72613
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	29803	29805	29807	g/hr	-	762	70125	69367
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	41860	41862	41864	g/hr	-	1071	98493	97427
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	7629	7629	7629	g/hr	-	26	262	236
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	33145	33147	33148	33150	g/hr	41602	341628	707430	407411
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	6559	6560	-	g/hr	-	2585	2586	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	690	690	-	-	g/kWh	20328	20328	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	690	690	-	-	g/kWh	172059	172059	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	15670	15673	15675	-	g/hr	55643	83479	27830	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	94046	94051	94054	g/hr	-	7357	73577	66222
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	8174	8136	g/hr	-	-	14975	14905
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	41860	41862	41864	g/hr	-	38029	77174	39145
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	224790	224807	224826	-	g/hr	39646	1251580	1212036	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	8268	8220	8174	-	g/hr	13088	19519	6470	-
Welder	Welders (40 < hp <= 50)[2]	6738	6741	6743	6746	g/hr	1188	37662	37693	1206
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	125618	125616	-	g/hr	-	542278	542286	-
	Generator Sets (100 < hp <= 175)[2]	-	30943	30947	-	g/hr				
					TOTAL (lb/yr)		2791285	7701980	8534327	2324459
					TOTAL (tpy)		1396	3851	4267	1162

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

LMN Wharves Repair and Modernization - CH4 Emissions

Equipment	Category	CH4 Emission Factor					CH4 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.03	0.02	0.02	0.02	g/hr	0.10	0.43	0.57	0.23
	Passenger Truck - 25 mph[1]	0.005	0.004	0.004	0.004	g/mi				
	Passenger Truck - start[1]	0.10	0.09	0.08	0.07	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	7.68	-	-	-	g/hr	3.38	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.54	-	-	-	g/hr	0.74	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.05	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.03	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.09	-	-	-	g/kWh	134.28	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	2.68	2.85	-	-	g/hr	3.31	3.52	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	1.17	1.24	1.32	1.38	g/hr	0.72	2.46	2.60	0.68
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	0.53	0.46	0.39	-	g/hr	0.30	2.36	1.80	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	0.76	0.66	-	g/hr	-	2.62	2.29	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	0.35	0.30	0.26	-	g/hr	0.06	1.65	1.40	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	0.40	0.36	0.31	g/hr	-	0.01	0.84	0.73
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	0.33	0.30	0.27	0.22	g/hr	0.09	0.19	5.27	4.37
Compressor	Air Compressors (75 < hp <= 100)[2]	0.28	0.23	0.20	-	g/hr	0.60	0.74	0.21	-
Compressor	Air Compressors (25 < hp <= 40)[2]	0.23	0.21	0.20	-	g/hr	0.86	1.17	0.37	-
Compressor	Air Compressors (175 < hp <= 300)[2]	0.57	0.48	0.42	-	g/hr	0.32	1.55	1.12	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	0.25	0.23	0.22	g/hr	-	0.21	0.38	0.17
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	7.89	7.73	7.59	g/hr	-	0.80	7.86	6.95
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	1.21	1.14	1.07	g/hr	-	5.29	8.14	2.97
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	5.10	5.10	5.10	-	g/hr	9.23	13.86	4.62	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	10.84	10.84	10.84	g/hr	-	0.04	1.32	1.28
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	0.60	0.52	g/hr	-	-	0.05	0.04
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	0.56	0.58	0.61	g/hr	-	3.64	6.37	2.67
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.05	0.06	0.06	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.03	0.03	0.03	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	0.43	0.42	0.41	g/hr	-	0.72	1.57	0.85
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	0.55	0.42	0.31	-	g/hr	1.52	1.74	0.44	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	0.43	0.45	0.48	0.51	g/hr	2.44	9.42	10.76	3.73
	Combination Short-Haul Truck - 25 mph[1]	0.04	0.04	0.05	0.05	g/mi				
	Combination Short-Haul Truck - start[1]	0.00	0.00	0.00	0.00	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	0.24	0.19	0.15	-	g/hr	0.52	0.61	0.16	-
Excavator	Excavators (50 < hp <= 75)[2]	-	0.40	0.37	0.36	g/hr	-	0.71	1.46	0.76
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	0.86	0.71	g/hr	-	-	0.64	0.56
	Generator Sets (175 < hp <= 300)[2]	-	-	0.90	0.85	g/hr				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	1.27	1.20	-	g/hr	-	4.40	4.14	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	0.56	0.58	0.61	g/hr	-	0.00	0.02	0.02
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.05	0.06	0.06	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.03	0.03	0.03	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	0.33	0.30	0.26	0.23	g/hr	0.00	2.52	5.18	2.60
Generator	Generator Sets (16 < hp <= 25)[2]	9.63	9.48	9.32	9.16	g/hr	35.56	129.56	141.94	48.26
Generator	Generator Sets (300 < hp <= 600)[2]	1.34	1.27	1.20	-	g/hr	0.75	4.12	3.21	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	3.95	3.93	3.92	g/hr	-	7.19	14.95	7.77
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	2.15	2.16	2.15	g/hr	-	4.61	37.08	32.35
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	0.73	0.66	0.60	-	g/hr	0.13	3.68	3.26	-
Jet Pump	Pumps (175 < hp <= 300)[2]	1.03	0.98	0.92	-	g/hr	0.58	3.35	2.64	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	0.71	0.60	0.51	0.41	g/hr	2.50	5.09	2.80	0.20
Motor Grader	Graders (100 < hp <= 175)[2]	-	0.23	0.19	0.15	g/hr	-	0.15	0.24	0.10
	Combination Short-Haul Truck - idle[1]	0.43	0.45	-	-	g/hr				

LMN Wharves Repair and Modernization - CH4 Emissions

Equipment	Category	CH4 Emission Factor					CH4 Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	0.04	0.04	-	-	g/mi	0.11	0.12	-	-
	Combination Short-Haul Truck - start[1]	0.00	0.00	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	0.33	0.34	0.36	0.36	g/hr	2.49	4.50	6.88	5.03
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	0.28	0.24	0.20	g/hr	-	0.01	0.56	0.45
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	0.35	0.30	0.24	g/hr	-	0.01	0.71	0.56
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	5.58	5.58	5.58	g/hr	-	0.02	0.19	0.17
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	0.33	0.28	0.25	0.21	g/hr	0.42	2.91	5.26	2.55
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	0.19	0.19	-	g/hr	-	0.08	0.07	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	2.65	2.65	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.09	0.09	-	-	g/kWh	22.44	22.44	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	0.32	0.32	0.32	-	g/hr	1.14	1.70	0.56	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	0.76	0.66	0.60	g/hr	-	0.06	0.52	0.42
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	0.58	0.61	g/hr	-	-	1.07	1.11
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	0.35	0.30	0.24	g/hr	-	0.31	0.55	0.23
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	2.60	2.43	2.10	-	g/hr	0.46	13.51	11.32	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	0.54	0.56	0.58	-	g/hr	0.85	1.33	0.46	-
Welder	Welders (40 < hp <= 50)[2]	0.30	0.28	0.27	0.24	g/hr	0.05	1.58	1.50	0.04
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	4.99	5.28	-	g/hr	-	19.54	20.42	-
	Generator Sets (100 < hp <= 175)[2]	-	0.65	0.62	-	g/hr				
						TOTAL (lb/yr)	229	289	326	128
						TOTAL (tpy)	0.11	0.14	0.16	0.06

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

LMN Wharves Repair and Modernization - N2O Emissions

Equipment	Category	N2O Emission Factor					N2O Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES										
Passenger Truck	Passenger Truck - idle[1]	0.00	0.00	0.00	0.00	g/hr	0.05	0.21	0.28	0.12
	Passenger Truck - 25 mph[1]	0.00	0.00	0.00	0.00	g/mi				
	Passenger Truck - start[1]	0.06	0.05	0.05	0.04	g/start				
CORAL TRANSPLANTATION										
Excavator	Excavators (1200 < hp <= 2000)[2]	-	-	-	-	-	-	-	-	-
Flat Bed Truck	Single Unit Short-Haul Truck - idle[1]	0.00	-	-	-	g/hr	0.004	-	-	-
	Single Unit Short-Haul Truck - 25 mph[1]	0.00	-	-	-	g/mi				
	Single Unit Short-Haul Truck - start[1]	0.01	-	-	-	g/start				
Tugboat & Auxiliary Generator (2)	Harbor Tug (Tier 0)[3]	0.02	-	-	-	g/kWh	29.84	-	-	-
Twin Engine Large Dive Boat	Inboard/Sterndrive (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Twin Engine Medium Dive Boat	Inboard/Sterndrive (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
CONSTRUCTION - TAILPIPE										
100-T Crawler Crane	Cranes (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
150-T Crane Barge	Cranes (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Air Compressor	Air Compressors (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Asphalt Paver	Paving Equipment (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Backhoe	Tractors/Loaders/Backhoes (75 < hp <= 100)[2]	-	-	-	-	-	-	-	-	-
Compressor	Air Compressors (75 < hp <= 100)[2]	-	-	-	-	-	-	-	-	-
Compressor	Air Compressors (25 < hp <= 40)[2]	-	-	-	-	-	-	-	-	-
Compressor	Air Compressors (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
Concrete Finisher	Surfacing Equipment (75 < hp <= 100)[2]	-	-	-	-	-	-	-	-	-
Concrete Mixer	Cement & Mortar Mixers (16 < hp <= 25)[2]	-	-	-	-	-	-	-	-	-
Concrete Pump	Pumps (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Concrete Saw	Concrete/Industrial Saws (6 < hp <= 11)[2]	-	-	-	-	-	-	-	-	-
Concrete Saw	Concrete/Industrial Saws (16 < hp <= 25)[2]	-	-	-	-	-	-	-	-	-
Concrete Slipform Paver	Paving Equipment (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
Concrete Truck	Single Unit Short-Haul Truck - idle[1]	-	0.00	0.00	0.00	g/hr	-	0.05	0.09	0.04
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.00	0.00	0.00	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.01	0.01	0.01	g/start				
Dewatering Pump	Pumps (50 < hp <= 75)[2]	-	-	-	-	-	-	-	-	-
Dozer	Crawler Tractor/Dozers (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
End Dump Truck	Combination Short-Haul Truck - idle[1]	0.00	0.00	0.00	0.00	g/hr	0.03	0.10	0.11	0.04
	Combination Short-Haul Truck - 25 mph[1]	0.00	0.00	0.00	0.00	g/mi				
	Combination Short-Haul Truck - start[1]	0.01	0.01	0.01	0.01	g/start				
Excavator	Excavators (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Excavator	Excavators (50 < hp <= 75)[2]	-	-	-	-	-	-	-	-	-
Excavator Dredge/Generator Set	Excavators (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
	Generator Sets (175 < hp <= 300)[2]	-	-	-	-	-				
Flat Deck Barge	Generator Sets (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Flatbed Truck	Single Unit Short-Haul Truck - idle[1]	-	0.00	0.00	0.00	g/hr	-	0.00003	0.0003	0.0002
	Single Unit Short-Haul Truck - 25 mph[1]	-	0.00	0.00	0.00	g/mi				
	Single Unit Short-Haul Truck - start[1]	-	0.01	0.01	0.01	g/start				
Forklift Truck	Rough Terrain Forklifts (75 < hp <= 100)[2]	-	-	-	-	-	-	-	-	-
Generator	Generator Sets (16 < hp <= 25)[2]	-	-	-	-	-	-	-	-	-
Generator	Generator Sets (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Generator	Generator Sets (6 < hp <= 11)[2]	-	-	-	-	-	-	-	-	-
Handheld Vibratory Compactor	Plate Compactors (3 < hp <= 6)[2]	-	-	-	-	-	-	-	-	-
Impact Hammer	Other Construction Equipment (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
Jet Pump	Pumps (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
Loader	Rubber Tire Loaders (175 < hp <= 300)[2]	-	-	-	-	-	-	-	-	-
Motor Grader	Graders (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
	Combination Short-Haul Truck - idle[1]	0.00	0.00	-	-	g/hr				

LMN Wharves Repair and Modernization - N2O Emissions

Equipment	Category	N2O Emission Factor					N2O Emissions (lb/yr)			
		2020	2021	2022	2023	units	2020	2021	2022	2023
On-Hwy Truck Tractor	Combination Short-Haul Truck - 25 mph[1]	0.00	0.00	-	-	g/mi	0.0004	0.0004	-	-
	Combination Short-Haul Truck - start[1]	0.01	0.01	-	-	g/start				
Pickup Truck	Light Commercial Truck - idle[1]	0.00	0.00	0.00	0.00	g/hr	0.00	0.00	0.00	0.00
Roller Compactor - drum	Rollers (75 < hp <= 100)[2]	-	-	-	-	-	-	-	-	-
Roller Compactor - tire	Rollers (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Roofing Kettle	Other General Industrial Eqp (11 < hp <= 16)[2]	-	-	-	-	-	-	-	-	-
Rough Terrain Crane	Cranes (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Skid Steer Loader	Skid Steer Loaders (40 < hp <= 50)[2]	-	-	-	-	-	-	-	-	-
Towing Tug (Generator)	Harbor Tug (Tier 0)[3]	0.02	0.02	-	-	g/kWh	0.59	0.59	-	-
Towing Tug (Main Engine)	Harbor Tug (Tier 0)[3]	0.02	0.02	-	-	g/kWh	4.99	4.99	-	-
Trailer Mounted Coring Drill	Bore/Drill Rigs (50 < hp <= 75)[2]	-	-	-	-	-	-	-	-	-
Truck Crane	Cranes (300 < hp <= 600)[2]	-	-	-	-	-	-	-	-	-
Truck-Mounted Striper	Single Unit Short-Haul Truck - idle[1]	-	-	0.00	0.00	g/hr	-	-	0.00	0.00
Vibratory Compactor	Rollers (100 < hp <= 175)[2]	-	-	-	-	-	-	-	-	-
Vibratory Hammer & Power Pack	Other Construction Equipment (600 < hp <= 750)[2]	-	-	-	-	-	-	-	-	-
Vibroprobe	N/A (electric)[2]	-	-	-	-	-	-	-	-	-
Water Truck	Single Unit Short-Haul Truck - idle[1]	0.00	0.00	0.00	-	g/hr	0.00	0.00	0.00	-
Welder	Welders (40 < hp <= 50)[2]	-	-	-	-	-	-	-	-	-
Work Tug/Generator Set	Inboard/Sterndrive (600 < hp <= 750)[2]	-	-	-	-	-	-	-	-	-
	Generator Sets (100 < hp <= 175)[2]	-	-	-	-	-				
						TOTAL (lb/yr)	35	6	0.5	0.2
						TOTAL (tpy)	0.02	0.003	0.0002	0.0001

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; All Processes; Maximum Monthly;
Emissions (lb/yr) = [Emission Factor (g/hr) x activity (hr/yr)]/(453.59 g/lb).

[3] U.S. EPA Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, Final Report, April 2009;
Emissions (lb/yr) = # equipment x [Emission Factor (Table 3-8, g/kWh) x # engines x load factor (Table 3-3) x activity (hr/yr) x average rated power (kW)]/(453.59 g/lb).

Equipment	Fuel	hp	Operating Hours				No. of Trips	Vehicle Miles Traveled (mi)				Onsite Idling (hr) ----------------------------- Material Handled* (ton/yr)			
			2020	2021	2022	2023	Trips	2020	2021	2022	2023	2020	2021	2022	2023
GOVERNMENT FLEET VEHICLES															
Passenger Truck	GASOLINE	200	-	-	-	-	3032	1159	5758	8392	3793	92	457	666	301
CORAL TRANSPLANTATION															
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	112	-	-	-	-	-	-	-	-	-
CONSTRUCTION															
100-T Crawler Crane	DIESEL	230	254	2346	2092	-	-	-	-	-	-	-	-	-	-
150-T Crane Barge	DIESEL	700	-	1571	1571	-	-	-	-	-	-	-	-	-	-
Air Compressor	DIESEL	145	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Asphalt Paver*	DIESEL	142	-	12	1067	1056	-	-	-	-	-	-	-	-	-
												-	14	1258	1244
Backhoe	DIESEL	80	124	285	8981	8820	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	80	973	1460	487	-	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	36	1674	2511	837	-	-	-	-	-	-	-	-	-	-
Compressor	DIESEL	275	254	1472	1218	-	-	-	-	-	-	-	-	-	-
Concrete Finisher	DIESEL	70	-	383	730	346	-	-	-	-	-	-	-	-	-
Concrete Mixer*	GASOLINE	18	-	46	462	415	-	-	-	-	-	-	-	-	-
												-	2	16	15
Concrete Pump	DIESEL	380	-	1988	3248	1259	-	-	-	-	-	-	-	-	-
Concrete Saw	GASOLINE	8	822	1232	411	-	-	-	-	-	-	-	-	-	-
Concrete Saw	GASOLINE	18	-	2	55	54	-	-	-	-	-	-	-	-	-
Concrete Slipform Paver	DIESEL	250	-	-	38	38	-	-	-	-	-	-	-	-	-
Concrete Truck	DIESEL	235	-	1988	3248	1259	8276	-	25755	43261	17506	-	205	345	140
Dewatering Pump	DIESEL	70	-	762	1702	941	-	-	-	-	-	-	-	-	-
Dozer	DIESEL	285	1262	1893	631	-	-	-	-	-	-	-	-	-	-
End Dump Truck*	DIESEL	400	1827	4874	6394	3347	12088	25254	91280	98412	32387	103	372	401	132
												26860	71668	94020	49212
Excavator	DIESEL	148	977	1464	487	-	-	-	-	-	-	-	-	-	-
Excavator	DIESEL	71	-	814	1786	972	-	-	-	-	-	-	-	-	-
Excavator Dredge*/Generator Set	DIESEL	513/200	-	-	328	328	-	-	-	-	-	-	-	-	-
												-	-	2333	2333
Flat Deck Barge	N/A	400	-	1571	1571	-	-	-	-	-	-	-	-	-	-
Flatbed Truck	DIESEL	380	-	9	88	79	24	-	13	125	113	-	0.1	1	1
Forklift Truck	DIESEL	78	4	3855	8942	5090	-	-	-	-	-	-	-	-	-
Generator	GASOLINE	27	1674	6197	6912	2389	-	-	-	-	-	-	-	-	-
Generator	DIESEL	400	254	1472	1218	-	-	-	-	-	-	-	-	-	-
Generator	GASOLINE	8	-	826	1725	899	-	-	-	-	-	-	-	-	-
Handheld Vibratory Compactor	GASOLINE	5	-	971	7797	6826	-	-	-	-	-	-	-	-	-
Impact Hammer	DIESEL	180	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Jet Pump	DIESEL	300	254	1552	1298	-	-	-	-	-	-	-	-	-	-
Loader*	DIESEL	200	1594	3875	2501	220	-	-	-	-	-	-	-	-	-
												22391	54444	35139	3086
Motor Grader	DIESEL	145	-	298	595	298	-	-	1488	2975	1488	-	-	-	-
On-Hwy Truck Tractor	DIESEL	380	76	76	-	-	38	1140	1140	-	-	6	6	-	-
Pickup Truck	DIESEL	310	3405	5922	8784	6267	-	-	-	-	-	-	-	-	-
Roller Compactor - drum	DIESEL	96	-	12	1067	1056	-	-	-	-	-	-	-	-	-
Roller Compactor - tire	DIESEL	134	-	12	1067	1056	-	-	-	-	-	-	-	-	-
Roofing Kettle	GASOLINE	8	-	2	16	14	-	-	-	-	-	-	-	-	-
Rough Terrain Crane	DIESEL	105	569	4675	9680	5575	-	-	-	-	-	-	-	-	-
Skid Steer Loader	DIESEL	49	-	179	179	-	-	-	-	-	-	-	-	-	-
Towing Tug (Generator)	DIESEL	400	80	80	-	-	-	-	-	-	-	-	-	-	-
Towing Tug (Main Engine)	DIESEL	4000	48	48	-	-	-	-	-	-	-	-	-	-	-
Trailer Mounted Coring Drill	DIESEL	55	1611	2416	805	-	-	-	-	-	-	-	-	-	-
Truck Crane	DIESEL	350	-	35	355	319	-	-	-	-	-	-	-	-	-
Truck-Mounted Striper	DIESEL	200	-	-	831	831	-	-	-	-	-	-	-	-	-
Vibratory Compactor	DIESEL	163	-	412	836	424	-	-	-	-	-	-	-	-	-
Vibratory Hammer & Power Pack	DIESEL	375-630	80	2525	2445	-	-	-	-	-	-	-	-	-	-
Vibroprobe	ELECTRIC	135	254	2346	2092	-	-	-	-	-	-	-	-	-	-
Water Truck	DIESEL	150	718	1077	359	-	-	-	-	-	-	-	-	-	-
Welder	DIESEL	47	80	2534	2535	81	-	-	-	-	-	-	-	-	-
Work Tug/Generator Set	DIESEL	750/150	-	3142	3142	-	-	-	-	-	-	-	-	-	-

Category		2020	2021	2022	2023	Units	Pollutant	HP Range	Fuel	ourceType	linkID	pollutant	fuel
		Emission Rate											
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) CO	16.53718375	13.81454333	12.12084067	10.80297823	g/hr	2	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) NOx	78.14782915	66.49588938	58.3105677	51.50768132	g/hr	3	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) CH4	0.354339954	0.296956217	0.259076579	0.227723953	g/hr	5	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) SO2	0.214279487	0.210535357	0.208151675	0.206190168	g/hr	31	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) VOC	4.935141887	4.022590644	3.411298524	2.924612526	g/hr	87	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) CO2	29488.64571	29491.24811	29492.95899	29494.30511	g/hr	90	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) PM10	4.022662279	3.367350902	2.972466631	2.658444908	g/hr	100	100 < hp <= 175	23				
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) PM2.5	3.901982609	3.266332624	2.883291574	2.578693487	g/hr	110	100 < hp <= 175	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) CO	24.12048036	19.68260176	16.99846396	14.89299825	g/hr	2	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) NOx	112.8162634	93.47681013	80.3360735	69.60813586	g/hr	3	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) CH4	0.570298734	0.477558354	0.416543326	0.365796202	g/hr	5	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) SO2	0.399771708	0.392915885	0.388640321	0.385144209	g/hr	31	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) VOC	7.753785812	6.3253151	5.393694585	4.656221665	g/hr	87	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) CO2	55534.98134	55539.11985	55541.62419	55543.65043	g/hr	90	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) PM10	4.928425778	4.018748241	3.467502562	3.032808736	g/hr	100	175 < hp <= 300	23				
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) PM2.5	4.780576722	3.898186394	3.363480207	2.941821935	g/hr	110	175 < hp <= 300	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) CO	7.301734842	5.939618336	5.225987481	4.792607001	g/hr	2	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) NOx	41.09923849	39.10929692	38.10924537	37.51805858	g/hr	3	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) CH4	0.232543814	0.211761407	0.199789676	0.192006055	g/hr	5	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) SO2	0.059883534	0.058297457	0.05744398	0.056910249	g/hr	31	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) VOC	2.029568451	1.757793083	1.605462833	1.508343704	g/hr	87	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) CO2	8498.348773	8499.071677	8499.514443	8499.773306	g/hr	90	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) PM10	1.130605901	0.771989835	0.593683249	0.48895988	g/hr	100	25 < hp <= 40	23				
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) PM2.5	1.096687448	0.748831344	0.575874981	0.474293274	g/hr	110	25 < hp <= 40	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) CO	27.67052734	23.01488291	20.03619265	17.60032886	g/hr	2	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) NOx	73.14178857	65.41492227	60.34467612	56.15558355	g/hr	3	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) CH4	0.277836245	0.228844964	0.20028557	0.176560458	g/hr	5	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) SO2	0.154744127	0.152039878	0.150313176	0.148890152	g/hr	31	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) VOC	4.324827997	3.450350965	2.890109284	2.444178841	g/hr	87	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) CO2	21276.25775	21278.7743	21280.36274	21281.62104	g/hr	90	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) PM10	4.59592948	3.89348075	3.41962841	3.034153249	g/hr	100	75 < hp <= 100	23				
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) PM2.5	4.458052257	3.776682496	3.317040066	2.943129094	g/hr	110	75 < hp <= 100	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) CO	45.80618622	42.13099516	39.22469547	36.32718048	g/hr	2	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) NOx	118.8290381	114.1811803	110.3448966	106.5305907	g/hr	3	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) CH4	0.319696097	0.319205983	0.317236377	0.314254332	g/hr	5	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) SO2	0.125879797	0.124185442	0.122647537	0.121077383	g/hr	31	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) VOC	10.69802629	9.770226303	9.070506454	8.383957319	g/hr	87	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) CO2	15669.99691	15672.71064	15674.72208	15676.71913	g/hr	90	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) PM10	9.224285344	8.439539305	7.822925904	7.211354035	g/hr	100	50 < hp <= 75	23				
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) PM2.5	8.947557405	8.186356608	7.588236379	6.995012806	g/hr	110	50 < hp <= 75	23				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) CO	3177.467195	3124.519713	3087.191185	3054.751473	g/hr	2	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) NOx	22.6867157	21.72009807	21.20343432	20.7627419	g/hr	3	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) CH4	8.201267392	7.890677671	7.725807951	7.588531249	g/hr	5	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) SO2	0.067909299	0.067756305	0.067624728	0.067513114	g/hr	31	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) VOC	119.4572126	113.2623859	109.7714477	106.8469376	g/hr	87	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) CO2	11172.83176	11147.45639	11125.72387	11107.28477	g/hr	90	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) PM10	1.108731609	1.113186496	1.126990065	1.139233211	g/hr	100	16 < hp <= 25	1				
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) PM2.5	1.020033573	1.024132464	1.036831126	1.048095729	g/hr	110	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) CO	4227.697044	4229.236917	4228.998001	4228.911287	g/hr	2	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) NOx	27.04029876	27.07131361	27.0666019	27.06489437	g/hr	3	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) CH4	10.81899881	10.84284809	10.83917211	10.83783527	g/hr	5	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) SO2	0.096208174	0.09620475	0.096205082	0.096205552	g/hr	31	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) VOC	83.81353513	83.95349106	83.9322791	83.92468497	g/hr	87	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) CO2	15828.28446	15827.65715	15827.75262	15827.78221	g/hr	90	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) PM10	1.889425244	1.894347028	1.89359261	1.893310476	g/hr	100	16 < hp <= 25	1				
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) PM2.5	1.738270256	1.742800123	1.742107315	1.741848466	g/hr	110	16 < hp <= 25	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) CO	1881.06439	1881.252911	1881.275192	1881.23725	g/hr	2	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) NOx	12.33280099	12.33670148	12.33711203	12.33632208	g/hr	3	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) CH4	5.096979499	5.099916756	5.100246992	5.09962544	g/hr	5	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) SO2	0.04225108	0.042250605	0.042250537	0.042250611	g/hr	31	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) VOC	41.15092108	41.16822407	41.17025574	41.16653233	g/hr	87	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) CO2	6951.452718	6951.385526	6951.372517	6951.392705	g/hr	90	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) PM10	0.900799367	0.901406027	0.9014735	0.901345907	g/hr	100	6 < hp <= 11	1				
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) PM2.5	0.828734374	0.829292424	0.829355034	0.829238254	g/hr	110	6 < hp <= 11	1				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) CO	16.37950389	14.11654283	12.5237259	10.73917265	g/hr	2	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) NOx	81.73163354	71.96349337	63.42985104	53.88630849	g/hr	3	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) CH4	0.331195588	0.282535462	0.246473394	0.207578137	g/hr	5	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) SO2	0.237852162	0.234375507	0.231946214	0.229304276	g/hr	31	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) VOC	4.041548689	3.357380262	2.859310448	2.34326006	g/hr	87	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) CO2	33144.77409	33146.65279	33148.16165	33149.60096	g/hr	90	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) PM10	4.065970438	3.495371445	3.113856014	2.669385798	g/hr	100	100 < hp <= 175	23				
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) PM2.5	3.943993605	3.390509241	3.020440937	2.589300654	g/hr	110	100 < hp <= 175	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) CO	21.86200627	18.5187124	15.93194301	13.46880799	g/hr	2	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) NOx	95.13198402	80.55584918	68.53028546	56.35511122	g/hr	3	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) CH4	0.534807878	0.45540471	0.390540084	0.326795285	g/hr	5	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) SO2	0.387230029	0.381630706	0.377493247	0.373881009	g/hr	31	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) VOC	6.184154791	5.138761217	4.352130576	3.660060182	g/hr	87	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) CO2	54260.70749	54263.69338	54265.98792	54267.94546	g/hr	90	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) PM10	4.133804755	3.488495051	3.0213136	2.602755675	g/hr	100	175 < hp <= 300	23				
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) PM2.5	4.009785288	3.383842621	2.930679942	2.52467564	g/hr	110	175 < hp <= 300	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) CO	67.52247946	54.91972608	46.33911029	40.46245046	g/hr	2	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) NOx	283.1215805	229.9052116	194.4159976	170.8952458	g/hr	3	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) CH4	0.911866951	0.757094827	0.660358775	0.601984392	g/hr	5	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) SO2	0.694589469	0.679537917	0.669753793	0.663502472	g/hr	31	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) VOC	14.24508626	11.66691107	9.90561911	8.697819208	g/hr	87	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) CO2	94038.43123	94045.80824	94050.88576	94054.32947	g/hr	90	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) PM10	10.16112176	8.349391379	7.123948908	6.298577645	g/hr	100	300 < hp <= 600	23				
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) PM2.5	9.856286887	8.098906878	6.910228759	6.109617783	g/hr	110	300 < hp <= 600	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) CO	29.53797559	23.26229412	18.15404199	13.11991654	g/hr	2	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) NOx	91.81357841	71.24538863	54.24473097	42.09180696	g/hr	3	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) CH4	0.546994151	0.41778679	0.313772747	0.229959681	g/hr	5	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) SO2	0.516586588	0.510785095	0.506330156	0.501247444	g/hr	31	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) VOC	5.337483444	4.355673312	3.643125397	2.87092069	g/hr	87	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) CO2	74574.51036	74577.26826	74579.52127	74581.58206	g/hr	90	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) PM10	5.536730225	4.574531968	3.795203606	2.851168124	g/hr	100	175 < hp <= 300	23				
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) PM2.5	5.370627608	4.437287167	3.681345704	2.76563263	g/hr	110	175 < hp <= 300	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) CO	17.66086507	14.20391629	11.59331201	8.837510768	g/hr	2	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) NOx	62.94186181	47.78930584	35.56981133	28.23399223	g/hr	3	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) CH4	0.241536952	0.189411256	0.150020979	0.112715878	g/hr	5	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) SO2	0.299680855	0.296402287	0.293951193	0.291360489	g/hr	31	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) VOC	2.631411997	2.122922162	1.74762533	1.351178244	g/hr	87	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) CO2	43574.6108	43576.0444	43577.11834	43578.2577	g/hr	90	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) PM10	4.490266969	3.622474912	2.960303264	2.224340896	g/hr	100	100 < hp <= 175	23				
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) PM2.5	4.35555894	3.513802714	2.87149219	2.157607481	g/hr	110	100 < hp <= 175	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) CO	462.0285843	404.6349822	364.3866861	321.0127218	g/hr	2	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) NOx	2936.883582	2825.573593	2743.422995	2662.879142	g/hr	3	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) CH4	7.675597715	7.174255525	6.774335446	6.29884518	g/hr	5	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) SO2	4.095826496	4.03380932	3.988966357	3.943712498	g/hr	31	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) VOC	103.7297121	93.14773503	85.08110143	76.55105504	g/hr	87	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) CO2	559685.7482	559715.3243	559738.1254	559763.023	g/hr	90	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) PM10	74.8418916	67.51556486	62.38716179	56.68458861	g/hr	100	1200 < hp <= 2000	23				
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) PM2.5	72.59657822	65.49012268	60.51563952	54.98409667	g/hr	110	1200 < hp <= 2000	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) CO	83.91245445	69.57288112	59.15345377	49.17178609	g/hr	2	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) NOx	223.8205388	190.006917	162.4137308	133.7308611	g/hr	3	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) CH4	1.163938176	0.996647091	0.860075751	0.71414368	g/hr	5	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) SO2	0.927258375	0.913736208	0.904116286	0.895326851	g/hr	31	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) VOC	11.9676563	10.11698924	8.805216341	7.608386368	g/hr	87	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) CO2	130015.1732	130020.5966	130024.3645	130027.9092	g/hr	90	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) PM10	13.23114856	11.1911758	9.820849661	8.543045889	g/hr	100	300 < hp <= 600	23				
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) PM2.5	12.83421859	10.8554459	9.526228121	8.286752556	g/hr	110	300 < hp <= 600	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) CO	21.35637588	15.30947018	12.23458438	10.55812941	g/hr	2	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) NOx	99.00322544	96.00480227	94.56248869	93.78218864	g/hr	3	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) CH4	0.448544199	0.39764138	0.370603722	0.355610364	g/hr	5	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) SO2	0.151564589	0.148010414	0.14593819	0.144590684	g/hr	31	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) VOC	3.455969574	2.788066023	2.445229115	2.248266771	g/hr	87	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) CO2	21550.95907	21552.83451	21553.78679	21554.32904	g/hr	90	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) PM10	2.271232529	1.630438869	1.286093929	1.081777718	g/hr	100	50 < hp <= 75	23				
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) PM2.5	2.203095263	1.581525077	1.24751049	1.049324594	g/hr	110	50 < hp <= 75	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) CO	54.91054152	48.82912504	43.61137308	39.27425147	g/hr	2	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) NOx	194.1945883	177.1016817	161.3746857	147.3361346	g/hr	3	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) CH4	0.684380229	0.650296788	0.6152251	0.580320544	g/hr	5	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) SO2	0.251712551	0.248033618	0.244464095	0.241113461	g/hr	31	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) VOC	17.10111265	15.4177093	13.91034295	12.59526244	g/hr	87	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) CO2	30937.67494	30942.55715	30946.80879	30950.70201	g/hr	90	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) PM10	11.62014446	10.49622682	9.476105781	8.572951547	g/hr	100	100 < hp <= 175	23				
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) PM2.5	11.27154177	10.18135282	9.191837594	8.315761776	g/hr	110	100 < hp <= 175	23				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) CO	3919.308194	3902.16708	3887.011959	3875.416439	g/hr	2	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) NOx	26.7078813	25.89916047	25.17888291	24.62826642	g/hr	3	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) CH4	9.634751567	9.482379031	9.315037786	9.164331344	g/hr	5	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) SO2	0.089713336	0.089695997	0.089693706	0.089699994	g/hr	31	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) VOC	108.9679704	106.1331793	103.5676556	101.5133856	g/hr	87	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) CO2	14759.37059	14756.4224	14755.86752	14756.80713	g/hr	90	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) PM10	1.533508279	1.539414269	1.536453805	1.528296497	g/hr	100	16 < hp <= 25	1				
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) PM2.5	1.410829152	1.416259411	1.41353818	1.406032609	g/hr	110	16 < hp <= 25	1				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) CO	84.57561252	75.2042194	67.33034084	60.30505727	g/hr	2	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) NOx	308.9709987	281.2394935	255.7841622	232.4022459	g/hr	3	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) CH4	1.007614695	0.95394513	0.89867713	0.845413953	g/hr	5	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) SO2	0.440159061	0.433748327	0.427534645	0.421716051	g/hr	31	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) VOC	26.64142415	24.02650385	21.71386985	19.61928842	g/hr	87	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) CO2	54270.1532	54277.6069	54284.24429	54290.4772	g/hr	90	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) PM10	17.2248308	15.43135197	13.83627749	12.39351728	g/hr	100	175 < hp <= 300	23				
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) PM2.5	16.70806068	14.96838191	13.42117385	12.02171458	g/hr	110	175 < hp <= 300	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) CO	164.7123246	147.2298349	131.9127416	118.092865	g/hr	2	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) NOx	548.9852965	499.5786432	453.9276806	411.958354	g/hr	3	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) CH4	1.342591222	1.269745068	1.196430159	1.125929298	g/hr	5	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) SO2	0.775736272	0.764427016	0.753459224	0.743189352	g/hr	31	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) VOC	36.48227198	32.5156736	29.16598454	26.17609692	g/hr	87	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) CO2	95640.72863	95652.38037	95662.39335	95671.08731	g/hr	90	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) PM10	25.04474293	22.3191709	19.95560278	17.83353039	g/hr	100	300 < hp <= 600	23				
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) PM2.5	24.29340567	21.6495262	19.35689026	17.29849952	g/hr	110	300 < hp <= 600	23				
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) CO	1652.306704	1652.082219	1651.097902	1650.447177	g/hr	2	6 < hp <= 11	1				
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) NOx	10.34112147	10.29516308	10.25811447	10.23706306	g/hr	3	6 < hp <= 11	1				
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) CH4	3.951513294	3.946945822	3.931274615	3.920830127	g/hr	5	6 < hp <= 11	1				
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) SO2	0.038150417	0.038149718	0.038151607	0.038153067	g/hr	31	6 < hp <= 11	1				
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) VOC	47.69488308	47.56243766	47.43126879	47.35187405	g/hr	87	6 < hp <= 11	1				

Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) CO2	6276.271055	6276.157015	6276.460952	6276.682867	g/hr	90	6 < hp <= 11	1
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) PM10	0.674626421	0.67660659	0.674627565	0.673061911	g/hr	100	6 < hp <= 11	1
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) PM2.5	0.620656697	0.622478233	0.620657136	0.619217437	g/hr	110	6 < hp <= 11	1
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) CO	22.19395493	16.97900267	13.76542846	11.35582755	g/hr	2	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) NOx	81.63544791	64.1447246	49.19965694	36.75016003	g/hr	3	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) CH4	0.312040026	0.23498714	0.185031041	0.147786346	g/hr	5	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) SO2	0.310451617	0.305569864	0.302544418	0.300305022	g/hr	31	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) VOC	3.364060066	2.546632286	2.062937689	1.716247944	g/hr	87	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) CO2	44586.21436	44588.3459	44589.86073	44590.86584	g/hr	90	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) PM10	5.60753231	4.305707612	3.49847536	2.884845025	g/hr	100	100 < hp <= 175	23
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) PM2.5	5.439302482	4.176540942	3.393525038	2.798298997	g/hr	110	100 < hp <= 175	23
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) CO	80.22538849	79.93721461	79.64370644	79.34299358	g/hr	2	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) NOx	392.3668865	381.7668501	371.4986097	361.5520515	g/hr	3	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) CH4	1.170630357	1.244587151	1.316038513	1.384802688	g/hr	5	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) SO2	0.380666713	0.380668305	0.380668574	0.380669275	g/hr	31	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) VOC	19.7339808	19.73415821	19.7331252	19.72932444	g/hr	87	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) CO2	41409.29131	41409.43018	41409.53285	41409.53991	g/hr	90	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) PM10	8.6808305	8.57169626	8.458919757	8.341712322	g/hr	100	175 < hp <= 300	24
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) PM2.5	8.42038651	8.31455324	8.205117851	8.091464085	g/hr	110	175 < hp <= 300	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) CO	139.1986371	138.699174	138.1895451	137.6678551	g/hr	2	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) NOx	687.7125531	669.8458911	652.5305932	635.7739204	g/hr	3	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) CH4	2.682593794	2.853487094	3.018482772	3.177342027	g/hr	5	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) SO2	0.660294468	0.660282749	0.660270895	0.6602612	g/hr	31	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) VOC	41.63321722	42.11679021	42.58031618	43.02260209	g/hr	87	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) CO2	71827.93	71826.75479	71825.49957	71824.37199	g/hr	90	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) PM10	14.27318706	14.01999169	13.76140728	13.49668252	g/hr	100	300 < hp <= 600	24
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) PM2.5	13.84499388	13.59939389	13.34858148	13.09178793	g/hr	110	300 < hp <= 600	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) CO	243.4454359	242.5711559	241.6799895	240.7679798	g/hr	2	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) NOx	1202.74135	1171.494008	1141.211484	1111.907937	g/hr	3	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) CH4	4.691588342	4.990465315	5.279014978	5.556858949	g/hr	5	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) SO2	1.154790949	1.154768225	1.154748821	1.154730854	g/hr	31	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) VOC	72.8125183	73.65809061	74.46879133	75.24238464	g/hr	87	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) CO2	125620.2039	125617.7109	125615.848	125613.7742	g/hr	90	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) PM10	24.962434	24.51956625	24.06732645	23.60440513	g/hr	100	600 < hp <= 750	24
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) PM2.5	24.21356356	23.78399928	23.34531043	22.89627171	g/hr	110	600 < hp <= 750	24
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) CO	43.21398675	38.54145552	34.67659986	30.31892896	g/hr	2	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) NOx	142.4075796	126.2946524	112.750361	98.70403061	g/hr	3	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) CH4	0.727510728	0.661827564	0.604707017	0.535190728	g/hr	5	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) SO2	0.529874012	0.524942697	0.520631063	0.515728772	g/hr	31	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) VOC	10.040298	8.817616223	7.80824712	6.762485625	g/hr	87	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) CO2	73991.24859	73994.68262	73997.47606	74000.68662	g/hr	90	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) PM10	8.567238334	7.687288983	6.932678979	6.072839956	g/hr	100	175 < hp <= 300	23
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) PM2.5	8.310184723	7.456662099	6.724672893	5.890652714	g/hr	110	175 < hp <= 300	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) CO	511.2026351	453.5724761	385.3266945	308.7807292	g/hr	2	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) NOx	994.8140753	875.7993393	746.4481024	603.0639385	g/hr	3	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) CH4	2.597776713	2.426367826	2.100455377	1.700040005	g/hr	5	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) SO2	1.761239732	1.730253984	1.692083403	1.648331253	g/hr	31	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) VOC	52.81871167	47.02903183	40.36980503	33.12403666	g/hr	87	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) CO2	224790.1669	224806.6556	224826.0674	224846.404	g/hr	90	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) PM10	56.14211929	49.32926337	42.20570486	34.40367523	g/hr	100	600 < hp <= 750	23
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) PM2.5	54.45779929	47.84940553	40.93954078	33.37159766	g/hr	110	600 < hp <= 750	23
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) CO	2063.820743	2063.666487	2063.66382	2063.690182	g/hr	2	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) NOx	13.52308576	13.52000733	13.5198885	13.52046292	g/hr	3	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) CH4	5.584663186	5.582327763	5.582210059	5.582681257	g/hr	5	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) SO2	0.046370811	0.046371035	0.046371176	0.046371074	g/hr	31	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) VOC	47.58376312	47.56997447	47.56919348	47.57203432	g/hr	87	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) CO2	7629.232391	7629.306106	7629.304621	7629.303136	g/hr	90	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) PM10	0.986721428	0.98623929	0.986214529	0.986312752	g/hr	100	11 < hp <= 16	1
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) PM2.5	0.907783403	0.907340037	0.907318048	0.907406381	g/hr	110	11 < hp <= 16	1
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) CO	31.43814192	28.31294727	25.06072615	21.85026561	g/hr	2	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) NOx	104.1024596	94.16309725	84.79187675	75.46736803	g/hr	3	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) CH4	0.442417243	0.402781111	0.358832821	0.313254848	g/hr	5	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) SO2	0.300289072	0.297369403	0.294230366	0.29101975	g/hr	31	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) VOC	6.164914939	5.395322248	4.666326698	3.976805414	g/hr	87	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) CO2	41569.23393	41571.45808	41573.4718	41575.34846	g/hr	90	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) PM10	7.41752341	6.798041819	6.084133544	5.329598709	g/hr	100	100 < hp <= 175	23
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) PM2.5	7.194997783	6.594102766	5.901609533	5.169716276	g/hr	110	100 < hp <= 175	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) CO	43.51379616	38.91747431	34.1571926	29.19791476	g/hr	2	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) NOx	139.4958409	123.5646212	108.4266189	93.45504428	g/hr	3	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) CH4	0.737960859	0.671112523	0.595739823	0.516568315	g/hr	5	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) SO2	0.523291714	0.518274897	0.512845948	0.507311043	g/hr	31	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) VOC	9.899967541	8.698584771	7.548023964	6.426008384	g/hr	87	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) CO2	72882.8862	72886.27364	72889.56352	72892.71164	g/hr	90	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) PM10	8.614295683	7.742068616	6.807751026	5.835616312	g/hr	100	175 < hp <= 300	23
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) PM2.5	8.355873404	7.509819027	6.603516138	5.660541432	g/hr	110	175 < hp <= 300	23
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) CO	498.2576359	498.6427	498.7509466	498.5019129	g/hr	2	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) NOx	5.071063279	5.085195482	5.089131697	5.080032788	g/hr	3	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) CH4	2.142100799	2.153697631	2.156926117	2.149460673	g/hr	5	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) SO2	0.018119038	0.018117202	0.018116664	0.018117841	g/hr	31	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) VOC	20.91023907	20.97833335	20.99731533	20.95343562	g/hr	87	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) CO2	2981.039147	2980.742228	2980.661454	2980.849728	g/hr	90	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) PM10	0.777045703	0.783182415	0.784889642	0.780941365	g/hr	100	3 < hp <= 6	1
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) PM2.5	0.714882041	0.720526257	0.722098601	0.718464367	g/hr	110	3 < hp <= 6	1
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) CO	87.15481916	77.46211267	69.33229774	62.09094993	g/hr	2	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) NOx	316.2610552	287.8660282	261.8022346	237.8627981	g/hr	3	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) CH4	1.032789178	0.977918956	0.921394007	0.866909313	g/hr	5	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) SO2	0.449773306	0.44322407	0.43687452	0.430928993	g/hr	31	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) VOC	27.30232174	24.62158968	22.25139389	20.10520458	g/hr	87	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) CO2	55455.52829	55463.22662	55470.12631	55476.43861	g/hr	90	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) PM10	18.18733457	16.30348166	14.6274907	13.11183507	g/hr	100	175 < hp <= 300	23
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) PM2.5	17.64172266	15.81437983	14.18867395	12.71848773	g/hr	110	175 < hp <= 300	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) CO	158.203311	141.3981857	126.6839718	113.4084089	g/hr	2	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) NOx	521.3850053	474.4584551	431.1000848	391.2374072	g/hr	3	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) CH4	1.275972548	1.206837237	1.137244922	1.070327271	g/hr	5	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) SO2	0.735589688	0.724864031	0.714463732	0.704725441	g/hr	31	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) VOC	34.72690778	30.95038551	27.76140682	24.91494623	g/hr	87	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) CO2	90690.73538	90701.68746	90710.99974	90719.43668	g/hr	90	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) PM10	24.81047872	22.11920996	19.78304217	17.68395939	g/hr	100	300 < hp <= 600	23
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) PM2.5	24.06616296	21.45563661	19.18955897	17.1534357	g/hr	110	300 < hp <= 600	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) CO	49.38017207	45.31552983	41.46561197	38.02942352	g/hr	2	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) NOx	117.4107667	112.8181222	108.465536	104.5510128	g/hr	3	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) CH4	0.433650515	0.426404108	0.418755967	0.410534477	g/hr	5	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) SO2	0.128284929	0.126416554	0.124609613	0.122913334	g/hr	31	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) VOC	10.9355624	9.957837128	9.040729847	8.242098643	g/hr	87	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) CO2	15803.93107	15806.76917	15809.43553	15811.76642	g/hr	90	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) PM10	8.649960442	7.845545988	7.0846416	6.41185431	g/hr	100	50 < hp <= 75	23
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) PM2.5	8.39047057	7.610175988	6.872102561	6.219508348	g/hr	110	50 < hp <= 75	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) CO	28.14488437	23.72670874	20.77260445	16.94364622	g/hr	2	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) NOx	99.45148964	87.15908427	76.12401694	63.1202833	g/hr	3	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) CH4	0.410864108	0.345848574	0.30096357	0.24257769	g/hr	5	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) SO2	0.298910207	0.294515744	0.291600472	0.287929905	g/hr	31	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) VOC	4.853905617	3.984830702	3.369944328	2.668094981	g/hr	87	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) CO2	41858.0288	41860.4617	41862.19041	41864.2241	g/hr	90	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) PM10	6.883662247	5.84317862	5.179190771	4.258571303	g/hr	100	100 < hp <= 175	23
Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) PM2.5	6.677143615	5.667885421	5.023813935	4.130818096	g/hr	110	100 < hp <= 175	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) CO	48.35007682	40.30914676	34.65985534	27.39590973	g/hr	2	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) NOx	92.23343185	84.87926167	78.44596683	70.84057748	g/hr	3	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) CH4	0.318435496	0.275388446	0.239800245	0.195295323	g/hr	5	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) SO2	0.213089998	0.209936834	0.207786711	0.205095862	g/hr	31	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) VOC	4.057896208	3.330219851	2.751947081	2.11947886	g/hr	87	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) CO2	29801.31458	29803.39791	29805.06003	29806.83806	g/hr	90	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) PM10	7.868398016	6.682146737	5.811862475	4.654071219	g/hr	100	75 < hp <= 100	23
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) PM2.5	7.632376719	6.48167017	5.637509615	4.51444728	g/hr	110	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) CO	54.26162833	47.2629974	40.63529298	35.24368313	g/hr	2	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) NOx	97.33983066	90.55375647	84.39458287	78.33723202	g/hr	3	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) CH4	0.331587424	0.296523543	0.262895945	0.231536755	g/hr	5	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) SO2	0.217569557	0.214812805	0.212193223	0.210119109	g/hr	31	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) VOC	5.018206917	4.255236736	3.597289636	3.020060526	g/hr	87	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) CO2	30094.01823	30096.26652	30098.14115	30099.76415	g/hr	90	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) PM10	8.735594805	7.698616272	6.707242854	5.861299279	g/hr	100	75 < hp <= 100	23
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) PM2.5	8.473523433	7.467655742	6.506022251	5.685457437	g/hr	110	75 < hp <= 100	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) CO	39.54961671	32.70405409	27.77290068	22.83726234	g/hr	2	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) NOx	120.1825151	101.1194671	85.19560279	68.65852598	g/hr	3	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) CH4	0.710991581	0.596336711	0.507970643	0.410229976	g/hr	5	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) SO2	0.517133881	0.509555703	0.504346108	0.499498166	g/hr	31	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) VOC	7.902923105	6.475535304	5.452290128	4.524517297	g/hr	87	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) CO2	72825.26817	72829.25965	72832.20086	72834.92466	g/hr	90	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) PM10	7.50879376	6.229691013	5.359223022	4.556723366	g/hr	100	175 < hp <= 300	23
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) PM2.5	7.283536575	6.042791236	5.198433843	4.42002805	g/hr	110	175 < hp <= 300	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) CO	15.58956362	13.67296444	12.16240545	10.84729561	g/hr	2	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) NOx	31.56392329	30.58224631	29.80869436	29.12175954	g/hr	3	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) CH4	0.201438458	0.194829156	0.190262075	0.185637539	g/hr	5	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) SO2	0.048456761	0.04791482	0.04748604	0.047090867	g/hr	31	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) VOC	3.821240261	3.345874433	2.967530647	2.639023475	g/hr	87	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) CO2	6557.2959	6558.67496	6559.77831	6560.743425	g/hr	90	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) PM10	2.517800355	2.197585722	1.949117836	1.733289963	g/hr	100	40 < hp <= 50	23
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) PM2.5	2.442268101	2.131657989	1.890643178	1.681292259	g/hr	110	40 < hp <= 50	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) CO	48.87465552	43.337244	39.04038206	35.07996325	g/hr	2	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) NOx	93.9661216	87.82849706	83.03881925	78.57082227	g/hr	3	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) CH4	0.277218897	0.252994443	0.234690528	0.217106003	g/hr	5	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) SO2	0.204516945	0.202475092	0.200881143	0.199394927	g/hr	31	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) VOC	5.753915967	4.931051681	4.288283831	3.717035568	g/hr	87	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) CO2	28438.66522	28441.1093	28442.90459	28444.63985	g/hr	90	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) PM10	8.110181208	7.234830128	6.55729429	5.932984193	g/hr	100	75 < hp <= 100	23
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) PM2.5	7.86686886	7.017789215	6.360567034	5.75499333	g/hr	110	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) CO	63.26315196	56.35605282	47.99550647	38.45804834	g/hr	2	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) NOx	64.76910862	59.18232361	52.41297409	44.75204161	g/hr	3	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) CH4	0.327531828	0.300026707	0.266174135	0.22452931	g/hr	5	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) SO2	0.09938628	0.097664904	0.095545151	0.093110269	g/hr	31	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) VOC	12.34361885	10.86433316	9.09872015	7.124318474	g/hr	87	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) CO2	12705.07273	12709.3662	12714.48306	12720.18882	g/hr	90	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) PM10	10.64685148	9.477405443	7.996200964	6.297179348	g/hr	100	75 < hp <= 100	23
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) PM2.5	10.32743741	9.193080324	7.756314989	6.108265358	g/hr	110	75 < hp <= 100	23
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) CO	30.13561976	26.37292083	22.6405503	18.8520659	g/hr	2	40 < hp <= 50	23
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) NOx	39.75099232	37.78279492	35.79050225	33.73688606	g/hr	3	40 < hp <= 50	23
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) CH4	0.295191964	0.282890401	0.268900622	0.243993264	g/hr	5	40 < hp <= 50	23
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) SO2	0.053309096	0.052251603	0.051158327	0.050000059	g/hr	31	40 < hp <= 50	23

Welders (40 < hp <= 50)	Welders (40 < hp <= 50) VOC	6.983200777	6.081379266	5.213207766	4.358006069	g/hr	87	40 < hp <= 50	23				
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) CO2	6738.141397	6740.794963	6743.318566	6745.781803	g/hr	90	40 < hp <= 50	23				
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) PM10	5.217201871	4.594268989	3.952478408	3.267368943	g/hr	100	40 < hp <= 50	23				
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) PM2.5	5.060688771	4.456438688	3.833903146	3.169349809	g/hr	110	40 < hp <= 50	23				
Passenger Truck	Passenger Truck - idle CO	11.82209661	9.765378937	8.054973663	6.605516495	g/hr	2		1	31	1	CO	GASOLINE
Passenger Truck	Passenger Truck - 25 mph CO	4.628856277	4.268484583	3.949222274	3.63431595	g/mi	2		1	31	2	CO	GASOLINE
Passenger Truck	Passenger Truck - start CO	19.64059079	17.94449581	16.4387825	14.97147706	g/start	2		1	31	3	CO	GASOLINE
Passenger Truck	Passenger Truck - idle NOx	1.20298152	0.989471799	0.810405819	0.657251957	g/hr	3		1	31	1	NOx	GASOLINE
Passenger Truck	Passenger Truck - 25 mph NOx	0.33252548	0.281032842	0.237378693	0.199828487	g/mi	3		1	31	2	NOx	GASOLINE
Passenger Truck	Passenger Truck - start NOx	1.123284026	0.983925342	0.86451263	0.757389972	g/start	3		1	31	3	NOx	GASOLINE
Passenger Truck	Passenger Truck - idle CH4	0.027864242	0.023562363	0.01996672	0.016846704	g/hr	5		1	31	1	Methane CH4	GASOLINE
Passenger Truck	Passenger Truck - 25 mph CH4	0.004863304	0.004408127	0.004011682	0.003637268	g/mi	5		1	31	2	Methane CH4	GASOLINE
Passenger Truck	Passenger Truck - start CH4	0.09852881	0.088071809	0.079030603	0.070533332	g/start	5		1	31	3	Methane CH4	GASOLINE
Passenger Truck	Passenger Truck - idle N2O	0	0	0	0	g/hr	6		1	31	1	Nitrous Oxide N2O	GASOLINE
Passenger Truck	Passenger Truck - 25 mph N2O	0	0	0	0	g/mi	6		1	31	2	Nitrous Oxide N2O	GASOLINE
Passenger Truck	Passenger Truck - start N2O	0.056063918	0.05160512	0.04787748	0.044540754	g/start	6		1	31	3	Nitrous Oxide N2O	GASOLINE
Passenger Truck	Passenger Truck - idle SO2	0.026317322	0.025549019	0.024786558	0.023892004	g/hr	31		1	31	1	SO2	GASOLINE
Passenger Truck	Passenger Truck - 25 mph SO2	0.003126785	0.003036746	0.002946326	0.002840184	g/mi	31		1	31	2	SO2	GASOLINE
Passenger Truck	Passenger Truck - start SO2	0.001555222	0.001533498	0.001511518	0.001481332	g/start	31		1	31	3	SO2	GASOLINE
Passenger Truck	Passenger Truck - idle VOC	1.637986237	1.4524206	1.298380989	1.163402838	g/hr	87		1	31	1	VOC	GASOLINE
Passenger Truck	Passenger Truck - 25 mph VOC	0.210892827	0.187865687	0.168365117	0.151158756	g/mi	87		1	31	2	VOC	GASOLINE
Passenger Truck	Passenger Truck - start VOC	2.119276765	1.867383256	1.654135886	1.461986168	g/start	87		1	31	3	VOC	GASOLINE
Passenger Truck	Passenger Truck - idle CO2	3960.863508	3845.131555	3729.81644	3595.137474	g/hr	90		1	31	1	Atmospheric CO2	GASOLINE
Passenger Truck	Passenger Truck - 25 mph CO2	470.5931999	457.0305283	443.3558666	427.3738965	g/mi	90		1	31	2	Atmospheric CO2	GASOLINE
Passenger Truck	Passenger Truck - start CO2	234.0667043	230.7914009	227.4492691	222.9033582	g/start	90		1	31	3	Atmospheric CO2	GASOLINE
Passenger Truck	Passenger Truck - idle CO2e	3961.548482	3845.710443	3730.312313	3595.546569	g/hr	98		1	31	1	CO2 equivalent	GASOLINE
Passenger Truck	Passenger Truck - 25 mph CO2e	470.7130704	457.1389158	443.4550411	427.4631536	g/mi	98		1	31	2	CO2 equivalent	GASOLINE
Passenger Truck	Passenger Truck - start CO2e	253.2043951	248.3427803	243.6667787	237.9158975	g/start	98		1	31	3	CO2 equivalent	GASOLINE
Passenger Truck	Passenger Truck - idle PM10	0.024133094	0.023812033	0.023580551	0.023124323	g/hr	100, 106, 107		1	31	1	Primary PM10 total	GASOLINE
Passenger Truck	Passenger Truck - 25 mph PM10	0.076357856	0.076167263	0.075992324	0.075444191	g/mi	100, 106, 107		1	31	2	Primary PM10 total	GASOLINE
Passenger Truck	Passenger Truck - start PM10	0.015657895	0.014728137	0.013932525	0.013168271	g/start	100, 106, 107		1	31	3	Primary PM10 total	GASOLINE
Passenger Truck	Passenger Truck - idle PM2.5	0.021348592	0.021064529	0.020859799	0.020456304	g/hr	110, 116, 117		1	31	1	Primary PM2.5 total	GASOLINE
Passenger Truck	Passenger Truck - 25 mph PM2.5	0.014224239	0.014055783	0.013901095	0.013684356	g/mi	110, 116, 117		1	31	2	Primary PM2.5 total	GASOLINE
Passenger Truck	Passenger Truck - start PM2.5	0.013851248	0.013028855	0.012324954	0.011648909	g/start	110, 116, 117		1	31	3	Primary PM2.5 total	GASOLINE
Light Commercial Truck	Light Commercial Truck - idle CO	15.30940428	13.27706431	11.49842462	9.986238446	g/hr	2		2	32	1	CO	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph CO	2.662322754	2.444917398	2.252386057	2.067055794	g/mi	2		2	32	2	CO	DIESEL
Light Commercial Truck	Light Commercial Truck - start CO	7.443907655	7.074779223	6.740633291	6.367012848	g/start	2		2	32	3	CO	DIESEL
Light Commercial Truck	Light Commercial Truck - idle NOx	25.41382519	22.26530191	19.31753564	16.87473172	g/hr	3		2	32	1	NOx	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph NOx	1.3241892	1.184472939	1.049213524	0.931448277	g/mi	3		2	32	2	NOx	DIESEL
Light Commercial Truck	Light Commercial Truck - start NOx	1.275063759	1.224539188	1.177080996	1.13142183	g/start	3		2	32	3	NOx	DIESEL
Light Commercial Truck	Light Commercial Truck - idle CH4	0.332027708	0.344531108	0.355422641	0.363796932	g/hr	5		2	32	1	Methane CH4	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph CH4	0.02604914	0.027092268	0.028052953	0.028737587	g/mi	5		2	32	2	Methane CH4	DIESEL
Light Commercial Truck	Light Commercial Truck - start CH4	0.235921148	0.245877165	0.255101689	0.259282659	g/start	5		2	32	3	Methane CH4	DIESEL
Light Commercial Truck	Light Commercial Truck - idle N2O	0	0	0	0	g/hr	6		2	32	1	Nitrous Oxide N2O	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph N2O	0	0	0	0	g/mi	6		2	32	2	Nitrous Oxide N2O	DIESEL
Light Commercial Truck	Light Commercial Truck - start N2O	0.003534545	0.003525744	0.003518067	0.003510399	g/start	6		2	32	3	Nitrous Oxide N2O	DIESEL
Light Commercial Truck	Light Commercial Truck - idle SO2	0.047251199	0.046262011	0.045307878	0.044346336	g/hr	31		2	32	1	SO2	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph SO2	0.005907422	0.005771728	0.005641692	0.005513512	g/mi	31		2	32	2	SO2	DIESEL
Light Commercial Truck	Light Commercial Truck - start SO2	0.002217968	0.002184546	0.002152381	0.002120242	g/start	31		2	32	3	SO2	DIESEL
Light Commercial Truck	Light Commercial Truck - idle VOC	3.163710051	2.697727755	2.288601328	1.949734241	g/hr	87		2	32	1	VOC	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph VOC	0.22854022	0.195614257	0.16668626	0.142344573	g/mi	87		2	32	2	VOC	DIESEL
Light Commercial Truck	Light Commercial Truck - start VOC	0.799746608	0.716146569	0.644079393	0.577305878	g/start	87		2	32	3	VOC	DIESEL
Light Commercial Truck	Light Commercial Truck - idle CO2	5559.261434	5457.724601	5358.285313	5255.816052	g/hr	90		2	32	1	Atmospheric CO2	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph CO2	694.6427131	680.5810791	666.9297939	653.2133473	g/mi	90		2	32	2	Atmospheric CO2	DIESEL
Light Commercial Truck	Light Commercial Truck - start CO2	261.1506189	257.9265786	254.7579042	251.4876086	g/start	90		2	32	3	Atmospheric CO2	DIESEL
Light Commercial Truck	Light Commercial Truck - idle CO2e	5567.552763	5466.321778	5367.156459	5264.893941	g/hr	98		2	32	1	CO2 equivalent	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph CO2e	695.2936387	681.2568397	667.6289605	653.9294293	g/mi	98		2	32	2	CO2 equivalent	DIESEL
Light Commercial Truck	Light Commercial Truck - start CO2e	268.0913247	265.1159211	262.1743331	259.0055294	g/start	98		2	32	3	CO2 equivalent	DIESEL
Light Commercial Truck	Light Commercial Truck - idle PM10	1.221556331	1.060891103	0.92131293	0.804764106	g/hr	100, 106, 107		2	32	1	Primary PM10 total	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph PM10	0.139018021	0.129636159	0.121555646	0.114968989	g/mi	100, 106, 107		2	32	2	Primary PM10 total	DIESEL
Light Commercial Truck	Light Commercial Truck - start PM10	0.030418435	0.027893892	0.025669753	0.023782805	g/start	100, 106, 107		2	32	3	Primary PM10 total	DIESEL
Light Commercial Truck	Light Commercial Truck - idle PM2.5	1.123829319	0.976015002	0.847605542	0.740381384	g/hr	110, 116, 117		2	32	1	Primary PM2.5 total	DIESEL
Light Commercial Truck	Light Commercial Truck - 25 mph PM2.5	0.069256838	0.060637956	0.053214888	0.047211885	g/mi	110, 116, 117		2	32	2	Primary PM2.5 total	DIESEL
Light Commercial Truck	Light Commercial Truck - start PM2.5	0.027984993	0.025662309	0.023616171	0.021880074	g/start	110, 116, 117		2	32	3	Primary PM2.5 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle CO	15.15244314	13.90004939	12.75015805	11.71181419	g/hr	2		2	52	1	CO	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph CO	2.064895106	1.868805165	1.691060592	1.532230287	g/mi	2		2	52	2	CO	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start CO	7.8550743	7.774237912	7.693518889	7.640193997	g/start	2		2	52	3	CO	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle NOx	35.14384698	31.30017794	27.93010597	24.9484042	g/hr	3		2	52	1	NOx	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph NOx	4.559411655	4.068913275	3.646046868	3.273616576	g/mi	3		2	52	2	NOx	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start NOx	0.917398093	0.92115281	0.924051928	0.925065907	g/start	3		2	52	3	NOx	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle CH4	0.535563427	0.561173833	0.584469175	0.605334281	g/hr	5		2	52	1	Methane CH4	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph CH4	0.051219872	0.053691798	0.055940578	0.05795498	g/mi	5		2	52	2	Methane CH4	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start CH4	0.028948162	0.030783335	0.032465111	0.03401524	g/start	5		2	52	3	Methane CH4	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle N2O	0	0	0	0	g/hr	6		2	52	1	Nitrous Oxide N2O	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph N2O	0	0	0	0	g/mi	6		2	52	2	Nitrous Oxide N2O	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start N2O	0.005054809	0.005056224	0.005057438	0.005061571	g/start	6		2	52	3	Nitrous Oxide N2O	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle SO2	0.070831793	0.070214871	0.069634355	0.069132877	g/hr	31		2	52	1	SO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph SO2	0.011263999	0.011164861	0.011071642	0.010991232	g/mi	31		2	52	2	SO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start SO2	0.00254221	0.002519428	0.002498011	0.002479678	g/start	31		2	52	3	SO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle VOC	7.66087195	6.812770604	6.046484159	5.362136806	g/hr	87		2	52	1	VOC	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph VOC	0.670212869	0.598099433	0.53268194	0.473965647	g/mi	87		2	52	2	VOC	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start VOC	0.051935079	0.051000289	0.050210571	0.04936969	g/start	87		2	52	3	VOC	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle CO2	8267.59828	8219.751711	8174.075263	8135.548512	g/hr	90		2	52	1	Atmospheric CO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph CO2	1314.706935	1306.984039	1299.619129	1293.420264	g/mi	90		2	52	2	Atmospheric CO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start CO2	296.7038608	294.9155027	293.2107043	291.7921461	g/start	90		2	52	3	Atmospheric CO2	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle CO2e	8280.974087	8233.763759	8188.685826	8150.671983	g/hr	98		2	52	1	CO2 equivalent	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph CO2e	1315.98585	1308.32515	1301.017171	1294.868131	g/mi	98		2	52	2	CO2 equivalent	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start CO2e	298.933162	297.1917276	295.5305159	294.1515249	g/start	98		2	52	3	CO2 equivalent	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle PM10	3.76969265	3.393147874	3.042547953	2.721424772	g/hr	100, 106, 107		2	52	1	Primary PM10 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph PM10	0.562604205	0.516869714	0.480705996	0.44872	g/mi	100, 106, 107		2	52	2	Primary PM10 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start PM10	0.054796532	0.050035367	0.045677384	0.041756697	g/start	100, 106, 107		2	52	3	Primary PM10 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - idle PM2.5	3.468104859	3.121683498	2.799143589	2.503703932	g/hr	110, 116, 117		2	52	1	Primary PM2.5 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - 25 mph PM2.5	0.341910775	0.300774063	0.26837578	0.239522072	g/mi	110, 116, 117		2	52	2	Primary PM2.5 total	DIESEL
Single Unit Short-Haul Truck	Single Unit Short-Haul Truck - start PM2.5	0.050412729	0.046032465	0.042023013	0.038415992	g/start	110, 116, 117		2	52	3	Primary PM2.5 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle CO	19.0845879	17.74324281	16.45956495	15.27360441	g/hr	2		2	61	1	CO	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph CO	3.58500128	3.291513406	3.013464514	2.75693646	g/mi	2		2	61	2	CO	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start CO	15.83272465	15.84754637	15.86165869	15.8762346	g/start	2		2	61	3	CO	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle NOx	57.31446292	52.27323119	47.89344769	43.80812022	g/hr	3		2	61	1	NOx	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph NOx	11.06815443	10.01263027	9.134386205	8.319636615	g/mi	3		2	61	2	NOx	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start NOx	0	0	0	0	g/start	3		2	61	3	NOx	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle CH4	0.426772646	0.454595254	0.481061248	0.505627801	g/hr	5		2	61	1	Methane CH4	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph CH4	0.042142512	0.04496038	0.047648547	0.050137879	g/mi	5		2	61	2	Methane CH4	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start CH4	0	0	0	0	g/start	5		2	61	3	Methane CH4	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle N2O	0	0	0	0	g/hr	6		2	61	1	Nitrous Oxide N2O	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph N2O	0	0	0	0	g/mi	6		2	61	2	Nitrous Oxide N2O	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start N2O	0.005040658	0.005043858	0.005046727	0.005049758	g/start	6		2	61	3	Nitrous Oxide N2O	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle SO2	0.072381208	0.071955164	0.071550075	0.071162874	g/hr	31		2	61	1	SO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph SO2	0.018407361	0.01829452	0.018186947	0.01808532	g/mi	31		2	61	2	SO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start SO2	0.002730863	0.002715798	0.002700785	0.002688002	g/start	31		2	61	3	SO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle VOC	8.586106188	7.82585135	7.15413623	6.484972578	g/hr	87		2	61	1	VOC	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph VOC	0.664369902	0.606804498	0.559335887	0.508209043	g/mi	87		2	61	2	VOC	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start VOC	0	0	0	0	g/start	87		2	61	3	VOC	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle CO2	8373.314183	8349.449503	8326.603243	8304.377443	g/hr	90		2	61	1	Atmospheric CO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph CO2	2129.280305	2122.713598	2116.382376	2110.360804	g/mi	90		2	61	2	Atmospheric CO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start CO2	315.9694022	315.187473	314.3610482	313.7308838	g/start	90		2	61	3	Atmospheric CO2	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle CO2e	8383.966186	8360.801501	8338.616379	8317.000737	g/hr	98		2	61	1	CO2 equivalent	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph CO2e	2130.330502	2123.833795	2117.572686	2111.611131	g/mi	98		2	61	2	CO2 equivalent	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start CO2e	317.4716847	316.6907376	315.8654409	315.2362767	g/start	98		2	61	3	CO2 equivalent	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle PM10	4.853222406	4.493610876	4.146582258	3.820217077	g/hr	100, 106, 107		2	61	1	Primary PM10 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph PM10	1.120650682	1.043615576	0.980107908	0.922057457	g/mi	100, 106, 107		2	61	2	Primary PM10 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start PM10	0.069482763	0.064497752	0.059783003	0.05536465	g/start	100, 106, 107		2	61	3	Primary PM10 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - idle PM2.5	4.464959412	4.134107603	3.814835672	3.514577305	g/hr	110, 116, 117		2	61	1	Primary PM2.5 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - 25 mph PM2.5	0.749021636	0.67829603	0.62053525	0.56720433	g/mi	110, 116, 117		2	61	2	Primary PM2.5 total	DIESEL
Combination Short-Haul Truck	Combination Short-Haul Truck - start PM2.5	0.063923818	0.059337643	0.055000155	0.050935294	g/start	110, 116, 117		2	61	3	Primary PM2.5 total	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) SO2	0.086666667	0.086666667	0.086666667	0.086666667	g/kWh	31					SO2	DIESEL (S = 0.1% or 1000 ppm)
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) NOx	13	13	13	13	g/kWh	3					NOx	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) VOC	0.27	0.27	0.27	0.27	g/kWh	87					VOC	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) CO	2.5	2.5	2.5	2.5	g/kWh	2					CO	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) PM10	0.261	0.261	0.261	0.261	g/kWh	100					PM10	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) PM2.5	0.24795	0.24795	0.24795	0.24795	g/kWh	110					PM2.5	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) CO2	690	690	690	690	g/kWh	90					CO2	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) N2O	0.02	0.02	0.02	0.02	g/kWh	6					Nitrous Oxide N2O	DIESEL
Harbor Tug (Tier 0)	Harbor Tug (Tier 0) CH4	0.09	0.09	0.09	0.09	g/kWh	5					Methane CH4	DIESEL
Air Compressors (100 < hp <= 175)	Air Compressors (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Air Compressors (175 < hp <= 300)	Air Compressors (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Air Compressors (25 < hp <= 40)	Air Compressors (25 < hp <= 40) N2O	-	-	-	-	-	6	25 < hp <= 40	23			Nitrous Oxide N2O	
Air Compressors (75 < hp <= 100)	Air Compressors (75 < hp <= 100) N2O	-	-	-	-	-	6	75 < hp <= 100	23			Nitrous Oxide N2O	
Bore/Drill Rigs (50 < hp <= 75)	Bore/Drill Rigs (50 < hp <= 75) N2O	-	-	-	-	-	6	50 < hp <= 75	23			Nitrous Oxide N2O	
Cement & Mortar Mixers (16 < hp <= 25)	Cement & Mortar Mixers (16 < hp <= 25) N2O	-	-	-	-	-	6	16 < hp <= 25	1			Nitrous Oxide N2O	
Concrete/Industrial Saws (16 < hp <= 25)	Concrete/Industrial Saws (16 < hp <= 25) N2O	-	-	-	-	-	6	16 < hp <= 25	1			Nitrous Oxide N2O	
Concrete/Industrial Saws (6 < hp <= 11)	Concrete/Industrial Saws (6 < hp <= 11) N2O	-	-	-	-	-	6	6 < hp <= 11	1			Nitrous Oxide N2O	
Cranes (100 < hp <= 175)	Cranes (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Cranes (175 < hp <= 300)	Cranes (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Cranes (300 < hp <= 600)	Cranes (300 < hp <= 600) N2O	-	-	-	-	-	6	300 < hp <= 600	23			Nitrous Oxide N2O	
Crawler Tractor/Dozers (175 < hp <= 300)	Crawler Tractor/Dozers (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Excavators (100 < hp <= 175)	Excavators (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Excavators (1200 < hp <= 2000)	Excavators (1200 < hp <= 2000) N2O	-	-	-	-	-	6	1200 < hp <= 2000	23			Nitrous Oxide N2O	
Excavators (300 < hp <= 600)	Excavators (300 < hp <= 600) N2O	-	-	-	-	-	6	300 < hp <= 600	23			Nitrous Oxide N2O	
Excavators (50 < hp <= 75)	Excavators (50 < hp <= 75) N2O	-	-	-	-	-	6	50 < hp <= 75	23			Nitrous Oxide N2O	
Generator Sets (100 < hp <= 175)	Generator Sets (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Generator Sets (16 < hp <= 25)	Generator Sets (16 < hp <= 25) N2O	-	-	-	-	-	6	16 < hp <= 25	1			Nitrous Oxide N2O	
Generator Sets (175 < hp <= 300)	Generator Sets (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Generator Sets (300 < hp <= 600)	Generator Sets (300 < hp <= 600) N2O	-	-	-	-	-	6	300 < hp <= 600	23			Nitrous Oxide N2O	
Generator Sets (6 < hp <= 11)	Generator Sets (6 < hp <= 11) N2O	-	-	-	-	-	6	6 < hp <= 11	1			Nitrous Oxide N2O	
Graders (100 < hp <= 175)	Graders (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Inboard/Sterndrive (175 < hp <= 300)	Inboard/Sterndrive (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	24			Nitrous Oxide N2O	
Inboard/Sterndrive (300 < hp <= 600)	Inboard/Sterndrive (300 < hp <= 600) N2O	-	-	-	-	-	6	300 < hp <= 600	24			Nitrous Oxide N2O	
Inboard/Sterndrive (600 < hp <= 750)	Inboard/Sterndrive (600 < hp <= 750) N2O	-	-	-	-	-	6	600 < hp <= 750	24			Nitrous Oxide N2O	
Other Construction Equipment (175 < hp <= 300	Other Construction Equipment (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Other Construction Equipment (600 < hp <= 750	Other Construction Equipment (600 < hp <= 750) N2O	-	-	-	-	-	6	600 < hp <= 750	23			Nitrous Oxide N2O	
Other General Industrial Eqp (11 < hp <= 16)	Other General Industrial Eqp (11 < hp <= 16) N2O	-	-	-	-	-	6	11 < hp <= 16	1			Nitrous Oxide N2O	
Paving Equipment (100 < hp <= 175)	Paving Equipment (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23			Nitrous Oxide N2O	
Paving Equipment (175 < hp <= 300)	Paving Equipment (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Plate Compactors (3 < hp <= 6)	Plate Compactors (3 < hp <= 6) N2O	-	-	-	-	-	6	3 < hp <= 6	1			Nitrous Oxide N2O	
Pumps (175 < hp <= 300)	Pumps (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23			Nitrous Oxide N2O	
Pumps (300 < hp <= 600)	Pumps (300 < hp <= 600) N2O	-	-	-	-	-	6	300 < hp <= 600	23			Nitrous Oxide N2O	
Pumps (50 < hp <= 75)	Pumps (50 < hp <= 75) N2O	-	-	-	-	-	6	50 < hp <= 75	23			Nitrous Oxide N2O	

Rollers (100 < hp <= 175)	Rollers (100 < hp <= 175) N2O	-	-	-	-	-	6	100 < hp <= 175	23	Nitrous Oxide N2O							
Rollers (75 < hp <= 100)	Rollers (75 < hp <= 100) N2O	-	-	-	-	-	6	75 < hp <= 100	23	Nitrous Oxide N2O							
Rough Terrain Forklifts (75 < hp <= 100)	Rough Terrain Forklifts (75 < hp <= 100) N2O	-	-	-	-	-	6	75 < hp <= 100	23	Nitrous Oxide N2O							
Rubber Tire Loaders (175 < hp <= 300)	Rubber Tire Loaders (175 < hp <= 300) N2O	-	-	-	-	-	6	175 < hp <= 300	23	Nitrous Oxide N2O							
Skid Steer Loaders (40 < hp <= 50)	Skid Steer Loaders (40 < hp <= 50) N2O	-	-	-	-	-	6	40 < hp <= 50	23	Nitrous Oxide N2O							
Surfacing Equipment (75 < hp <= 100)	Surfacing Equipment (75 < hp <= 100) N2O	-	-	-	-	-	6	75 < hp <= 100	23	Nitrous Oxide N2O							
Tractors/Loaders/Backhoes (75 < hp <= 100)	Tractors/Loaders/Backhoes (75 < hp <= 100) N2O	-	-	-	-	-	6	75 < hp <= 100	23	Nitrous Oxide N2O							
Welders (40 < hp <= 50)	Welders (40 < hp <= 50) N2O	-	-	-	-	-	6	40 < hp <= 50	23	Nitrous Oxide N2O							
Bulldozing	Bulldozing Fugitive PM10	2.47009855	2.47009855	2.47009855	2.47009855	lb/hr				Fugitive PM10	s (%): 23	M (%): 10				η (%): 25	watering
Material Handling	Material Handling Fugitive PM10	0.000296262	0.000296262	0.000296262	0.000296262	lb/ton				Fugitive PM10		M (%): 10	k: 0.4	U (mph): 10.2		η (%): 0	none
Grading	Grading Fugitive PM10	0.57375	0.57375	0.57375	0.57375	lb/mi				Fugitive PM10					S (mph): 5	η (%): 25	watering
Bulldozing	Bulldozing Fugitive PM2.5	0.968721238	0.968721238	0.968721238	0.968721238	lb/hr				Fugitive PM2.5	s (%) 23	M (%): 10				η (%): 25	watering
Material Handling	Material Handling Fugitive PM2.5	4.48626E-05	4.48626E-05	4.48626E-05	4.48626E-05	lb/ton				Fugitive PM2.5		M (%): 10	k: 0.1	U (mph): 10.2		η (%): 0	none
Grading	Grading Fugitive PM2.5	0.05198858	0.05198858	0.05198858	0.05198858	lb/mi				Fugitive PM2.5					S (mph): 5	η (%): 25	watering
Asphalt Paving	Asphalt Paving VOC	0.26	0.26	0.26	0.26	% by wt.				VOC	Assume medium cure, 45% by volume of diluent in cutback						