PRELIMINARY FINAL

ENVIRONMENTAL ASSESSMENT

For

Pacific Deep Electromagnetic Research Measurement Array (PACDERMA) Infrastructure Installation

at the

Pacific Missile Range Facility

Kauai, Hawaii

2025

The Naval Sea System Command (NAVSEA) tailored the breadth and depth of analysis in this Environmental Assessment (EA) to ensure that the environmental analysis did not exceed the congressionally-mandated page limit. In this regard, I certify that NAVSEA considered the factors mandated by the National Environmental Policy Act (NEPA), the EA represents NAVSEA's good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally-mandated page limits, and that this prioritization reflects NAVSEA's expert judgement. Any considerations addressed briefly or left unaddressed were comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed, or were comparatively unimportant or frivolous.

I certify that the EA represents NAVSEA's good-faith effort to fulfill NEPA's requirements within the congressionally-mandated timeline, that such effort is substantially complete, that NAVSEA has thoroughly considered the factors mandated by NEPA, and that the analysis contained herein is adequate to inform and reasonably explain the final decision regarding the proposed federal action.

Dr. Kerry A. Clark
Acting Executive Director
Safety and Regulatory Compliance

Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Pacific Deep Electromagnetic Research Measurement Array (PACDERMA) Infrastructure Installation
Project Location:	Pacific Missile Range Facility, Kauai, Hawaii
Lead Agency for the EA:	Department of the Navy
Affected Region:	Kauai, Hawaii
Action Proponent:	Naval Sea Systems Command (NAVSEA), Naval Surface Warfare Center, Carderock Division (NSWCCD)
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Date:	September 2025

Naval Sea Systems Command (NAVSEA), Naval Surface Warfare Center, Carderock Division (NSWCCD) has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) and the Department of Defense NEPA Implementing Procedures. The Proposed Action is to construct the Pacific Deep Electromagnetic Research Measurement Array (PACDERMA), an underwater electromagnetic measurement system to characterize electric fields. This system would be installed in the waters of the Pacific Ocean off the Pacific Missile Range Facility (PMRF) on the island of Kauai, Hawaii. The system includes electromagnetic sensors and beacons placed on or tethered to the seafloor, connected by cables and junction boxes. The array (cables, beacons, and sensors) would be installed at a depth sufficient for the safe measurement and navigation of naval vessels in the ocean environment. The system would connect to shore via a shore landing cable passed through an underground conduit installed via horizontal directional drilling (HDD). HDD would be completed during 2026 and the installation of the array and at-sea cables would occur in 2027. This EA evaluates the potential environmental impacts associated with one action alternative and the No Action Alternative to the following resource areas: benthic habitat, terrestrial habitat, water resources, terrestrial invertebrates, aquatic invertebrates and coral, birds, fish, essential fish habitat (EFH), sea turtles, terrestrial mammals, and marine mammals. The results of the analysis indicate that the Proposed Action would not significantly impact the environment.

EXECUTIVE SUMMARY

ES-1. Proposed Action

The Naval Surface Warfare Center, Carderock Division (NSWCCD), a Command of the U.S. Department of the Navy (Navy), proposes to construct an underwater electromagnetic measurement system to characterize the electromagnetic fields generated by oceanographic processes and naval vessels. The Pacific Deep Electromagnetic Research Measurement Array (PACDERMA) would be constructed in the waters of the Pacific Ocean off of the Pacific Missile Range Facility (PMRF) on Kauai, Hawaii. The PACDERMA system would include electromagnetic sensors and beacons placed on or tethered to the seafloor, connected by cables and junction boxes. The array (cables, beacons, and sensors) would be installed at a depth sufficient for the safe measurement and navigation of naval vessels in the ocean environment. The system would connect to shore via two trunk cables on the seafloor attached to a shallow water junction box, which also connects to a shore landing cable routed through an underground conduit. The conduit would run from a water depth of approximately 65–70 ft (20–21 m) to an upland, onshore location about 560 ft (171 m) from the shoreline and about 15 ft (5 m) above mean sea level, connecting the PACDERMA system to onshore infrastructure. The underground conduit would be installed via horizontal directional drilling (HDD), a process in which a drill rig onshore drills down from the upland location at a precise, shallow angle, then steers to emerge at a specific location underwater, bypassing the sensitive nearshore environment. The Proposed Action would commence in the spring of 2026. HDD would be completed during 2026 and the installation of the array and at-sea cables would occur in 2027. Following installation, all system components would be kept on a maintenance cycle to ensure they remain operable. This would include emergent issues requiring repair.

ES-2. Purpose and Need for the Proposed Action

The purpose of the Proposed Action is to provide an underwater electromagnetic measurement capability within the Pacific Ocean. A system is needed in the Pacific Ocean to characterize the electromagnetic environment and the effectiveness of electromagnetic field management techniques. The need for the Proposed Action is to ensure a thorough understanding of the electromagnetic environment present and the effectiveness of the techniques used to manage shipboard electromagnetic fields. Certain present and future classes of Navy vessels require periodic electromagnetic measurements to ensure they meet strict performance requirements over their entire lifecycle. This Proposed Action is necessary to establish mission-capable readiness for Pacific-based vessels.

ES-3. Alternatives Considered

Alternatives were developed for analysis based upon the following reasonable alternative screening factors: location in the Pacific Ocean, central to naval bases; sufficient water depth for the safe measurement and navigation of naval vessels; low levels of recreational and commercial vessel traffic; minimal sources of interference present, creating an electromagnetic-friendly environment for signal measurement (i.e., minimal sound interference and without water components that could degrade system performance); and access to existing infrastructure to support the laying of cables. The Navy explored three alternate locations and sites that were not carried forward for analysis because they would not meet the purpose and need for the Proposed Action. Thus, only the Proposed Action and a No Action Alternative were carried forward. Under the No Action Alternative, the underwater electromagnetic measurement system would not be constructed in a Pacific Ocean location.

ES-4. Summary of Environmental Resources Evaluated in this Environmental Assessment

The National Environmental Policy Act (NEPA) and the Department of Defense NEPA Implementing Procedures specify that an Environmental Assessment (EA) should address those resource areas potentially subject to impacts. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact. The following resource areas have been addressed in this EA: physical resources (benthic habitat, terrestrial habitat, water resources) and biological resources (aquatic invertebrates and coral, birds, fish, essential fish habitat (EFH), sea turtles, terrestrial mammals, marine mammals). Because potential impacts were considered to be negligible or nonexistent, the following resources were not evaluated in this EA: air resources, visual resources, socioeconomic resources, cultural resources, public health and safety, and other physical or biological resources, such as aquatic vegetation.

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

The Navy consulted with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) under section 7 of the Endangered Species Act (ESA) regarding the Proposed Action to receive their concurrence with the Navy's finding that the Proposed Action may affect, but is not likely to adversely affect ESA-listed species or critical habitat. Species and critical habitat included in the NMFS consultation included the following: giant manta ray (*Manta birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), green sea turtle (*Chelonia mydas*) and their proposed critical habitat, hawksbill sea turtle (*Eretmochelys imbricata*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), the Main Hawaiian Islands Insular stock of the false killer whale (*Pseudorca crassidens*), sperm whale (*Physeter macrocephalus*), and Hawaiian monk seal (*Neomonachus schauinslandi*). Species included in the USFWS consultation were the: band-rumped storm petrel (*Hydrobates castro*), Hawaiian common gallinule (*Gallinula galeata sandvicensis*), Hawaiian coot (*Fulica alai*), Hawaiian duck (*Anas wyvilliana*), Hawaiian goose (*Branta [Nesochen] sandvicensis*), Hawaiian petrel (*Pterodroma sandwichensis*), Hawaiian stilt (*Himantopus maxicanus knudseni*), Newell's shearwater (*Puffinus auricularis newelli*), short-tailed albatross (*Phoebastria [Diomedea] albatrus*), and Hawaiian hoary bat (*Lasiurus cinereus semotus*).

None of the species protected under the Marine Mammal Protection Act have been predicted to be exposed to noise or any other disturbance that would rise to harassment levels as a result of the Proposed Action. Further, with appropriate Standard Operating Procedures, strike or disturbance from vessels and objects (i.e., sensors, cables, equipment, divers) are unlikely and neither HDD nor cable laying would result in harassment of marine mammals. Therefore, the

Navy is not requesting an Incidental Harassment Authorization. The results of the analysis indicate that the Proposed Action would not significantly impact physical or biological resources. The Proposed Action would have no effect on all other resources.

Table ES- 1. Environmental Consequences of the Proposed Action and No Action Alternative

Resource Area	*No Action Alternative*	*Proposed Action*
Physical Resources: benthic habitat, terrestrial habitat, water resources	No change to baseline	Potential impacts would be temporary and localized to the footprint of the objects and/or construction. In the at-sea portion of the proposed action area, soft sediment is expected to shift back as it normally would following a natural disturbance. No long-term increases in turbidity would be anticipated. Pursuant to NEPA, there would be no significant effects to benthic habitat, terrestrial habitat, or water resources as a result of the Proposed Action.
Biological Resources: aquatic invertebrates and corals, EFH	No change to baseline	With SOPs and Protective Measures (Chapter 5), potential impacts from the Proposed Action would range from short to long term. The Proposed Action is not expected to result in population-level effects to aquatic invertebrate or coral species; however, some individuals may suffer mortality during PACDERMA system installation. Pursuant to NEPA, there would be no significant impacts to biological resources as a result of the Proposed Action. In accordance with the MSA, the Proposed Action would result in a long term reduction in the quantity of EFH in specific parts of the proposed action area—specifically a total area of 19 ft^2 (1.8 m^2) of coral.
Biological Resources: birds, fish, sea turtles, terrestrial mammals, marine mammals	No change to baseline	With SOPs and Protective Measures (Chapter 5), potential impacts from the Proposed Action would be temporary and/or minimal. The Proposed Action is not expected to result in population-level effects to marine species. Pursuant to NEPA, there would be no significant effects to biological resources as a result of the Proposed Action.
Biological Resources: proposed green sea turtle critical habitat	No change to baseline	There is overlap between the proposed green sea turtle critical habitat and the proposed action area. Pursuant to NEPA, the Proposed Action would have no significant effect on sea turtle critical habitat within the proposed action area. In accordance with the ESA, the Proposed Action would not destroy or adversely modify proposed green sea turtle critical habitat.
Biological Resources: Threatened and Endangered Species	No change to baseline	With SOPs and Protective Measures (Chapter 5), potential impacts from the Proposed Action would likely be limited to behavioral response to disturbances. The Proposed Action would have minimal effects to protected species. Pursuant to NEPA, there would be no significant effects to threatened or endangered species as a result of the Proposed Action. Pursuant to the ESA, the Proposed Action may affect, but is not likely to adversely affect ESA-listed birds, fish, sea turtles, terrestrial mammals, or marine mammals.
Socioeconomic Resources	No change to baseline	No change to baseline
Cultural Resources	No change to baseline	No change to baseline

EFH = Essential Fish Habitat; ESA = Endangered Species Act; NEPA = National Environmental Policy Act; MSA = Magnuson–Stevens Fishery Conservation and Management Act; PACDERMA = Pacific Deep Electromagnetic Research Array; SOP = Standard Operating Procedure

Environmental Assessment

Pacific Deep Electromagnetic Research Measurement Array (PACDERMA) Infrastructure Installation

Pacific Missile Range Facility, Kauai, Hawaii

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Abbreviations and Acronyms

Acronym	*Definition*	*Acronym*	*Definition*
°C	degrees Celsius	L	liter(s)
°F	degrees Fahrenheit	m	meter(s)
°N	degrees North latitude	m^2	square meter(s)
°S	degrees South latitude	MBTA	Migratory Bird Treaty Act
µPa	microPascal	MHI	Main Hawaiian Islands
AINJ	auditory injury	mi	mile(s)
BMH	beach manhole	MMPA	Marine Mammal Protection Act
cm	centimeter(s)	MSA	Magnuson-Stevens Fishery Conservation and Management Act
CFR	Code of Federal Regulations	NAVSEA	Naval Sea Systems Command
CZMA	Coastal Zone Management Act	Navy	Department of the Navy
dB	decibels	NEPA	National Environmental Policy Act
dBA	A-weighted decibels	NMFS	National Marine Fisheries Service
dB re 1 µPa at 1 m	Decibels referenced at 1 microPascal at 1 meter	NOAA	National Oceanic and Atmospheric Administration
DPS	Distinct Population Segment	NRHP	National Register of Historic Places
EA	Environmental Assessment	NSWCCD	Naval Surface Warfare Center Carderock Division
EFH	Essential Fish Habitat	NUWC	Naval Undersea Warfare Center
ESA	Endangered Species Act	NWHI	Northwest Hawaiian Islands
EEZ	Exclusive Economic Zone	OPNAVINST	Office of the Chief of Naval Operations Instruction
FEP	Fishery Ecosystem Plan	PACDERMA	Pacific Deep Electromagnetic Research Array
FR	Federal Register	PMRF	Pacific Missile Range Facility
ft	foot (feet)	RHIB	rigid-hull inflatable boat
ft^2	square foot (feet)	ROV	remotely operated vehicle
gal	gallon(s)	SHPD	State Historic Preservation Division
HDD	horizontal directional drilling	SOPs	standard operating procedures
Hz	Hertz	SPL	sound pressure level
in	inch(es)	U.S.	United States
INRMP	Integrated Natural Resource Management Plan	U.S.C.	United States Code
kHz	kilohertz	USFWS	U.S. Fish and Wildlife Service
km	kilometer(s)	yds	yards

1 Proposed Action, Purpose, and Need

1.1 Proposed Action

The Naval Sea Systems Command (NAVSEA) has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA; 42 United States Code [U.S.C.] § 4321 *et seq*.) and Department of Defense NEPA Implementing Procedures (30 June 2025).

The Naval Surface Warfare Center, Carderock Division (NSWCCD) proposes to construct an underwater electromagnetic measurement system, called the Pacific Deep Electromagnetic Research Measurement Array (PACDERMA), to characterize electromagnetic fields generated by oceanographic processes and naval vessels in the waters of the Pacific Ocean off the island of Kauai, Hawaii (Figure 1-1). The PACDERMA system would be used to periodically analyze the electromagnetic fields and the effectiveness of electromagnetic field management processes utilized by the Navy. The installation would begin on shore in 2026 and installation of the at-sea system would begin in 2027.

The PACDERMA system would include electromagnetic sensors and beacons placed on or tethered to the seafloor, connected by cables and junction boxes. The array (cables, beacons, and sensors) would be installed at a depth sufficient for the safe measurement of naval vessels in this specific ocean environment. The system would connect to shore via two trunk cables on the seafloor attached to a shallow water junction box, which also connects to a shore landing cable routed through an underground conduit. The conduit would run from a water depth of approximately 65–70 ft (20–21 m) to an upland, onshore location about 560 ft (171 m) from the shoreline and about 15 ft (5 m) above mean sea level, connecting the PACDERMA system to onshore infrastructure. The underground conduit would be installed via horizontal directional drilling (HDD), a process in which a drill rig on shore drills down from the upland location (Figure 1-2) at a precise, shallow angle, then steers to emerge at a specific location underwater, bypassing the sensitive nearshore environment. Onshore elements of the PACDERMA system include construction and installation of a beach manhole (BMH; depicted as HDD entry in Figure 1-2), connection of cables through existing terrestrial conduit and a small amount of new conduit, and housing of signal processing equipment and a workstation within a new CONEX shipping container. Following installation, all system components would be kept on a maintenance cycle (Section 1.1.5) to ensure they are working properly and any emergent issues outside of the maintenance cycle would also require repair.

1.1.1 Onshore Construction Site

Shore construction and system shore component installation would occur over two months. Installation of the array would begin on shore in 2026, where the construction laydown area would be set up to complete installation of the BMH at the HDD entry point as well as pull manholes. New conduit trenches would be dug from the BMH to the Communications Hut (Building 575; Figure 1-2) and potentially from the Naval Undersea Warfare Center (NUWC) Keyport MK30 Shop Operations Center (Building 447) to a new CONEX box that will serve as the PACDERMA operations center.

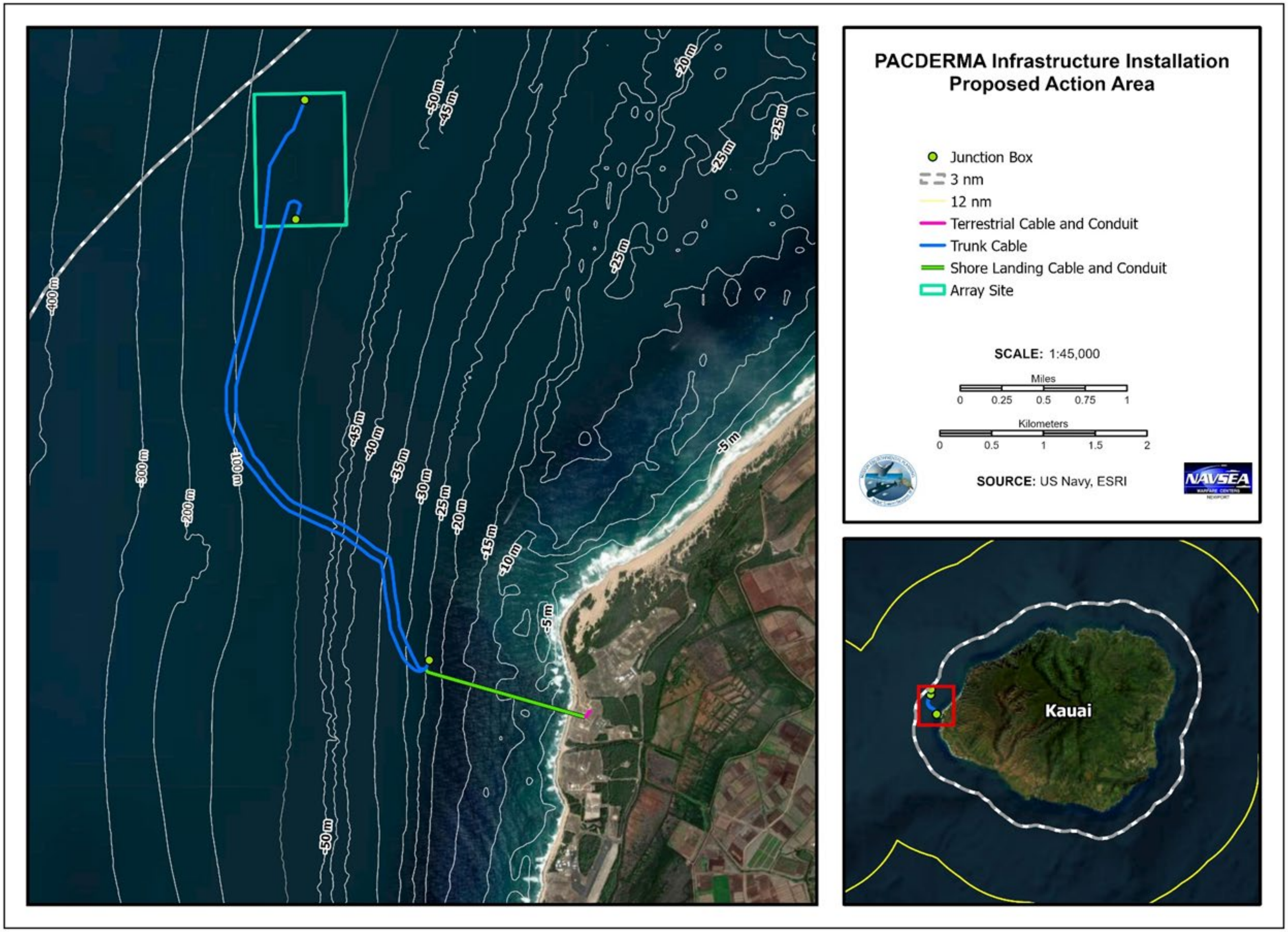

Figure 1-1. Proposed Action Area at the Pacific Missile Range Facility (PMRF)

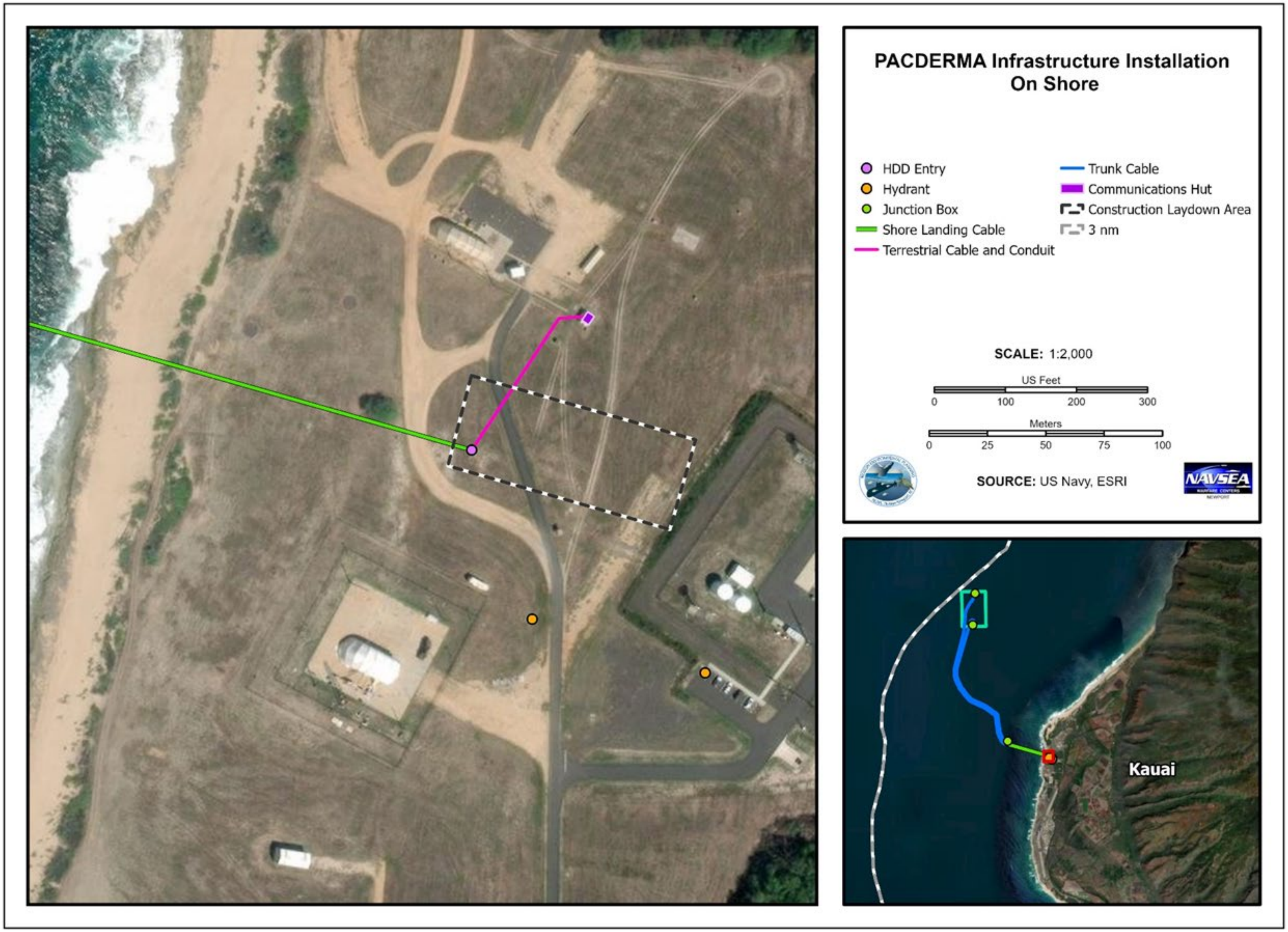

Figure 1-2. Onshore Portion of the Proposed Action Area at PMRF

Cable would then be run through the conduits and a lightning protection system would be installed. Construction would only occur during daytime work hours; there would be no active work or lights on during nighttime hours (Chapter 5). The onshore construction site would be established on an area composed of mainly grassy vegetation. Soil will be characterized by geotechnical bores to determine the drill rig size and drill bit type. A construction laydown area of approximately 42,640 square feet (ft^2; 4,000 square meters [m^2]) is considered sufficient for this operation. The drill rig would be stabilized with an anchor or spudding. Multiple pre-construction surveys have been completed at the Pacific Missile Range Facility (PMRF) to ensure that the area is free of obstructions, rocky areas, and sensitive resources (Levicki and Pintarelli 2025; Levicki et al. 2025; NAVFAC 2023). Erosion control would be added to the site during the placement of all equipment.

The proposed bore entry point (Figure 1-2) is on shore at PMRF, approximately 15 ft (5 m) above mean sea level and 560 ft (171 m) from the waterline. While the hole drilled by the rig would be 14 inches (in; 35.6 centimeters [cm]) in diameter, the entry point would measure approximately 6 ft (2 m) long by 4 ft (1 m) wide by 4 ft (1 m) deep. A small containment pit would be excavated for recovery of the drilling fluid. The HDD laydown area would measure approximately 130 ft by 328 ft (40 m by 100 m) and would include secured covers on or around the containment pit or other dug areas to prevent entry by personnel or animals.

The BMH anchors the offshore cables and receives the conduit. The BMH would be constructed or installed (if prefabricated) on shore. The size of the BMH would be determined by landed cable specifications. An example size would be 12 ft (4 m) long by 6 ft (2 m) wide by 7 ft (2 m) deep. A coil of armored cable, fiber, and power bundles, as well as one or more splices would be secured to the inside of the BMH. While it is preferred to bury the BMH, it is also possible that it would be installed on the surface. The BMH would have an access hole, at least 3 ft (1 m) in diameter, closed over with a removable steel cover. A crane would install the BMH.

Once onshore project work is complete, the construction site would be restored to its original condition. This would entail removal of all temporarily placed equipment (e.g., rigging mats, concrete anchor, trucks, etc.) and backfill of any excavated areas that remain (Chapter 5).

1.1.2 Description of HDD Process

After the onshore site has been prepared and equipment has been stabilized (Section 1.1.2), HDD operations would commence. The HDD process would involve drilling and horizontal placement of piping into the ground, ultimately angling the bore hole to the punch out location offshore. Drilling mud (a mixture of water and bentonite clay) would be injected under pressure into the drill pipe to rotate the drill head. The resulting slurry (drilling mud and soil cuttings) would return through the HDD bore hole to the containment pit. The slurry would then be pumped to a solids control system. The cuttings would be separated for disposal and the drilling mud would be recirculated for use. Excess returns of the drilling mud and the disposed soil cuttings, estimated at a combined 2,500 gallons (gal; 9,500 liters [L]) per day, would be dried and trucked to an approved offsite disposal location through coordination with PMRF public works. At the conclusion of HDD, pulling lines (messenger lines) would be installed within the pipe, allowing the shore landing cable to be attached by divers and pulled ashore when the cable arrives by ship (Section 1.1.3). The end of the pipe would then be capped and sealed. HDD operations would occur for up to 50 days. Including set up and demobilization time, the drilling operation would be expected to take approximately 3 months.

There are two main methods to steer the drill: a gyro tool or magnetic wireline steering. The gyro tool requires no modification to the site. Magnetic wireline steering requires the temporary placement of two wires on the surface of the ground from the rig to shallow water. The wires are about 0.125 in (0.3 cm) in diameter and laid by hand on the surface and either staked or weighted into position at certain locations using standard wooden or metal survey stakes or sandbags, respectively. If this method is chosen, the position of the stakes or sandbags would be selected to avoid sensitive resources.

The HDD process requires as much as 50,000 gal (189,271 L) of water per day. The water would be cycled back to the containment pit and recirculated as much as possible. Two fire hydrants are located within 225 ft (69 m) of the proposed HDD entry point (Figure 1-2) and would be used to meet the daily water requirement during drilling. The HDD contractor may bring separate water tanks as supplements or for maintaining a supply for immediate needs.

The drill hole would be 14 in (36 cm) in diameter. The shore landing cable within the conduit would have a diameter of up to 2 in (5 cm), which would be installed in one directionally-drilled bore. The HDD entry point would be about 5,000 ft (1,524 m) from the anticipated punch out location on the seafloor in a water depth of 65–70 ft (20–21 m). The precise drilling distance would need to be determined by survey, as the path would be angled at 12 to 16 degrees (down from the entry and up again to return to the surface/punch out location on the seafloor). The bore profile would cross the shoreline at least 110 ft (34 m) below grade. The exact horizontal and vertical profiles of the drill path are not currently known and would be determined by the drilling contractor.

1.1.3 At-Sea Cable and Array Installation

In 2027, a shore landing cable would be connected to the shallow water junction box then fed shoreward through the conduit to the BMH to connect the offshore array to the onshore conduit and facilities. Approximate measurements of the PACDERMA system components (Figure 1-1) are detailed in Table 1-1. Measurements are broken out into the shallow waters (<100 ft [30 m]) where diver activities would occur and deeper waters (100–328 ft [30–100 m]). Included in the deeper waters portion of the proposed action area is the array site, measuring 2,854 ft by 4,183 ft (870 m by 1,275 m). During installation, components may shift slightly from these approximate locations. To account for this, cable lengths have been increased by 10 percent. There is the potential that each trunk cable will be split by the presence of a junction box about halfway along the length of the cable, so two additional junction boxes are listed as well. In all water depths, cable routes will have been surveyed by bathymetric equipment and either divers or a remotely operated vehicle (ROV) before installation.

In the shallow waters of the proposed action area, there would be about 5,000 ft (1,524 m) of shore landing cable (Figure 1-1) within the conduit installed via HDD. This cable and conduit would all be underground (Figure 1-1) and would not disturb the nearshore environment or seafloor. The final 650 ft (198 m) of the shore landing cable is on the seafloor and is accounted for in Table 1-1.

The shore landing cable would terminate onshore in the BMH. A dive team would feed the cable into the bore tube using an attached messenger line. The cable would then be pulled to the onshore BMH using a winch placed ashore and a bellmouth (to curve the cable into the tube). The offshore end of the shore landing cable would be connected to the shallow water junction box on board the support vessel. Once the shore landing cable is connected and tested, the first trunk cable would be connected to the junction box, which would then be lowered to the seafloor. The first half of the array would be laid at the end of the first trunk cable. The vessel would then return to the shallow water junction box to connect the second trunk cable and lay the second half of the array. The junction box would be bottom-mounted and would measure approximately 7 by 9 ft (2 by 3 m) wide by 5 ft (1.5 m) tall. It would be anchored to the seafloor using helical anchors. In the first maintenance cycle (2029–2031), a shallow water environmental sensor may be installed via cable less than 500 ft (152 m) from the shallow water junction box. Additional junction boxes would be installed at the seaward ends and (possibly) in the middle of each trunk cable (splitting each trunk cable into two shorter cable sections). These junction boxes would enclose the transition between the trunk cables and array cables that connect to the sensors and beacons in the array. When equipment needs to be disconnected from any junction box, the junction box would be brought to the surface with a winch. The winch cable may be attached to sensors, anchor structures, or junction boxes with an ROV.

Table 1-1. Approximate Measurements of PACDERMA System Components

Location	***System Component***	***Area of System Component Footprint***
Shallow waters (> 100 ft [30 m])	Shore landing cable in underground conduit (4,960 ft [1,511 m])	N/A
	Shore landing cable to shallow water junction box (650 ft [198 m])	108 ft^2 (10 m^2)
	Shallow water junction box	32 ft^2 (3 m^2)
	Trunk cable A to 100 ft (30 m) depth (1,460 ft [445 m])	243 ft^2 (23 m^2)
	Trunk cable B to 100 ft (30 m) depth (1,750 ft [533 m])	292 ft^2 (27 m^2)
	Environmental sensor (diameter: 5 ft [2 m]) and cable (200 ft [61 m])	53 ft^2 (5 m^2)
Deeper waters (100-328 ft [30-100 m])	Trunk cable A to array site (22,444 ft [6,840 m])	3,741 ft^2 (348 m^2)
	Trunk cable B to array site (18,868 ft [5,751 m])	3,145 ft^2 (292 m^2)
	Potentially 2 additional inline junction boxes	86 ft^2 (8 m^2)
Array Site 2,854 ft x 4,183 ft (870 m x 1,275 m)	Junction box A	43 ft^2 (4 m^2)
	Junction box B	43 ft^2 (4 m^2)
	Seafloor sensors (qty: 6)	194 ft^2 (18 m^2)
	Buoy sensor anchor structures (qty: 4)	91.5 ft^2 (8.5 m^2)
	Beacons (max qty: 8)	max 16 ft^2 (1.5 m^2)
	Array cables (total) (18,558 ft [5,656 m])	3,093 ft^2 (287 m^2)

The dive support vessel would be a 30–80 ft (9–24 m) vessel and likely operate along with a rigid-hull inflatable boat (RHIB) measuring 30–40 ft (9–12 m). The dive support vessel would use a controlled drift during dive work, not registering any speed (i.e., less than one knot). The maximum travel speed of the dive support vessel would be 10 knots in the proposed action area. If the RHIB is transiting to deliver supplies or crew, it may travel up to 12 knots in waters less than 65 ft (20 m) in the proposed action area. If these vessels need to anchor, they would do so using epoxy anchor eyes installed on the bottom during the installation or helical hand screws. The cable installation vessel would travel within the proposed action area using main engines with propellers and a rudder and could hold station mainly using bow and stern thrusters. The vessel would likely be around 220 ft (67 m) long and travel at an average speed of less than one knot while laying cable and would not be moving (but would not be anchored) while deploying equipment. The vessel would travel within the proposed action area at a maximum speed of approximately 12 knots. Precise cable routes will be refined following pre-installation surveys to avoid areas of high relief and steep slope. Adjustments to routes have been made based off shallow water surveys, and deeper water surveys are forthcoming. According to shallow water diver surveys completed in 2023, some cable crossings would need to occur. PACDERMA cables would cross perpendicularly to existing cables to the maximum extent practicable.

To stabilize cables, articulated pipe sections made of ductile iron would be installed by divers over the cables in the nearshore environment, from the punch out location (65–70 ft [20–21 m] depth) to around 100 ft (30 m) depth. The shoreward end of the pipe assembly would be clamped to the seaward end of the cable conduit installed by HDD. Where the shore landing cable exits and joins the shallow water junction box, an adapter flange would be covered with split pipe. Approximately every other installed pipe section would be anchored to the seafloor. On hard bottom, divers would drill into the substrate and inject an environmentally safe epoxy to fasten the clamp. On soft bottom, sand anchors would be inserted into the seafloor and secured to articulated pipe. All stabilization would be performed following cable installation using a smaller dive support vessel. Each trunk cable would be armored and would run from the shallow water junction box to the array site, located at a depth of 230–300 ft (70–91 m). The entire system may contain up to five junction boxes.

The array would consist of six bottom sensors, four mid-water sensors, and six to eight moored and/or cabled beacons. The bottom sensors are each approximately 32 ft^2 (3 m^2) and made of a non-metallic fiberglass composite. The sensor buoys would be on 110 ft (33 m) buoy tethers, which are each attached to an anchor structure on the seafloor, placing them approximately 116 ft (35 m) from the seafloor. The painted steel anchor structure is 7 by 9 ft (2 by 3 m). The mid-water sensor anchors would sit in 230–300 ft (70–91 m) of seawater, leaving 114–184 ft (34–56 m) of navigational clearance. Up to 8 beacons would also be positioned in the water column. Each beacon would be tethered to a 135-pound (61-kilogram) steel Dor Mor pyramid anchor with a 2 ft^2 (0.2 m^2) footprint. Each tether would be 25 ft (7.6 m) long. Combined, the laydown area of the array would be 2,854 by 4,183 ft (870 by 1,275 m) (Figure 1-1), with the area of each component detailed in Table 1-1. Sensors or anchor structures would be lifted with a winch and moved overboard. An acoustic release would be triggered to place the sensor or anchor structure on the seafloor and an Ultra Short Baseline system would be used to position each component prior to releasing to its final location. The use of these acoustic systems is covered by the 2025 Draft Hawaii California Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement and associated consultations and are therefore not analyzed herein. Offshore system installation and cable landing operations, including ship mobilization and demobilization, would take about 19 days to complete and would not commence until 2027.

1.1.4 Notional Schedule

Table 1-2 shows a high-level schedule for accomplishing onshore and nearshore construction activities to support the installation of the PACDERMA system at PMRF. The schedule is notional and subject to change.

Table 1-2. Notional Schedule for PACDERMA Infrastructure Installation

Dates	*Task*
Apr-Jun 2026	Minor shore construction and system shore component installation
Jul-Sept 2026	HDD operations (equipment setup and drilling), BMH construction
Apr-Jun 2027	Offshore system installation and cable landing operations, including ship mobilization and demobilization
Apr-Sept 2027	Installation of the array, cables, and junction boxes
	Use of calibrated source to test the system

1.1.5 Maintenance of the PACDERMA System

Regular maintenance (on a 6-year basis) would need to occur to ensure the cables and array sensors are working properly. If the array is not functioning properly, troubleshooting would occur from the CONEX facility and offshore via an ROV. Unforeseen emergency situations or storms may impact system components requiring a vessel to recover them for repair. Depending on the issue, new equipment or cable may require installation, or temporary replacement during repair. Cables may require splicing. In general, if a component is brought to the surface, the amount of cable that would come off the bottom is approximately 1.5 to 2 times the water depth in the location of the repair.

Over the first five years that the PACDERMA system is in place, it is anticipated that the shallow water junction box would need to be brought to the surface several times. Within this time frame, an additional passive environmental sensor may be installed adjacent to the shallow water junction box, connected by a cable, to groundtruth measurements. In this area, because the cable on the bottom is typically protected by split pipe and other methods, a small amount of cable would be coiled to allow the shallow water junction box to be lifted to the surface while armored cable remains anchored to the seafloor.

It would be expected that sensors in the array would require replacement after 5–6 years. All array cables would need to be recovered from the bottom for that replacement. In addition, regular maintenance would occur on a 6-year cycle. This may entail painting, removal of biofouling, or replacement of components. The shore landing cable, which is protected in the conduit, has a life expectancy of 25 years. The trunk cables, which connect from the shallow water junction box out to the array junction boxes, may require replacement every 18 years, depending on damage incurred from the environment. Once these cables require replacement, new cables would be laid down in the same general footprint as the original cable. Old cables would not be removed as they would become part of the bottom substrate due to natural environmental processes and provide potential habitat. Array maintenance would involve the use of an ROV as well as a vessel with a U-frame suited to deploying the ROV and retrieving array components.

1.2 Purpose and Need for the Proposed Action

The purpose of the Proposed Action is to provide an underwater electromagnetic measurement capability within the Pacific Ocean. The United States (U.S.) Navy (Navy) operates a similar electromagnetic field measurement system in the Atlantic Ocean. However, an equivalent capability in the Pacific Ocean does not exist and is required to characterize the electromagnetic environment and the effectiveness of electromagnetic field management techniques.

The need for the Proposed Action is to ensure a thorough understanding of the electromagnetic environment present and the effectiveness of the techniques used to manage shipboard electromagnetic fields. Certain present and future classes of U.S. Navy vessels require periodic electromagnetic measurements to ensure they meet strict performance requirements over their entire lifecycle. This Proposed Action is necessary to establish mission-capable readiness for Pacific-based vessels.

1.3 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the Proposed Action and the No Action Alternative. The environmental resources analyzed in this EA include physical resources (benthic habitat, terrestrial habitat, and water resources) and biological resources (aquatic invertebrates and coral, birds, fish, essential fish habitat [EFH], sea turtles, terrestrial mammals, and marine mammals).

1.4 Relevant Laws and Regulations

The Navy has prepared this EA based upon federal and state laws, statutes, regulations, and policies that are pertinent to the implementation of the Proposed Action. All relevant laws are listed in Table 6-1 and discussed further in Appendix A.

1.5 Public and Agency Participation and Intergovernmental Coordination

1.5.1 Public Participation

The EA will be available for public comment. 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 Navy has also participated in weekly One Kauai meetings for communication and outreach discussions involving forthcoming actions occurring at PMRF.

1.5.2 Interagency Coordination

The Navy has consulted with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) for species under their jurisdiction regarding the Proposed Action’s compliance with Section 7(a)(2) of the ESA. On June 2, 2025, the USFWS issued concurrence on the Navy’s conclusions in Chapter 5 of the ESA Section 7 informal consultation.

On May 9, 2025, NMFS concurred with the Navy's conclusions in Chapter 5 of the ESA expedited Section 7 informal consultation. The Navy has consulted with NMFS regarding impacts to EFH within the proposed action area. On June 10, 2025, NMFS concurred with the Navy's conclusions in Chapter 5 of the EFH expedited consultation.

After conducting an archaeological subsurface testing and ground penetrating radar in the proposed area of the construction site on shore, no impacts to historic properties are expected and review would fall under the Programmatic Agreement among the Commander Navy Region Hawaii, the Advisory Council on Historic Preservation and the Hawaii State Historic Preservation Officer regarding Navy Undertakings in Hawaii. The Navy will produce a memo to document these findings and report to the Hawaii State Historic Preservation Division (SHPD) in order to meet responsibilities pursuant to Section 106 of the NHPA. The Navy plans to submit a permit application with the U.S. Army Corps of Engineers (USACE) under Section 10 of the Rivers and Harbors Act. When the permit is received it will be for USACE Nationwide Permits 5 and 57, a water quality certification (under Section 401 of the Clean Water Act). The Navy has found that the PACDERMA Infrastructure Installation is consistent with the "Navy/Marine Corps *De Minimis* Activities Under CZMA" list (dated 9 July 2009) as determined by the Hawaii Coastal Zone Management program and the Department of the Navy. The Navy has determined these listed actions have insignificant coastal effects in accordance with the Department of Commerce, NOAA, and CZMA federal consistency regulations (15 CFR part 930.33(3)). These actions are exempt from a negative determination or a consistency determination from the State of Hawaii. An application for a National Pollutant Discharge Elimination System (NPDES) permit will be submitted by the HDD contractor for a construction project disturbing more than an acre of land.

2 Alternatives Considered

The following subsections detail the screening factors and alternative considerations.

2.1 Screening Factors

NEPA and the Department of Defense NEPA Implementing Procedures 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 that meet the purpose and need require detailed analysis.

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

- Pacific Ocean location, relatively central to naval bases in the Pacific Ocean;
- Sufficient water depth for the safe measurement and navigation of naval vessels in this ocean environment;
- Low levels of recreational and commercial vessel traffic;
- Minimal sources of interference—an electromagnetic-friendly environment for signal measurement with minimal sound interference (from vibrations, ship traffic, high sea state, etc.) and lacking water components (e.g., sulfur) that could degrade system performance;
- Presence of existing infrastructure (i.e., buildings, facilities) to support signal measurement operations; and
- Access to existing infrastructure to support the laying of cables (and potentially HDD) required to install a signal measurement system offshore.

2.2 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action and a No Action Alternative were identified and are analyzed within this EA. Careful consideration was given to the specific locations, alignments, methodology, and design of the Proposed Action. PMRF is the only location central to naval bases in the Pacific Ocean where there is existing infrastructure, including both facilities and conduit, conducive to laying cables and installing an offshore array in an electromagnetic-friendly environment in suitable water depth.

2.2.1 Proposed Action

The Proposed Action would install and maintain an underwater electromagnetic measurement system offshore of PMRF on Kauai in Hawaii (Figure 1-1), as described in Section 1.1. The range at PMRF is the only location that meets the screening factors listed in Section 2.1.

2.2.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur at PMRF. The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA and provides a baseline for measuring the environmental consequences of the action alternatives.

2.3 Alternatives Considered but Not Carried Forward for Detailed Analysis

The following alternatives were considered, but they were not carried forward for detailed analysis in this EA as they did not meet the purpose and need for the project nor satisfy the reasonable alternative screening factors presented in Section 2.1. Alternative locations were considered, but were not carried forward due to risks outlined in Table 2-1.

Table 2-1. Alternative Locations Considered

Alternative Location	***Reason Not Carried Forward***
Southeast Alaska Acoustic Measurement Facility	The facility is located near Ketchikan, Alaska, which is far from naval bases in the Pacific Ocean. In addition, the seawater grounding at this facility would contaminate measurements and a site could not be located away from interference of the grounding.
Joint Base Pearl Harbor Hickam	The site is the location of a major vessel homeport but does not currently contain any cabling or existing infrastructure. The bottom depth also drops off quickly, leaving little flat ground for system installation and causing a need for additional infrastructure that would increase vibration, contaminating measurements.
Deep water location at PMRF	An increased depth would mean increased cost due to length of cable, as well as design and materials. New bottom sensors would need to be designed and new structures would need to be incorporated to raise them off the seafloor to the correct depth. Likely, this would increase noise and vibration of the equipment, contaminating measurements.

3 Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that may be impacted from implementing the Proposed Action or action alternatives. All potentially relevant environmental resource areas were initially considered for analysis in this EA. In compliance with NEPA, and the Department of Defense NEPA Implementing Procedures, 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 herein is commensurate with the anticipated level of potential environmental impact.

As part of the process to determine the potential effects from the Proposed Action, the Navy identified potential resources and stressors to analyze. Resources that have been eliminated from further consideration in this EA and the rationale for eliminating them are presented in Table 3-1.

Table 3-1. Resources Not Carried Forward for Analysis in this EA

Resources	***Reason for Elimination from Analysis***
Aesthetics	The Proposed Action would occur on the Naval Base at Barking Sands, PMRF and at sea. After completion, other than one center of operations (a CONEX box) all PACDERMA infrastructure installed during the Proposed Action would be underground or underwater and would not alter the viewshed of the area in any way.
Air quality	Since the Proposed Action would occur in an attainment area (Environmental Protection Agency (EPA) 2024b) and would not generate emissions in nonattainment areas, the Proposed Action is not subject to analysis under the General Conformity Rule. Additionally, as the Proposed Action consists of only minimal vessels and equipment for a limited, short-term duration of time, air quality would not be altered in any measurable way.
Airspace	There would be no elements of the Proposed Action that utilize or alter the use of airspace.
Commercial and recreational fishing	Due to the restricted nature of PMRF, commercial catch is not landed near the proposed action area, nor does recreational fishing occur with regularity from Barking Sands Beach. In addition, the Proposed Action would have no impact to fisheries resources.
Cultural and historical resources	On shore, a ground penetrating radar survey and archaeological subsurface testing were conducted in the spring of 2025 within the bounds of the proposed onshore construction site. Offshore, side scan sonar surveys will be conducted along the entire cable lay path. Divers and/or an ROV will be used where there appears to be environmentally sensitive or hazardous areas of the seafloor. Thus far, no cultural, archaeological, or historical resources were discovered during these surveys, with deeper water surveys still forthcoming. It is not foreseen that these resources would be present in the proposed action area.
Hazardous materials	There would be no release or risk of unintentional release of any hazardous materials due to the Proposed Action. Bentonite, used in HDD operations, has low acute toxicity, and any spill would be prevented through implementation of an incidental spill management plan by the HDD contractor.
Infrastructure	Although PACDERMA infrastructure may be located in the same conduits and at-sea range as other cables, the Proposed Action would not impact the existing infrastructure.
Land use	PACDERMA installation would occur offshore of PMRF alongside similar infrastructure. Land use on base and at sea on the range would remain unchanged due to the Proposed Action.

Public health and safety	The Proposed Action poses no risk to public health or human safety. No hazardous materials or wastes would be released, nor would the Proposed Action create any public safety concerns.
Recreation and tourism	Public access to the shoreline of PMRF is limited both because it is a Navy base and because the beach is difficult to get to if access is not authorized. Recreational activities in the offshore area of PMRF include air, kayak, and boat tours of the Na'Pali Coast, snorkeling and scuba diving trips, fishing charters, whale-watching cruises, and overnight Hawaiian cruises. While there may be a brief closure of the at-sea area during installation of the cables and array, the Proposed Action would have no lasting impacts to recreation or tourism.
Transportation and shipping	Transportation and shipping to Kauai is limited, and none of the companies are located on the western coast of Kauai. While there may be a brief closure of the at-sea area during installation of the cables and array, the Proposed Action would have no lasting impacts to transportation or shipping.
Utilities	While PACDERMA infrastructure may exist alongside utility cables, the Proposed Action would have no impact to existing utilities.
Wild and scenic rivers	No wild and scenic rivers are located within the proposed action area.

3.1 Physical Resources

Physical resources include non-living elements and habitats in water and on land. Habitat can be defined as the resources and conditions present in an area that support the living species. The physical resources analyzed in for impacts in this EA are benthic habitat (Section 3.1.1), terrestrial habitat (Section 3.1.2), and water resources (Section 3.1.3).

3.1.1 Benthic Habitat

Benthic habitat has the potential to be impacted by the in-water portion of the Proposed Action. The HDD exit point, where the cable lay will begin along the seafloor, occurs at a depth of approximately 65–70 ft (20–21 m). Nearshore habitat mapping close to the shoreline of Kauai shows predominantly hardbottom habitat, characterized by pavement and limestone “fingers” with occasional sand channels (Navy 2002; NOAA National Centers for Coastal Ocean Science (NCCOS) 2023). The seafloor within the proposed action area is primarily hard bottom or sandy substrate, becoming sandier in deeper waters. The nearshore biological cover is largely macroalgae, between 10 and 50 percent coverage (NOAA NCCOS 2023). This habitat provides settlement opportunities for reef corals and functions as habitat for a variety of fish and macroinvertebrates (Navy 2002).

A preliminary dive survey of the cable path, from the HDD exit point (65 ft [20 m]) west to a depth of approximately 115 ft (35 m), observed hardbottom habitat characterized by bare terrain with minimal small corals and other marine life (NAVFAC 2023). The exit point occurs along the limestone shelf break, which can slope rapidly to depth. No observations of macroalgae were noted along this path during the survey. Deeper portions of the proposed action area have not been consistently mapped. However, the limestone shelf break typically drops to sand at about 82–98 ft (25–30 m) of water (Navy 2002). The lack of cover and structure in the benthic habitat throughout the deeper portion of the proposed action area results in a minimal presence of marine species. With the exception of some wandering predatory species (e.g., some fishes), marine organisms in or near this portion of the proposed action area are sparse and aggregated near the limited structures along the bottom (Navy 2002).

3.1.2 Terrestrial Habitat

The terrestrial habitat that may be impacted by the Proposed Action would be found within the construction site for the HDD and associated activities, which is approximately one acre and situated about 500 ft (152 m) inland at PMRF. Terrestrial habitat in the proposed action area consists mainly of grassy vegetation. No sensitive habitat or vegetation are present. A habitat classification and vegetation mapping study conducted at PMRF in 2005 describes the proposed action area as landscaped non-native vegetation (PMRF 2024). This habitat is essentially mowed lawn, primarily comprised of Buffelgrass and Bermuda grass. Other weedy non-native species may also be present, particularly along the dirt road that runs through the proposed action area.

Overall, the area in and around the proposed construction site is dry; there is little surface water, except for the Nohili Ditch to the south, which drains agricultural lands east of PMRF. The soil is composed of Jaucus loamy fine sand, which is a permeable, calciferous soil that results in little surface runoff or water erosion (PMRF 2024). However, where vegetation has been removed, the wind erosion hazard may be severe. Jaucus loamy fine sand is the most common soil type at PMRF and is present throughout the western and southern parts of Kauai (PMRF 2024).

The terrestrial habitat in the proposed action area is not complex; the landscaped (mowed), non-native species that dominate the area may provide limited habitat value to local wildlife. After the Proposed Action is completed, the area will be backfilled, reseeded, and restored to the extent possible and as suitable according to standard operating procedures (SOPs; Chapter 5).

3.1.3 Water Resources

Coastal marine waters at PMRF serve as habitat for a variety of species, including vegetation, invertebrates, fishes, sea turtles, and marine mammals. In addition to water chemistry, turbidity of the area impacts its quality as habitat for these species. In 2022, a biological and benthic habitat assessment was carried out at PMRF, including measurements of water chemistry along its coastline (Miller et al. 2022). Three vertical profile sampling sites were conducted near the planned punch out location for the HDD at depths of approximately 16 ft (5 m), 39 ft (12 m), and 57 ft (18 m). Although these sampling sites are shallower than most of the proposed action area, they do provide relevant information regarding water resources in and near the area, particularly its shallower portions. At the three sites, pH varied between 8.14 and 8.18, dissolved oxygen between 94 and 104 percent, and temperature between 80.15 and 81.5 °F (26.75 and 27.5 °C). Salinity was consistent across sites at approximately 34.9 parts per thousand (ppt). In other words, conditions are typical for coastal oceanic environments in the region, presenting no values that would be expected to negatively impact local ecology.

3.2 Biological Resources

Biological resources include living, native or naturalized plant and animal species and the habitats in which they occur. Due to their listing status, any ESA-listed or other special status species are discussed in their respective categories below. Species-specific hearing information is discussed in depth in Appendix D and in summarized in Table 4-4 for the purpose of analysis.

3.2.1 Aquatic Invertebrates and Coral

Aquatic invertebrates are a large, diverse group containing tens of thousands of species distributed ubiquitously throughout the global marine environment (Brusca and Brusca 2003). Benthic and epibenthic (animals that live on the surface of the substrate) invertebrates may be sessile (immobile and attached to substrate), sedentary (limited in mobility), or highly mobile (Cairns and Bayer 2009; University of California Berkeley 2019a, 2019b). Pelagic organisms vary in their swimming abilities, ranging from weak (e.g., ctenophore) to substantial (e.g., squid) (Segura-Puertas et al. 2009; University of California Berkeley 2019b).

Invertebrate groups and their distribution in the proposed action areas are presented in Table 3-2. No ESA-listed invertebrate species are known to occur within the proposed action area.

Table 3-2. Groups of Invertebrates That May Be Present in the Proposed Action Area

Common Name[1] (Taxonomic Group)[2]	***Description***	***Presence in Proposed Action Area***	
		Vertical Distribution	
		Pelagic	***Benthic***
Foraminifera, radiolarians, ciliates (kingdom Protozoa)	Benthic and planktonic single-celled organisms; shells typically made of calcium carbonate or silica.	x	x
Flatworms (phylum Platyhelminthes)	Simplest form of marine worms with a flattened body.		x
Ribbon worms (phylum Nemertea)	Worms with a long extension from the mouth (proboscis) that helps capture food.		x
Roundworms (phylum Nematoda)	Small worms; many live in close association with other animals (typically as parasites).	x	x
Sponges (phylum Porifera)	Large species have calcium carbonate or silica structures embedded in cells to provide structural support.		x
Corals, anemones, hydroids, jellyfish (phylum Cnidaria)	Benthic and pelagic animals with stinging cells; sessile corals are main builders of coral reef frameworks.	x	x
Segmented worms (phylum Annelida)	Highly mobile marine worms; many tube-dwelling species.		x
Bryozoans (phylum Bryozoa)	Lace-like animals that exist as filter feeding colonies. Form either encrusting or bushy tuft-like lacy colonies.		x
Cephalopods, bivalves, sea snails, chitons (phylum Mollusca)	Mollusks are a diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle. Mollusks such as squid are active swimmers and predators, others such as sea snails are predators or grazers, and clams are filter feeders.	x	x

Common Name[1] (Taxonomic Group)[2]	Description	Presence in Proposed Action Area	
		Vertical Distribution	
		Pelagic	Benthic
Shrimp, crabs, crayfish, barnacles, copepods (phylum Arthropoda – Crustacea)	Diverse group of animals, some of which are immobile. Most have an external skeleton. All feeding modes from predator to filter feeder.	x	x
Sea stars, sea urchins, sea cucumbers (phylum Echinodermata)	Predators and filter feeders with tube feet.		x

[1] Major species groups (those with more than 1,000 species) are based on the World Register of Marine Species (World Register of Marine Species Editorial Board 2015) and Catalogue of Life (Roskov et al. 2015).
[2] Classification generally refers to the rank of phylum, although Protozoa is a traditionally recognized group of several phyla of single-celled organisms (e.g., historically referred to as kingdom Protozoa, which is still retained in some references, such as in the Integrated Taxonomic Information System).

Non-coral macroinvertebrate species observed in the nearshore environment of the proposed action area include limpets or ʻopihi (*Cellana* spp.), littorine snails (*Littorina* sp. and *Nerita* sp.), rock oysters (*Spondylus tenebrosus*), cone shells (*Conus* spp.), sea urchins (*Echinometra mathaei*), and sea cucumbers (*Holothuria atra*) (Dollar and Brock 2007). ʻOpihi are culturally significant mollusks and have been historically harvested in Hawaii (Bird and Toonen 2014). In 2013, surveys were conducted along the entire coastline of the PMRF and an estimated 110,000 black foot ʻopihi (*Cellana exarata*), and 4,000 yellow foot ʻopihi, (*C. sandwicensis*) were found at PMRF. Giant ʻopihi (*C. talcosa*), were observed, but are considered extremely rare, likely due to lack of suitable habitat (Bird and Toonen 2014).

Pelagic aquatic invertebrates include plankton and nekton. Planktonic animals commonly undergo diel migration—daily migrations to surface waters at dusk and a return to deeper waters at dawn. Within the pelagic zone, plankton are highly stratified by depth, with most of the biomass in the upper portions of the water column (Navy 2018a). The benthic zone is the most diverse and species-rich habitat, where the majority of the species within the ocean can be found. The greatest densities of aquatic invertebrates are typically found in and on the seafloor (Sanders 1968). The diversity and abundance of Arthropoda (e.g., crabs, lobsters, and barnacles) and Mollusca (e.g., snails, clams, scallops, and squid) are highest on the bottom over the continental shelf due to high productivity and availability of complex habitats relative to typical soft-bottom habitat of the deep ocean (Karleskint et al. 2006). However, soft-bottom habitats support a wide variety of invertebrate species including crabs, shrimp, clams, snails, and polychaete worms (Talley et al. 2000; Thompson et al. 1993).

According to the PMRF Integrated Natural Resource Management Plan (INRMP), within the proposed action area in the nearshore environment the most abundant coral species are lobe coral (*Porites lobata*), cauliflower coral, and ringed rice coral (*Montipora patula*) (PMRF 2024). Shallow water surveys completed in and around the HDD punch out location (at roughly 65 ft [20 m] depth) and along the cable corridor (up to 100 ft [30 m] depth due to dive limitations) indicated there was limited presence of coral and no massive coral formations. The report states that “the seafloor had some small sand patches, cobbles, shells, and corals” (NAVFAC 2023). The Navy conducted an ROV survey in 2018 to support the modernization of two nearby

PMRF offshore ranges. An analysis of this ROV footage estimated coral cover to be approximately 2.6 percent in the relative area (NUWC Newport 2022), which is just under one mile southwest from the proposed location of PACDERMA shallow water junction box.

Deep-water corals can occur, forming mounds of intermediate (cobble-sized) substrate over hard-bottom areas (Lumsden et al. 2007). Ross et al. (2017) reported deep-water coral mounds in areas dominated by soft and intermediate bottom where coral attaches to mounds created by successive growth. Because deep-water corals do not contain symbiotic algae, most species filter feed on plankton (Tsao and Morgan 2005). In general, deep-water species are considered to occur at depths below 164 ft (50 m) (National Oceanic and Atmospheric Administration and National Centers for Coastal Ocean Science 2016). Within the proposed action area in the offshore environment, antler coral (*Pocillopora eydouxi*), cauliflower coral, lobe coral, rice coral, black coral (*Antipathes griggi*), and wire coral (*Cirrhipathes anguina*) are present (PMRF 2024). Deep-water surveys of the proposed action area, which will assist in coral outcrop avoidance, will be conducted prior to cable installation.

3.2.2 Birds

At PMRF, birds are the most diverse group of species documented, with 76 species of birds documented base-wide, 46 of them being native species. Some of these birds are migratory and only stop over on their way to other areas, while others come to the island to nest, and still others are endemic and are found on the island year-round. General bird orders are discussed below and in Table 3-3 and ESA-listed bird species are discussed in Table 3-4 and Section 3.2.2.1.

Table 3-3. Groups of Birds That May Be Present in the Proposed Action Area

Taxonomic Order	*Representative Species Present*	*Distribution Within or Near the Proposed Action Area*	*Foraging Behavior*
Accipitriformes	Osprey (*Pandion haliaetus*)	Commonly found near bodies of water such as lakes, rivers, estuaries, and coastal regions.	Aerial divers
Anseriformes	Hawaiian goose (*Branta sandvicensis*), Hawaiian duck (*Anas wyvilliana*)	Common in coastal waters or large lakes and rivers during migration and overwintering. Anseriformes would likely only be encountered on land within the proposed action area.	Ground feeding; dabbling
Charadriiformes	Sanderling (*Calidris alba*), Pacific golden plover (*Pluvialis fulva*), Hawaiian stilt (*Himantopus mexicanus knudseni*)	Broadly distributed birds that occur along beaches, coastlines, inland rivers, freshwater wetlands, and salt marshes. Charadriiformes would only be present along the shoreline or at sea within the proposed action area.	Ground feeding; plunging; probing; diving
Falconiformes	Peregrine falcon (*Falco peregrinus*)	Nests terrestrially; may feed in shallow waters. May be encountered on shore within the proposed action.	Aerial pursuit; ground feeding

Taxonomic Order	*Representative Species Present*	*Distribution Within or Near the Proposed Action Area*	*Foraging Behavior*
Passeriformes	Kauai ʻelepaio (*Chasiempis sclateri*), Hawaiian crow (*Corvus hawaiiensis*), Japanese white-eye (*Zosterops japonicus*), house finch (*Carpodacus mexicanus*)	Common in lowland areas along coasts, tidal marshes, rivers, streams, floodplains, and lakes.	Aerial pursuit; gleaning; ground feeding
Pelecaniformes	Black-crowned night-heron (*Nycticorax nycticorax hoactli*), cattle egret (*Bubulcus ibis*)	Occur in salt and freshwater wetlands and water bodies, coastal bays, inlets, estuaries, and rivers.	Dipping
Procellariiformes	Short-tailed albatross (*Phoebastria albatrus*), band-rumped storm-petrel (*Oceanodroma castro*), wedge-tailed shearwater (*Puffinus pacifus*)	These species are highly pelagic and widely distributed, coming to land only to breed.	Diving
Suliformes	Great frigatebird (*Fregata minor*), brown booby (*Sula leucogaster*)	Occupy diverse aquatic habitats year-round, including ponds, lakes, rivers, estuaries, and coastal waters. Suliformes would only be encountered at sea within the proposed action area.	Diving

3.2.2.1 ESA-Listed Birds

There are 11 ESA-listed bird species under the jurisdiction of the USFWS that may occur within the proposed action area. Critical habitat has not been designated for any of these species and is not discussed further. Table 3-4 provides details about the ESA-listed bird species and their potential for occurrence within the proposed action area. The likelihood of occurrence of each ESA-listed species is designated as “potential” (i.e., seasonal or infrequent, but regular occurrence), “likely” (regular occurrence), or “unlikely” (no recorded occurrence) based on species-specific literature. The ESA-listed bird species are discussed in further detail in Section B.1 of Appendix B, excerpted from the Section 7 consultation with the USFWS (Navy Sea Systems Command Naval Surface Warfare Center Carderock Division (NSWCCD) 2025), but all information pertinent to analysis can be found in Table 3-4. Many bird species are associated with wetland habitats, such as those depicted in Figure 3-1. Some wetlands mentioned in Table 3-4 are not shown in Figure 3-1 due to their distance from the proposed action area. Nohili Ditch is pictured south of the proposed action area, while Kawaiʻele and Kinikini Ditches are farther south.

Table 3-4. ESA-Listed Birds That May Be Present in the Proposed Action Area

Species	*Scientific Name*	*ESA Status*	*Occurrence at PMRF*	*Occurrence within the Proposed Action Area*
Band-rumped storm petrel (Hawaii DPS)	*Hydrobates castro*	Endangered	Potential; Breeding season visitor from May to October and April to June. Known to fly over base during trips between nesting and foraging sites. Fledglings also fly through the area on their first trip to the sea and may fall out during fledgling season.	Potential; May be encountered in the at sea portion of the proposed action area or flying over the construction site at night. Breeding colonies are located outside of the proposed action area.
Hawaiian common gallinule	*Gallinula galeata sandvicensis*	Endangered	Likely; Year-round resident. Commonly observed in Kinikini Ditch and Kawaiʻele Ditch (also known as Dry Ditch). Nesting has been documented in Kinikini Ditch and young hatchlings are routinely observed in the Kawaiʻele Ditch during the summer months.	Unlikely; Common observations and known nesting locations occur outside of the proposed action area. Preferred habitat is a variety of wetlands, none of which occur within the proposed action area. Never been observed in the proposed action area with regular monitoring.
Hawaiian coot	*Fulica alai*	Endangered	Likely; Year-round resident. Commonly observed at Kinikini Ditch and the oxidation pond where nesting is frequently recorded.	Unlikely; Common observations and known nesting locations occur outside of the proposed action area. Preferred habitat is a variety of wetlands, none of which occur within the proposed action area. Never been observed in the proposed action area with regular monitoring.
Hawaiian duck	*Anas wyvilliana*	Endangered	Likely; Year-round resident. Frequently observed in ditches and at oxidation pond. Young hatchlings have been observed at the oxidation pond and Kawaiʻele Ditch.	Unlikely; Have not been recorded at sea in this area. Preferred habitat is a variety of wetlands, none of which occur within the proposed action area.
Hawaiian goose	*Branta (Nesochen) sandvicensis*	Threatened	Likely; Year-round resident on Kauai. Commonly observed throughout site known nesting at Kinikini Ditch, the oxidation pond complex, HIANG complex, THAAD complex, and beach cottages.	Likely; Commonly observed throughout the site; travel through grassy fields or forest edges.
Hawaiian petrel	*Pterodroma sandwichensis*	Endangered	Potential; Breeding season visitor. Known to fly over the base when traveling between nesting and foraging areas.	Potential; May be encountered in the at sea portion of the proposed action area or flying over the construction

Species	Scientific Name	ESA Status	Occurrence at PMRF	Occurrence within the Proposed Action Area
			Fledglings also fly through the area on their first trip to the sea and may fall out during fledgling season.	site at night. Breeding colonies are located outside of the proposed action area.
Hawaiian stilt	*Himantopus maxicanus knudseni*	Endangered	Likely; Year-round resident. Commonly observed in the ditches surrounding the base, at the oxidation pond complex, and occasionally foraging on the beach. Not known to nest on installation, however adults are regularly observed with their fledged young at PMRF.	Potential; May be encountered along the shore of the proposed action area; extremely unlikely to be encountered at sea.
Newell's shearwater	*Puffinus auricularis newelli*	Threatened	Potential; Breeding season visitor from April to October. Known to fly over base when traveling between nesting sites and at-sea foraging areas. Fledglings also fly through the area on their first trip to the sea and are vulnerable to fall out during fledgling season.	Potential; May be encountered in the at sea portion of the proposed action area or flying over the construction site at night. Breeding colonies are located outside of the proposed action area.
Short-tailed albatross	*Phoebastria (Diomedea) albatrus*	Endangered	Potential; Migrant. Rare, only one sighting at PMRF, recorded in 2000, near runway.	Unlikely; May occur within the at sea portion of the proposed action area as a migrant in the fall months.

HIANG = Hawai'i Air National Guard; THAAD = Terminal High Altitude Area Defense

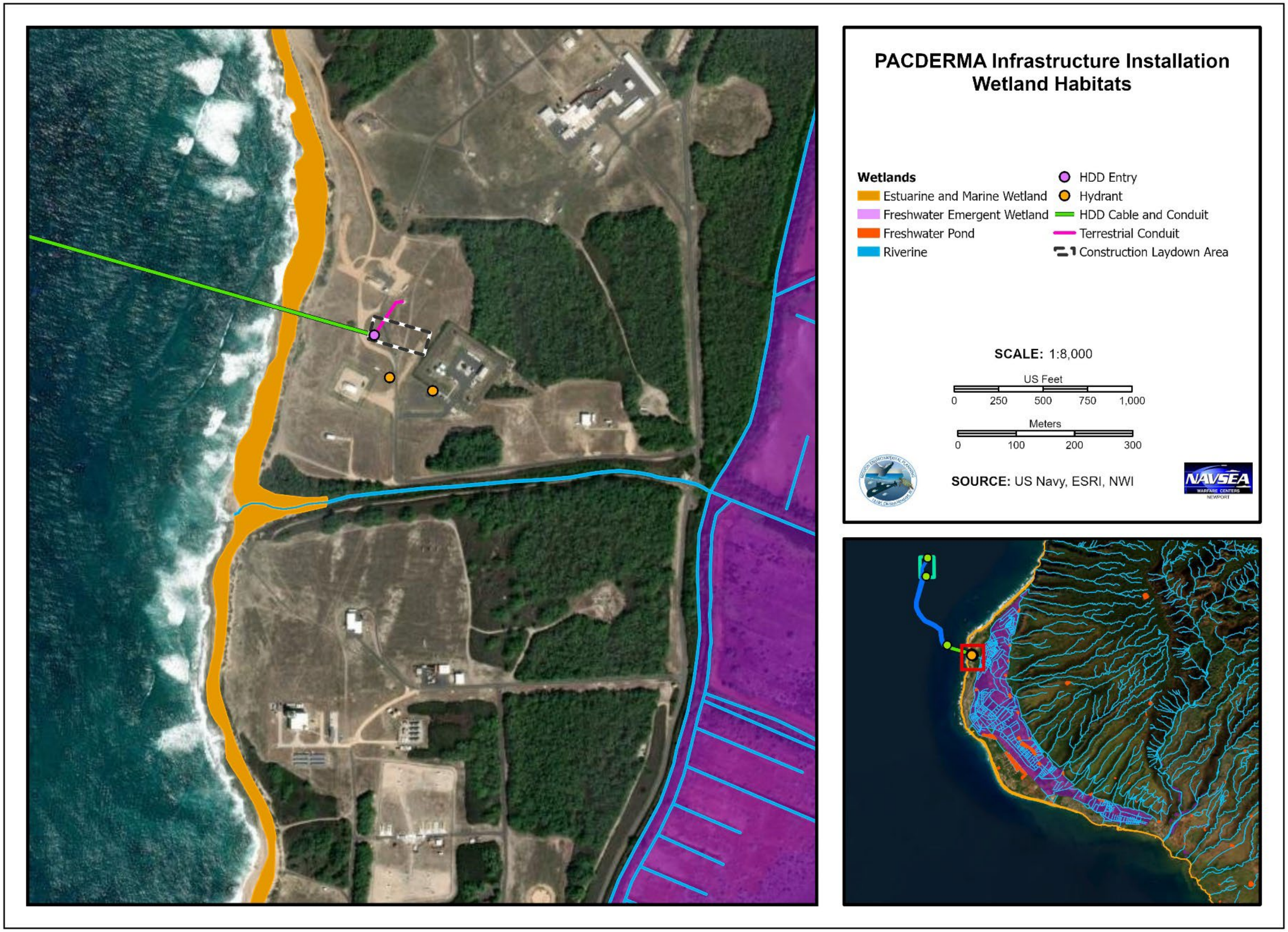

Figure 3-1. Wetlands at PMRF

3.2.3 Fish

Many factors affect the abundance and distribution of fish; however, the primary driving factors include temperature, salinity, pH, physical habitat, ocean currents, latitudinal gradients, and fish life stage (Helfman et al. 2009; Nelson et al. 2016). A species' mobility at various life stages (e.g., pelagic larvae versus demersal adult) also affects distribution (Bowen and Avise 1990). In general, coastal ecosystems support a greater diversity of fish species, and the open ocean and freshwater areas support a lower diversity and biomass of fish species (Nelson et al. 2016). Fish within the proposed action area can be broadly categorized as coastal marine species. As the in-water proposed action area does not extend beyond the continental shelf or slope, offshore marine fish communities are not expected to occur. All life stages of fish may be present, though adult fish may only be present for a limited time frame.

Reefs provide important nursery habitat for larval and juvenile fish, which in turn support a large and diverse food web of fish and invertebrates (Gulf of Mexico Fishery Management Council 1981; Page and Burr 2011; Paxton and Eschmeyer 1998; Williams et al. 2010). Feeding strategies among nearshore fish species are highly variable. Fish may actively hunt, ambush hunt, lure prey with modified body parts, feign death, scavenge, or filter feed (Helfman et al. 2009). The variety of food sources is equally diverse, including fish, invertebrates, phytoplankton, feces and detritus, and eggs of fish and invertebrates, amongst others (Helfman et al. 2009). It should be noted that the in-water portion of the proposed action area begins at the punch out location at 65 ft (20 m) depth and continues along the cable path to a depth of 230–300 ft (70–91 m) where the sensor array would be laid. Fish located in shallower or deeper waters than the proposed action area are not considered herein. Shallow water surveys of the cable path and HDD punch out location (roughly 65–100 ft (20–30 m]) have been completed and show habitat that "had some small sand patches, cobbles, shells, and corals". The divers stated that they saw a limited amount of sea life, including fish, and large coral formations were not present in the proposed action area (NAVFAC 2023). Lack of large coral formations would mean limited nursery habitat for fish.

3.2.3.1 ESA-Listed Fish

There are two ESA-listed fish species under the jurisdiction of NMFS that may occur within the proposed action area. Critical habitat has not been designated for these species and is not discussed further. Table 3-5 provides a list of these species and their potential for occurrence within the proposed action area. The ESA-listed fish species are discussed in further detail in Section B.2 of Appendix B, excerpted from the Section 7 consultation with NMFS.

Table 3-5. ESA-Listed Fish That May Be Present in the Proposed Action Area

Species	*Scientific Name*	*ESA Status*	*Likelihood of Occurrence within the Proposed Action Area*
Giant manta ray	*Manta birostris*	Threatened	Potential; Highly migratory, may be in coastal or oceanic environments (Couturier et al. 2012). Occurs worldwide in tropical, subtropical, and temperate waters and is commonly found offshore, in oceanic waters, and near productive coastlines. Breeding sites outside the proposed action area. No aggregations in the proposed action area.

Species	*Scientific Name*	*ESA Status*	*Likelihood of Occurrence within the Proposed Action Area*
Oceanic whitetip shark	*Carcharhinus longimanus*	Threatened	Potential; Primarily in epipelagic oceanic environments and around offshore islands (Young et al. 2016). Occurs in tropical and subtropical oceans throughout the world. They live from the surface of the water to at least 500 ft (152 m) deep. Breeding occurs outside of the proposed action area.

3.2.4 Essential Fish Habitat

The Western Pacific Region Fishery Management Council (WPRFMC) has authority over the fisheries based in and surrounding the state of Hawaii. This includes the designation of EFH and habitat areas of particular concern. WPRFMC subdivides EFH into water column EFH and benthic habitat EFH, with benthic habitat further subdivided into benthic substrate and biogenic habitat. In 2010, the WPRFMC ceased the practice of issuing fishery management plans for singular Management Units (e.g., Bottomfish, Pelagic Fish) and instead uses a geographic approach. Therefore, all EFH protected in the State of Hawaii is captured in the single Hawaii Archipelago Fishery Ecosystem Plan (FEP) (WPRFMC 2009a) and its amendments, although Management Units are still utilized within the FEP. The Management Units with designated EFH occurring within the proposed action area are detailed in Table 3-6.

Table 3-6. Management Units with Designated EFH in the Proposed Action Area

Management Unit	*Water Column*	*Benthic Substrate*	*Biogenic Habitat*	*Species reclassified to ECS*[1]
Bottomfish and Seamount Groundfish[2]	X	X	X	No
Pelagic	X			No
Crustacean	X	X	X	Yes, some species

[1] ECS = Ecosystem Component Species, as defined by Amendment 5 to the FEP for the Hawaii Archipelago (50 CFR § 665.221, November 1, 2018)

[2] There is no Seamount Groundfish EFH in the proposed action area.

A complete description of the life stages of designated EFH found within the proposed action area is in Table 3-7. The information in Table 3-7 was used for analysis within this EA, and is further discussed in the EFH Assessment (Navy Sea Systems Command (NAVSEA) 2025b) and excerpted from that document into Appendix C for ease of reference. A list of Management Unit and Ecosystem Component Species that may be present is also in this appendix.

Table 3-7. Description of EFH in the Proposed Action Area by Life Stage and Management Unit

Species Complex	*Life Stage*	*Description of EFH*
Bottomfish Management Unit		
Shallow-water Bottomfish Species Complex	Eggs/Larvae	Pelagic zone of the water column in depths from the surface to 787 ft (240 m), extending from the official U.S. baseline to a line on which each point is 50 miles (mi; 80 kilometers [km]) from the baseline.
	Post-hatch Pelagic	Pelagic zone of the water column in depths from the surface to 787 ft (240 m), extending from the official U.S. baseline to the Exclusive Economic Zone (EEZ) boundary.

	Post-settlement and Sub-adult	Benthic or benthopelagic zones, including all bottom habitats, in depths from the surface to 787 ft (240 m) bounded by the official U.S. baseline and 787-ft (240-m) isobath.
	Sub-adult/Adult	Benthopelagic zone, including all bottom habitats, in depths from the surface to 787 ft (240 m) bounded by the official U.S. baseline and 787-ft (240-m) isobath.
Intermediate Bottomfish Species Complex	Eggs/Larvae	Pelagic zone of the water column in depths from the surface to 919 ft (280 m; *Aphareus rutilans* and *Pristipomoides filamentosus*) or 1,050 ft (320 m; *Hyporthodus quernus*) extending from the official US baseline to a line on which each point is 50 mi (80 km) from the baseline.
	Post-hatch Pelagic	Pelagic zone of the water column in depths from the surface 919 ft (280 m; *A. rutilans* and *P. filamentosus*) or 1,050 ft (320 m; *H. quernus*), extending from the official U.S. baseline to the EEZ boundary.
	Post-settlement	Benthic (*H. quernus and A. rutilans*) or benthopelagic (*A. rutilans* and *P. filamentosus*) zones, including all bottom habitats, in depths from the surface to 919 ft (280 m; *A. rutilans* and *P. filamentosus*) or 1,050 ft (320 m; *H. quernus*) bounded by the 131-ft (40-m) isobath and 328-ft (100-m; *P. filamentosus*), 919-ft (280-m; *A. rutilans*), or 1,050-ft (320-m; *H. quernus*) isobaths.
	Sub-adult/Adult	Benthic (*H. quernus*) or benthopelagic (*A. rutilans and P. filamentosus*) zones, including all bottom habitats, in depths from the surface to 919 ft (280 m; *A. rutilans and P. filamentosus*) or 1,050 ft (320 m; *H. quernus*) bounded by the 131-ft (40-m) isobath and 919-ft (280-m; *A. rutilans* and *P. filamentosus*) or 1,050-ft (320-m; *H. quernus*) isobaths.
Deep-water Bottomfish Species Complex	Eggs/Larvae	Pelagic zone of the water column in depths from the surface to 1,312 ft (400 m), extending from the official U.S. baseline to a line on which each point is 50 mi (80 km) from the baseline.
	Post-hatch Pelagic	Pelagic zone of the water column in depths from the surface to 1,312 ft (400 m), extending from the official U.S. baseline to the EEZ boundary.
Pelagic Management Unit		
Temperate Complex	Eggs, Post-hatch Pelagic, and Post-settlement	The water column down to a depth of 656 ft (200 m), from the shoreline to the outer limit of the EEZ.
Tropical Complex		
Sharks	Sub-adult/Adult	The water column down to a depth of 3,281 ft (1,000 m).
Squid		
Crustacean Management Unit		
Kona Crab	Eggs, Post-hatch Pelagic, and Post-settlement	The water column from the shoreline to the outer limit of the EEZ, to a depth of 492 ft (150 m) throughout the Western Pacific Region.
	Sub-adult/Adult	All of the bottom habitat from the shoreline to a depth of 328 ft (100 m) throughout the Western Pacific Region.

3.2.5 Sea Turtles

Terrestrial reptile species are not present on Kauai. Sea turtles on land are not considered in the analysis due to the limited impacts from the Proposed Action, as they do not bask on shore in the proposed action area.

All sea turtles that may be found at sea within the proposed action area are ESA-listed. Of the six sea turtle species that are found in U.S. waters or that nest on U.S. beaches, two may be found within the proposed action area (Table 3-8). These species are discussed in further detail, excerpted from the Section 7 consultation (Navy Sea Systems Command (NAVSEA) 2025a), in Section B.3 of Appendix B. Leatherback sea turtles (*Dermochelys coriacea*) rarely occur inside of the 328-ft (100-m) isobath and olive ridley sea turtles (*Lepidochelys olivacea*) are likewise only seen in deep oceanic waters around Hawaii; therefore, these sea turtle species would not be expected in the proposed action area. Loggerhead sea turtles (*Caretta caretta*) are also considered rare visitors to the Hawaiian Islands (Hawaii DLNR 2015) and would not likely be present. The USFWS and NMFS share federal jurisdiction for sea turtles. The USFWS has responsibility over the terrestrial environment (e.g. nesting beaches), while NMFS has responsibility in the marine environment. Green sea turtles (*Chelonia mydas*) occur year-round at PMRF, and both basking and nesting turtles have been recorded near the proposed action area. Hawksbill sea turtles (*Eretmochelys imbricata*) are rarely reported offshore of PMRF and have never been recorded on land in the proposed action area. While the green sea turtle was included in consultation with the USFWS, the Navy found that there would be no effect to the green sea turtle from the stressors of the Proposed Action. The USFWS did not include the green sea turtle in its analysis of effects (Navy Sea Systems Command Naval Surface Warfare Center Carderock Division (NSWCCD) 2025).

Table 3-8. ESA-Listed Sea Turtle Species That May Be Present in the Proposed Action Area

Common Name	***Scientific Name***	***ESA Status***	***Critical Habitat within the Proposed Action Area***	***Occurrence within the Proposed Action Area***
Green sea turtle	*Chelonia mydas*	Threatened (Central North Pacific Distinct Population Segment [DPS])	Proposed	Year-round; in open waters and nesting/basking on shore
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	No	Rare in open waters; not recorded on shore

3.2.5.1 Proposed Green Sea Turtle Critical Habitat

In 2023, NOAA Fisheries proposed to designate new areas of critical habitat (Figure 3-2) and modify existing critical habitat for threatened and endangered DPSs in areas under U.S. jurisdiction. This includes the Central North Pacific DPS, which is in the proposed action area. Proposed critical habitat includes nearshore areas from the mean high water line to 66 ft (20 m) depth located along the coasts of multiple states and territories, including Hawaii (88 FR 46572; July 19, 2023). The USFWS excluded Barking Sands Beach from green sea turtle critical habitat proposal due to the INRMP in place at PMRF, prepared under section 101 of the Sikes Act (16 U.S.C. 670a).

For green sea turtles, the physical or biological features essential to the conservation of the species (i.e., essential features) include reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting essential features. Because the reproductive essential features have been defined as "from the mean high water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by USFWS, to allow for the transit, mating, and internesting of reproductive individuals, and the transit of post-hatchlings," this would not include Barking Sands Beach at PMRF, as it was excluded from the USFWS proposed critical habitat designation. Because green sea turtle migration is not constricted or confined by a continental shelf, current, or other feature, and occurs over a large, oceanic environment without defining features (such as depth or distance from shore), no migratory feature was identified or defined for the Central Pacific DPS. For rest and protection from predators, green turtles retreat to underwater refugia located near foraging areas. Such refugia include caves, coral recesses, the undersides of ledges, and sandy bottom areas (called "nests") that are relatively free of strong currents and disturbances (Balazs 1980). Based on the data detailed in the Draft Biological Report (NMFS 2023), all nearshore waters of Kauai, from the mean high water line to 20 m (66 ft) depth, contain benthic foraging/resting essential features that may require special management considerations or protections. This area is of high conservation value to the Central North Pacific DPS because it supports a high density of foraging/resting green turtles (Becker et al. 2019).

3.2.6 Terrestrial Mammals

The ESA-listed Hawaiian hoary bat is the only native terrestrial mammal that may be present in the proposed action area. This species is discussed further in Section B.4 of Appendix B, the text of which was excerpted from the Section 7 consultation with the USFWS (Navy Sea Systems Command Naval Surface Warfare Center Carderock Division (NSWCCD) 2025). Other, non-ESA-listed terrestrial species that may be found in the proposed action area are listed in Table 3-9. All of these non-ESA-listed terrestrial species are considered pests whose populations should be kept in control. Non-native predators are the primary invasive animal management issue at PMRF (PMRF 2024).

Table 3-9. Terrestrial Mammals That May Be Present in the Proposed Action Area

Species	***Scientific Name***	***Likelihood of Occurrence in the Proposed Action Area***
Common house mouse	*Mus muscalis*	Rare
Feral cat	*Felis catus*	Common
Feral dog	*Canis familiaris*	Uncommon
Hawaiian hoary bat	*Lasiurus cinereus semotus*	Uncommon; roosting areas not present in proposed action area; may fly over construction site at night
Polynesian rat	*Rattus exulans*	Uncommon
Roof rat	*Rattus rattus*	Common

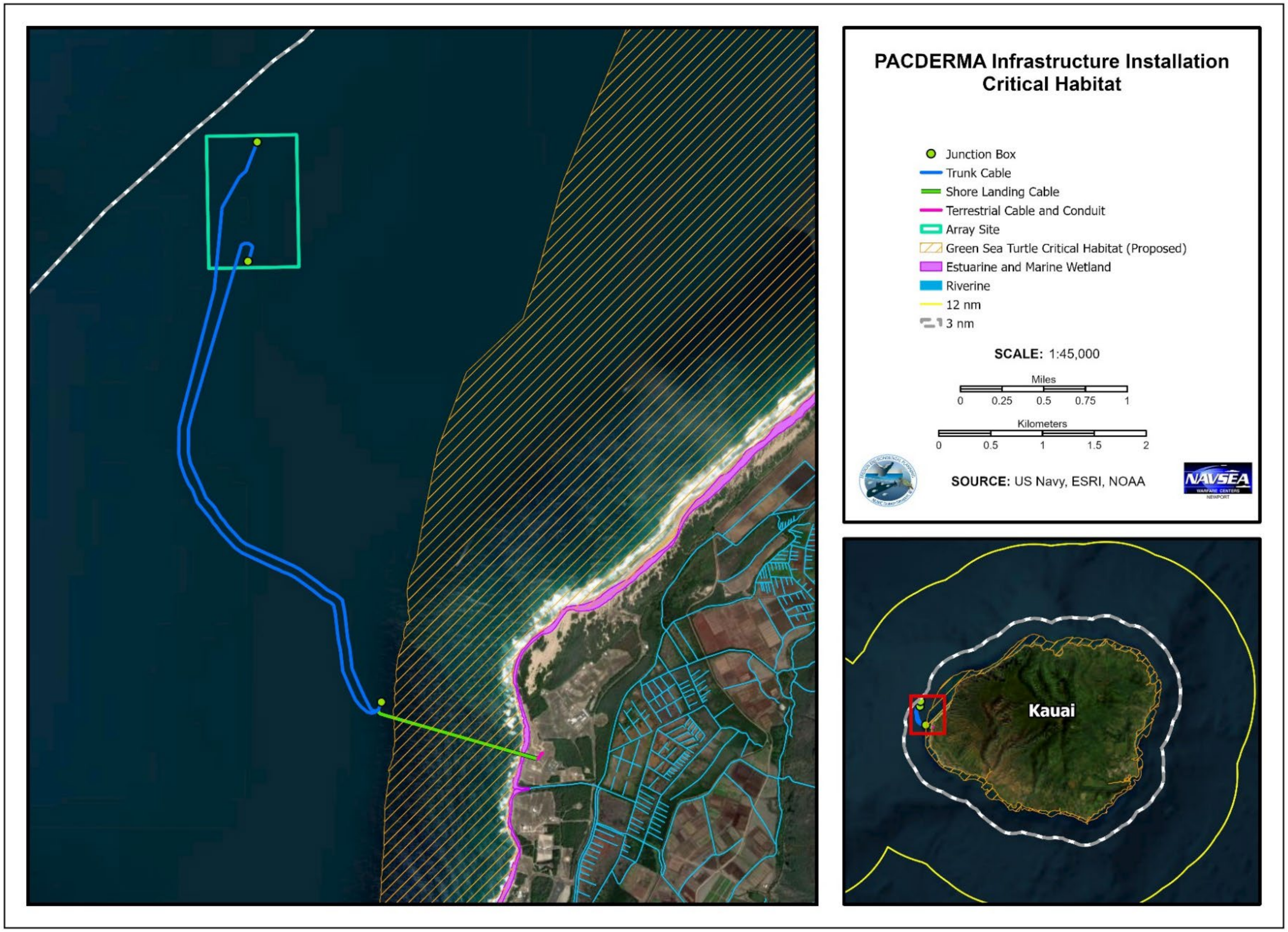

Figure 3-2. Proposed Critical Habitat for the Green Sea Turtle (Central North Pacific DPS) in the Proposed Action Area

3.2.7 Marine Mammals

Twenty marine mammal species may occur in the proposed action area: five mysticetes, fourteen odontocetes, and one pinniped (Table 3-10). The likelihood of occurrence of each marine mammal species is designated as “potential” (i.e., seasonally or infrequent, but regular occurrence), “likely” (regular and/or seasonal occurrence), or “unlikely” (no recorded occurrence) based on the most recent NMFS stock assessment report (Carretta et al. 2023), the PMRF INRMP (PMRF 2024), and species-specific literature. Three ESA-listed marine mammals may occur in the proposed action area, and are detailed in their own subsections, which are excerpted from the Section 7 consultation with NMFS (Navy Sea Systems Command (NAVSEA) 2025a): sei whale (*Balaenoptera borealis*) (Section B.5.1), false killer whale (*Pseudorca crassidens*)—the Main Hawaiian Islands (MHI) Insular DPS—(Section B.5.2), and Hawaiian monk seal (*Neomonachus schiauinslandi*) (Section B.5.3). Blue whales, fin whales, and sperm whales are considered unlikely to be present in the proposed action area during the timing of the installation, which would be in summer. These species will not be discussed further. There is no critical habitat for any ESA-listed marine mammal species in the proposed action area. All other marine mammal species that may occur in the proposed action area are protected under the Marine Mammal Protection Act (MMPA), even if they are not listed under the ESA.

Table 3-10. Marine Mammal Species’ Presence in the Proposed Action Area

Common Name	***Scientific Name***	***MMPA Status***	***ESA Status***	***Occurrence within the Proposed Action Area***
Mysticetes				
Blue whale	*Balaenoptera musculus*	Depleted	Endangered	Unlikely. Sighting frequency in Hawaii is low; peak abundance is seasonal, generally occurring in the winter (Bradford et al. 2013a)
Fin whale	*Balaenoptera physalus*	Depleted	Endangered	Unlikely. Considered rare in Hawaiian waters (NOAA 2022a; PMRF 2024); encounters documented in the fall and winter at PMRF but not in the summer with regular acoustic detections (Guazzo et al. 2021; Helble et al. 2020; Martin et al. 2023)
Sei whale	*Balaenoptera borealis*	Depleted	Endangered	Potential. Considered rare in Hawaiian waters (Smultea et al. 2010); have been encountered at PMRF with occasional acoustic detections (Martin et al. 2021).
Humpback whale	*Megaptera novaeangliae*	Depleted (Central North Pacific Stock)	N/A (Hawaii DPS)	Likely. Migrations to Hawaii in December through April for calving and breeding season (Baird et al. 2015; Mobley et al. 2001); commonly observed off PMRF with regular acoustic detections (Martin et al. 2023; PMRF 2024).

Common Name	Scientific Name	MMPA Status	ESA Status	Occurrence within the Proposed Action Area
Minke whale	*Balaenoptera acutorostrata*	N/A	N/A	Potential. Observed in fall through spring (Jefferson et al. 2015; Kuker et al. 2005); regular acoustic detections off PMRF (Martin et al. 2023).
Odontocetes				
Sperm whale	*Physeter macrocephalus*	Depleted	Endangered	Unlikely. Occurs in Hawaiian Islands during mid-spring with the lowest densities occurring in summer and fall (Merkens et al. 2019); typically found in water depths greater than 1,000 ft (305 m) (NMFS 2010); would not be expected in the proposed action area in summer.
False killer whale	*Pseudorca crassidens*	Depleted (MHI Insular Stock)	Endangered (MHI Insular DPS)	Likely. Inhabiting waters up to 60 nm from shore in shallow (less than 164 ft [50 m]) to very deep (greater than 13,123 ft [4,000 m]) waters (Baird et al. 2010; Baird et al. 2011; Oleson et al. 2010); occasionally observed off PMRF (PMRF 2024).
Pygmy killer whale	*Feresa attenuata*	N/A	N/A	Potential. Prefers deeper waters, may have island-associated resident populations (Donahue and Perryman 2008; National Marine Fisheries Service 2014c; PMRF 2024).
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	N/A	Potential. May occur in nearshore areas as part of island-associated resident populations around Kahoolawe, Maui, Lanai, and north of PMRF (Bradford et al. 2013b; PMRF 2024).
Dwarf sperm whale	*Kogia sima*	N/A	N/A	Potential. Prefers deeper waters (Baird et al. 2013; National Marine Fisheries Service 2014e); may occur as part of island-associated resident population (PMRF 2024).
Fraser's dolphin	*Lagenodelphis hosei*	N/A	N/A	Potential. Sightings primarily around the NWHI (Baird et al. 2013; Bradford et al. 2017; Carretta et al. 2010; National Marine Fisheries Service 2011), but occurs year-round in deeper waters and recorded off PMRF (PMRF 2024).
Blainville's beaked whale	*Mesoplodon desirostris*	N/A	N/A	Potential. Prefers deeper waters (Barlow et al. 2006; National Marine Fisheries Service 2014a; Schorr et al. 2010), but occurs in low numbers year round, possibly as part of resident population (PMRF 2024).
Melon-headed whale	*Peponocephala electra*	N/A	N/A	Potential. Occurs throughout the MHI (Bradford et al. 2017; Oleson et al. 2013); occasionally observed off PMRF (Carretta et al. 2023).

Common Name	Scientific Name	MMPA Status	ESA Status	Occurrence within the Proposed Action Area
Pantropical spotted dolphin	*Stenella attenuata*	N/A	N/A	Potential. Range overlaps with the proposed action area, but rarely seen off Kauai and PMRF (Carretta et al. 2023; PMRF 2024).
Striped dolphin	*Stenella coeruleoalba*	N/A	N/A	Potential. Prefers deeper waters (Baird et al. 2013; Mobley et al. 2001; National Marine Fisheries Service 2014f); rarely observed off PMRF (PMRF 2024).
Spinner dolphin	*Stenella longirostris*	N/A	N/A	Likely. Range overlaps with the proposed action area (Carretta et al. 2023); commonly observed off PMRF (PMRF 2024).
Rough-toothed dolphin	*Steno bredanensis*	N/A	N/A	Likely. Present throughout the MHI with a regular occurrence of Kauai (Carretta et al. 2023; Kratofil et al. 2023); commonly observed off PMRF (PMRF 2024).
Bottlenose dolphin	*Tursiops truncatus*	N/A	N/A	Likely. Range overlaps with proposed action area (Carretta et al. 2023); commonly observed off PMRF (PMRF 2024).
Goose-beaked whale	*Ziphius cavirostris*	N/A	N/A	Potential. Prefers deeper waters (Baird et al. 2013; Jefferson et al. 2015; National Marine Fisheries Service 2014b), but occurs year-round likely as part of island-associated resident population and occasionally observed off PMRF (PMRF 2024).
Pinnipeds				
Hawaiian monk seal	*Neomonachus schauinslandi*	Depleted	Endangered	Likely. Individuals on Kauai tend to stay close to the island (Wilson et al. 2017b); commonly observed on beaches at PMRF; pupping occurs between February and August (PMRF 2024).

3.2.7.1 ESA-Listed Marine Mammals

Details about ESA-listed species are summarized in Table 3-10 and discussed in detail in Section B.5 of Appendix B. The text of this appendix is excerpted from the Section 7 consultation with NMFS {Navy Sea Systems Command (NAVSEA), 2025 #1045}.

3.2.7.2 Non-ESA-Listed Marine Mammals

Two baleen whale species may occur in the proposed action area that are not listed under the ESA: humpback whale (*Megaptera novaeangliae*) and the minke whale (*Balaenoptera acutorostrata*). Humpback and minke whales are typically found during the summer in high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs. This seasonality would indicate these whales would likely not be present during the summer installation time frame in the proposed action area; data indicates regular detections off of PMRF from fall to spring (Martin et al. 2023; PMRF 2024). Those whales that may be present in or near the proposed action area belong to the Hawaiian stocks of humpback and minke whales (Carretta et al. 2023).

Fourteen species of odontocetes may be present in the proposed action area, with two being ESA-listed (Table 3-10). Unlike mysticetes, the presence of odontocetes is typically driven by resident island-associated populations and local prey abundance. At least five of the odontocete species that may occur in or near the proposed action area are thought to be a part of island-associated resident populations that occur in relatively nearshore Kauai (and nearby Niihau) specifically or the MHI more generally (Carretta et al. 2023; PMRF 2024). In some cases, such as the short-finned pilot whale, this can result in social group or demographic independence between populations near Kauai and other Hawaiian islands (Carretta et al. 2023; Van Cise et al. 2017). In other cases, local observations have identified specific pods of spinner dolphins associated with the nearshore coastal waters of PMRF, which were found with a high degree of regularity in the area (Navy 2002).

With deep-diving odontocetes, such as the beaked whales, detections may be rare or irregular due to behavioral patterns, including deep foraging dives and ecological associations with deeper waters. Despite this, occasional to regular acoustic detections demonstrate the presence of beaked whales in and near the proposed action area. For example, Martin et al. (2023; 2022) regularly identified acoustic signals from Blainville's and goose-beaked whales, as well as other odontocetes, during annual marine mammal monitoring in PMRF. In contrast, there are regular detections of dolphins—particularly spinner, rough-toothed, and bottlenose—visually observed at the sea surface off PMRF in and near the proposed action area (PMRF 2024). More generally, the ranges of all 12 non-ESA listed odontocetes overlap with proposed action area (Carretta et al. 2023). Given the depth range of cable-lay path (65–300 ft [20–91 m]), those species may occur in or near the proposed action area, even if occurrences are rare or irregular, as in the case for some toothed whales.

4 Environmental Consequences

This chapter presents an analysis of the potential effects of the Proposed Action on the affected environment. Effects are analyzed to determine if they rise to the level of significance. “Significantly,” as used in NEPA, requires considerations of both context and intensity of environmental effects of an action. Factors that should be considered in evaluating an action’s significance are: geographic extent of the action, duration of the action’s effects, risk of controversial or highly uncertain or unique and unknown environmental impacts, whether the action is related to other reasonably foreseeable actions, and whether the action threatens a violation of Federal, State, or local laws and regulations. Some stressors of the Proposed Action were determined to have no significant impact and are not discussed further in this document.

Table 4-1. Stressors Removed from Further Analysis

Stressor	***No Significant Impact Determination***
Entanglement	Research on subsea cables has demonstrated that cable-laying activities and laid cables do not commonly result in entanglement interactions with marine animals (Taormina et al. 2018; Wood and Carter 2008). Typical entanglement risks—slack cable and loops—would not result from the Proposed Action.
Invasive species	This risk would be mitigated by SOPs listed in Chapter 5. Vessels in use during the Proposed Action would likely be from either Kauai or from Oahu and would follow these SOPs to ensure that species are not transferred from one island to another in ballast water or by any other means. Therefore, introduction of new species to Kauai would not be expected as a result of the Proposed Action.
Hazardous materials	Bentonite used in HDD operations is not considered a hazardous material, but efforts would be made not to release the bentonite slurry into the environment. The drilling contractor would detail the efforts to mitigate the risk of incidental spill in the mitigation plan that will be required by the contracting company. While HDD is not yet contracted, a sample of typical SOPs are listed in Chapter 5. In this way, point source pollution would not be expected as a result of the Proposed Action.

Each stressor from the Proposed Action is discussed in detail in the sections below. Stressors are listed in Table 4-2.

Table 4-2. Stressors Occurring During the Proposed Action

Type of Stressor	***Cause of Stressor***	***Potential Impact***
Acoustic Stressors		
Underwater noise	Vessels, hand-held drills	Behavioral disturbance
In-air noise	Vessels, construction, HDD	Behavioral disturbance
Physical Stressors		
Vessel movement	Cable-laying vessel, support vessels	Strike, physical disturbance
Object deployment	Sensors, cables, junction boxes, HDD drill head (punch out)	Strike, physical disturbance, turbidity
Terrestrial disturbance	Construction equipment, conduit installation, HDD	Physical disturbance

Conclusion statements under each applicable law or regulation under the Proposed Action are included in Section 4.4.

4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. No system installation would occur off the coast of Kauai and no construction would be set up at PMRF. The Navy would not be able to characterize electromagnetic fields in the Pacific Ocean. There would be no impact to resources in Hawaii. This alternative is not discussed in further detail in this document.

4.2 Underwater and In-Air Noise

The Proposed Action would include the introduction of sound into the water and air. The underwater sources of sound included for analysis are hand-held tool noise and vessel noise. It is assumed that any noise created by the drilling rig would not be audible underwater, due to the location of the rig itself and the depth of the drilling beneath the seafloor during drilling. Drilling noise is, however, included for in air analysis, alongside construction noise. Table 4-3 provides a list of sources associated with the Proposed Action and their sound characteristics.

Table 4-3. Sources of Underwater and In-Air Noise

Source Type	*Frequency Range (in Hz or kHz)*	*Source Level (dB re 1 µPa= in-water dBA = in-air)*	*Where Detected*
Hand-held tools	10 Hz – 40 kHz	163 dB re 1 µPa	Underwater
Small vessel	1–7 kHz	175 dB re 1 µPa at 1 m	Underwater; in air
Large vessel (cable-laying)	5–500 Hz	171–190 dB re 1 µPa at 1 m	Underwater; in air
Construction site (crane, excavator, earthmoving trucks and equipment)	Broadband 32 Hz – 10 kHz	85–116 dBA	In air
HDD (drill rig and equipment)	Broadband 32 Hz – 8 kHz	111 dBA	In air

The response of an animal to an anthropogenic sound would depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Other variables such as the animal's sex or age, the distance from the sound source, and whether it is perceived as approaching or moving away can also affect the way an animal responds to a sound (Wartzok et al. 2003).

4.2.1 Underwater Noise

Underwater noise would result from the use of underwater hand drills used to secure cabled array infrastructure to the seafloor, as described in Section 1.1.3, and vessel noise from the cable-laying vessel, dive support vessel, and RHIB. The use of tools and vessels at sea would occur intermittently over a 19-day window of time.

Hand-held hydraulic drills would be used by divers to install seafloor bolts to stabilize cables in water depths of 100 ft (30 m) or less (Section 1.1.3). The duration of this noise would be intermittent over the course of cable stabilization, which takes approximately 7 days. The frequency range of hydraulic drills similar to those likely to be used in the Proposed Action have been measured from 10 Hz to 40 kHz (John J. McMullen Associates Inc. 1984; Navy 2003). Several studies determined the Sound Pressure Levels (SPLs) of tools similar to those used during the Proposed Action: a Stanley hand drill underwater measured 159 decibels referenced at 1 micropascal at 1 meter (dB re 1 µPa at 1 m) from the source (Anthony et al. 2009); a variety of hand-held tools used during an offshore wind installation measured an average of 161 dB re 1 µPa at the source (Nedwell and Howell 2004); and a rock socket drill used for the installation of large pier piles measured 163 dB re 1 µPa at the source (Nedwell et al. 2003; Ward 2012). Based on these reports, the Navy assumes an approximate level of 163 dB re 1 µPa at the source for the hand drills used in the Proposed Action. Noise generated by the use of hand-held hydraulic drills would be short and punctuated.

Since underwater noise from hand-held hydraulic drills would only occur in the shallow water portion of the proposed action area, including near the HDD exit point, the only ESA-listed marine species that would likely be exposed to this type of underwater noise are the green sea turtle, hawksbill sea turtle, and Hawaiian monk seal. Giant manta rays are highly migratory and are not known to congregate off Kauai; therefore, the likelihood of overlap with underwater drilling activities associated with the Proposed Action is unlikely. Oceanic white tip sharks, as well as sei and MHI insular false killer whales, forage in deeper water and are, therefore, unlikely to occur in the shallow water portion of the proposed action area where tool use would occur. Additionally, as discussed in the SOPs and protective measures in Chapter 5, hand-held drilling activities would not commence if sea turtles or marine mammals were visually spotted in the area and would only recommence once the area is clear of these species.

Overall, larger vessels, like the cable-laying vessel (220 ft [67 m]) and diver support vessels (30–80 ft [9–24 m]) generate noise at low frequencies (less than 1,000 Hz) because of their relatively high power, deep draft, and slower-turning engines and propellers (McKenna et al. 2013; Richardson et al. 1995). The frequency range of noise emitted from these vessels is estimated to be between 5 and 500 Hz (Hildebrand 2009; National Research Council 2003; Urick 1983). The source level in water could range from 171–190 dB re 1 µPa at 1 m (Hood et al. 2012; Luz 1983; NMFS 2012; Richardson et al. 1995; U.S. Coast Guard 2013; Ylikoski et al. 1995). During cabled array installation, both types of vessels could be moving slowly through the proposed action area, and therefore, they would be even quieter than similarly sized vessels moving at normal transit speeds (e.g., 10–15 knots). A smaller RHIB may be used during nearshore cable stabilization involving divers. This vessel produces broadband noise of a higher frequency (1–7 kHz) and may move at faster speeds when transiting, but would often be stationary during work.

Underwater noise is not expected to cause auditory injury (AINJ) because the sound created by tools and vessels is not intense, would be attenuated through the water column, and/or only occurs in temporary, short bursts (i.e., the hand-held drills). As species would likely not approach divers using tools, this sound would be neither prolonged nor intense (i.e., loud). Further, ESA-listed and other species that may occur seasonally in the proposed action area would be able to move away from the Proposed Action if disturbed. Therefore, only behavioral responses and masking could result from underwater noise associated with the Proposed Action. Behavioral responses to both the activity and vessel noise would mean that any exposure to vessel noise would be brief and low intensity. As a result, neither vessel nor tool noise would cause a shift in the hearing threshold of any species or species group. Proposed green sea turtle critical habitat would not be impacted by underwater noise as the associated

PBFs do not include soundscape or noise as essential features. The potential impacts to resources from underwater noise are summarized in Table 4-4.

Table 4-4. Potential Impacts to Biological Resources as a Result of Underwater Noise

Species	*Hearing Range in Water*	*Underwater Sound*	*Potential Impacts*
Invertebrates (decapods and cephalopods only)	below 200 Hz, potentially up to 3 kHz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	
Birds	1–5 kHz	Tools: 10 Hz – 40 kHz	Do not overlap spatially
		Vessels: 5–500 Hz, 1–7 kHz	Most vessel noise is outside range of best hearing
Fish	most species: 50 Hz – 1 kHz with best sensitivity from 100– 400 Hz; specialists: over 4 kHz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	
Sea Turtles	50 Hz – 1.6 kHz, with maximum sensitivity from 100–400 Hz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	
Marine Mammals: Mysticetes	7 Hz – 35 kHz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	
Marine Mammals: Odontocetes	150 Hz – 160 kHz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	
Marine Mammals: Pinnipeds	0.2 kHz – 33 kHz	Tools: 10 Hz – 40 kHz	Masking, behavioral response
		Vessels: 5–500 Hz, 1–7 kHz	Most vessel noise is outside range of best hearing

Underwater noise from vessels and tool use may impact any species for which there is overlap with their range of best hearing. Vessel noise in the proposed action area is present due to existing boat traffic, which contributes to the ambient sound environment (Hildebrand 2009). It is expected that the vessels associated with the Proposed Action would contribute to ambient levels of sound in the proposed action area, but the vessel is not expected to change current ambient sound levels. Vessel noise associated with the Proposed Action would be short-term and temporary but could impact animal species via masking and behavioral response. Vessel noise is not expected to result in more than a temporary behavioral reaction of species in the vicinity of the Proposed Action. It would be expected that any species would return to their normal behavior shortly after exposure, which would not result in any population-level impact.

4.2.1.1 Potential Impacts to Aquatic Invertebrates and Coral

The overlap of underwater noise and the hearing range of invertebrates is detailed in Table 4-4. Impacts to invertebrates from vessel noise is relatively unknown, but it is likely that some species would be able to perceive the low-frequency sources generated from the vessel or tools used during the Proposed Action, which could result in masking acoustic communication in invertebrates such as crustaceans (Staaterman et al. 2011). However, it is expected that much of the underwater noise may not be well-detected, or detected at all, by most invertebrate species. Studies of sound energy effects on invertebrates are few and identify only behavioral responses. Masking of important acoustic cues used by invertebrates during larval orientation and settlement may lead to localized reductions in recruitment success (Simpson et al. 2011). Because the change in underwater noise levels would be minimal and not prolonged (lasting only 19 days), there would be only short term and temporary impacts to aquatic invertebrates, including coral.

In accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to aquatic invertebrates.

4.2.1.2 Potential Impacts to Birds

Underwater noise from vessels and tool use may impact diving water birds in the proposed action area, including the ESA-listed Newell's shearwater. The overlap of underwater noise and the hearing range of birds is detailed in Table 4-4. Tool noise from use of hand-held drills would likely have only extremely limited effects on birds, as the source of any tool noise would be at depths of 65 ft (20 m), but no more than 100 ft (30 m) in the proposed action area. Consequently, tool noise is unlikely to have significant impacts on birds and is not considered further in this section. Birds foraging in or near the waters of the proposed action area may be able to detect some higher frequency underwater vessel noise while diving for prey, but most vessel noise is outside their range of best hearing. Underwater vessel noise may elicit short-term behavioral responses in exposed birds, such as an avoidance response. This may temporarily disrupt some birds' foraging activities, but affected birds would be expected to move a short distance away from the vessel and resume normal activity. Given that feeding is the main activity of birds while on the water, they would likely choose to feed away from vessel operations.

In accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to birds. In accordance with the ESA, the underwater noise resulting from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed species that may be present in the at-sea portion of the proposed action area, including the band-rumped storm petrel, Hawaiian petrel, Newell's shearwater, or short-tailed albatross. There would be no effect to the Hawaiian common gallinule, Hawaiian duck, Hawaiian stilt, Hawaiian coot, or the Hawaiian goose from underwater noise associated with the Proposed Action, as those species occur primarily onshore in freshwater and terrestrial habitats. Pursuant to the Migratory Bird Treaty Act (MBTA), underwater noise associated with the Proposed Action would not result in significant adverse effects on migratory bird populations.

4.2.1.3 Potential Impacts to Fish

The overlap of underwater noise and the hearing range of fish is detailed in Table 4-4. Underwater noise associated with the Proposed Action would include low-frequency and broadband sounds that would likely be detected by most fish species, including ESA-listed giant manta rays and oceanic whitetip sharks (Mickle and Higgs 2022a). Masking can impede the flight response of fish from predators or may not allow fish to detect potential prey in the area. It is not anticipated that impacts from masking would affect the individual fitness of a fish, as individuals are expected to move away from sound exposure and resume normal behavior. Underwater noise also has the potential to result in general disturbance, which could result in short-term behavioral or physiological responses (e.g., avoidance, stress, increased heart rate) of fish. Behavioral reactions of fish may include changing direction of travel, changing position within the water column, avoidance of the disturbance, and startle response. While vessel sounds may influence the behavior of some fish species (e.g., startle response), other fish species can be unresponsive (Becker et al. 2013). The punctuated bursts associated with hand-held tool noise may result in startle and avoidance responses from nearby fish; however, it is unlikely these responses would be prolonged as fish would likely rapidly move away from the sound source. Although vessel or hand-held drill noise could cause some short-term changes in behavior, any disturbance would be temporary, and any exposed fish would be expected to return to their normal behavior shortly after exposure as the vessel departs the area or the dive teams use tools at a particular site. Although underwater noise could cause some short-term changes in fish behavior, any disturbance is expected to be temporary.

In accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to fish. In accordance with the ESA, underwater noise associated with the Proposed Action may affect, but is not likely to adversely affect the ESA-listed giant manta ray or oceanic whitetip shark.

4.2.1.4 Potential Impacts to EFH

Underwater noise would not be expected to compromise the quality of water column EFH, as it would be temporary, only lasting approximately 19 days. Acoustic stressors associated with the Proposed Action may result in a minimal and temporary adverse effect to water column EFH designated for the Pelagic Fish, Bottomfish, or Crustacean MUS. Acoustic stressors would not impact abiotic bottom habitat or biogenic habitat EFH.

Therefore, in accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to EFH. Furthermore, underwater noise associated with the Proposed Action would not significantly reduce the quantity or quality of EFH designated for the Bottomfish and Seamount Groundfish, Pelagic Fish, or Crustacean Management Units.

4.2.1.5 Potential Impacts to Sea Turtles

The overlap of underwater noise and the hearing range of sea turtles is detailed in Table 4-4. Due to the location of the tool use, SOPs (Chapter 5) would ensure that drilling activities would not take place if sea turtles were spotted by lookouts or divers in the water, reducing the probability that tool noise would be detected by sea turtles. Overall, while it is likely that sea turtles would be able to perceive the low-frequency sounds of the cable-laying and dive support vessels, sea turtles appear to rely on senses other than hearing for foraging and navigation, such as vision and magnetic orientation, to interact with their environment (Avens and Lohmann 2003; Narazaki et al. 2013). Diaz et al. hypothesize that increased vessel noise may prompt a response from sea turtles that then must be confirmed via visual cues (Díaz et al.

2024). Consequently, sound may play a role in sea turtle behavior, but its importance is unclear. Therefore, underwater noise associated with the Proposed Action is expected to result in, at most, minor avoidance responses of sea turtles over short periods of time. It would be expected that sea turtles would move to a nearby area if disturbed by underwater noise and continue their regular behavior. Population-level impacts would not be anticipated.

There would be no impacts to proposed green sea turtle critical habitat as a result of underwater noise. Though vessel and tool use would occur at the edge of proposed green sea turtle critical habitat, the majority of the at-sea portion of the Proposed Action would occur in waters deeper than the proposed critical habitat. The physical or biological features essential to the conservation of the green sea turtle include those for reproductive, migratory, benthic foraging/resting, and surface-pelagic foraging/resting. Underwater noise would not impede any of these essential functions from taking place and would not restrict the movement of green sea turtles in the area. Given that underwater noise would occur intermittently over the course of 19 days and would primarily be in an area outside of the 66-ft (20-m) depth contour, there would be no effect to proposed green sea turtle critical habitat as a result of underwater noise associated with the Proposed Action.

In accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to sea turtles. In accordance with the ESA, underwater noise associated with the Proposed Action may affect, but is not likely to adversely affect the ESA-listed green sea turtle or hawksbill sea turtle.

4.2.1.6 Potential Impacts to Marine Mammals

Noise produced by underwater tools would have the potential to impact only marine mammals occurring in the shallow depths (less than 100 ft [30 m]) of the proposed action area where diver activity would occur. Species present at this depth may include the ESA-listed Hawaiian monk seal and a variety of non-ESA-listed dolphin species. The visual cues of people and equipment are likely to discourage Hawaiian monk seals from approaching the divers using hand tools and the SOPs and protective measures identified in Chapter 5 would further decrease the chance of exposure of a Hawaiian monk seal to underwater tool noise, as divers act as lookouts and would not commence tool use if a Hawaiian monk seal were observed within 50 yards (yd; 150 ft [46 m]) of the location of the activity. The majority of other species in Table 3-10 are not likely to occur at the shallow depths associated with the tool use (Carretta et al. 2023; National Marine Fisheries Service 2010c; Oleson et al. 2010).

All marine mammals that may occur in the proposed action area are highly mobile and would likely avoid the vessels used in the Proposed Action, particularly as the vessels are primarily slowly moving or stationary. Mysticetes would be most likely to experience masking as a result of the Proposed Action. The Lombard effect (i.e., increased source level and vocalization duration) has been noted in both mysticetes and odontocetes as a result of low-frequency vessel noise (Erbe et al. 2019). The ability to shift to different frequencies allows for continued communication, lessening the impacts of masking as it relates to communication. In addition, because the vessels are mostly stationary, and only operating for about 19 days in total, marine mammals could easily avoid the source of disturbance and any potential masking impacts would not occur. There are less studies conducted using smaller (higher frequency) vessels, but it is assumed masking impacts would be relatively the same despite the difference in frequency level.

Behavioral reactions of whales may include changes in dive duration, travel speed, or a cessation of foraging behavior. Pinniped reactions to vessels are variable and include a wide spectrum of possibilities from avoidance and alert reactions to attraction (Richardson et al. 1995). Given the short duration (19 days) and stationary nature of the underwater noise, it would be expected that marine mammals could avoid the area of disturbance. The Navy would follow SOPs (Chapter 5) to minimize the impact of vessel noise by monitoring the presence of marine mammals. Reactions of exposed individuals would not be expected to significantly disrupt behavioral patterns, such as migration, breathing, nursing, breeding, feeding, and sheltering to a point where the behavior pattern is abandoned or significantly altered or result in reasonably foreseeable takes of marine mammals.

In accordance with NEPA, underwater noise associated with the Proposed Action would not result in significant impacts to marine mammals. Furthermore, underwater noise associated with the Proposed Action would not result in reasonably foreseeable takes under the MMPA. Additionally, in accordance with the ESA, the underwater noise from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed sei whale, MHI insular false killer whale, or Hawaiian monk seal.

4.2.2 In-Air Noise

In-air noise from construction equipment (including the HDD rig) and vessels associated with the Proposed Action has the potential to impact birds (Section 4.2.2.1) and terrestrial mammals (Section 4.2.2.2). In-air noise would not have impacts on cetaceans, fish, or other in-water resources, as in-air noises are absorbed and attenuated when crossing the air-water interface do not present risks to marine resources. As such, these resources are not discussed further in this section.

Green sea turtles and Hawaiian monk seals may both be present on PMRF beaches during the Proposed Action. In particular, both animals haul out (seals) or bask (sea turtles) near the Nohili Ditch outflow, which lies 1,200 ft (365 m) southwest of the proposed action area (Figure 3-1). This distance would result in substantial attenuation of in-air noise to ambient levels in locations where these species may be present. Therefore, there would be no effect to sea turtles or seals from in-air noise associated with the Proposed Action and they are not discussed further in this section.

Vessels are common in the waters around PMRF, resulting in ambient vessel traffic noise that would serve as a baseline in the proposed action area. Most information on in-air vessel noise focuses on noise produced by moored ships as they load and unload (Badino et al. 2012a; Badino et al. 2012b; Borelli et al. 2015a; Borelli et al. 2015b), while the ambient, environmental noise from the vessels while underway would consist of localized engine sounds, grinding and humming noises from the operation of winches and other machinery, and use of the ship’s horn. Sound from construction, HDD, and associated activities (e.g., trucks moving to the site) would be temporary and intermittent, lasting for hours at a time when HDD operations are underway. The operational sound level of the drill rig would be roughly 111 dBA. Other equipment would be expected to operate near or less than this level and would likely be far less frequent than drill noise during onshore construction.

In-air noise would not be expected to cause AINJ to birds or terrestrial mammals, including ESA-listed bats, because the sound created by construction and vessels is not intense and would be attenuated through the air. Construction and vessel noise would occur on a day-to-day basis, but would only be temporary during the time frame of the construction (3 months) or installation (19 days). Further, ESA-listed and other species that may occur in the proposed action area would be able to move away from the Proposed Action if disturbed. Therefore, only behavioral responses and masking could result from in-air noise associated with the Proposed Action and are discussed for each resource group below.

Much like underwater noise, in assessing the potential impacts to resources from construction equipment noise, a variety of factors must be considered, including source characteristics, animal presence, animal hearing range, duration of exposure, and impact thresholds. Potential acoustic impacts could include acoustic injury or behavioral response.

4.2.2.1 Potential Impacts to Birds

Birds residing on shore, adjacent to the proposed action area, or flying over the proposed action area may be able to detect the in-air construction or vessel noise. It would be expected that birds disturbed by the vessel noise at sea could move to another area to forage. Any birds foraging or resting near the proposed action area on shore would likely exhibit a behavioral response to human activity and noise, including HDD and construction noises, which would cause them to leave or avoid the drill site and nearby areas. While some species, including ESA-listed birds like the Hawaiian common gallinule, Hawaiian duck, Hawaiian coot, and Hawaiian stilt regularly forage on land (or in very shallow water at the shore) at PMRF, they prefer wet habitats, such as ditches and freshwater ponds, which are outside of the proposed action area (Figure 3-1). The ESA-listed Hawaiian goose may be present on shore in the proposed action area. The onshore habitat within the proposed action area does not provide specialized habitat for the Hawaiian goose or any other species that is not available to the birds elsewhere nearby. Therefore, the likelihood that a bird would remain near the drill site during operations is extremely low.

In accordance with NEPA, in-air noise associated with the Proposed Action would not result in significant impacts to birds. In accordance with the ESA, the in-air noise resulting from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed band-rumped storm petrel, Hawaiian common gallinule, Hawaiian coot, Hawaiian duck, Hawaiian goose, Hawaiian petrel, Hawaiian stilt, Newell’s Townsend’s shearwater, or short-tailed albatross. Pursuant to the MBTA, in-air noise associated with the Proposed Action would not result in significant adverse effects on migratory bird populations.

4.2.2.2 Potential Impacts to Terrestrial Mammals

Potential impacts to terrestrial mammals would only be from construction noise, as these species would not be present at sea where vessel noise could be detected. Therefore, there would be no risk of acoustic impacts from vessel noise. The ESA-listed Hawaiian hoary bat is the only native terrestrial mammal that may be present in the proposed action area, while the non-native feral dog, feral cat, and common house mouse may also be present in or near the proposed action area. The Hawaiian hoary bat occurs throughout PMRF (PMRF 2024). It nests and rests primarily in woody vegetation outside of the proposed action area; however, it may be encountered foraging anywhere throughout PMRF including in and near the proposed action area.

Studies on masking in bats have shown that bats can change echolocation call parameters in response to noise, either increasing the call sound level and/or increasing the call duration. Bats may also change their peak frequency to not overlap with the masking noise (Gomes and Goerlitz 2020). However, the primary echolocation frequency of Hawaiian hoary bats is around 30 kHz, which is a higher frequency than the in-air noise associated with the Proposed Action. Therefore, masking noise necessary to the survival of bats is unlikely. Masking of terrestrial mammals may occur within the proposed action area. However, given the small size of the construction site and the attenuation of sound over distance, it would be unlikely for these species to remain in an area where masking would occur for more than a short duration of time.

Construction noise that is able to be detected may elicit short-term behavior impacts to Hawaiian hoary bats, such as alert or startle responses; however, these impacts would be rare, temporary, and intermittent. Because the proposed action area does not include roosting or resting habitat, it would not be expected that bats would be impacted during daylight hours. It is possible that noise from construction activities in twilight hours could impact foraging bats, eliciting avoidance. However, given the temporary and intermittent nature of construction noise and the small overlap of frequencies emitted versus detected, it would not be expected that construction noise would cause more than short-term behavior responses in Hawaiian hoary bats, and no population-level impacts would be expected. Based on the ranges in Appendix D, it would be expected that dogs, cats, and mice could detect the low frequency construction noise. It would be expected that these species could avoid the onshore area of disturbance. Construction noise may elicit short-term behavior impacts to terrestrial mammals, such as alert or startle responses, but would not cause the abandonment of essential behaviors such as breeding, feeding, or sheltering.

In accordance with NEPA, in-air noise associated with the Proposed Action would not result in significant impacts to terrestrial mammals. In accordance with the ESA, in-air noise from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed Hawaiian hoary bat.

4.2.3 Summary of Underwater and In-Air Noise Consequences

PACDERMA infrastructure installation would temporarily increase underwater and in-air noise conditions in the proposed action area. Vessel noise would likely not be elevated above ambient noise levels in the proposed action area due to the baseline level of vessel traffic. Tool noise would be intermittent and would only occur in shallower (less than 100 ft [30 m]) waters of the proposed action area, and impacts would not extend above the water's surface. Because the tools are used by divers, it is unlikely any species would approach the divers when tools are in use and making noise. Construction noise would be broadband and would occur on shore over the course of 3 months, mostly during daylight hours.

Any effects to biological resources would be brief in nature as the Proposed Action would only increase the baseline noise conditions while an animal is in close proximity to the construction site or vessels operating in the water. Species avoidance of the diver, construction, and vessel activity would diminish the intensity due to attenuation of sound over distance. Masking would be unlikely as species would not stay near operations for a prolonged period of time.

Given the slow speed of the vessels associated with the Proposed Action and the short period of time biological resources would spend in the vicinity of in-water activities, vessel and tool noise associated with the Proposed Action may affect individual fish, sea turtles, or marine mammals within the proposed action area; however, behavioral responses, which are the most likely response, would be short-term and insignificant. Because species would likely only spend a short period of time in or near the construction site, construction noise may impact individual birds and terrestrial mammals, but behavioral responses would be short-term and insignificant.

4.3 Physical Stressors

Physical stressors associated with the Proposed Action include vessel movement, object deployment, and HDD operations. Vessel movement would be limited, as support vessels are typically either very slow moving (less than 1 knot) or stationary while completing system installation. Object deployment includes system components (e.g., cables, sensors, buoys), diver activity, and ROV usage. The duration of the at-sea stressors (vessel movement and object deployment) would be a 19-day window in which the at-sea installation occurs. HDD operations would occur on shore, over a period of roughly 3 months. Recovery of objects (sensors, beacons, anchor structures, etc.) would occur during installation and during periodic maintenance. Recovery would consist of lifting objects off the bottom (including portions of attached cable) and potentially replacing or repairing and replacing them. HDD operations include setup of the construction site (use of vehicles, ground stabilization, etc.), staking of guy wires that may be used to steer the rig, drilling from shore to the punch out location, trenching of new conduit areas, and construction of an onshore BMH.

The possible impacts of these stressors would be strike, disturbance, and turbidity. Table 4-5 lists the resources analyzed in this document and any potential physical stressors that may impact those resources.

Table 4-5. Potential Impacts to Resources as a Result of Physical Stressors

Resource	***Physical Stressors That Overlap the Resource***	***Potential Impacts***
Benthic Habitat	Object deployment	Localized and temporary increase in turbidity; small area of unavailable habitat once cables and sensors are installed on the seafloor
Terrestrial Habitat	HDD operations	Disturbance of terrestrial habitats due to trenching, staking of guy wires, HDD, and construction site setup
Water Resources	Object deployment	Localized and temporary increase in turbidity as objects are raised or lowered from the seafloor

Invertebrates and Corals	Vessel movement Object deployment	Injury or death due to strike, behavioral response
Birds	Vessel movement HDD operations	Behavioral response
Fish	Vessel movement Object deployment	Behavioral response
EFH	Object deployment	Localized and temporary increase in turbidity; decrease in the amount of available EFH; potential direct damage to biogenic EFH due to strike
Sea Turtles	Vessel movement Object deployment	Behavioral response
Terrestrial Mammals	HDD operations	Behavioral response
Marine Mammals	Vessel movement Object deployment	Behavioral response

4.3.1 Strike

There is a risk of strike to species from objects being deployed from vessels and the movement of vessels supporting the Proposed Action. However, this risk is considered low due to the mobility of the most species that may occur in the proposed action area, the slow, controlled manner at which objects would be deployed to the seafloor, slow vessel speeds employed during the Proposed Action, and SOPs and protective measures (Chapter 5) that would be included as a part of the Proposed Action.

In general, vessel strike is more likely to occur to large, slow-moving species that spend more time at the surface or those species with limited mobility. Slowly- moving vessels are less likely to strike animals because they would have time to detect and move out of the way of vessels. Slowly-moving vessels and small vessels are less likely to injure or kill an animal if a strike should occur. Similarly, slowly moving objects under controlled descent are less likely to strike animals, as they would have time to avoid these objects. It would be extremely unlikely for birds at sea to be struck by slow-moving vessels during daylight hours when operations occur, or by objects being lowered through the water column; therefore, birds are not discussed further in this section. Similarly, marine fish are able to detect vessels, therefore, the likelihood of collision between vessels and adult or juvenile fish is extremely low because fish are highly mobile and would avoid an approaching vessel, especially one moving slowly at a maximum of one knot (Becker et al. 2013; Misund 1997). The likelihood of marine fish to be close to objects as they are deployed, and to be therefore subject to disturbance or a strike, is so low as to be negligible. Fish are not discussed further in this section.

4.3.1.1 Potential Impacts to Aquatic Invertebrates and Corals

Strike of aquatic invertebrates and corals is more likely due to the limited mobility of many invertebrate species. Objects deployed on the bottom and HDD occurring within the bottom sediment would likely kill or injure benthic invertebrates in the footprint of the equipment. However, these populations are very large and only a very small amount of individuals would be impacted. Because coral is a sessile invertebrate, objects striking individual heads of coral may cause mortality. The coral in the proposed action area appears to be small and scattered; it would therefore be difficult to avoid while laying cable in the shallower portion of the proposed action area. Coral coverage is estimated at 2.6 percent by recent surveys. Given this coverage, the footprint of equipment, and the area in which coral would have enough light to grow, the Navy estimates up to 19 ft^2 (1.8 m^2) of coral may suffer mortality as a result of object deployment associated with the Proposed Action. There would, however, be no population-level impacts to aquatic invertebrates.

In accordance with NEPA, strike associated with the Proposed Action would not result in significant impacts to aquatic invertebrates or coral.

4.3.1.2 Potential Impacts to EFH

Strike stressors caused by object deployment associated with the Proposed Action may have an adverse effect on biogenic habitat designated as EFH for the Bottomfish and Crustacean MUS. Localized alterations to biogenic habitats, such as benthic invertebrates associated with soft-bottom (e.g., echinoderms, hydroids, amphipod tubes, bryozoans), and hard-bottom (e.g., corals) environments may occur. The Proposed Action has the potential to harm or kill individual animals constituting a portion of biogenic habitat designated as EFH if infrastructure is deployed on or adjacent to them. Within the proposed action area, most of the bottom cover is sand. In the shallow waters of the proposed action area, where biogenic habitat is more prevalent, the percentage of coral cover on available hard bottom is very low (2.6 percent) and scattered. Divers would be present to assist in precision placement of the shallow water junction box, but would not be able to maneuver cables around small coral heads. Due to the short-term duration of installation activities, and the relatively small area of impact, the potential for adverse effects on biogenic EFH would be short term. Shallow water surveys completed in and around the HDD punch out location (at roughly 65 ft [20 m] depth) and along the cable corridor (up to 100 ft [30 m]) found there was limited presence of coral and no massive coral formations. The report states that "the seafloor had some small sand patches, cobbles, shells, and corals" (NAVFAC 2023). As stated in the SOPs (Chapter 5), cable paths would target soft-bottom habitat, limiting the potential for impacts to vegetated hard bottom, as well as coral habitats. Any likely impacts to biogenic habitat EFH would be limited to those areas directly in line with cables. The trunk cables and shore landing cable are anticipated to impact 728 ft^2 (68 m^2) of benthic habitat in a water depth of less than 100 ft (30 m). Using the 2018 Navy estimate of 2.6 percent coral cover, approximately 19 ft^2 (1.8 m^2) of coral could be impacted by the deployment of this infrastructure. Overall, there would be a potential for object deployment to cause a temporary and localized reduction in the quantity of biogenic EFH if sensors are placed on top of soft-bottom biogenic EFH, which would take some time to recover. However, as detailed in Chapter 5, coral would be avoided whenever practicable, but divers could not be present beneath or too close to the cable-laying vessel when it is in operation. No coral would likely be impacted around the shallow water junction box as this area is predominantly soft bottom and placement would be guided by divers. Sand is required for the stability of this infrastructure and there would be some flexibility about where it could be placed. In the deeper portions of the proposed action area, where divers would not assist in cable-laying activities, there could be impacts to biogenic EFH, but these habitats are less prevalent due to available sunlight.

Due to the short-term duration of installation activities, and the relatively small area of impact, the potential for adverse effects on biogenic EFH would be short term. Most soft-bottomed invertebrate populations, which cover the majority of the proposed action area, recover quickly from disturbance (Dernie et al. 2003; Hiddink et al. 2017), but any corals damaged by installation would take some time to recover and resettle.

In accordance with NEPA, strike associated with the Proposed Action would not result in significant impacts to EFH. Under the MSA, strike would not cause measurable, long-term adverse effects to the quality or quantity of biogenic habitat EFH.

4.3.1.3 Potential Impacts to Sea Turtles

Sea turtles may occur at or near the surface in open-ocean and coastal areas during feeding or when surfacing to breathe, although they typically spend a majority of their time submerged (Renaurd and Carpenter 1994; Sasso and Witzell 2006). Adult sea turtles are generally at the surface for short periods; hatchlings and juveniles spend more time at the surface while in ocean currents or at the surface while basking. Sea turtles have been observed to elicit short-term responses in their reactions to vessels, and their reaction time was greatly dependent on the speed of the vessel (Hazel et al. 2007). Although it is difficult to determine whether sea turtle response to vessel traffic is visual or auditory in nature, it is assumed sea turtles can hear approaching vessels. Greater vessel speeds increase the probability that sea turtles would fail to flee from an approaching vessel (Hazel et al. 2007). Due to the slow speeds of the vessels (speeds of less than one knot during work and up to 12 knots during travel for the cable vessel in the proposed action area, and speeds up to 12 knots in waters less than 65 ft [20 m] during travel for the RHIB in the proposed action area) and the slow and controlled deployment of sensors, cables, and the ROV, risk to strike during the Proposed Action is reduced. Slow-moving objects traveling through the water column would be highly unlikely to strike or injure a sea turtle, as a sea turtle would need to be directly in the path of the object to be impacted.

In accordance with NEPA, strike associated with the Proposed Action would not result in significant impacts to sea turtles. Strike associated with the Proposed Action may affect, but is not likely to adversely affect the ESA-listed green sea turtle or hawksbill sea turtle. There would be no effect to proposed green sea turtle critical habitat from strike.

4.3.1.4 Potential Impacts to Marine Mammals

Vessel strike has the potential to impact marine mammals by causing injury from collisions, though size and speed of the vessel are important factors whether a collision would cause injury or death in the event of a strike. The likelihood of marine mammals to be close to objects as they are deployed, and to be then subject to disturbance or a strike, is so low as to be negligible.

Marine mammals off the coast of Kauai are frequently exposed to vessel movement due to research, ecotourism, commercial, government, and private vessel traffic. Some species have been noted to have limited reactions to slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Richardson et al. 1995; Terhune and Verboom 1999; Watkins 1986). The species most vulnerable to collisions with commercial and Navy ships are those that move slowly or spend extended periods of time at the surface (Navy 2018b). Conversely, pinnipeds are less likely to encounter vessels as they regularly spend time outside of the water (e.g., hauled out on land). For much of the duration of vessel use, vessels would not be moving or would be moving very slowly, further decreasing the possibility of strike or injury to any marine mammal, especially those that are fairly maneuverable, such as dolphins. Many of the large marine mammal species (Table 3-10) that would be most susceptible to vessel strike are unlikely to be found even in the deepest depths of the proposed action area. The likelihood of an individual cetacean encountering one of the Proposed Action vessels, which would only be present temporarily, is low. Although there are not specific documented studies of sei whales and vessel interactions, they are considered fast swimmers, (e.g., they can reach speeds of 34 mi/hour (54.7 km/hr) (NOAA 2022b). Vessel strikes for MHI insular false killer whales are considered infrequent in Hawaii (Baird 2009; Graham 2021) and they have occasionally been observed riding bow waves (Baird 2009; Graham 2021); therefore, they seem to be less vulnerable to vessel collisions than larger, slower-moving cetaceans. Additionally, there is sufficient evidence that vessel strikes are not causing population-level effects to MHI insular false killer whales (Graham 2021). Even at higher speeds, vessel strike is not considered a major concern for Hawaiian monk seals (Antonelis et al. 2006; Marine Mammal Commission 2001; National Marine Fisheries Service 2007, 2010b, 2014d) because pinnipeds appear to suffer fewer impacts from vessel collisions than cetaceans. During foraging trips offshore, the seals typically remain along the seafloor and would not encounter vessels at the surface (Wilson et al. 2017a; Wilson et al. 2017b), furthering limiting the risk of strike.

In this area, the cable-laying vessel would be moving slowly along the cable lay path or would be stationary deploying sensors and other equipment. Objects being lowered slowly through the water column would be both unlikely to strike a marine mammal and unlikely to injure a marine mammal in the unlikely event that this were to occur. Smaller more maneuverable marine mammals (Table 3-10) may overlap with the shallower portion of the proposed action area where divers, the dive support vessel, and the RHIB would also operate. The increased level of activity and SOPs (Chapter 5) in place would further reduce the likelihood that a marine mammal would be struck by vessels or objects in the water.

In accordance with NEPA, strike associated with the Proposed Action would not result in significant impacts to marine mammals. Strike associated with the Proposed Action may affect, but is not likely to adversely affect the ESA-listed sei whale, MHI insular false killer whale, or Hawaiian monk seal. Furthermore, strike associated with the Proposed Action would not result in reasonably foreseeable takes under the MMPA.

4.3.2 Physical Disturbance

At sea, marine species may be physically disturbed by moving vessels, objects being deployed off the vessels, and diver presence associated with the Proposed Action. Vessels, in particular, have the potential to alter the behavior of marine fish, sea turtles, and marine mammals through disturbance. Marine species off the coast of Kauai are frequently exposed to vessel movement due to research, ecotourism, commercial, government, and private vessel traffic. It is assumed that both vessel noise and visual cues associated with the presence of a vessel play a role in prompting behavioral reactions from animals. Reactions to vessels often include changes in general activity (e.g., from resting or feeding to active avoidance), changes in surfacing-respiration dive cycles, and changes in speed and direction of movement. Previous experiences of an animal with vessels are also important in determining the degree and type of response elicited from an animal-vessel encounter. Some species have been noted to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Richardson et al. 1995; Terhune and Verboom 1999; Watkins 1986).

The Proposed Action would involve HDD operations as well as the laydown of on an onshore construction site, which would cause terrestrial disturbance. These activities ashore may include site preparation, staking for HDD guy wires, drilling, and movement of equipment and materials within the onshore portion of the proposed action area. The construction site is approximately 1 acre and situated about 500 ft (152 m) inland of the shoreline at PMRF. Road access and some conduit infrastructure already exist at the site and would not need to be constructed prior to the Proposed Action.

Population-level impacts would not occur to invertebrates or corals in the proposed action area. System components would become habitat for benthic invertebrates. If objects are recovered for maintenance, the invertebrate species encrusting those objects may suffer mortality if not returned to the water promptly. Resulting mortality would not be extensive given the populations of benthic invertebrates in the area. The footprint of the cable is small and coral is sparsely populating the proposed action area, but if cable stabilization were to fail, loose cable may cause scouring of the seafloor, damaging sessile benthic invertebrates. These would not be population-level impacts and, once repaired, species could recover.

Although green sea turtles and Hawaiian monk seals can be present on PMRF beaches, including relatively near the proposed action area, they are not present within the terrestrial portion of the proposed action area. Additionally, there is a dune system between areas they are known to occur and the construction site, with the HDD path running north of their most likely nearby haul-out location (Nohili Ditch outflow). Furthermore, the HDD would be far enough underground that it would not impact terrestrial animals on PMRF beaches. If stakes need to be installed from the construction laydown area to the shoreline, in order to steer the HDD, this setup would take a very minimal amount of time and could be done at a time when these species could be easily avoided, as the stakes would be placed manually and these species could be watched for easily on land. SOPs (Chapter 5) would be followed. Consequently, terrestrial disturbance resulting from the Proposed Action would not be expected to have significant impacts on Hawaiian monk seals or sea turtles. As such, these species are not considered further in this analysis.

4.3.2.1 Potential Impacts to Benthic Habitat and EFH

The entirety of the proposed action area is located in waters less than 328 ft (100 m) deep. All of this benthic habitat includes designated EFH (Section 3.2.4). The proper operation and longevity of the system requires that cables and sensors be laid in areas free of obstructions like large boulders or bottom topography that is steep or cavernous. As a result, surveys were conducted or are planned to occur along the potential cable path as well as in the area of the HDD punch out location in order to avoid such bottom features. Cable routes were selected to target soft-bottom or sandy benthic habitats; hard-bottom, high-relief substrate would be avoided (Chapter 5). The cable is small in diameter (less than 2 in [5 cm], and the proposed action area is fairly dynamic (i.e., turbid due to wave action). Over time, cables would become integrated into the benthic habitat by becoming buried under shifting unconsolidated sediments (e.g., sand), or by serving as a hard-bottom substrate, which could then be used by colonizing benthic organisms.

The alteration of soft substrate to hard substrate would occur to a small amount of bottom habitat (387.5 ft^2 [36 m^2]; calculations from Table 1-1) by installing sensors and anchor structures over the substrate and thus reducing the quantity of available soft-bottom substrate. While over time bottom currents are likely to shift unconsolidated sandy sediments, burying portions of the sensors and anchor structures (effectively restoring soft-bottom benthic substrate in some areas), the sensors must remain mostly uncovered to best operate and would be too large to become completely covered by sand. The hard surface of unburied sensors and anchor structures represents a type of hard-bottom substrate available to sessile benthic organisms seeking a hard substrate suitable for colonization, including species with EFH in this area.

Once the infrastructure settles, it would remain stationary on the seafloor and would not move with waves or currents due to the stabilization and weight of the components that are part of the system. Infrastructure installed on the seafloor in less than 100 ft (30 m) of water (where the influence of waves and surface currents could cause infrastructure to shift on the seafloor) would be anchored in place to prevent movement and damage to the infrastructure as well as the seafloor habitat. Clamps would be used to secure the shore landing and trunk cables to the seafloor. Clamps would be installed approximately every 33 ft (10 m). SOPs and protective measures (Chapter 5) would be implemented to reduce impacts to the benthic habitat and EFH from physical disturbance.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to the benthic habitat or EFH. Under the MSA, there would be a small, long-term reduction in the quantity of abiotic bottom habitat EFH from physical disturbance caused by the Proposed Action.

4.3.2.2 Potential Impacts to Terrestrial Habitat

The potential impacts to terrestrial habitat as a result of terrestrial disturbance would be due to the use of equipment, guy wire stakes, HDD, and trenching for new conduit within the onshore construction site. Terrestrial habitats in the proposed action area consist mainly of grassy vegetation. No sensitive habitat or vegetation are present, and no trees, shrubs, or bushes are present. A habitat classification and vegetation mapping study conducted at PMRF in 2005 describes the proposed action area as landscaped non-native vegetation, which is the second-most common vegetation type throughout the installation (PMRF 2024). This habitat is essentially mowed lawn, primarily comprised of buffelgrass and Bermuda grass. Other weedy non-native species may also be present, particularly along the dirt road that runs through the proposed action area.

The terrestrial habitats in the proposed action area are not complex; the landscaped (mowed), non-native species that dominate the area may provide limited habitat value to local animal species. Regardless, terrestrial habitats may be impacted by the Proposed Action, as trenching and HDD take place and equipment and the laydown area in the proposed action area would be in place for a few months. After the Proposed Action is completed, the area will be backfilled, reseeded, and restored as possible and appropriate according to the SOPs and protective measures (Chapter 5).

In accordance with NEPA, physical disturbance from HDD operations associated with the Proposed Action would not result in significant impacts to terrestrial habitat.

4.3.2.3 Potential Impacts to Water Resources

The potential impacts to water resources as a result of terrestrial disturbance would be due to the use of equipment, HDD, and trenching for new conduit within the onshore construction site. While construction activities, including HDD, could affect water in or near the proposed action area, any impacts would be temporary and relevant only to rainwater and associated runoff. The Proposed Action would not occur in or near a wetland or other freshwater site, and appropriate SOPs and protective measures (Chapter 5) would be applied to limit any drainage issues that may arise due to construction activities. Similarly, while the HDD process uses water supplied from a nearby fire hydrant or other supply to mix the slurry used for drilling, any excess slurry would be re-captured within the construction area. In addition, as the end of HDD nears, bentonite would no longer be added to the drilling fluid, leaving only water to mix as the punch out location is reached. This measure (Chapter 5) is meant to limit any bentonite reaching the marine environment. As a result, water quality in and around the proposed action area is not expected to experience more than negligible and temporary impacts, and any slurry and bentonite used in drilling would remain contained in the HDD system or other storage area until it is shipped offsite.

In accordance with NEPA, physical disturbance from HDD operations associated with the Proposed Action would not result in significant impacts to water resources.

4.3.2.4 Potential Impacts to Birds

Birds in the proposed action area may be exposed to vessel movement and HDD operations during the Proposed Action. While it is difficult to differentiate between behavioral responses to sound and visual cues associated with a disturbance, like the presence of a vessel (Hazel et al. 2007), it is assumed that both play a role in prompting reactions from animals. At sea, support vessels would only be present for 19 days (and are mostly stationary when conducting work). In addition, birds are highly maneuverable in air, and it would be a rare occurrence for a bird to be underwater, diving directly in the path of a deployed object. Because installation of the system would not occur during times of reduced visibility or rough seas, impacts to birds from the at-sea installation activities would be limited to behavioral reactions, which are discussed below.

The potential impacts to birds from terrestrial disturbance would be due to the use of equipment, guy wire staking/weighting, HDD, and trenching for new conduit within the onshore construction site. If stakes or sandbags need to be placed in order to steer the HDD rig, this setup would take a very minimal amount of time, and could be done at a time when nesting birds could be easily avoided, as the stakes/sandbags would be placed manually, visible nesting birds could be monitored on land, and underground burrows would be flagged for avoidance by the natural resources team at PMRF. Terrestrial habitats in the proposed action area consist mainly of grassy vegetation with no trees or shrubs. No sensitive habitat, such as wetlands, or non-grass vegetation are present. Therefore, there are no specialized resources that typically draw birds to this area. PMRF has much more suitable bird habitat than that located in the proposed action area. Therefore, if present, birds, including ESA-listed species, may move away from this area of terrestrial disturbance to an area better suited to breeding, feeding, nesting, or resting. Of the ESA-listed bird species detailed in Table 3-4, Hawaiian geese would be more likely to be encountered in the proposed action area as they utilize grass and shrublands and feed on vegetation. Any impacts to Hawaiian geese would be minimal and temporary, such as if these birds move out of the proposed action area to forage elsewhere. Once construction and HDD activities have concluded, birds could return to the area. Any impacts to birds would be minor and temporary. Behavioral reactions of birds to onshore disturbance are discussed below.

Behavioral responses of birds to a physical disturbance may include changes in general activity (e.g., from resting or feeding to active avoidance), changes in flight patterns, and changes in speed and direction of movement. The most likely response of a bird to any disturbance is flushing from the area; however, birds would be expected to return to normal behavior soon after the disturbance has occurred. As vessel speeds are slow (less than one knot when not transiting), vessel movement is not expected to cause more than short term behavioral responses in birds. Similarly, due to location and the time of year, onshore construction would not disrupt breeding or nesting activities of birds at PMRF. Birds are either not likely to respond to physical disturbances or are not likely to respond in ways that would significantly disrupt normal behavior patterns that include, but are not limited to, migration, breeding, feeding, or sheltering. As a result, any response caused by the Proposed Action would be limited to a temporary and localized behavioral disturbance. No population-level effects would be expected.

While sea-going species of ESA-listed birds (i.e., the band-rumped storm petrel, Hawaiian duck, Hawaiian petrel, Hawaiian stilt, Newell's shearwater, or short-tailed albatross) may overlap with the movement of vessels at sea, it is unlikely these species of birds would overlap with the proposed action area. Species like petrels, shearwaters, and albatross typically forage in pelagic habitats, over waters deeper than 3,281 ft (1,000 m), while the Hawaiian stilt may forage along the shoreline and the Hawaiian duck would forage in freshwater habitats. It is unlikely these species would overlap with vessel movement in the proposed action area, which is about 3 nautical miles from shore, in a maximum water depth of 300 ft (91 m). Furthermore, the Proposed Action involves installation only during daytime work hours; there would be no active work at night and no lights on during nighttime hours that may impact bird behavior during those hours. Therefore, there would be no effect from the Proposed Action on these species.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to birds. In accordance with the ESA, physical disturbance resulting from the at-sea portion of the Proposed Action may affect, but is not likely to adversely affect the ESA-listed species that may be present, including the band-rumped storm petrel, Hawaiian duck, Hawaiian petrel, Hawaiian stilt, Newell's Townsend's shearwater, or short-tailed albatross. There would be no effect to the ESA-listed Hawaiian common gallinule, Hawaiian coot, or the Hawaiian goose from at-sea disturbances associated with the Proposed Action, as those species are freshwater inhabitants whose presence would not overlap with the system installation. In accordance with the ESA, physical disturbance resulting from the onshore portion of the Proposed Action may affect, but is not likely to adversely affect the ESA-listed species that may be present on land, including the Hawaiian common gallinule, Hawaiian coot, Hawaiian duck, Hawaiian stilt, or the Hawaiian goose. There would be no effect from terrestrial disturbances to the ESA-listed band-rumped storm petrel, Hawaiian petrel, Newell's shearwater, or short-tailed albatross as these species would not likely be present other than at sea. Pursuant to the MBTA, physical disturbance associated with the Proposed Action would not result in significant adverse effects on migratory bird populations.

4.3.2.5 Potential Impacts to Fish

Fish are capable of detecting approaching objects by sound, water movement, or visual cues (Becker et al. 2013; Misund 1997). If startle and avoidance responses occur as a result of vessel movement, object deployment, or diver presence in the area, normal patterns of behavior would quickly resume, and impacts to feeding and breeding would be unlikely to occur. Deployed cable and equipment would create new structure on the bottom that some fish species could use for shelter, however the extent of this impact is limited given the relatively small footprint of deployed equipment on the seafloor. It is likely that fish would treat objects similar to natural hard structures on the seafloor, and any changes in behavior would be minimal and would not have population-level impacts.

Given the transient nature of both ESA-listed species—giant manta rays and oceanic whitetip sharks—it would be highly unlikely that they would encounter a vessel during the Proposed Action and would not likely encounter the divers in shallow waters. Some studies have found that sightings of large marine fish, such as manta rays, have decreased in areas of high tourist boat traffic (Graham 2007; O'Malley et al. 2013), which may indicate avoidance of the area. Individual fish found in the proposed action area may be temporarily displaced during the Proposed Action. Consequently, vessel movement and object deployment may potentially result in short-term behavioral impacts to fish, including ESA-listed species. However, disturbance would not be prolonged given the temporary presence (19 days) of the vessels associated with the Proposed Action. In shallow waters, installation would take approximately 7 days, so disturbance by vessels, objects, and divers would be brief and localized.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to fish. In accordance with the ESA, physical disturbance from the

Proposed Action may affect, but is not likely to adversely affect the ESA-listed giant manta ray or oceanic whitetip shark.

4.3.2.6 Potential Impacts to Sea Turtles

Sea turtles in the proposed action area, both of which are ESA-listed species, may be exposed to vessel movement and object deployment, including diver activities, during the Proposed Action. Green and hawksbill sea turtles may occur at or near the surface in open-ocean and coastal areas during feeding or when surfacing to breathe, although they typically spend a majority of their time submerged (Renaurd and Carpenter 1994; Sasso and Witzell 2006) or basking on shore, likely near the Nohili Ditch outfall, outside of the proposed action area. While sea turtles are diving (i.e., feeding) or basking, they would not be susceptible to vessel movement, which only takes place at the water's surface, but may encounter objects or divers in the water. Adult green and hawksbill sea turtles typically forage for vegetation or sponges on the seafloor at depths shallower than the depths at which most of the system installation would occur. However, as described in Section 3.1.1, a dive survey showed that the cable path near the HDD punch out location is primarily barren hard bottom, and would not be an ideal foraging location for sea turtles. Deployed cable and equipment would create new structure on the bottom that some sea turtle species may encounter, however the extent of this impact is limited given the relatively small footprint of deployed equipment on the seafloor and the depth at which sensors are located. It is likely that sea turtles would treat objects similar to natural hard structures on the seafloor, and any changes in behavior would be minimal and would not have population-level impacts.

Sea turtles have been observed to elicit short-term responses in their reactions to vessels, and their reaction time was greatly dependent on the speed of the vessel (Hazel et al. 2007). Avoidance behavior, as displayed with a slow moving vessel, would be short and of low intensity, such as moving a short distance away (Hazel et al. 2007). The slow or stationary nature of the vessels used in the Proposed Action increase the probability that sea turtles would attempt to avoid the vessel (Hazel et al. 2007). The likelihood of sea turtles to be close to objects as they are deployed, and to be therefore subject to disturbance as they move through the water column, is so low as to be negligible. Sea turtles have well-developed underwater vision and would likely detect an object descending through the water column (Southwood et al. 2008). Individual green or hawksbill sea turtles in the proposed action area may be temporarily displaced during the Proposed Action. However, any behavioral reactions to vessels, objects, or divers would be minimized due to SOPs, which require stopping system installation when sea turtles are sighted (Chapter 5). Cable laying can pause in an attempt to avoid sea turtles when practicable. No population-level impacts to sea turtles would be expected as a result of physical disturbance associated with the Proposed Action.

Proposed green sea turtle critical habitat is located in the proposed action area and has been proposed in order to protect sea turtles as they move from nesting and basking beaches to foraging areas, refuges, and mating areas. The essential features of the critical habitat include areas used for these activities. Because sea turtles have been seen basking and foraging in the vicinity of the Nohili Ditch outfall (south of the proposed action area), it is assumed this habitat contains essential features. However, shallow water surveys conducted along the cable path and surrounding the punch out location show that suitable vegetation for foraging and habitat for refugia are not present in the proposed action area. The HDD punch out location is at the deepest depth, at the edge of the green sea turtle proposed critical habitat. Shallow water installation activities would be focused to a relatively small area around the HDD punch out location and shallow water junction box, completed within a relatively short period of time (7 days), and would involve divers. As such, physical disturbance by vessels or object deployment within the shallow waters of the proposed action area would occur in a limited area, only be temporary, and short in duration, thus posing no obstruction (including artificial light) to the reproduction or feeding of green sea turtles. Other than an intermittent transit out to the proposed action area each day, vessels would either not be moving or would be moving very slowly and would not impact the green sea turtle habitat in any way.

Due to the slow speeds of the vessels (less than 1 knot during installation) and objects being installed, physical disturbance to sea turtles would be minimal. Additionally, any vessel used in the Proposed Action would include lookouts for marine species, as per the SOPs (Chapter 5). Although the cable-laying vessel cannot move from the area once cable installation has begun, they could temporarily stop laying cable to allow a marine animal to continue away from the area when practicable. Therefore, the most likely response of sea turtles to vessel movement is behavioral response. Behavioral responses to vessel movement may include diving if at the surface, swimming away while at the surface, or surfacing if on the bottom. Short-term behavioral responses would not result in population-level impacts.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to sea turtles. In accordance with the ESA, physical disturbance from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed green sea turtle or hawksbill sea turtle. Physical disturbance associated with the Proposed Action would not cause the destruction or adverse modification of proposed green sea turtle critical habitat.

4.3.2.7 Potential Impacts to Terrestrial Mammals

The potential impacts to terrestrial mammals as a result of physical disturbance would be due to the use of equipment, guy wire staking, HDD, and trenching for new conduit within the onshore construction site. As stated in Section 3.1.2, terrestrial habitats in the proposed action area consist mainly of grassy vegetation with no trees, shrubs, or bushes. No sensitive habitat, such as wetlands, or vegetation are present. Therefore, there are no specialized resources that draw terrestrial mammals to this area. The non-native feral dog, feral cat, and common house mouse may also be present in or near the proposed action area. Feral dogs and cats are known dangers to protected species at PMRF. They will not be disproportionately impacted by terrestrial disturbance associated with the Proposed Action and will not be further analyzed herein. The ESA-listed Hawaiian hoary bat is the only native terrestrial mammal that may be present in the proposed action area. This species requires woody vegetation greater than 15 ft (5 m) in height for roosting habitat (PMRF 2024), and the proposed action area does not include any such vegetation. Consequently, roosting and breeding activities are extremely unlikely to be impacted by terrestrial disturbance caused by the Proposed Action. Furthermore, the Proposed Action involves construction only during daytime work hours; there would be no active work at night and no lights on during nighttime hours that may impact bat behavior during those hours.

In general, the terrestrial portion of the proposed action area may be used for shelter, foraging, or breeding activities by terrestrial mammals. During daytime work hours, behavioral avoidance responses from mammals would be expected as noise and activity would deter foraging or breeding near construction. PMRF has a wide range of suitable terrestrial habitat than that located in the proposed action area. Therefore, if present, terrestrial mammals may move away from this area of terrestrial disturbance to an area better suited to breeding, feeding, nesting, or resting. Terrestrial mammals in or near the proposed action area are likely already accustomed to human activity given the area's location on PMRF property near other active roads and buildings; consequently, this avoidance behavior and any potential interactions would likely not represent a novel change for resident terrestrial mammals. Once construction and HDD activities have concluded, mammals could return to the area. SOPs and protective measures (Chapter 5) would be in place to ensure terrestrial mammals would not become trapped in trenches or pits at the construction site. Hawaiian hoary bats likely face little risk of interaction with construction activities or active terrestrial disturbance. As nocturnal hunters, bats would rarely interact with active construction equipment or personnel, and during twilight hours when interaction may be possible, it is expected that the bats would exhibit minor avoidance behaviors. Construction equipment also presents little collision risk for bats, which navigate by echolocation and are primarily at risk of collision with structures such as fences, which would not be utilized (Chapter 5). If stakes need to be installed in order to steer the HDD, this setup would take a minimal amount of time, and could be done at a time when ESA-listed bats could be easily avoided, as the stakes would be placed manually and these species are mainly present at dusk or after dark. Given the small footprint (1 acre) of the onshore portion of the Proposed Action, it is unlikely that temporarily removing this area from use by mammals would present a significant impact on the species present. While the Proposed Action would cause limited and temporary disturbances to terrestrial habitat, it is unlikely these will result in long-term or population-level impacts on terrestrial mammals.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to terrestrial mammals. In accordance with the ESA, physical disturbance associated with the Proposed Action may affect, but is not likely to adversely affect the ESA-listed Hawaiian hoary bat.

4.3.2.8 Potential Impacts to Marine Mammals

Marine mammals in the proposed action area, many of which are ESA-listed species, may be disturbed by vessel movement, object deployment, or diver presence. Overall, most marine mammals that may be present in the proposed action area (Table 3-10) either typically occur in deeper waters beyond the array site, or forage throughout the water column or near the surface. Sei whales, for instance, typically forage by surface skimming, while humpback whales forage by lunging towards the surface, and minke whales perform side-lunges. Many of the marine mammals are typically at depths beyond those in the proposed action area. With the exception of these species, few of the species spend more time at the surface than necessary to breathe. As a result, while a variety of marine mammals may occur in the proposed action area, a limited number of individuals are likely to encounter activities associated with the Proposed Action.

Marine mammals react to disturbance in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses, while other animals ignore the stimulus altogether (Terhune and Verboom 1999; Watkins 1986). Cetaceans have been found to generally ignore transiting vessel traffic as it approaches, although they may engage in last minute avoidance maneuvers (Laist et al. 2001). Some marine mammals, including bottlenose dolphins and ESA-listed Hawaiian monk seals, prey on animals on the seafloor, and may encounter system components on the seafloor, depending on the depths in which they forage. However, most object deployment would occur in areas where most marine mammal species are not actively foraging. A shallow water dive survey showed that the cable path near the HDD punch out location is primarily barren hard bottom, and would not be an ideal foraging location for marine mammals (Section 3.1.1). If marine mammals were to encounter system components while foraging, it would not be expected that these physical interactions would result in anything more than minor behavioral responses, such as relocation to a new foraging area. Deployed cable and equipment would create new structure on the bottom. It is likely that marine mammals would treat objects similar to natural hard structures on the seafloor, and any changes in behavior would be minimal and would not have population-level impacts.

Marine mammals, including ESA-listed species, would be expected to return to normal behavior shortly after encountering a disturbance, continuing with normal behavior with little to no impact. All vessels would carry lookouts, minimizing the risk of a vessel crossing paths with a marine mammal at the surface, particularly at close range. Due to the slow speeds of the vessels (speeds of less than 1 knot during system installation) and objects being installed, physical disturbance to marine mammals would be minimal. SOPs (Chapter 5) would minimize risks to marine mammals. Although the cable-laying vessel cannot move from the area once cable installation has begun, they could temporarily stop laying cable to allow a marine animal to continue away from the area when practicable. Therefore, the most likely response of marine mammals to physical disturbance is behavioral response. Behavioral responses to a disturbance may include diving if at the surface, swimming away while at the surface, or surfacing if near the bottom. Short-term behavioral responses would not result in population-level impacts.

In accordance with NEPA, physical disturbance associated with the Proposed Action would not result in significant impacts to marine mammals. Additionally, in accordance with the ESA, physical disturbance from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed sei whale, MHI insular false killer whale, or Hawaiian monk seal. Physical disturbance associated with the Proposed Action would not result in reasonably foreseeable takes under the MMPA.

4.3.3 Turbidity

According to the EPA, the waters off the coast of Barking Sands Beach and Polihale State Park (just north of Barking Sands Beach) are impaired due to turbidity, which means that there are suspended soil particles, algae, microbes, or organic matter (EPA 2024a). Therefore, predeployment conditions in the proposed action area would likely be turbid. The potential causes of sediment suspension (i.e., turbidity) include the disturbance of bottom substrate by object deployment (e.g., cables, divers, equipment) and emergence of the HDD rig drill head. As stated in the SOPs (Chapter 5), cables and equipment are always moved in a way that would ensure gradual, controlled descent of equipment; therefore, impacts would be localized to the bottom substrate in the footprint of the object, which may then become temporarily suspended in the water column. In the moment that the drill head passes from beneath the substrate to the water column on the other side, there would be an increase in suspended sediment in the water column. The turbidity plume would be expected to be approximately four times the diameter of the deployed object, meaning that a 2 in (5 cm) cable could result in an 8 in (20 cm) sediment plume. Larger objects would create larger plumes. However, given the depth and location of the punch out location, in the lee of Kauai, sediment would settle from the water column fairly quickly, returning the water to pre-disturbance conditions.

Because the proposed action area is already turbid, and the objects are always moved in a way that is slow and controlled (Chapter 5), the limited and brief increase in turbidity would not have significant impacts on aquatic invertebrates and corals, fish, EFH, birds, sea turtles, or marine mammals. The temporary impacts of disturbance to the water column would be so minimal as to be immeasurable.

4.3.3.1 Potential Impacts to Water Resources

Sediment temporarily suspended in the water column by deployed objects landing on the seafloor could have minor and localized impacts to water resources. There would not be a measurable change in turbidity as a result of object deployment associated with the Proposed Action and water quality would not be altered as a result of the Proposed Action.

In accordance with NEPA, turbidity associated with the Proposed Action would not result in significant impacts to water resources.

4.3.3.2 Potential Impacts to Sea Turtles

There may be potential impacts to sea turtle proposed critical habitat as a result of HDD punch out and resulting turbidity. The proposed critical habitat is from the mean high water line to 66 ft (20 m) depth and the punch out location would tentatively be located in 65–70 ft (20–21 m) of water, but any number of circumstances might occur to cause the drill to need to punch out in a slightly shallower location within the proposed green sea turtle critical habitat. If this were to occur, impacts would be a brief, localized sediment plume as the drill head passes from beneath the sediment into the water column. As this area has been surveyed and does not appear to contain foraging habitat, it is unlikely sea turtles would be present. The bottom is mostly hard, so the major change to the habitat would be the creation of the conduit itself. The essential features of the green sea turtle critical habitat concern areas for reproduction, resting, and feeding, as well as migrating between these areas. The temporary increase in turbidity at drill punch out would not impact habitat well suited to any of these essential functions, nor would it impede the ability of sea turtles to migrate safely to these areas. The main area in use by green sea turtles is south of the proposed action area where there is available sea grass habitat, a beach for nesting/basking, and refugia areas just offshore. SOPs and mitigation measures (Chapter 5) would protect the migrating sea turtles themselves, and divers located in the water to stabilize and lay cable would avoid specific areas. A combination of the Chapter 5 mitigations and the incidental spill prevention plan put in place by the HDD contractor would protect the general aquatic habitat during system installation and HDD.

In accordance with NEPA, turbidity associated with the Proposed Action would not result in significant impacts to sea turtles. In accordance with the ESA, turbidity from the Proposed Action may affect, but is not likely to adversely affect the ESA-listed green or hawksbill sea turtle and would not cause the destruction or adverse modification of proposed critical habitat for the ESA-listed green sea turtle.

4.3.4 Summary of Physical Stressor Consequences

PACDERMA infrastructure installation would result in the risk of strike, physical disturbance, and a temporary increase in turbidity in the footprint of deployed objects. The risk of strike to most species would be incredibly low due to the slow speeds of the vessels used in cable-laying and object deployment. Lookouts and divers in the water (Chapter 5) would further reduce the risk of injury or death, even to corals in the proposed action area, though some risk would still exist. Most species would have a behavioral response to activities both onshore and at sea, resulting in temporary avoidance of the area of disturbance. Impacts to resources from physical stressors are summarized in Table 4-6.

4.4 Conclusions

A summary of the conclusions for all resources from the Proposed Action is below.

Table 4-6. Summary of Conclusions

Resource	***Stressors Analyzed***	***Potential Impacts***	***Conclusion***
Benthic habitat	Physical disturbance	Damage if hard or biotic hard bottom, disturbance or temporary sediment suspension if soft bottom	NEPA: No significant impact
Terrestrial habitat	Physical disturbance	Disturbance of soil and grassy field habitat on shore	NEPA: No significant impact
Water resources	Physical disturbance Turbidity	No change to water quality. Temporary suspension of sediment or small amounts of storm runoff from construction	NEPA: No significant impact
	Turbidity		
Aquatic invertebrates and coral	Underwater noise	Behavioral response	NEPA: No significant impact
	Strike	Injury or mortality from vessel propellers or objects contacting invertebrates on the bottom	
Birds	Underwater noise	Behavioral response or brief/temporary masking	NEPA: No significant impact. MBTA: No take of migratory birds; no adverse impact to bird populations; no effect to migratory birds. ESA: May affect, not likely to adversely affect ESA-listed birds
	In-air noise		
	Physical disturbance		
Fish	Underwater noise	Behavioral response or brief/temporary masking	NEPA: No significant impact. ESA: May affect, not likely to adversely affect ESA-listed fish.
	Physical disturbance		
EFH	Underwater noise	Minimal and temporary reduction in quality of water column EFH	NEPA: No significant impact. MSA: A long term reduction in the quantity of benthic and biotic EFH in the proposed action area and temporary reduction in the quality of water column EFH in the proposed action area.
	Strike	Long term reduction in the quantity of EFH in the footprint of devices	
Sea turtles	Underwater noise	Behavioral response, masking	NEPA: No significant impact. ESA: May affect, but not likely to adversely affect ESA-listed sea turtles. The Proposed Action would not result in the destruction or adverse modification of proposed green sea turtle critical habitat.
	Strike	Injury or mortality	
	Physical disturbance	Behavioral response	
	Turbidity	Sediment suspended in critical habitat area, brief/temporary reduction in the quality of habitat for foraging	
Terrestrial mammals	In-air noise	Behavioral response or brief/temporary masking	NEPA: No significant impact. ESA: May affect, but not likely to adversely affect ESA-listed bats.
	Physical disturbance		
Marine mammals	Underwater noise	Behavioral response or brief/temporary masking	NEPA: No significant impact. ESA: May affect, but not likely to adversely affect ESA-listed marine mammals. MMPA: No reasonably foreseeable takes of marine mammals.
	Strike	Injury	
	Physical disturbance	Behavioral response	

5 Standard Operating Procedures and Protective Measures

Both SOPs and protective measures would be implemented during the Proposed Action. SOPs serve the primary purpose of providing for safety and mission success and are implemented regardless of their secondary benefits to a resource. Protective measures are used specifically to avoid or reduce potential impacts to a resource. The SOPs and protective measures that are applicable to potential impacts to ESA-listed marine species from the Proposed Action are provided below.

5.1 Standard Operating Procedures

Vessel Operations

- Issuance of a Notice to Mariners would alert boaters to the need to avoid areas of installation activity.
- Semi-permanent anchoring would be utilized and installed clear of sensitive resources based on benthic surveys.
- Vessels would operate at slow speeds (expected to be slower than 10 knots) when performing work. Vessels in the proposed action area would travel at speeds necessary for safe and efficient navigation, i.e., at speeds necessary to maintain steerage if towing equipment, but not so fast that objects in the water cannot be avoided. These considerations would be expected to further reduce the potential for ship strike of protected marine species.
- Vessels associated with the Proposed Action would immediately (or as soon as operational security considerations allow) notify U.S. Navy- PMRF Natural Resources staff member at the PMRF resource hotline (808-208-4416) and the U.S. Pacific Fleet command center (808-471-5250) if a dead or seriously injured sea turtle or marine mammal is observed during a Navy activity.
- Vessels associated with the Proposed Action would carry a Ship Oil Pollution Emergency Plan (SOPEP) kit for clean-up in the unlikely event of a fuel spill and would adhere to all Navy (Office of the Chief of Naval Operations Instruction [OPNAVINST] 5090.1E, June 25, 2021, 39-3 Requirements), and Coast Guard (Clean Water Act, section 311) requirements regarding the containment, cleanup, and reporting of spills.
- Vessels (commercial or Navy-owned) associated with the Proposed Action would operate under all provisions laid out in the OPNAVINST 5090.1E (June 25, 2021) or other federal requirements for appropriate ballast water discharge and/or treatment to prevent introduction of a non-native/invasive species. As practicable, Navy small boats would be free of organic material.
- Navy vessels would follow the provisions in the Uniform National Discharge Standards (UNDS) program, which establishes national discharge standards for vessels of the Armed Forces for pumping gray water (40 CFR 1700.26). Commercial vessels involved would be expected to adhere to any applicable national standard of performance per the Vessel Incidental Discharge Act (89 FR 82074; Oct 9, 2024).

- Vessels would follow provisions of the Clean Water Act (33 U.S.C. 1322) and the OPNAVINST 5090.1E (June 25, 2021) as they pertain to federal regulations for disposing of black water.

Deployment of Equipment

- All objects would be lowered to the bottom (or installed) in a controlled manner.
- Sensor placement locations would be identified in advance to minimize at-sea mission time and navigation. Vessel movement and drift would be minimized to ensure that the proposed cable, sensor, and/or installation plan is followed with limited deviation.
- Use of established cable routes and corridors would be considered in order to reduce the potential for unnecessary contact with previously undisturbed coral, living hardbottom or other high-quality habitats. These habitats would be avoided to the maximum extent practicable.
- The Navy would identify in advance the proposed cable route that would minimize the required cable path and length of cable deployment. Existing cables and tying-in to established junction boxes (where feasible) would be used to the maximum extent practicable to minimize the length of cable required. The actual cable route selected when practicable would be based on a corridor resulting in minimal impacts on resources.
- During cable installation, vessel lookouts would ensure that sea turtles and marine mammals are not present before beginning to lay cable. Cable at the surface of the water should be monitored for species presence and operations can be paused if species are present until they depart, though vessels cannot move from their locations.
- The ROV would be cleaned, then shipped in a container to PMRF. It is unlikely any living organisms would survive this transit, but in order to minimize the spread of invasive species, the ROV would be inspected and cleaned of any organic material prior to being placed aboard the vessel.
- In order to avoid emergency stoppage once cable laying and array installation have begun, the installation plan has been built in 4–6 hour blocks of work. Should rough weather be forecast, for example, work could stop at the end of that block and continue when conditions improve. This would hopefully eliminate the need to pause and hold station with cable out or terminate the installation before the block of work has ended.
- At-sea mission time and navigation would be minimized to reduce potential contact with protected marine species.

Diver Operations

- All in-water dive activities will be halted if an ESA-listed species were to come within 50 yds of divers. Work can begin or resume once the animal has voluntarily departed the area and the activity would no longer adversely affect the animal.
- Divers would use reef-safe sunblock to avoid impacts to corals.
- Divers would clean gear prior to using gear during the Proposed Action.

Upland Construction

- Onshore construction would occur only during daytime work hours. There would be no active work at night and no lights on during nighttime hours.
- No fencing that may harm birds or bats would be erected around the construction site.
- Covers would be placed over dug areas (i.e., holes or depressions) that could pose an entrapment hazard to wildlife.
- Placement of stakes/sandbags and guy wires to electromagnetically steer the HDD rig would be placed by hand and would avoid the dune areas of cultural significance and visible animal species or nests that may be present at PMRF on shore.

Hazardous Materials and Safety

- Safety data sheets would be adhered to at all times.
- All garbage would be disposed of properly. Debris and other waste would be prevented from entering or remaining in the marine environment for the duration of installation activities.
- Any hazardous material would be kept in labeled containers to prevent discharge.
- No toxic substances would be introduced to the land, beach, or ocean environment during cable/sensor installation activities. Hazardous materials would be disposed of in compliance with all applicable federal, state and local laws, regulations, codes and ordinances.

5.2 Protective Measures

- Vessels would include marine species lookouts that have successfully completed the most recent version of the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series and the U.S. Navy Marine Species Awareness Training. While on watch, personnel shall employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the Lookout Training Handbook. Visual observations of applicable marine species would be communicated immediately to the appropriate watch station for information dissemination and appropriate action.
  - Introduction to the U.S. Navy Afloat Compliance Training Series https://www.youtube.com/watch?v=NWhnT-42Z3c
  - Marine Species Awareness Training (MSAT) https://www.youtube.com/watch?app=desktop&v=D1_uLRdzWxA
- No attempt would be made to feed, touch, or otherwise intentionally interact with any ESA-listed marine species.
- Vessels would increase vigilance if marine animals have been sighted in the area and would take reasonable and practicable actions to avoid collisions and activities that might result in a close interaction (of less than 100 yds). When not actively laying cable, vessels would avoid approaching marine mammals head on and shall maneuver to maintain a distance of 500 yds from observed whales and 200 yds from all other marine mammals and sea turtles (except bow riding dolphins). Floating weeds, algal mats, *Sargassum* rafts, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals would be taken where these are present.

6 Other Considerations Required by NEPA

Consistency with Other Federal Laws, Plans, Policies, and Regulations

In accordance with 42 U.S.C. 4332(H) and 32 CFR 773.3(b), 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 6-1 identifies the principal federal laws and regulations that are applicable to the Proposed Action and describes briefly how compliance with these laws and regulations would be accomplished.

Table 6-1. Principal Federal Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, Controls	***Status of Compliance***
NEPA (42 U.S.C. § 4321 *et seq*.), DoD NEPA implementing Procedures and Navy policy (e.g., OPNAVINST 5090.1E)	This EA has been prepared in accordance with NEPA and Navy NEPA procedures. Public participation and review are being conducted in compliance with NEPA.
Clean Air Act (42 U.S.C. § 7401 *et seq*.)	Since the Proposed Action would occur in an attainment area and would not generate emissions in non-attainment areas, the Proposed Action is not subject to analysis under the General Conformity Rule.
Clean Water Act (42 U.S.C. § 1251 *et seq*.)	A water quality certification will be included in the Army Corps permit, which will be obtained in the near future.
Coastal Zone Management Act (16 U.S.C. § 1451 *et seq*.)	PACDERMA infrastructure installation is consistent with the "Navy/Marine Corps *De Minimis* Activities Under CZMA" list (dated 9 July 2009). The actions are exempt from a negative determination or a consistency determination from the State of Hawaii.
Endangered Species Act (16 U.S.C. section 1531 *et seq*.)	This EA considers effects on species listed as threatened or endangered pursuant to this act and their designated critical habitat. In accordance with the ESA, informal consultation was initiated with the USFWS based on the determination that the Proposed Action may affect, but is not likely to adversely affect the ESA-listed band-rumped storm petrel, Hawaiian common gallinule, Hawaiian coot, Hawaiian duck, Hawaiian goose, Hawaiian petrel, Hawaiian stilt, Newell's shearwater, short-tailed albatross, or Hawaiian hoary bat. Concurrence was received from the USFWS on June 2, 2025. The Navy also consulted with NMFS, determining that the Proposed Action may affect, but is not likely to adversely affect the giant manta ray, oceanic whitetip shark, green sea turtle, hawksbill sea turtle, sei whale, MHI insular false killer whale, or Hawaiian monk seal. The Proposed Action would not cause the destruction or adverse modification of proposed green sea turtle critical habitat. Concurrence from NMFS was received on May 9, 2025.
Marine Mammal Protection Act (16 U.S.C. section 1361 *et seq*.)	This EA considers effects on protected marine mammal species pursuant to this act. Based on the analysis contained within this EA, the Navy is not required to submit an application for an Incidental Harassment Authorization with the USFWS or NMFS as take of marine mammals would not be expected.
Migratory Bird Treaty Act (16 U.S.C. §§ 703-712)	This EA considers effects on migratory birds under this act. Based on the analysis contained within this EA, the Navy is not required to consult with the USFWS as there would be no take of migratory birds and no significant adverse effects on migratory bird populations.

MSA (16 U.S.C. § 1801 *et seq*.)	This EA considers effects on EFH designated within the proposed action area. In accordance with the MSA, consultation with NMFS was initiated based on the determination that there would be a long term impact to the quality or quantity of EFH as a result of the Proposed Action. NMFS concurred with this finding and submitted conservation recommendations under the MSA, which were accepted by the Navy on June 10, 2025.
National Historical Preservation Act (54 U.S.C. § 3001018 *et seq*.)	The Navy completed a ground penetrating radar survey and a subsurface archaeological testing of the proposed action area on shore. No traditional Hawaiian features, deposits, or cultural materials were identified, and no burials or isolated human skeletal remains were encountered. A pipe, interpreted as a fuel line, was documented and determined not eligible for the National Register of Historic Places (NRHP). Therefore, no impacts to historic properties would be expected and review would fall under the Programmatic Agreement among the Commander Navy Region Hawaii, the Advisory Council on Historic Preservation and the Hawaii SHPD regarding Navy undertakings in Hawaii. The Navy will produce a memo to document these findings and report to the Hawaii SHPO in order to meet responsibilities pursuant to Section 106 of the NHPA.
Rivers and Harbors Act (33 U.S.C. § 401 *et seq*.)	The Navy will complete an application for a U.S. Army Corps of Engineers permit due to disturbance of the seafloor during infrastructure installation. This will not be obtained before the signing of the FONSI.
NPDES (33 U.S.C. § 1342 *et seq*.)	The Navy HDD contracting company will complete an application for a NPDES permit for disturbing an area of greater than 1 acre of land. This will not be obtained before the signing of the FONSI.

6.1 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 effect 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 and the consumption of fuel, oil, and lubricants for support vessels and construction equipment. Implementation of the Proposed Action would not result in significant irreversible or irretrievable commitment of resources.

6.2 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 effects on the environment and the consequences that these effects may have on the maintenance and enhancement of the long-term productivity of the affected environment. Effects that narrow the range of beneficial uses of the environment are of particular concern, such as using a parcel of land that eliminates the possibility of other uses at that site. In the short-term, the Proposed Action would result in temporary effects to physical and biological resources. No long-term effects are anticipated. The Proposed Action would not result in any effects that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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Appendix A Applicable Laws and Policies

This appendix is a summary of the federal and state statutes and regulations that are potentially applicable to the Proposed Action as presented in this EA. This list includes statutes and regulations that have been followed and require no further action, as well as those for which permits or authorizations have been, or may be at a future date, requested.

A.1 Endangered Species Act

The purpose of the ESA (16 U.S.C. §§ 1531–1544) is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the USFWS or 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 (16 U.S.C. § 1536 (a)(2)). Regulations implementing the ESA include a requirement for consultation on those actions that “may affect” a listed species or adversely modify critical habitat.

If an agency’s Proposed Action would “take” a listed species, then the agency must obtain an incidental take authorization from the responsible wildlife agency. The ESA defines the term “take” to mean “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct” (16 U.S.C. § 1532(19)). The regulatory definitions of “harm” and “harass” from NMFS and the USFWS are relevant to the Navy’s determination as to whether the Proposed Action would result in adverse effects on listed species.

- Harm is defined by regulation as “an act which actually kills or injures” fish or wildlife. “Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering” (50 CFR §§ 17.3. 50 CFR 222.102 (USFWS)).
- Harass is defined by USFWS regulation to mean an “intentional or negligent act or omission which creates 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” (50 CFR § 17.3). NMFS has not defined the term in its regulations.

In accordance with the ESA, informal consultation with USFWS was initiated based on the determination that the Proposed Action may affect, but is not likely to adversely affect the ESA-listed band-rumped storm petrel, Hawaiian common gallinule, Hawaiian coot, Hawaiian duck, Hawaiian goose, Hawaiian petrel, Hawaiian stilt, Newell’s shearwater, short-tailed albatross, or Hawaiian hoary bat. Concurrence was received from USFWS on June 3, 2025 and is referenced at 2025-0097657.

Informal consultation with NMFS was initiated based on the determination that the Proposed Action may affect, but is not likely to adversely affect the giant manta ray, oceanic whitetip shark, green sea turtle, hawksbill sea turtle, leatherback sea turtle, loggerhead sea turtle, olive ridley sea turtle, blue whale, fin whale, MHI insular false killer whale, sei whale, sperm whale, Hawaiian monk seal, or proposed green sea turtle critical habitat. Concurrence was received from NMFS on May 12, 2025 and is referenced at PIRO-2025-01213, I-PI-25-2490-DG, INQ-2024-00273.

A.2 Marine Mammal Protection Act

All marine mammals are protected under the provisions of the MMPA (16 U.S.C. §§ 1361–1407). The MMPA prohibits any person or vessel from "taking" marine mammals in U.S. waters without authorization. The act further regulates "takes" of marine mammals by U.S. citizens on the high seas. The term "take," as defined in Section 3 (16 U.S.C. § 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

The MMPA defines harassment as applied to military readiness activities. The Proposed Action constitutes a military readiness activity as defined in Public Law 107–314 (16 U.S.C. § 703) because these activities constitute "training operations of the Armed Forces that relate to combat, as well as adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use." For military readiness activities, such as the Proposed Action, the relevant definition of harassment is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild ("Level A harassment"); or
- Disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered ("Level B harassment") [16 U.S.C. §§ 1362(18)(B)(i), (ii)].

The Proposed Action would not result in any "take" of marine mammals, and therefore, an Incidental Harassment Authorization or Letter of Authorization under the MMPA was not required.

A.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA; 16 U.S.C. §§ 703–712) is the primary law in the U.S. established to conserve migratory birds. The MBTA prohibits the taking, killing, or possessing of any migratory bird or their parts, nests, or eggs, unless permitted by regulation.

The 2003 National Defense Authorization Act provided interim authority to members of the Armed Forces to incidentally take migratory birds during approved military readiness activities without violating the MBTA. The National Defense Authorization Act provided this interim authority to give the Secretary of the Interior time to exercise his/her authority under section 704(a) of the MBTA to prescribe regulations authorizing such incidental take. The Secretary of the Interior delegated this task to the USFWS. On February 28, 2007, the USFWS issued a final military readiness rule authorizing members of the Armed Forces to incidentally take migratory birds during military readiness activities.

The definition of military readiness activities applies to the MBTA in the same way that it applies to the MMPA, and the Proposed Action is considered a military readiness activity for the purposes of this Act. Under this regulation, the Navy must consider the potential environmental effects of its actions and assess the adverse effects of military readiness activities on migratory birds. If a Proposed Action may result in significant adverse effects on a population of migratory bird species, the Navy shall consult with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate those effects. A significant adverse effect on a population is defined as an effect that could, within a reasonable period of time, diminish the capacity of a population of a migratory bird species to sustain itself at a biologically viable level (50 CFR § 21.3). Conservation measures, as defined in 50 CFR § 21.3, include project designs or mitigation activities that are reasonable from a scientific, technological, and economic standpoint and are necessary to avoid, minimize, or mitigate the take of migratory birds or other potentially adverse effects.

Since the Proposed Action did not result in any significant adverse effects on populations of migratory bird species or takes of migratory bird species, consultation with USFWS under the MBTA was not required.

A.4 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. §§ 1801 – 1822), enacted to conserve and restore the nation’s fisheries, includes a requirement for NMFS and regional fishery management councils to describe and identify EFH for all species that are federally managed. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the MSA, federal agencies must consult with the Secretary of Commerce regarding any activity or proposed activity that is authorized, funded, or undertaken by the agency that may adversely affect EFH. An adverse effect is any effect that may reduce the quantity or quality of EFH. Adverse effects may include 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.

Consultation with NMFS was initiated based on the determination that the Proposed Action may cause a reduction in the quality or quantity of designated EFH in the proposed action area. The Navy found that impacts to EFH are expected to be short term, lasting between weeks and up to three years, except for the effects from the placement of sensors, junction boxes, and anchor structures, which would be long term. Proposed EFH conservation measures were received from NMFS on June 11, 2025. The Navy responded to these conservation measures and EFH consultation was completed on July 10, 2025.

A.5 Section 10 of the Rivers and Harbors Act

The Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. § 403) states that the creation of any obstruction not affirmatively authorized by Congress below the Ordinary High Water elevation of navigable waters of the United States is prohibited. Section 10 gives the U.S. Army Corps of Engineers the authority to approve and permit the creation of these obstructions as part of regulated activities, including but not limited to any disturbance of soils/sediments or modification of a navigable waterway.

It is expected that the installation of the PACDERMA system falls under one or more nationwide permits for specific activities. Preliminary meetings have been conducted with the Army Corps of Engineers and permits will be obtained prior to construction. Certain nationwide permits contain conditions that allow for the inclusion of Clean Water Act and Coastal Zone Management Act (CZMA) considerations as well. It is expected PACDERMA Section 10 permits will include provisions for CWA and CZMA, which are discussed below. This permit would not be obtained from the U.S. Army Corps of Engineers until after the completion of the NEPA process, and therefore a concurrence date cannot be included in this EA.

A.6 Coastal Zone Management Act

The CZMA (16 U.S.C. §§ 1451 – 1466) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones. The CZMA defines the coastal zone as extending "to the outer limit of State title and ownership under the Submerged Lands Act," which is 3 NM or 9 NM from the shoreline, depending on the location (16 U.S.C. § 1453(1)). The extent of the coastal zone inland varies from state to state. Section 307 of the CZMA stipulates that where a federal project initiates reasonably foreseeable effects to any coastal use or resource (land or water use, or natural resource), the action must be consistent to the maximum extent practicable with the enforceable policies of the affected state's federally approved coastal management plan. The Hawaii Office of Planning and Sustainable Development is the lead agency for coastal management for Hawaii and is responsible for enforcing Hawaii's federally approved coastal management plan, the Hawaii Coastal Zone Management Program. However, federal lands, which are "lands the use of which is by law subject solely to the discretion of…the Federal Government, its officers or agents," are statutorily excluded from the State's "coastal zone" (16 U.S.C. § 1453(1)). If, however, the proposed federal activity affects coastal resources or uses beyond the boundaries of the federal property (i.e., has spillover effects), the CZMA Section 307 federal consistency requirement applies, as described below. As a federal agency, the Navy is required to determine whether its proposed activities would affect the coastal zone.

A Consistency Determination, or a Negative Determination, may be submitted for review of federal agency activities. A federal agency submits a consistency determination when it determines that its activity may have an effect on a state coastal use or resource. In accordance with 15 CFR § 930.39, the consistency determination would include a brief statement indicating whether the proposed activity would be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the management program. The consistency determination should be based on evaluation of the relevant enforceable policies of the management program. In accordance with 15 CFR § 930.35,

> if a Federal agency determines that there would not be coastal effects, then the Federal agency shall provide the State agencies with a negative determination for a Federal agency activity: (1) Identified by a State agency on its list, as described in § 930.34(b), or through case-by-case monitoring of unlisted activities; or (2) Which is the same as or is similar to activities for which consistency determinations have been prepared in the past; or (3) For which the Federal agency undertook a thorough consistency assessment and developed initial findings on the coastal effects of the activity.

Thus, a Negative Determination must be submitted to a state if the agency determines no coastal effects and one or more of the triggers above is met.

The Navy has found that the PACDERMA Infrastructure Installation is consistent with the "Navy/Marine Corps *De Minimis* Activities Under CZMA" list (dated 9 July 2009) as determined by the Hawaii Coastal Zone Management program and the Department of the Navy. The Navy has determined these listed actions have insignificant coastal effects in accordance with the Department of Commerce, NOAA, and CZMA federal consistency regulations (15 CFR part 930.33(3)). These actions are exempt from a negative determination or a consistency determination from the State of Hawaii. The appropriate point of contact at the Department of Business, Economic Development, and Tourism will be notified of the project EA.

A.7 National Historic Preservation Act

The National Historic Preservation Act of 1966 (54 U.S.C. §§ 300101 – 300321) requires federal agencies to consider the impact of their actions on historic resources. Key elements of the Act include setting federal policy for preserving the nation’s cultural heritage; establishing the NRHP; establishing State Historic Preservation Offices; establishing the Advisory Council on Historic Preservation; and charging federal agencies to be responsible stewards of historic properties. Section 106 requires that each federal agency identify and assess the effects its actions may have on historic properties.

Based on a review of the NRHP, an archaeological literature review of previous archaeological studies completed at PMRF, a ground penetrating radar survey, and a subsurface archaeological survey of the project area, the Navy will determine if the project would have any effect on historic properties pursuant to the NHPA. The proposed action area has been previously disturbed and multiple archaeological surveys have been completed in and adjacent to the proposed action area. No impacts to historic properties are expected and review would fall under the Programmatic Agreement among the Commander Navy Region Hawaii, the Advisory Council on Historic Preservation and the Hawaii SHPD regarding Navy Undertakings in Hawaii. The Navy will produce a memo to document these findings and report to the Hawaii SHPD in order to meet responsibilities pursuant to Section 106 of the NHPA.

A.8 National Pollutant Discharge Elimination System

Created in 1972 by Section 402 of the Clean Water Act (33 U.S.C. §§ 1251 – 1388), the National Pollutant Discharge Elimination System (33 U.S.C. §1342) is a permit program that addresses water pollution by regulating point sources that discharge pollutants to the waters of the United States. NPDES permits contain limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people’s health. In Hawaii, the NPDES permitting is administered by the Department of Health, Clean Water Branch as authorized by the Environmental Protection Agency. Any activity that disturbs at minimum one acre of land is required to have construction storm water NPDES permit coverage.

Given the area of land disturbed by the trenching and construction laydown area of the Proposed Action, the HDD contractor plans to apply for a NPDES permit close to the time of construction. This permit will not be obtained until after the completion of the NEPA process, and therefore a date cannot be included in this EA.

Appendix B ESA-Listed Species Excerpts from the Section 7 Consultations

B.1 ESA-Listed Birds

B.1.1 Band-Rumped Storm Petrel

The Hawaii DPS of the band-rumped storm petrel (*Hydrobates castro*) is listed as endangered under the ESA (81 Federal Register [FR] 67786; September 30, 2016). There is currently no critical habitat designated for the species. They are regularly observed in coastal waters around the islands of Kauai, Niihau, and Hawaii. They have the potential to occur at PMRF as breeding visitors. Breeding colonies would be located outside of the proposed action area. Band-rumped storm petrels may be encountered in the proposed action area at sea or fly over the proposed action area at night.

Band-rumped storm petrels occur close to land where warm, deep waters of 3,280 ft (1,000 m) to more than 6,560 ft (2,000 m), are near islands in the Hawaiian archipelago; otherwise, they occur offshore or in upwelling regions (USFWS 2022).

During the breeding season, which is believed to start in April or May and end in October (Slotterback 2002), band-rumped storm petrels nest in areas with steep cliffs and barren lava flows at high elevations in the Main Hawaiian Islands (MHI). The breeding range of this species includes the islands of Hawaii, Lanai, Kauai, and Lehua (Antaky et al. 2019). Breeding occurs once yearly and pairs produce only one egg (Raine et al. 2017). Between 171 and 221 nesting pairs are estimated on Kauai (Wood et al. 2003), concentrated along the Nā Pali coast, particularly canyons in Kalalau Valley, Polihale, and Waimea Canyon (Raine et al. 2017), outside of the proposed action area. Nests are in burrows or crevices in rock or lava (International Union for the Conservation of Nature 2016; USFWS 2005b).

During the nesting season, deep-water habitats (more than 3,280 ft [1,000 m]) close to shore are typically used for foraging. Fishermen reported the majority of sightings of storm petrels at about 3 miles (mi; 5 kilometers [km]) off the Nā Pali Coast of Kauai (International Union for the Conservation of Nature 2016; Wood et al. 2002). During the non-breeding season, band-rumped storm petrels are distributed in the Pacific from Japan east to Central America and northern South America (Slotterback 2002). Colonies may remain at sea during the day and return to breeding colonies at night to roost (Overton et al. 2014; USFWS 2005b). Band-rumped storm-petrels may be found in groups of only a few birds or of up to 100 individuals.

When not at their nesting sites, adults spend most of their time foraging on the open ocean throughout the year (USFWS 2005b). Based on records from the Galapagos Islands, band-rumped storm petrels most likely feed on small fish, squid, and crustaceans (USFWS 2005b). Food is captured while sitting on the water or off the surface, by bill snatching as the bird gently flies just above the surface of the water (International Union for the Conservation of Nature 2016). They have been sighted foraging during the day (Lee 1984), but may also forage at night (Slotterback 2002).

B.1.2 Hawaiian Common Gallinule

The Hawaiian common gallinule (*Gallinula galeata sandvicensis*), formerly named the Hawaiian common moorhen (80 FR 25860; June 23, 2015), is listed as endangered under the ESA (32 FR 4001; March 11, 1967). Currently, critical habitat has not been designated for Hawaiian common gallinules. Hawaiian common gallinules may be present at PMRF year-round.

Hawaiian common gallinules are only found on the islands of Kauai and Oahu. Similar to other Hawaiian waterbirds, gallinules utilize a variety of wetland habitats such as freshwater marshes, ponds, coastal estuaries, irrigation ditches, and artificial reservoirs (USFWS 2011). Within these habitats, gallinules prefer areas with robust emergent vegetation near open water, floating mats of vegetation, and water depths of less an 3 ft (1 m) (USFWS 2011). At PMRF, gallinules have been commonly observed in the Kinikini Ditch and the Kawai'ele Ditch at the southern end of the facility, outside of the proposed action area.

The breeding season for gallinules occurs year-round, however peak breeding occurs from March to August. Nests are typically found in emergent vegetation in shallow water, on the ground if vegetation is insufficient, or in or on emergent or floating mats of vegetation (USFWS 2011). Nesting has been documented at PMRF in Kinikini Ditch. Information regarding the diet of Hawaiian common gallinules is limited, however it is assumed that the diet is similar to the common gallinule and is influenced on availability. Main foods include plants such as grasses, sedges, and legumes, algae, small insects, and snails (Bannor and Kiviat 2002).

B.1.3 Hawaiian Coot

The Hawaiian coot (*Fulica alai*) is listed as endangered under the ESA (35 FR 16047; October 13, 1970). Currently, no critical habitat has been designated for Hawaiian coots. The Hawaiian coot may be present at PMRF year-round, however, there is a lesser likelihood of occurrence within the proposed action area as preferred habitat is not found there. At PMRF, the Hawaiian coot has never been observed in the proposed action area, even with regular monitoring.

Hawaiian coots inhabit Kauai year-round. Although Hawaiian coots do not normally fly and only do so when migrating (Pratt and Brisbin Jr. 2002), they may migrate between islands in response to rainfall (Pratt and Brisbin Jr. 2002). They typically occur within the coastal plain and range from sea level to 850 ft (260 m), rarely to 3,500 ft (1,067 m), preferring lowland wetland habitats with suitable emergent plant growth interspersed with open water (Brisbin Jr. and Mowbray 2002). However, some birds have been observed in mountain streams and stock ponds at higher elevations on Hawaii. Hawaiian coots prefer freshwater wetlands, but will use brackish wetlands, and rarely, saline habitats (USFWS 2011).

Hawaiian coots nest in a mix of dense emergent vegetation and open water, though their nesting habitats are not well studied. They appear to prefer freshwater areas for nesting (Pratt and Brisbin Jr. 2002). Hawaiian coots forage in water less than 12 in (30 cm) deep, but can dive in water up to 48 in (120 cm) deep (USFWS 2011). There is very little research on the diet of Hawaiian coots, but Munro (1960) observed evidence that they consume mollusks and seeds and leaves of aquatic plants (Munro 2012).

B.1.4 Hawaiian Duck

The Hawaiian duck (*Anas wyvilliana*), or koloa maoli ("native duck"), is listed as endangered under the ESA (32 FR 4001; March 11, 1967). Currently, no critical habitat has been designated for this species. The Hawaiian duck may occur at PMRF year-round. The Hawaiian duck has not been recorded at sea in this area and is not likely to be present on shore near the proposed action area as there are no freshwater wetlands present.

The Hawaiian duck historically used a wide variety of natural wetland habitats for nesting and feeding, including freshwater marshes, flooded grasslands, coastal ponds, streams, montane pools, and forest swamplands at elevations ranging from sea level to 9,900 ft (3,000 m). They also use agricultural and artificial wetlands as feeding habitat. They may also use irrigation ditches, flooded ephemeral fields, reservoirs, and the mouths of larger streams as feeding or nesting areas (USFWS 2011).

Hawaiian ducks are opportunistic foragers and feed on various prey items such as snails, insect larvae, earthworms, tadpoles, crayfish, fish, aquatic invertebrates, seeds, rice, algae, and various wetland plants (Engilis et al. 2002). They forage in shallow water, less than 9 in (24 cm) deep, along the edges of streams, wetlands, littoral zone of reservoirs and ponds, and ephemeral sites (Engilis et al. 2002).

B.1.5 Hawaiian Goose

The Hawaiian goose (*Branta sandvicensis*) is listed as threatened throughout its range under the ESA (84 FR 69918; December 19, 2019). Currently, no critical habitat has been designated for the species. Hawaiian geese may be present at PMRF year-round. Hawaiian geese may travel through grassy fields or forest edges, and therefore may be found in the proposed action area.

The Hawaiian goose can be found throughout the Hawaiian islands of Hawaii, Kauai, Maui, and Molokai. Generally, Hawaiian geese utilize shrublands, grasslands, lava flows with sparse vegetation, and coastal wetlands (Banko et al. 2020). On Kauai, they are primarily found in lowland habitats such as coastal wetlands consisting of coastal dune vegetation, nonnative grasslands, and shrublands (Banko et al. 2020; USFWS 2011). Hawaiian geese are non-migratory, however, they are capable of inter-island flight. Hawaiian geese nesting sites range from these coastal lowlands to subalpine zones. Nests are typically constructed on the ground in the shade of vegetation (Banko et al. 2020). Breeding season extends from August to April with nesting peaking around December.

Hawaiian geese are browsing grazers who feed on leaves, seeds, flowers, and fruits, although their diet depends on the vegetation present within their habitat (Banko et al. 2020).

B.1.6 Hawaiian Petrel

The Hawaiian petrel (*Pterodroma sandwichensis*), originally listed as the Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*), is listed as endangered under the ESA throughout its range (32 FR 4001; March 11, 1967). Currently, no critical habitat has been designated for the Hawaiian petrel. Hawaiian petrels may be encountered at sea during the breeding season (March to October) in the proposed action area.

The Hawaiian petrel is present throughout the offshore waters of the Hawaiian Islands during the breeding season (Ainley et al. 1997a; BirdLife International 2016a), from March to October. Typically, clutch size is only one egg, and breeding pairs return to the same nesting site annually. Presently, breeding colonies are found only in remote areas on Kauai (Troy et al. 2017). Under pressure of predation, most nesting habitat is at the highest elevations available in the MHI. These nesting areas would be located outside of the proposed action area.

During the non-breeding season, Hawaiian petrels primarily occur in equatorial waters of the eastern tropical Pacific, generally between 20 °N and 10 °S (USFWS 2005a). The population on Kauai has declined 78 percent since 1993, or six percent annually (Raine et al. 2017).

The Hawaiian petrel typically forages well offshore, but tends to feed closer to shore during the spring (Spear et al. 1999). Hawaiian petrels forage mostly on squid (50 to 75 percent of their diet), fish, and crustaceans (BirdLife International 2016a). They capture prey by resting on the water surface and dipping their bill and by pursuing species while in flight, such as flying fish (BirdLife International 2016a).

B.1.7 Hawaiian Stilt

The Hawaiian stilt (*Himantopus mexicanus knudseni*) is listed as endangered under the ESA (35 FR 16047; October 13, 1970). Currently, no critical habitat has been designated for this species. Hawaiian stilts are considered a subspecies of the black-necked stilt (*Himantopus mexicanus*). The Hawaiian stilt may occur at PMRF year-round, typically at the ditch systems and along the shoreline or beach. It would be unlikely to encounter Hawaiian stilts at sea in the proposed action area.

Hawaiian stilts inhabit Kauai year-round. Hawaiian stilts use a variety of aquatic habitats, primarily at lower elevations with water depth less than 9 in (24 cm), utilizing areas of sparse, low-growing perennial vegetation or exposed tidal flats. They readily disperse between various islands in response to rainfall patterns and the flooding and drying of ephemeral lakes (Reed et al. 2011) and could overlap with the proposed action during this time.

Hawaiian stilts nest from mid-February through August almost exclusively on human-maintained wetland areas (Reed et al. 2011), as other wetlands are too overgrown (Reed et al. 1998). They generally nest on freshly exposed mudflats interspersed with low growing vegetation. Birds may move between the nest site and a foraging area.

Hawaiian stilts are opportunistic feeders and prey upon a wide variety of invertebrates and other aquatic organisms within shallow water or mud flats. They forage in freshwater, brackish, and saltwater environments (Reed et al. 2011).

B.1.8 Newell's Shearwater

Newell's (Townsend's) shearwater (*Puffinus auricularis newelli*) is listed as threatened under the ESA (40 FR 44149; September 25, 1975). There is currently no critical habitat designated for the species. The Newell's shearwater is endemic to the Hawaiian Islands and may occur at sea in the proposed action area during the breeding season from March to April or flying over the shore at night.

Newell's shearwater nesting is confined to the MHI, including Kauai. Nesting occurs on steep, densely vegetated mountain slopes and on dry sparsely vegetated cliffs (USFWS 2005), outside of the proposed action area. During the non-breeding season, Newell's shearwaters spend most of their time in pelagic habitats (USFWS 2005), mostly east and south of the Hawaiian Islands (Ainley et al. 1997b).

Newell's shearwaters forage only over open ocean waters of depths greater than 6,562 ft (2,000 m) (Spear et al. 1995). Even when nesting, they feed over deep waters and are typically within 15 mi (24 km) of island shores (BirdLife International 2016b). Research on these shearwaters' foraging habits suggests that squid are a primary source of their diet. Newell's shearwaters capture food by pursuit-plunging (diving into water and swimming after prey, typically 33–98 ft [10–30 m] deep) (BirdLife International 2016b).

Kauai holds 90 percent of the remaining population of Newell's shearwaters. Radar data collected from 1993 to 2001 exhibited declines of 72 percent of visiting shearwaters in Kauai (Day et al. 2003). A more recent study (1993 to 2013) (Raine et al. 2017), found worsening trends, with radar count data indicating a decline of 94 percent of overall shearwater numbers.

B.1.9 Short-Tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*) is listed as endangered under the ESA throughout its range (65 FR 46643; July 31, 2000). Currently, no critical habitat has been designated for this species. Short-tailed albatrosses may occur in the proposed action area, but would be considered rare on shore and unlikely at sea.

Short-tailed albatrosses move seasonally around the North Pacific Ocean (USFWS 2005c), concentrating along the edge of the continental shelf and upwelling zones (Piatt et al. 2006). In Hawaii, a small population of birds nest in the Northwestern Hawaiian Islands, otherwise, occurrences around the islands are pelagic in nature as forage or migrate (USFWS 2008).

During the breeding season, short-tailed albatrosses prefer to nest on isolated, windswept, offshore islands protected from human access (USFWS 2000). Almost all of these birds nest on two uninhabited islands outside the proposed action area: Torishima Island (78 percent of breeding pairs) and Minami-Kojima (22 percent of breeding pairs) (Hasegawa and DeGange 1982). A few documented pairs nest on Midway Atoll and Kure Atoll in the Northwestern Hawaiian Islands outside of the proposed action area (USFWS 2020).

Short-tailed albatrosses are surface feeders and scavengers, foraging at the surface on shrimp, squid, and fish (USFWS 2008).

B.2 ESA-Listed Fish

B.2.1 Giant Manta Ray

The giant manta ray (*Manta birostris*) is listed as threatened under the ESA (83 FR 2916; January 22, 2018) throughout its range. NMFS determined that designation of critical habitat was not prudent based on a comprehensive review of best scientific data available; there are no identifiable physical or biological features that are essential to the conservation within areas under U.S. jurisdiction (84 FR 66652, December 5, 2019). There is a potential for giant manta rays to occur in the proposed action area, though not in large aggregations.

Giant manta rays are cosmopolitan yet uncommon species, with worldwide distribution throughout tropical and temperate waters between 40 °N and 40 °S latitude, though most have a tropical to subtropical distribution, preferring water temperatures of 68–79 °F (20–26 °C) (Dewar et al. 2008; NOAA Fisheries 2019). They utilize sandy bottom habitat, seagrass beds, shallow reefs, and the ocean surface both inshore and offshore. Although the species tends to be solitary, they aggregate at cleaning sites (i.e., areas where rays congregate to be cleaned by small fish or crustaceans) as well as to feed and mate. Regional populations are small and commonly show a degree of site fidelity to the specific regions, such as cleaning stations and feeding sites (Marshall et al. 2022).

The giant manta ray is the largest mobulid species (e.g., manta rays and devil rays), and is also highly migratory, making seasonal visits along productive coastlines with regular upwelling, oceanic island groups, and near offshore pinnacles and seamounts in all three temperate and tropical ocean basins (Froese and Pauly 2018). Seasonal migrations are usually more than approximately 621 mi (1,000 km); however, they are not likely across ocean basins (NOAA Fisheries 2019).

Giant manta rays are found throughout the Hawaiian Islands, with hundreds of individuals participating in the aggregations in high productivity offshore areas such as seamounts and offshore islands (Defenders of Wildlife 2015). One such aggregation occurs along the Kona coast off the Big Island of Hawaii and is timed to peak seasonal abundances of prey such as zooplankton. Although there are no known manta ray aggregations in or near the proposed action area (Couturier et al. 2012; Froese and Pauly 2018), there is a potential for them to occur in the proposed action area as it is within their range.

Giant manta rays forage by swimming with their cephalic fins in an “O” shape and opening their mouths wide. Manta rays primarily feed on planktonic organisms such as euphausiids, copepods, mysids, decapod larvae, and shrimp, and some small and moderately sized fish as well (Couturier et al. 2012). Because manta rays feed on zooplankton, they are generally found in shallow waters, but may dive to 3,281 ft (1,000 m) or more (Marshall et al. 2022) to supplement foraging on deep-sea organisms (Burgess 2017).

B.2.2 Oceanic Whitetip Shark

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as threatened under the ESA (83 FR 4153; January 30, 2018) throughout its range. NMFS determined that designation of critical habitat was not prudent based on a comprehensive review of best scientific data available; there are no identifiable physical or biological features that are essential to the conservation for the species (85 FR 12898; March 5, 2020). There is a potential for oceanic whitetip sharks to occur in the proposed action area.

Oceanic whitetip sharks are found worldwide in warm tropical and subtropical waters between the 30° N and 35° S latitudes near the surface of the water column (Young et al. 2016). Oceanic whitetips occur throughout the Central Pacific. This species has a clear preference for open ocean waters, with abundances decreasing with greater proximity to continental shelves and offshore islands. Preferring warm waters near or over 68° F (20° C) and offshore areas, the oceanic whitetip shark is known to undertake seasonal movements to higher latitudes in the summer and may regularly survey extreme environments (i.e., deep depths, low temperatures) as a foraging strategy (Young et al. 2016). Typically, these sharks spend most of their time in the upper portion of the water column, from the surface to a depth of 200 m (656 ft) (NOAA Fisheries 2024). Oceanic whitetip sharks diving in the offshore waters of the Hawaiian Islands dove to a maximum depth of 820 ft (250 m) but spent most of their time within 328 ft (100 m) of the surface (Musyl et al. 2011).

Oceanic whitetip sharks are usually solitary, but may congregate near shipwrecks or if following pilot whales. It is believed that the oceanic whitetip sharks are exploiting the pilot whales' ability to find squid, which is a preferred prey item for both species (Compagno 1984).

Oceanic whitetip sharks are opportunistic feeders. Primarily, they feed on fishes and cephalopods (Bonfil et al. 2008), but they are known to feed on sea birds, marine mammals, other sharks and rays, mollusks, crustaceans, and even garbage (Compagno 1984; Cortés 1999). While they are normally slow swimmers, fast bursts of speed are common when darting towards prey (Papastamatiou et al. 2018).

B.3 ESA-Listed Sea Turtles

B.3.1 Green Sea Turtle

The green sea turtle was listed as threatened under the ESA in 1978 (43 FR 32800; July 28, 1978). In 2016, NMFS and USWFS reclassified green sea turtles into 11 different DPSs (80 FR 34594; April 6, 2016). Only the Central North Pacific (CNP) DPS, which is listed as threatened, may occur in the proposed action area. In 2015, the CNP DPS had an estimated abundance of 3,846 nesting females; 96 percent of these could be found on French Frigate Shoals, while an estimated 16 nesting females were present at Kauai (Seminoff et al. 2015). USFWS has proposed to designate critical habitat on land (88 FR 46376; July 19, 2023); however, the unit located near the proposed action area does not include PMRF, listing the facility as a protected area. Simultaneously, NMFS has proposed to designate marine critical habitat for the green sea turtle in nearshore waters off the coast of Hawaii, including Kauai (88 FR 46572; July 19, 2023). More details about this proposed critical habitat can be found in Section 3.2.5.1.

Green sea turtles are distributed globally and found in tropical and subtropical waters along continental coasts and islands between 30° N and 30° S. They are the most common sea turtle species in the waters surrounding the Hawaiian Islands, occurring in the coastal waters of the MHI throughout the year. They migrate seasonally to the Northwestern Hawaiian Islands (NWHI) to reproduce. Most of the Hawaiian green sea turtle population nests in French Frigate Shoals in the Papahānaumokuākea Marine National Monument. They largely travel to the main Hawaiian Islands to forage for food and bask on the beaches. They are common in the oceanic zone (areas of ocean lying in between the continental shelves) surrounding the Hawaiian Islands. Both basking and nesting green sea turtles have been documented on PMRF beaches, particularly at the Nohili Ditch outflow just south of the proposed action area (Diendorf 2012; Lauritsen 2015; U.S. Air Force 2022). At PMRF, sea turtles typically lay their nests between May and July (PMRF 2024). Farther offshore in open water, green sea turtles occur in lower numbers and densities (Seminoff et al. 2015).

The diet of green sea turtles varies between life stages. Pelagic hatchings and juveniles eat mollusks, jellyfish, and crustaceans, while adults eat seagrasses and macroalgae as they forage closer to shore. Based on the behavior of captive post-hatchlings and juvenile green turtles, it is presumed that those in pelagic habitats live and feed within 10 ft (3 m) of the surface (NMFS and USFWS 1998). Rice and Balazs (2008) found that adult green sea turtles migrating between the NWHI and MHI would dive at night, but they only reached 13 ft (4 m) during the day. In their coastal habitat, green sea turtles typically make dives shallower than 98 ft (30 m) (Hatase et al. 2006), often not exceeding 17 m (56 ft) (Hays et al. 2004; Rice and Balazs 2008). The majority of the proposed action area is deep (greater than 70 m [230 ft]) and likely devoid of vegetation, such as marine algae or seagrasses. A preliminary dive survey from the HDD exit point west along the initial portion of the cable lay path (approximate depth of 65 ft [20 m] to 115 ft [35 m]) showed the seafloor to be largely barren terrain with minimal small corals or marine life (NAVFAC 2023).

B.3.2 Hawksbill Sea Turtle

The hawksbill sea turtle is listed as endangered under the ESA (35 FR 8490; June 2, 1970). Critical habitat for the hawksbill sea turtle has only been designated within the coastal waters of Mona and Monito Islands, Puerto Rico (63 FR 46696; September 2, 1998); there is no critical habitat designated for the hawksbill sea turtle in Hawaii.

Hawksbill sea turtle movement within the marine environment is not fully understood, but it is believed that they inhabit coastal waters of more than 108 countries (Groombridge and Luxmoore 1989). In 2013, there were an estimated 950 to 1185 nesting female turtles in the Central Pacific Ocean, including 20 or fewer in Hawaii (NMFS and USFWS 2013). In Hawaii, hawksbill sea turtles are mostly found in the coastal waters of the MHI. Stranded or injured hawksbill sea turtles are occasionally found in the NWHI (Parker et al. 2009). Research suggests that movements of Hawaiian hawksbills are relatively short, with individuals generally migrating through shallow coastal waters and few deep-water transits between the islands. Post-nesting migration distance ranges from 57 to 214 mi (91 to 344 km) in Hawaii) (Parker et al. 2009). Hawksbill sea turtles primarily nest on the southeastern beaches of the Island of Hawaii; however, a few turtles nest on Maui and Molokai (NMFS and USFWS 2013). Hawksbill sea turtles may occur within the proposed action area as they are observed on rare occasions in the open waters offshore PMRF (U.S. Air Force 2022). Brunson et al. (2022) noted 13 cases of hawksbill strandings on Kauai between 1984 and 2018, but none of these were on the island’s west coast or near the proposed action area. There are no records of hawksbill turtles occurring onshore or nesting at PMRF; however, there is still the possibility of future nesting (PMRF 2024).

Post-hatchling hawksbill sea turtles feed on algae in floating habitats in the open ocean (Plotkin and Amos 1998; Van Houtan et al. 2016). Juvenile hawksbill sea turtles forage on sponges, sea squirts, algae, mollusks, crustaceans, jellyfish, and other invertebrates (Bjorndal 1997). Older juveniles and adults are more specialized, feeding primarily on sponges, which compose as much as 95 percent of their diet in some locations (Meylan 1988; Witzell 1983). Research on hawksbills in the eastern Pacific found that adult turtles generally use shallow waters, and the majority of their dives were in less than 66 ft (20 m) of water (Gaos et al. 2012).

B.4 ESA-Listed Terrestrial Mammal

B.4.1 Hawaiian Hoary Bat

The Hawaiian hoary bat is listed as endangered under the ESA (35 FR 16047; October 13, 1970). Currently, no critical habitat has been designated for the species. The Hawaiian hoary bat may be present in the proposed action area year-round.

The Hawaiian hoary bat is present throughout most of the Hawaiian Islands. It roosts in trees and other tall woody vegetation, either alone or with dependent pups, and forages over open, vegetated, stream, and coastal systems. At PMRF, Hawaiian hoary bats are typically most common in the fall and winter but are present throughout all seasons. Roosting and foraging are known to occur at PMRF; breeding and pup rearing likely occur at the base (PMRF 2024). Breeding season is between September and December, and pups typically fledge between June and August. The bats require woody vegetation greater than 15 ft (5 m) in height for roosting habitat (PMRF 2024), and the proposed action area does not include any such vegetation. Consequently, it is extremely unlikely the Hawaiian hoary bat would be roosting or breeding in or near the Proposed Action, and vulnerable pups (i.e., those that cannot yet fly) would likely not occur in or near the proposed action area.

While roosting is unlikely, Hawaiian hoary bats may forage over the proposed action area during the night. A 2010-2011 survey found that the Hawaiian hoary bat uses the majority of PMRF for foraging year-round (PMRF 2024). Foraging habitat includes the proposed action area—essentially, an open field—as well as nearby coastal terrestrial and aquatic systems. Hawaiian hoary bats typically prey on nocturnal beetles and moths across a wide array of elevations (Bonaccorso et al. 2015; Gorresen et al. 2017; Jacobs 1999; Todd 2012).

B.5 ESA-Listed Marine Mammals

B.5.1 Sei Whale

The sei whale was listed as endangered under the Endangered Species Preservation Act of 1969 (35 FR 12222; 30 July 1970), the predecessor to the ESA. When the ESA was passed in 1973, the sei whale was listed as endangered throughout its range. No critical habitat is currently designated for the sei whale. Sei whales are divided into the Nova Scotia, Eastern North Pacific, and Hawaii stock. Only the Hawaii stock is found within the proposed action area and is discussed below. An abundance of 401 (CV = 0.84) individuals were estimated for the Hawaiian Exclusive Economic Zone (EEZ) in 2010; this estimation represents a 58.5 percent increase in abundance from 2002 (Bradford et al. 2021).

Sei whales have a global distribution in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere, but are not often seen near the coast and occur from the tropics to polar zones in both hemispheres. Sei whales are restricted to the mid-latitude temperate zone and undergo seasonal migrations. Calving occurs in the midwinter, in low latitude portions of the species' range. They have largely unpredictable patterns, but when they are present, they tend to occur in numbers (i.e., not singletons). Currently, the population structure of sei whales has not been adequately defined; therefore, populations are often divided on an ocean basin level (NMFS 2011). Two subspecies have been identified (although not yet confirmed with empirical evidence): the northern sei whale (*Balaenoptera borealis borealis*) and southern sei whale (*Balaenoptera borealis schleglii*); definitive conclusions regarding this classification cannot be made but the ranges of these populations are not known to overlap (Rice 1998). Sei whales are rarely sighted in Hawaiian waters (Smultea et al. 2010). However, sei whales have previously been observed near PMRF. There were 138–472 sei whale tracks[1] recorded from bottom mounted hydrophones at PMRF during January 2011 to August 2019 (Martin et al. 2021).

Sei whales feed on plankton (copepods and krill), small schooling fish, and cephalopods (NOAA 2022b). They mainly feed at dawn by lunge feeding or skimming, as well as sub-surface lunge feed (NOAA 2022b; Segre et al. 2021). Sei whales sub-surface lunge feed by diving for 5–20 minute periods. Unlike most whale species, sei whales directly sink below the water surface rather than arching their back or showing their flukes before they dive (NOAA 2022b). They have been recorded to dive between a few feet up to 98 ft (30 m) while lunge feeding (Segre et al. 2021).

B.5.2 Main Hawaiian Islands Insular False Killer Whale

There are three DPSs designated for false killer whales that make up the Hawaiian Islands Stock Complex: the Hawaii pelagic DPS (offshore waters beyond 7 mi [11 km] off the Hawaiian Islands), the NWHI DPS (58 mi [93 km] radius around the NWHI), and the MHI insular false killer whale DPS (45 mi [72 km] radius around the MHI) (Bradford et al. 2018; Bradford et al. 2013b; Bradford et al. 2017; Bradford et al. 2015; Carretta et al. 2017; Forney et al. 2010; Oleson et al. 2010). The MHI insular false killer whale DPS is listed as endangered (77 FR 70915; November 28, 2012) and is the only false killer whale DPS that overlaps with the proposed action area. NMFS designated critical habitat (83 FR 35062; August 23, 2018); however, it was determined that the benefits of excluding PMRF offshore ranges from this designation outweighed the benefits of inclusion, and that exclusion would not result in the extinction of the species. Therefore, MHI insular false killer whale critical habitat is excluded from the proposed action area and not analyzed in this document.

The MHI insular false killer whale is the smallest of the DPSs and is estimated at between 150–200 individuals (Baird 2016). Individuals that are part of the insular Hawaiian population move widely among the islands, inhabiting waters up to 75 mi (120 km) from shore (Baird 2016) in shallow (less than 164 ft [50 m]) (Baird et al. 2010) to very deep (greater than 13,123 ft [4,000 m]) water (Baird et al. 2010; Baird et al. 2011; Oleson et al. 2010), although they prefer waters deeper than 3,300 ft (1,000 m) (National Marine Fisheries Service 2022). Individuals have been documented as far as 76 mi (122 km) offshore over a total range of 31,969 square miles

[1] The number of tracks recorded are provided as a range because some sei whale tracks could not be differentiated from fin whale tracks. The total number of tracks does not represent the total number of individuals, as single individuals can be recorded multiple times (Martin et al. 2021).

(82,800 square kilometers) (Baird et al. 2012). There have been multiple recent encounters of false killer whales at PMRF (Baird et al. 2021; Baird et al. 2022b)). However, it is still considered rare to encounter this species within the PMRF boundary (Baird et al. 2021).

False killer whales feed on large pelagic fish and squid and feed both during the day and at night. When they capture prey, many individuals tend to converge, and their prey items may be shared among several animals in the group (Baird et al. 2010). Four MHI insular false killer whales found stranded in Hawaii from 2010 through 2016 had stomach contents that included prey items such as various squid and jack species, yellowfin tuna (*Thunnus albacares*), mahi mahi (*Coryphaena hippurus*), marlin (*Makaira* sp.; *Kajikia* sp.), and bonefish (*Albula vulpes*) (West 2016).

B.5.3 Hawaiian Monk Seal

The Hawaiian monk seal is the only pinniped expected to occur in or near the proposed action area. The seal is listed as endangered under the ESA (41 FR 51611; November 23, 1976). Approximately 350 to 400 seals occur in the MHI, and the total combined MHI and NWHI seal population is approximately 1600 (Carretta et al. 2023). Pursuant to ESA section 4(a)(3)(B), PMRF is not included in this critical habitat designation because the species is managed under the PMRF INRMP, which NMFS finds to provide a benefit to the species. Additionally, pursuant to ESA section 4(b)(2), PMRF offshore ranges are excluded from the critical habitat designation (80 FR 50925; September 21, 2015) because the national security benefits of exclusion outweigh the benefits of inclusion, and exclusion will not result in extinction of the species. Therefore, there is no critical habitat in the proposed action area.

Hawaiian monk seals are among the rarest marine mammals in the world. The majority of the monk seal population lives in the NWHI, within the Papahānaumokuākea National Marine Monument (over 900 nm from the proposed action area), though they are also found on the MHI. The six main breeding sites for Hawaiian monk seals are in the NWHI. Additionally, a small breeding population is found throughout the MHI, where births have been documented on most of the major islands (Gilmartin and Forcada 2009; National Marine Fisheries Service 2007, 2010a, 2014d). Abundances were lower on islands that were more densely populated with humans (Baker and Johanos 2004), although the overall monk seal population within the MHI has been increasing recently, by approximately two percent per year (Baker et al. 2016; Carretta et al. 2021; National Marine Fisheries Service 2010a, 2014d; National Marine Fisheries Service NMFS 2022; Wilson et al. 2017b). Hawaiian monk seals migrate at a higher rate within MHI than between NWHI and MHI (Johanos et al. 2014; Robinson et al. 2021). Species dispersal is greatest between sites separated by less than or equal to 62 mi (100 km) and infrequent between sites greater than 248 mi (400 km) apart (Johanos et al. 2014). Hawaiian monk seals on Kauai have been noted for having small home ranges, staying near the island, or traveling to Niihau and back (Wilson et al. 2017b). Hawaiian monk seals are likely to occur within the proposed action area as there have been previous sightings near and within the PMRF boundary (Baird et al. 2022a; Duke University 2022).

Hawaiian monk seals are benthic foragers, feeding on fish, cephalopods and crustaceans. Adults are typically nocturnal hunters, foraging in waters between 3 and 1,640 ft (1 and 500 m) in depth (National Marine Fisheries Service 2007, 2014d; Parrish and Littnan 2007). The inner reef waters next to the islands are critical to weaned pups learning to feed (Gilmartin and Forcada 2009). Foraging habitat near the breeding atolls and seamounts is commonly restricted to waters less than 328 ft (100 m) in depth. Feeding has been observed in reef caves, as well as on fish hiding among coral formations (Parrish et al. 2000; Parrish et al. 2008). When foraging, Hawaiian monk seals spend most of their time in nearshore, shallow marine habitats but can rapidly cover large areas in search of food and may travel hundreds of miles in a few days (D'Amico 2013; Littnan 2011; Stewart et al. 2006; Wilson et al. 2012). Foraging patterns are complex and vary between colonies by season, age, and sex. In general, Hawaiian monk seals are found to forage extensively within the atoll barrier reefs and on the leeward slopes of reefs and islands at colony sites (Stewart et al. 2006). Studies have shown that the average foraging trip can be 18 mi (30 km) in distance, 19 hours in duration, and remain within the 1,969-ft (600-m) depth contour (Littnan 2011). Foraging trips from 2007–2014 in areas around the MHI were shorter in duration and distance than foraging trips in areas around the NWHI, suggesting that the foraging habitat is better in the MHI (Cahoon et al. 2013; Wilson et al. 2017a; Wilson et al. 2017b).

Appendix C Additional Essential Fish Habitat Species Information from the Essential Fish Habitat Assessment

The complete list of species included in each Management Unit in the proposed action area are listed in Table C-1 and discussed further in the sections below.

Table C-1. List of Species in Each EFH Management Unit in the Proposed Action Area

Bottomfish Management Unit Species		***Crustacean Management Unit Species***	
Silver jaw jobfish	*Aphareus rutilans*	Kona crab	*Ranina ranina*
Pink snapper	*Pristipomoides filamentosus*	***Crustacean Ecosystem Component Species***	
Pink snapper	*Pristipomoides sieboldii*	Slipper lobster	Family Scyllaridae
Snapper	*Pristipomoides zonatus*	Spiny lobster	*Panulirus penicillatus*
Sea bass	*Hyporthodus quernus*	Spiny lobster	*Panulirus marginatus*
Red snapper	*Etelis carbunculus*		
Longtail snapper	*Etelis coruscans*		
Gray jobfish	*Aprion virescens*		
Pelagic Management Unit Species			
Albacore	*Thunnus alalunga*	Oceanic whitetip shark	*Carcharhinus longimanus*
Bigeye thresher shark	*Alopias superciliosus*	Oilfish	Family Gempylidae
Bigeye tuna	*Thunnus obesus*	Pelagic thresher shark	*Alopias pelagicus*
Black marlin	*Makaira indica*	Pomfret	Family Bramidae
Blue marlin	*Makaira nigricans*	Purple flying squid	*Sthenoteuthis oualaniensis*
Blue shark	*Prionace glauca*	Sailfish	*Istiophorus platypterus*
Northern bluefin tuna	*Thunnus thynnus*	Salmon shark	*Lamna ditropis*
Common thresher shark	*Alopias vulpinus*	Shortfin mako shark	*Isurus oxyrinchus*
Diamondback squid	*Thysanoteuthis rhombus*	Silky shark	*Carcharhinus falciformis*
Frigate and bullet tunas	*Auxis thazard, A. rochei*	Skipjack tuna	*Katsuwonus pelamis*
Kawakawa	*Euthynnus affinis*	Slender tunas	*Allothunnus spp.*
Longfin mako shark	*Isurus paucus*	Shortbill spearfish	*Tetrapturus angustirostris*
Mackerel	*Scomber spp.*	Striped marlin	*Tetrapurus audax*
Mahimahi	*Coryphaena hippurus, C. equiselas*	Swordfish	*Xiphias gladius*
Moonfish	*Lampris spp.*	Wahoo	*Acanthocybium solandri*
Neon flying squid	*Ommastrephes bartami*	Yellowfin tuna	*Thunnus albacares*

C.1 Bottomfish and Seamount Groundfish Management Unit

Table 3-7 details all EFH for bottomfish and seamount groundfish species classified under the Bottomfish and Seamount Groundfish Management Unit. It should be noted there is no Seamount Groundfish EFH in the proposed action area.

The distribution of adult bottomfish in the western Pacific region is closely linked to suitable physical habitat (Friedlander 2004; Friedlander and DeMartini 2002; Ralston 1984; Ralston and Polovina 1982). Pacific islands are primarily volcanic peaks with steep drop-offs and limited shelf ecosystems, distinct from continental shelf ecosystems on the U.S. mainland. Bottomfish species under the WPRFMC jurisdiction typically are found concentrated on the steep slopes of deep-water banks. Adult bottomfish typically are found in habitats characterized by hard substrate and high structural complexity. By contrast, the PACDERMA proposed action area, particularly the areas where the infrastructure would be placed, are relatively nondescript sandy bottom without areas of high relief or structural complexity. However, some species of bottomfish (groupers) may be less dependent on hard-bottom substrate at depth (Parrish 1987) and some juvenile bottomfish species have been found on flat, featureless shallow banks, as opposed to high-relief areas where adults occur (Parrish 1989). Parrish et al. (1997) found that juvenile pink snapper (*Pristipomoides filamentosus*) preferred a bottom substrate of sediment with no relief.

Bottomfish populations are found in patchy, uneven distributions within their natural habitat (Friedlander 2004; Moffitt 1980, 1993). In Hawaii, the bottomfish fishery targets several species of snappers, jacks, and a single species of grouper. These target species are generally found at depths of 165 to 900 ft (50 to 270 m) (Brodziak et al. 2011).

The eggs and larvae of all bottomfish species are pelagic and directly influenced by the prevailing ocean currents. There have been very few taxonomic studies of these early life stages of bottomfish and their distribution. Because of the existing scientific uncertainty about the distribution of the eggs and larvae of bottomfish, the WPRFMC designated the water column extending from the shoreline to the outer boundary of the U.S. EEZ to a depth of 1,312 ft (400 m) as EFH for bottomfish eggs and larvae throughout the western Pacific region, which includes the entirety of the proposed action area (Table 3-7) (WPRFMC 1986, 2009a).

C.2 Pelagic Management Unit

The WPRFMC has used the best available scientific information to describe EFH in text and tables that provide information on the biological requirements for each life stage of all Pelagic Management Unit Species (MUS). Because of the large gaps in scientific knowledge about the life histories and habitat requirements of many Pelagic MUS in the western Pacific region, the WPRFMC adopted a precautionary approach in designating EFH to ensure that enough habitats are protected to sustain managed species. The species complex designations for the Pelagic MUS are temperate species, tropical species, sharks, and squid (Table 3-7). The designations of these complexes are based on the ecological relationships among species and their preferred habitat. The entire water column overlying the proposed action area is designated as EFH for all life stages of all Pelagic MUS (WPRFMC 2009b).

The eggs and larvae of all Pelagic MUS are pelagic. They are slightly buoyant when first spawned, are spread throughout the mixed layer, and are subject to advection by the prevailing ocean currents. Because the eggs and larvae of the Pelagic MUS are found distributed throughout the tropical (and in summer, the subtropical) epipelagic zone, EFH for these life stages has been designated as the epipelagic zone (all waters above 656 ft [200 m] depth) from the shoreline to the outer limit of the EEZ. The only generic variation in this distribution pattern occurs in the northern latitudes of the Hawaii EEZ, which extends farther into the temperate zone than any other EEZ covered by the Pelagic FEP. In these higher latitudes, eggs and larvae are rarely found during the winter months (November to February). Since the Proposed Action is limited to the waters adjacent to Kauai that are less than 328 ft (100 m), all epipelagic surface waters within the proposed action area are designated as EFH for Pelagic MUS eggs and larvae. Pacific Pelagic MUS EFH only includes the water column and not benthic habitat (Table 3-6).

C.3 Crustacean Management Unit

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the WPRFMC has designated EFH for crustacean species assemblages, referred to as Crustacean MUS. Only one species complex designation overlaps the proposed action area—the Kona crab (*Ranina ranina*). The designation of this complex is based on the ecological relationships among the species and its preferred habitat. Recently, the Spiny Lobster and Slipper Lobster Management Units (also included in the Crustacean MUS) were reclassified as Ecosystem Component Species under Amendment 5 of the FEB for the Hawaii Archipelago. Although this does not change the area for which Crustacean EFH is designated, these species complexes no longer have designated EFH.

Kona crabs inhabit coastal waters from 30 to 330 ft (10 to 100 m), and they range across the tropical and subtropical Indo-Pacific, preferring sandy substrates where they can bury themselves in order to ambush prey (generally small fish). As a result, Kona crabs could be present throughout the proposed action area. Kona crab EFH designated in the proposed action area and region is presented in Table 3-7.

Although little data exist on the preferred depth distribution of Management Unit invertebrate larvae in Hawaii, the depth distributions of other crustacean species common in the Indo-Pacific region have been documented. For example, later stages of lobster larvae of the family *Panuliridae* have been found at depths between 264 and 396 ft (80 and 120 m) (WPRFMC 2009a). For these reasons, the WPRFMC designated EFH for Kona crab eggs and larvae from the shoreline to the outer limit of the EEZ—in the water column from the surface to a depth of 492 ft (150 m) throughout the western Pacific region. The EFH for juvenile and adult Kona crab is detailed in Table 3-7 and overlaps with the proposed action area for all life stages.

Appendix D Species-Specific Hearing Information

Species-specific hearing information is displayed in Table D-1 with detailed information used to generate the table in the sections below.

Table D-1. The Hearing Ranges of Each Species Group in the Proposed Action Area

Species Group	*In Air*		*In Water*	
	Hearing Range	*Best Hearing Sensitivity*	*Hearing Range*	*Best Hearing Sensitivity*
Invertebrates				
General	N/A	N/A	<1000 Hz (some to 3 kHz)	<200 Hz
Birds				
General	20 Hz – 10 kHz	1 – 5 kHz	0.5 – 4 kHz	N/A
Fish				
General	N/A	N/A	50 – 1000 Hz	100 – 400 Hz
Elasmobranchs	N/A	N/A	20 Hz – >100 kHz	<100 Hz
Sea Turtles				
General	50 – 800 Hz	300 – 400 Hz	50 Hz – 1.6 kHz	100 – 400 Hz
Marine Mammals				
Low Frequency Cetaceans (Mysticetes)	N/A	N/A	7 Hz – 35 kHz	<1 kHz
Mid-Frequency Cetaceans (Odontocetes)	N/A	N/A	<200 kHz	150 Hz – 160 kHz
Phocids	unknown	0.1 – 33 kHz	40 Hz – 90 kHz	0.2 – 33 kHz
Terrestrial Mammals				
General	<91 kHz	N/A	N/A	N/A
Bats	2 – 110 kHz	>5 kHz	N/A	N/A

general = not specialized; Hz = hertz; kHz = kilohertz

D.1 Invertebrate Hearing

Hearing capabilities of invertebrates are largely unknown. Outside of studies conducted to test the sensitivity of invertebrates to vibrations, very little is known on the effects of anthropogenic underwater noise on invertebrates (Edmonds et al. 2016; Hawkins and Popper 2017; Solé et al. 2023). Many studies that have assessed the impacts of noise on invertebrates have overlooked the sensitivity of these species to particle motion rather than sound pressure (Hawkins and Popper 2017; Popper and Hawkins 2018). In the review of 46 studies on behavioral and physiological responses of invertebrates (mostly crustaceans and mollusks) to underwater sound, Davies et al. (2024) found that anthropogenic noises and synthetic sounds generally have negative effects on invertebrate behavior and physiology, while environmental sounds have a slightly beneficial impacts.

While data are limited, research suggests that some of the major cephalopods and decapods may hear only low-frequency (less than 1 kiloHertz [kHz]) sources, with best sensitivities at lower frequencies (Hawkins and Popper 2017; Mooney et al. 2010; Radford and Stanley 2023). A few cephalopods may sense higher frequencies up to 1,500 Hertz (Hz) (Hu et al. 2009). Both behavioral and auditory brainstem response studies suggest that crustaceans may sense frequencies up to 3 kHz, but best sensitivity is likely below 200 Hz (Dinh and Radford 2021; Goodall et al. 1990; Lovell et al. 2005). Decapod crustaceans respond primarily to sounds well below 1 kHz (Edmonds et al. 2016; Radford and Stanley 2023; Solé et al. 2023).

Aquatic invertebrates that can sense local water movements with ciliated cells include cnidarians, flatworms, segmented worms, urochordates (tunicates), mollusks, and arthropods (Budelmann 1992; Solé et al. 2023; Solé et al. 2016). Species of cephalopods (e.g., octopus, squid) and crustaceans (e.g., crab, shrimp, lobster) have statocysts that may be involved in sound detection (El-Dairi et al. 2024; Solé et al. 2023). Statocysts allow an animal to sense movement and may enable some species, such as cephalopods and crustaceans, to be sensitive to water particle movements associated with sound (Hu et al. 2009; Mooney et al. 2012a; Popper and Hawkins 2018; Popper et al. 2001; Solé 2024). Many invertebrates have been shown to be more sensitive to particle motion associated with sound, rather than sound pressure (Popper and Hawkins 2018). Aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources because any acoustic sensory capabilities, if present at all, are limited to detecting water motion and water particle motion near a sound source falls off rapidly with distance. However, sound propagation models used to assess the distance over which impacts might occur have rarely been validated by actual measurements and are ineffective at modelling transmission under shallow water conditions, close to or within the seabed, or at the surface (Hawkins and Popper 2017; Popper and Hawkins 2018).

A review of crustacean sensitivity of high amplitude underwater noise by Edmonds et al. (2016) determined that crustaceans may be able to hear the frequencies at which they produce sound, but it remains unclear which noises are incidentally produced and if there are any negative effects from masking them. The production of sound has only been described in two groups of crustaceans: barnacles and decapods (Solé et al. 2023). Acoustic signals produced by crustaceans range from low-frequency rumbles (20–60 Hz) to high frequency signals (20–55 kHz) (Edmonds et al. 2016; Patek and Caldwell 2006; Solé et al. 2023; Staaterman et al. 2011).

Aquatic invertebrates may produce and use sound in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Edmonds et al. 2016; Popper et al. 2001). Some crustaceans produce sound by rubbing or closing hard body parts together, such as lobsters and snapping shrimp (Patek et al. 2009; Radford and Stanley 2023). The snapping shrimp chorus makes up a significant portion of the ambient noise budget in many locales (Lillis et al. 2017; Radford and Stanley 2023; Song et al. 2023). Each click is up to 190 dB re 1 μPa, with the acoustic activity dominating the high frequency (greater than 2 kHz) soundscape of shallow reefs (Lillis and Mooney 2018; Song et al. 2023; Song et al. 2021). Other crustaceans, such as mantis shrimp, make low-frequency rasping or rumbling noises, perhaps used in defense or territorial display, that are often obscured by ambient noise (Patek and Caldwell 2006).

Sea stars are not known to be capable of hearing and instead rely primarily on olfaction and other chemical cues for communication with their surroundings (Garm 2017).

There is no evidence that adult coral can perceive or are affected by sound. However, evidence does suggest that coral larvae are able to perceive sounds, and acoustic cues may aide larvae at small spatial scales in locating coral reefs on which to recruit (Pysanczyn et al. 2023). Invertebrate larvae, including coral larvae, have been shown to settle in areas of greater acoustic cues, especially low-frequency sound, as these are commonly associated with healthy coral reef environments (Pysanczyn et al. 2023). Larvae are most likely to respond to sounds within 328 ft (100 m), although sounds may be detected as far as 1,640 ft (500 m) away (Pysanczyn et al. 2023).

D.2 Bird Hearing

Although hearing range and sensitivity has been measured for many terrestrial birds, little research has been conducted on the hearing capabilities of marine birds. A review of 32 terrestrial and marine species indicates that birds generally have the greatest hearing sensitivity between 1 and 5 kilohertz (kHz) (Beason 2004; Dooling 2002; Dooling and Therrien 2012). Research shows that very few birds can hear below 20 hertz (Hz)(Beason 2004). Most birds have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Beason 2004; Dooling 2002).

Hearing capabilities have been studied for several seabirds, though not necessarily those found in the Hawaiian Islands, and the results indicate that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general (Beason 2004; Crowell 2016; Crowell et al. 2015; Crowell et al. 2016; Johansen et al. 2016; Larsen et al. 2020; Mooney et al. 2019; Wever et al. 1969). Studies of long-tailed duck (*Clangula hyemalis*), common eider (Somateria mollissima), surf scoter (*Melanitta perspicillata*) (Crowell et al. 2015; McGrew et al. 2022), Atlantic puffin (*Fratercula arctica*), and common murre (*Uria aalge*) (Mooney et al. 2019) support previous conclusions that birds generally have greatest hearing sensitivity between 1 and 5 kHz. Two field studies (Mooney et al. 2020; Mooney et al. 2019) of wild captured Atlantic puffins produced auditory curves between 0.5 and 6 kHz, similar to measurements for other seabirds. Smith et al. (2023) found the same range in marbled murrelet (*Brachyramphus marmoratus*). Hansen et al. (2017) studied great cormorants (*Phalacrocorax carbo*) and found that they can hear between 1 and 4 kHz, with a maximum hearing sensitivity at 2 kHz. Larsen et al. (2020) discovered that great cormorants have underwater hearing sensitivity at least as good as their aerial sensitivity, possessing anatomical adaptations for underwater hearing (e.g., a thickened eardrum).

Crowell et al. (2015) also compared the vocalizations of ten diving bird species to the region of highest sensitivity of in-air hearing. Of the birds studied, vocalizations of only eight species were obtained due to the relatively silent nature of two of the species. The peak frequency of the vocalizations for seven of the eight species fell within the range of highest sensitivity for in-air hearing, recorded between 1 and 3 kHz. Crowell et al. (2015) suggested that the colonial nesters tested had relatively reduced hearing sensitivity because they relied on individually distinctive vocalizations over short ranges. Additionally, they observed that species with more sensitive hearing were those associated with freshwater habitats, which are quieter when compared to marine habitats with wind and wave noise.

Although hearing is important to seabirds in air, it is unknown if seabirds use hearing or vocalizations underwater for foraging, communication, predator avoidance or navigation (Crowell 2016; Dooling and Therrien 2012). Diving birds may not hear as well underwater, compared to other (non-avian) species, based on adaptations to protect their ears from pressure changes (Dooling and Therrien 2012; Hetherington 2008). There are many anatomical adaptations in diving birds that may reduce sensitivity both in air and underwater. Anatomical ear adaptations include cavernous tissue in the meatus and middle ear that may fill with blood during dives to compensate for increased pressure on the tympanum, active muscular control of the meatus to prevent water entering the ear, and interlocking feathers to create a waterproof outer covering (Crowell et al. 2015; Rijke 1970; Sadé et al. 2008).

Zeyl et al. (2022) used nano-CT scanning of the ears of 127 bird species to measure the morphological adaptations to aerial and underwater hearing. Deep diving species have heavily modified middle ears, including smaller tympanic membranes and columella footplate of the middle ear, shorter extrastapedius, and reduced cranial air volume and connectivity. These features likely facilitate hearing underwater and provide baroprotection, while potentially constraining the sensitivity of aerial hearing.

Birds generally hear best within the frequency range of their own calls (1-5 kHz)(Dooling et al. 2016), with larger birds hearing lower frequencies better and smaller birds hearing higher frequencies (Zeyl et al. 2022). Owls are an exception, possessing superior low-frequency hearing for hunting, and some, like barn owls, also have enhanced high-frequency hearing for prey localization (Carr and Christensen-Dalsgaard 2015). This close relationship between bird vocalizations and hearing sensitivity highlights the 1-5 kHz range as particularly important for avian species.

D.3 Fish Hearing

Although hearing capability data only exist for just over 100 of the more than 37,000 fish species (Fricke et al. 2024; Ladich and Fay 2013; Popper 2023), current data suggest that most species of fish detect sounds from 50 hertz (Hz) to 1 kilohertz (kHz), with best hearing sensitivity from 100 to 400 Hz (Popper 2003; Popper and Fay 2011). Some fish possess morphological adaptations or specializations that can enhance their sensitivity to sound pressure and are able to hear sounds above 1 kHz to possibly as high as 180 kHz (Popper 2008; Popper et al. 2019).

All fish have two sensory systems to detect sound in the water: the inner ear, which functions much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish’s body (Popper and Hawkins 2020; Popper and Schilt 2008). The lateral line system is sensitive to external particle motion arising from sources within a few body lengths of the animal (Popper et al. 2014). The lateral line detects particle motion at low frequencies from less than 1, up to about 400 Hz (Coombs and Montgomery 1999; Hastings and Popper 2005; Higgs and Radford 2013; Popper et al. 2005; Webb et al. 2008). The inner ears of fishes are directly sensitive to acoustic particle motion rather than acoustic pressure.

Some species of fish with a swim bladder are more sensitive to underwater sound since they can detect particle motion and sound pressure. A fish’s swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear (Radford et al. 2012; Rogers et al. 2023). Fish with swim bladders or other gas-filled structures generally have better sensitivity and better high-frequency hearing than fish without these structures (Popper and Hawkins 2018; Popper et al. 2014; Rogers et al. 2023). Connections between the swim bladder and the inner ear also enhance hearing capabilities and sound pressure detection. For example, Clupeiformes, which possess a swim bladder, are generally able to detect sounds to about 4 kHz (Mann et al. 2001; Mann et al. 1997; Popper et al. 2004). One subfamily of clupeids (i.e., Alosinae) can detect high-frequency (10 to 100 kHz) and very high-frequency (above 100 kHz) sounds (Mann et al. 2001; Mann et al. 1997; Popper et al. 2022).

Based on this information above, fishes can be categorized by possession (or not) of anatomical features that affect their hearing capabilities and sensitivity. The categories of fishes included are listed in Table D-2.

Table D-2. Categorization of Fish by Anatomical Features that Affect their Hearing Capabilities

Category	***Example Species***	***Description***	***Frequency Range***	***References***
No swim bladder or other gas chamber	elasmobranchs, paddlefish, some tuna	Hearing is limited to particle motion detection frequencies	Below 1.5 kHz	(Chapuis and Collin 2022; Ladich and Fay 2013; Popper et al. 2014)
Swim bladder that is not involved in hearing	salmonids, sturgeon	Lack the anatomical hearing specializations and principally detect particle motion	Potentially up to 1 kHz	(Ladich and Fay 2013; Popper and Calfee 2023; Popper et al. 2014; 2019)
Swim bladder or gas chamber involved in hearing	carp, sardines, anchovies	Possess anatomical specializations that enhance hearing and can detect sound pressure	Below 1 kHz up to 4 kHz	(Ladich and Fay 2013; Popper et al. 2014)
Swim bladder and high-frequency hearing	knifefish, shad	Possess anatomical specializations that allow detection of ultrasonic stimulation and are capable of sound pressure detection	Below 1 kHz, from 10 to over 100 kHz, and possibly as high as 180 kHz	(Higgs et al. 2004; Ladich and Fay 2013; Mann et al. 2001; 1998)

kHz = kilohertz; Modified from Popper et al. (2014)

Fish not only detect sound, but many also produce sound. More than 109 families of fish are noted for producing sound, with most vocal fish producing low-frequency sounds between 100 and 300 Hz (Ladich 2019; Rice et al. 2022; Rountree et al. 2003). Fish produce sounds in a variety of ways, such as by sonic muscles on or near the swim bladder, rubbing or striking of skeletal elements, grinding of teeth, or fast jaw slams (Fine and Parmentier 2015; Kasumyan 2008; Parmentier et al. 2007; Putland et al. 2019). Fish often produce sound under the following conditions: (1) they are alarmed or presented with harmful stimuli (Ladich 2019; Myrberg 1981; Pereira et al. 2020); (2) during the mating season for courtship, spawning, and defending territories (Fine and Parmentier 2015; Monczak et al. 2022; Pereira et al. 2014; Putland et al. 2019);and (3) to maintain school or shoal cohesion (Van Oosterom et al. 2016).

D.3.1 Elasmobranch Hearing

Unlike other fish, elasmobranchs do not have a swim bladder (Mickle and Higgs 2022b). As such, they are incapable of detecting sound pressure and are limited to detection of particle motion (Ladich and Fay 2013; Mickle and Higgs 2022b). The data on hearing in species tested in the elasmobranch group (e.g., nurse shark (*Ginglymostoma cirratum*), little skate (*Leucoraja erinacea*), and Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)) show that they do not hear particularly well and that their best hearing is at low frequencies (below 100 Hz)(Casper and Mann 2009; Casper et al. 2003; Casper and Mann 2006). The hearing range of tested elasmobranchs is from roughly 20 Hz up to 1.5 kHz, with similar thresholds in all species above 100 Hz (Casper and Mann 2009; Chapuis and Collin 2022; Mickle and Higgs 2022b). The hearing range of smaller sharks is approximately 40 to 1,500 Hz (Myrberg 2001), and for smaller rays, the hearing range is 100 to 1,000 Hz (Casper et al. 2003; Casper and Mann 2006).

D.4 Sea Turtle Hearing

Limited data and information on sea turtle hearing and sound production exist. Sea turtles have no ear pinnae (external ear openings), as their middle ears are covered by a layer of fat that is overlain by a thick layer of skin on their external head surface called the tympanum (Popper et al. 2014). This layer of fat over the middle ear is a distinguishing feature of sea turtle ear morphology (Bartol and Musick 2003). Sea turtle ears are adapted for hearing in-water and in-air, with auditory structures that receive sound via bone conduction (Lenhardt et al. 1985), resonance of the middle ear cavity (Willis et al. 2013), or standard tympanic middle ear path (Hetherington 2008). Electrophysiological, behavioral, and morphological studies on hearing indicate that sea turtles hear low frequency sounds both in-water and in-air (Bartol and Ketten 2006; Bartol et al. 1999; Lavender et al. 2014; Martin et al. 2012; Ridgway et al. 1969; Willis et al. 2013).

Hearing abilities have been studied with sub-adult, juvenile, and hatchling subjects in green (*Chelonia mydas*) (Bartol and Ketten 2006; Ketten and Bartol 2005; Piniak et al. 2016; Ridgway et al. 1969), Kemp's ridley (*Lepidochelys kempii*) (Ketten and Bartol 2005), loggerhead (*Caretta caretta*) (Bartol et al. 1999; Ketten and Bartol 2005; Lavender et al. 2014; Martin et al. 2012), and leatherback sea turtles (*Dermochelys coriacea*) (Harms et al. 2014; Piniak et al. 2012b). Due to similar anatomy among sea turtles, the results of studies on these species provide insight into hearing in all sea turtles. Only one study examined the auditory capabilities of an adult sea turtle, which was a loggerhead turtle, and that study confirmed that adult hearing is similar to measurements of juvenile and hatchling hearing ranges (Martin et al. 2012). Hawksbill sea turtle (*Eretmochelys imbricate*) hearing has been studied to a lesser extent, and no published studies to date have reported audiograms of olive ridley turtles (*Lepidochelys olivacea*) (Kastelein et al. 2024).

The Navy compiled known data on sea turtle hearing and developed a composite audiogram (Figure D-1) (Navy 2024). Studies of hearing ability show that sea turtles' in-water hearing ranges generally lie between 50 hertz (Hz) and 1.6 kilohertz (kHz), with maximum sensitivity between 100 and 400 Hz, and that hearing sensitivity drops off rapidly at higher frequencies (Bartol and Ketten 2006; Ketten and Bartol 2005; Piniak et al. 2012a; Piniak et al. 2016; Popper et al. 2014).

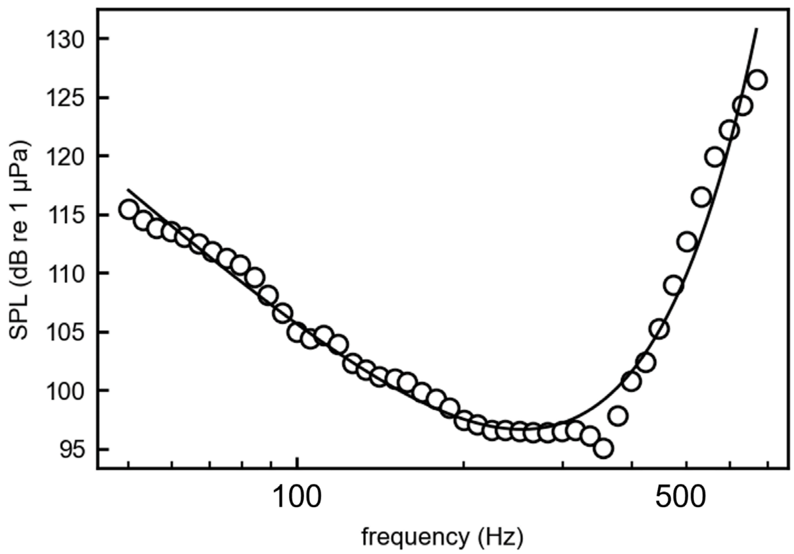

Figure D-1. Composite Audiogram used in Sea Turtle Criteria and Thresholds

dB re 1 μPa = decibels referenced to 1 micropascals; Hz = hertz; SPL = sound pressure level

Very little is known about sea turtle sound production or how sound may be used for communication or other purposes. Charrier et al. (2022) were the first to document underwater sound production for the green sea turtle (juveniles). The juvenile green sea turtles produced 10 distinct sounds that were associated with pulses, low amplitude calls, frequency-modulated sounds, and squeaks. It was suggested that these sounds may be used for communication because the frequency bandwidth of sounds produced largely fell within the green sea turtle in-water hearing range (50 Hz to 1.6 kHz) (Charrier et al. 2022). Some croaks and squeaks were above the hearing range of green sea turtles (greater than 2 kHz), and Charrier et al. (2022) suggested that these sounds may not be fully heard by the turtles.

Studies have indicated that green sea turtles have the broadest underwater hearing range (50 Hz to 1.6 kHz) (Papale et al. 2020). Subadult green sea turtles, on average demonstrate the lowest hearing threshold at 300 Hz (93 dB re 1 μPa), with thresholds increasing at frequencies above and below 300 Hz (Bartol and Ketten 2006; Piniak et al. 2016). Juvenile and sub-adult green sea turtles detect sounds from 100 to 500 Hz underwater, with maximum sensitivity at 200 to 400 Hz (Bartol and Ketten 2006). Auditory brainstem response recordings on green sea turtles showed a peak response at 300 Hz (Yudhana et al. 2010). Auditory brainstem response testing was also used to detect thresholds for juvenile green sea turtles (lowest threshold 93 dB re 1 μPa at 600 Hz) (Bartol and Ketten 2006).

D.5 Terrestrial Mammal Hearing

In amphibians, reptiles, and birds, the ears are internally paired either through the mouth or through an interaural canal. This allows for directionality of sound detection and enhances sound-localization cues. There were three major anatomical developments in the evolution of the mammalian ear. One was the evolution of the three-boned middle ear. The second was the development of external ears (pinnae). The third was the acoustic isolation of the two ears. Having lost the directionality of coupled ears, mammals evolved both the ability to hear sounds above 10 kHz and external ears. This allowed them to use two high-frequency cues for localizing: the difference in the intensity of a sound at the two ears, and the directionality induced by the pinnae (Heffner and Heffner 2018). The auditory systems of humans and other mammals share the same basic plan and physical structures—soundwaves are collected in the outer ear and amplified via the middle ear before being transduced into electrical signals by the inner ear (Barber et al. 2020). The tympanic membrane both absorbs and shunts acoustic energy to prevent the reflection of sounds within the ear, so it plays an important role in auditory sensitivity (Bergevin and Olson 2014). The pinnae may also contribute to differences in hearing sensitivities amongst mammal species (Barber et al. 2020). Because the magnitude of the high-frequency locus cues depends on the size of the head and pinnae relative to the wavelength of the sound, smaller mammals hear higher frequencies than larger mammals in order to use these cues (Heffner and Heffner 2018).

Terrestrial mammals at PMRF include feral dogs and cats, mice, rats, and bats. These species' hearing ranges are detailed in Table D-3.

Table D-3. Hearing Ranges of Terrestrial Mammals at PMRF

Terrestrial species	*Approximate Hearing Range*
Dog	47 Hz – 45kHz
Cat	45 Hz – 64 kHz
Rat	200 Hz – 76 kHz
Mouse	1–91 kHz
Bat	2–110 kHz

The use of echolocation by bats, as well as by toothed whales (e.g., dolphins, killer whales), is an example of how, after mammals evolved high-frequency hearing, it was exploited for another function.

D.5.1 Bat Hearing

Although hearing ranges for bats are not well documented, bats generally have poor hearing at low frequencies. Bat call frequencies are typically categorized as low- (less than 25 kHz), mid- (25–35 kHz), or high-frequency (greater than 40 kHz). Bats are able to adjust their frequencies used in echolocation to be either higher or lower than the range of best hearing for their prey (Faure et al. 1993). Bat calls can range from 11 to 212 kHz (Jones and Holderied 2007; Maryland Department of Natural Resources 2019). Sound detection levels are somewhat dependent on ambient noise, and bats increase the loudness of their calls when they encounter noise (Hage et al. 2013; Luo and Wiegrebe 2016). Some bats have the capacity to hear lower frequencies (less than 5 kHz), particularly insectivorous bats that orient towards low-frequency sounds produced by their prey, such as mating calls and rustling noises (Geipel et al. 2021; Poussin and Simmons 1982).

D.6 Marine Mammal Hearing

Marine mammals have been separated into functional hearing groups based on taxonomy and the range of frequencies that could be detected underwater or in air for pinnipeds (Finneran et al. 2017; NMFS 2018b; Southall et al. 2007). Members of three of those functional groups are found within the proposed action area: low-frequency cetacean, mid-frequency cetacean, phocid in air, and phocid in water.

D.6.1 Low-Frequency Cetacean (Mysticete) Hearing

All mysticetes (baleen whales) are included in the low-frequency cetacean hearing group. There are no direct measurements of hearing sensitivity in low-frequency cetaceans (NMFS 2018a; Southall et al. 2019). Thus, hearing predictions for mysticetes are based on other methods including: anatomical studies and modeling (Cranford and Krysl 2015; Houser et al. 2001; Parks et al. 2007; Tubelli et al. 2012); vocalizations (see reviews in (Au and Hastings 2008; Richardson et al. 1995; Wartzok and Ketten 1999); taxonomy; and behavioral responses ((Dahlheim and Ljungblad 1990); see review in (Reichmuth et al. 2007)). It is generally assumed that most animals hear well in the frequency ranges similar to those used for their vocalizations (songs or calls), which are mainly below 1 kHz in baleen whales, although auditory frequency range and vocalization frequencies do not always perfectly align (Richardson et al. 1995). A hearing range of 7 Hz to 35 kHz has been estimated based on observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses for the group (NMFS 2018a). Watkins (1981) cites fin whales producing a variety of vocalizations that range from 10 to 200 Hz. Although, more recent findings suggest a narrower range of vocalizations 20 to 40 Hz (Romagosa et al. 2021). Sei whale vocalizations are the least studied of all the rorqual whales; however, Knowlton (1991) reported sei whale vocalizations at 21 Hz to 3.5 kHz.

D.6.2 Mid-Frequency Cetacean (Odontocete) Hearing

Odontocetes (toothed whales) in the mid-frequency cetacean hearing group include ESA-listed MHI insular false killer whales and sperm whales. These animals use echolocation to sense their environment. Hearing sensitivity has been directly measured for approximately one-third of the species within this group (Southall et al. 2019). Although auditory frequency range and vocalization frequencies do not always perfectly align, it is assumed that most marine mammals hear well in the frequency ranges similar to those used for their vocalizations. MHI insular false killer whales and sperm whales have a broad hearing range extending to 200 kHz, but the frequency of best hearing range is considered from 150 Hz to 160 kHz (Mooney et al. 2012b; National Marine Fisheries Service 2018a; Tougaard et al. 2014). Vocalizations for sperm and false killer whales were measured 400 Hz to 22 kHz (Southall et al. 2019; Weir et al. 2007), and 3 kHz to 87 kHz (Baumann-Pickering et al. 2015; Murray et al. 1998; Southall et al. 2019), respectively. Odontocetes use additional underwater communicative signals, including tonal whistles, clicks, and pulsed calls. These signals are usually short-duration (500–200 microseconds), specialized clicks used with peak frequencies between 10 and 200 kHz to detect, localize, and characterize underwater objects such as prey (Au 1993; Galatius et al. 2019; Wartzok and Ketten 1999).

D.6.3 Phocid Hearing

Unlike cetaceans who spend their entire lives in the water, pinnipeds are adapted to live part of their lives in water and part on land and therefore would be expected to adapt to hearing in water and in air. Pinnipeds produce sounds both in air and in water that range in frequency from approximately 100 Hz to several tens of kHz; and it is believed that these sounds only serve social functions, such as male-male vocal boundary displays, mother-pup recognition, and reproduction (Miller 1991). The phocid hearing group encompasses true seals, including Hawaiian monk seals. Phocids have larger, more dense middle ear ossicles, inflated auditory bulla, and larger sections of the inner ear (i.e., tympanic membrane, oval window, and round window) than their otariid counterparts, which make them more adapted for underwater hearing (Hemilä et al. 2006; Kastak and Schusterman 1998; Mulsow et al. 2011; Reichmuth et al. 2013; Schusterman and Moore 1978; Terhune and Ronald 1975). With captive animals, in a controlled environment, Hawaiian monk seals demonstrated a best hearing range of 0.2kHz to 33 kHz in water (Sills et al. 2021) and 0.1 to 33 kHz in air (Ruscher et al. 2021). These experiments showed poor hearing in the low-frequency range in water (Sills et al. 2021) and poor sensitivity to airborne sounds when compared to other phocids (Ruscher et al. 2021). Generally, the underwater functional hearing ranges of phocid species is 40 Hz to 90 kHz (NMFS 2024).