3.0
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

The following sections succinctly describe the existing environment of the areas that could be affected by the Proposed Action and the Recovery-not-possible Alternative under consideration. The descriptions provide relevant information for those unfamiliar with the environmental setting. In addition, they provide the context for understanding the environmental analysis and conclusions discussed in chapter 4.0. Lastly, they provide the environmental baseline against which impacts of the alternatives can be compared. Emphasis is placed on those features or components of the affected environment that could be impacted, and on identifying the particular vulnerabilities of these environmental components.

The criteria for inclusion or exclusion of particular environmental components and their attributes are whether the Proposed Action and the Recovery-not-possible Alternative could potentially impact, directly or indirectly, that environmental component and its attributes. Using these criteria, the following components are studied in detail: water quality; marine biological resources, including coral reefs; health and safety; hazardous materials and hazardous wastes; and airspace use. These components are addressed in the following sections. The geographical area that could potentially be affected by the Proposed Action and the Recovery-not-possible Alternative, referred to as the region of influence (ROI), varies depending on the environmental resource. The data and information presented is commensurate with the importance of the potential impact.

Hawaiian Islands Marine Environment Background Information

Natural hazards are a fact of life on Hawaii's coasts. Hazards that specifically impact coastal areas and that may be encountered during implementation of the Proposed Action include storm surges and seasonal high waves. Winds, currents (particularly regional currents), tides, and seas (surface waves) also add to hazards in the waters off Oahu. Winds, currents, tides, and seas are all critical features of the marine environment and are discussed briefly below.

High Winds and Storm Surge

Tropical cyclones periodically threaten the Hawaiian Islands. Such storms generate high winds and waves, heavy rains, marine storm surge, tornadoes, waterspouts, and small-scale, intense winds. Storm effects can be considerable even when a hurricane does not pass directly over an island. Unfortunately, the factors that influence the severity of storm-surge flooding (such as coastal topography, tidal stage and height at the time of the storm, and location relative to the eye of the hurricane) cannot be predicted more than a few days in advance. (Juvik and Juvik, eds, 1998)

Seasonal High Waves

Sudden high waves and the strong currents they generate are probably the most consistent and predictable coastal hazards in Hawaii. High surf is a condition of dangerous waves 10 to 20 feet (3 to 6 meters) high or more. On Oahu's southern coast, high surf usually forms during summer, when storms in the southern hemisphere generate waves of 4 to 10 feet (1 to 3 meters). Sets of large waves can develop suddenly, often doubling in size within a few seconds. The coastal water level increases under these conditions, and the seaward surge of excess water generates extremely dangerous rip currents. (Juvik and Juvik, eds, 1998)

Regional Currents

The Hawaiian Islands affect the waters around the islands by interactions with large-scale ocean currents and wind speed variations in the lee of the islands. On the southern boundary of Oahu, for example, trade winds with speeds of 22 to 44 miles per hour (10 to 20 meters per second) are separated from the calmer lee by a narrow boundary area (wind shear line). Variations in winds have subtle effects on current patterns. Clockwise eddies can form under the southern shear lines. Off the southern coast of Oahu, surface currents average about 0.33 feet per second (10 centimeters per second), but can vary by as much as a 1 foot per second (30 centimeters per second) (Juvik and Juvik, eds, 1998).

Tides

Local underwater surface contours affect the ranges and phases of tides along the shore as the tidal cycles wrap around the Hawaiian Islands. Tidal currents result from tidal variations in sea level, and near shore they are often stronger than the large-scale offshore flow. The semi-daily and daily tidal currents tend to be aligned with the shoreline off Oahu. However, due to the variability of tidal currents around the island and other factors, they cannot be predicted as precisely as the general sea level. Strong swirls often result from tidal currents flowing around points, such as Barbers Point, and headlands and can be hazardous to divers. (Juvik and Juvik, eds, 1998)

Surface Waves

Offshore of Oahu the seas are moderately rough, with wave heights of 3 to 14 feet (1 to 4 meters). These vary seasonally with trade wind intensity. Between the islands, where the winds are funneled, the seas are intensified. The lee, shielded from the winds, is generally calmer. Along the shores waves become steeper and break as they enter the shallow water. The south shores of the Hawaiian Islands, shielded from northwesterly swells, are usually calm in winter. During the summer, swells are commonly 3 to 9 feet (1 to 3 meters) high. Breaking waves move water toward the shore, where it escapes along shore. The water then returns to sea as narrow rip currents generally located where the bottom is deepest. Although forecasts about general wave conditions can be made, the size or timing of individual waves cannot be predicted. (Juvik and Juvik, eds, 1998)

3.1 WATER QUALITY

Region of Influence

The ROI for water quality is defined as the area potentially affected by the activities necessary to implement the Proposed Action. For the purposes of this document it is the water immediately around *Ehime Maru*, an elliptical cone-shaped column of water from the ship to the sea surface, that would be the pathway for any petroleum product releases, and the sea surface area indicated on the plume model figures in appendix H.

Marine Environment

The general composition of the ocean includes water, sodium chloride, dissolved gases, minerals, and nutrients. These characteristics determine and direct the interactions between the sea water and its inhabitants. Table 3-1 lists the general mineral composition of sea water. Appendix I, part 1, presents a more detailed list of elements and their behavior in sea water. The most important physical and chemical properties are temperature, salinity, density, pH, and dissolved gases.

Table 3-1: General Mineral Composition of Sea Water

Constituent	Concentration (in parts per million)	Constituent	Concentration (in parts per million)
Chloride	18,980	Lead	.004–.005
Sodium	10,560	Selenium	.004
Sulfate	2,560	Arsenic	.003–.024
Magnesium	1,272	Copper	.001–.09
Calcium	400	Tin	.003
Potassium	380	Iron	.002–.02
Bicarbonate	142	Cesium	~.002
Bromide	65	Manganese	.001–.01
Strontium	13	Phosphorus	.001–.01
Boron	4.6	Thorium	= <.0005
Fluoride	1.4	Mercury	.0003
Rubidium	.2	Uranium	.00015–.0016
Aluminum	.16–1.9	Cobalt	.0001
Lithium	.1	Nickel	.0001–.0005
Barium	.05		
Iodide	.05		
Silicate	.04–8.6		
Nitrogen	.03–.9		
Zinc	.005–.014		

Source: U.S. Geological Survey, no date.

Temperature

Water temperature is one of the most important physical factors of the marine environment. Temperature controls the rate at which chemical reactions and biological processes occur (Waller, 1996). In addition, most organisms have a distinct range of temperatures in which they may thrive. A greater number of species live within the moderate temperature zones, with fewer species tolerant to extremes in temperature. Typically, the vast majority of organisms cannot survive dramatic temperature fluctuations.

Temperature gradients are created when warmer, lighter water floats above colder, denser water. A thin, narrow band of stable water called a thermocline separates the warm and cold layers of water. In tropical latitudes, the thermocline is present as a permanent feature and is located 200 to 1,000 feet (approximately 60 to 300 meters) below the surface. The thermocline acts as a depth barrier to many plants and animals and often represents the boundary between hospitable and inhospitable water masses for many species of organisms. (Waller, 1996)

Salinity

Salinity refers to the salt (sodium chloride) content of sea water. For oceanic waters, the salinity is approximately 35 parts of salt per 1,000 parts of sea water. Variations in the salinity of ocean water are linked primarily to climatic conditions. Salinity variations are at their highest at the surface of the water. The salinity of surface water is increased by the removal of water through evaporation. Alternately, salinity decreases through dilution from the addition of fresh water (e.g., rain, runoff from fresh water sources such as streams). Estuaries and coastal areas represent transition zones from saltwater to fresh water. Sea water salinity has a profound effect on the concentration of salts in the tissues and body fluids of organisms. Slight shifts of salt concentrations in the bodies of animals can have stressful or even fatal consequences. Therefore, animals have either evolved mechanisms to control body salt levels, or they let them rise and fall with the levels of the sea water around them. (Waller, 1996)

In addition to the direct effects on marine biota, salinity also has an effect on the ocean's physical properties. For example, salinity helps maintain a constant temperature throughout the ocean depths. A high salt content in water slightly increases its density, which makes it resistant to drastic temperature fluctuations.

Density

Density (mass per unit volume) of sea water is dependent upon its composition and is affected by temperature. The dissolved salt and other dissolved substances contribute to the higher density of sea water versus fresh water. As temperatures increase, density decreases. Accordingly, water that is more dense will sink, while water that is less dense will rise. Therefore, oceans can be thought of as having a three-layered system of water masses. The three layers of the ocean are the surface layer (0 to 550 feet [0 to 168 meters]), an intermediate layer (550 to 1,500 feet [168 to 457 meters]), and a deep-water layer (1,500 feet [457 meters] to the seafloor). (Waller, 1996) *pH*

The measure of the acidity or alkalinity of a substance, known as the pH, is based on a scale ranging from 1 (highly acidic) to 14 (highly basic). A pH of 7 is considered neutral. Surface sea water often has a pH between 8.1 and 8.3 (slightly basic), but in deeper water the acidity of ocean water is very stable with a neutral pH. In shallow seas and coastal areas, the pH can be altered by plant and animal activities, pollution, and interaction with fresh water. (Waller, 1996)

Dissolved Gases

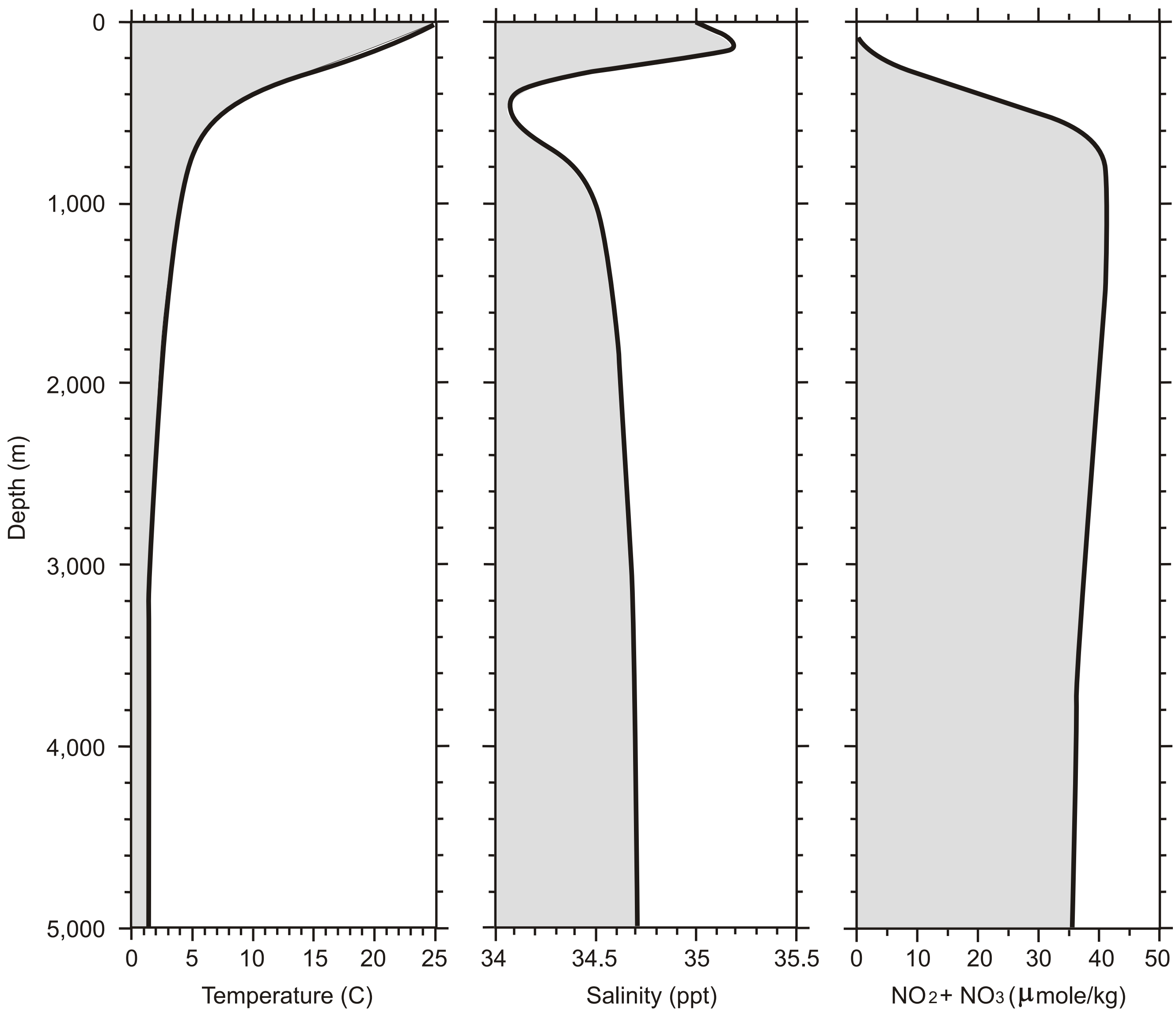
Oxygen is not readily soluble in sea water. The amount of oxygen present in sea water will vary with the rate of production by plants, consumption by animals and plants, bacterial decomposition, and by surface interactions with the atmosphere. Most organisms require oxygen for their life processes. When surface water sinks to deeper levels, it retains its store of oxygen. (Waller, 1996)

Carbon dioxide is a gas required by plants for photosynthetic production of new organic matter. Carbon dioxide is 60 times more concentrated in sea water than it is in the atmosphere. Sea water in tropical regions has lower levels of all dissolved gases in a given volume of water compared to sea water in high latitude areas (Waller, 1996).

Figure 3-1 depicts the average vertical profiles of temperature, salinity, and major nutrients computed from a series of monthly surface-to-bottom measurements made between 1988 and 1995 at Ocean Station Aloha located north of Oahu. Essentially the same conditions would be expected south of Oahu. Near the surface, the water column is mixed by wind and has uniform properties; the depth of the turbulent layer varies from nearly 400 feet (120 meters) in winter to less than 100 feet (30 meters) in summer. Below the mixed layer there is a sharp decrease in temperature (a thermocline), from 77 degrees Fahrenheit (F) (25 degrees Celsius [C]) at the surface to 41 degrees F (5 degrees C) at 2,300 feet (700 meters) depth, then a gradual decrease to 36 degrees F (1.5 degrees C) at the bottom. The salinity distribution reflects the sinking of water from the north: higher salinity water of 35.2 parts per thousand (ppt) at 500 feet (150 meters) depth, traceable to the high surface salinity water north of Hawaii; and low salinity water of 34.1 ppt at 1,670 feet (500 meters) depth, traceable to low surface salinity water further to the northwest. Below this depth, salinity increases gradually to 34.7 ppt for abyssal waters. The concentration of nutrients is small at the surface, but increases steadily to the bottom. Similar vertical distributions are found for phosphate and silicate. (Flament, et al., 1996)

3.1.1 CURRENT LOCATION

Because of its depth, the quality of sea water at the current location is expected to be relatively high. Chemical water quality data are not available for the ship's current location; however, data were available for sea water quality at a dredged material disposal site located near the shallow-water recovery site. Major components of sea water



Source: University of Hawaii, no date

LEGEND

C - Celcius
ppt - Parts per thousand
NO_2 - Nitrite
NO_3 - Nitrate
m - Meters

Average Vertical Distribution of Temperature, Salinity, and Major Nutrients in Hawaiian Waters

Figure 3-1

include particulate organic mater (plant detritus), particulate inorganic material (minerals), gases, organic and inorganic colloids, and dissolved organic and inorganic solutes (Millero and Sohn, 1992). Table 3-1 lists the general mineral composition of sea water.

Prior studies of the water chemistry in the ocean south of Oahu show the region is more oceanic than coastal in character. From September 1976 to April 1977, dissolved oxygen concentrations in the surface waters in this area were supersaturated, increased slightly between depths of 75 and 300 feet (25 and 100 meters), and gradually decreased with depth. Most dissolved oxygen values in this area remain above 4 milliliters/liter. Characteristic oxygen profiles for the Pacific Ocean show surface oxygen concentrations ranging from approximately 5 milliliters/liter to a minimum of less than 1 milliliter/liter between depths of 450 and 1,200 feet (150 and 400 meters), then increasing to approximately 3 milliliters/liter near the bottom (U.S. Environmental Protection Agency, 1980).

During December 1976, the pH of surface waters in the area averaged 8.1, increased to 8.2 between 75 and 150 feet (25 and 50 meters) depth, and then decreased to a minimum of 7.9 at 1,200 feet (400 meters) depth. During April 1977, pH values were significantly lower, averaging 7.6 at the surface, increasing to 7.7 between 300 and 450 feet (100 and 150 meters) depth, and finally decreasing to 7.6 at 1,200 feet (400 meters) depth (U.S. Environmental Protection Agency, 1980).

Heavy metals concentrations in the water column may be caused by natural background levels in volcanic rocks and corals. The total water column concentrations of silver, cadmium, chromium, and copper in this area are below the minimum detection limit of 1 micrograms/liter. Lead and nickel are below the minimum detection limits of 5 micrograms/liter and 4 micrograms/liter, respectively. An analysis for mercury and zinc yielded abnormally high values that were thought to be caused by contamination of the sample (U.S. Environmental Protection Agency, 1980).

Nutrients concentration measurements in this area of phosphate, total phosphorus, and nitrate-nitrite concentrations, are low in the surface layers, increasing with depth, with the greatest increases occurring below a depth of 450 feet (150 meters). These measurements are typical of oceanic waters. Ammonium concentrations vary, generally decreasing with depth (U.S. Environmental Protection Agency, 1980).

Surface currents around the Hawaiian Islands are generally east to west with a typical speed of 10 inches per second (25 centimeters per second). At the depth of *Ehime Maru*, current velocity is expected to be less than 4 inches per second (10 centimeter per second) (Flament, et al., 1996).

3.1.2 TRANSIT ROUTE TO THE SHALLOW-WATER RECOVERY SITE

Water quality is expected to be relatively high from the current location to the shallow-water recovery site, where the human-caused pollutants described in section 3.1.3 may occur.

3.1.3 REEF RUNWAY SHALLOW-WATER RECOVERY SITE

Basic water quality standards applicable to all waters in Hawaii are that they shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including the following:

- Materials that will settle to form objectionable sludge or bottom deposits
- Floating debris, oil, grease, scum, or other floating materials
- Substances in amounts sufficient to produce taste in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to produce objectionable color, turbidity, or other conditions in the receiving waters
- High or low temperatures; biocides; pathogenic organisms; toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water
- Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life
- Soil particles resulting from erosion on land involved in earthwork, such as the construction of public works; highways; subdivisions; recreational, commercial, or industrial developments; or the cultivation and management of agricultural lands (State of Hawaii, 2000)

The State of Hawaii classifies the marine waters within the ROI as Class A. It is the objective of Class A waters that their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge that has not received the best degree of treatment or control compatible with the criteria established for this class (State of Hawaii, 2000).

Human-caused pollutants, while well mixed, may degrade water quality at the site. Pollutants can generally be characterized as being derived from non-point sources and point sources.

Non-point source pollution is mainly caused by surface runoff moving over and through the ground, carrying contaminants. Rainwater, running off roofs, lawns, streets, industrial sites, and pervious and impervious areas, comprises surface runoff. As urban runoff travels overland, it can pick up sediment and debris; rubber, oil, grease, and other automobile-related residuals; lawn and garden fertilizers and pesticides; and lead, zinc, asbestos, PCBs, and a host of other pollutants (Belt Collins Hawaii, 1993).

The National Pollutant Discharge Elimination System program is administered by the State of Hawaii's Department of Health, which regulates point sources of pollution. Major point source discharges to Mamala Bay are those from the Sand Island, Honouliuli, and Fort Kamehameha Wastewater Treatment Plants outfalls. Minor point source discharges are those from approximately 30 industrial and agricultural sources. Point source discharges are the sources of conventional pollutants, including biochemical oxygen demand, total suspended solids, together with nutrients, indicator bacteria, pathogenic microorganisms, and some metals (Colwell, Orlob, and Schubel, 1996).

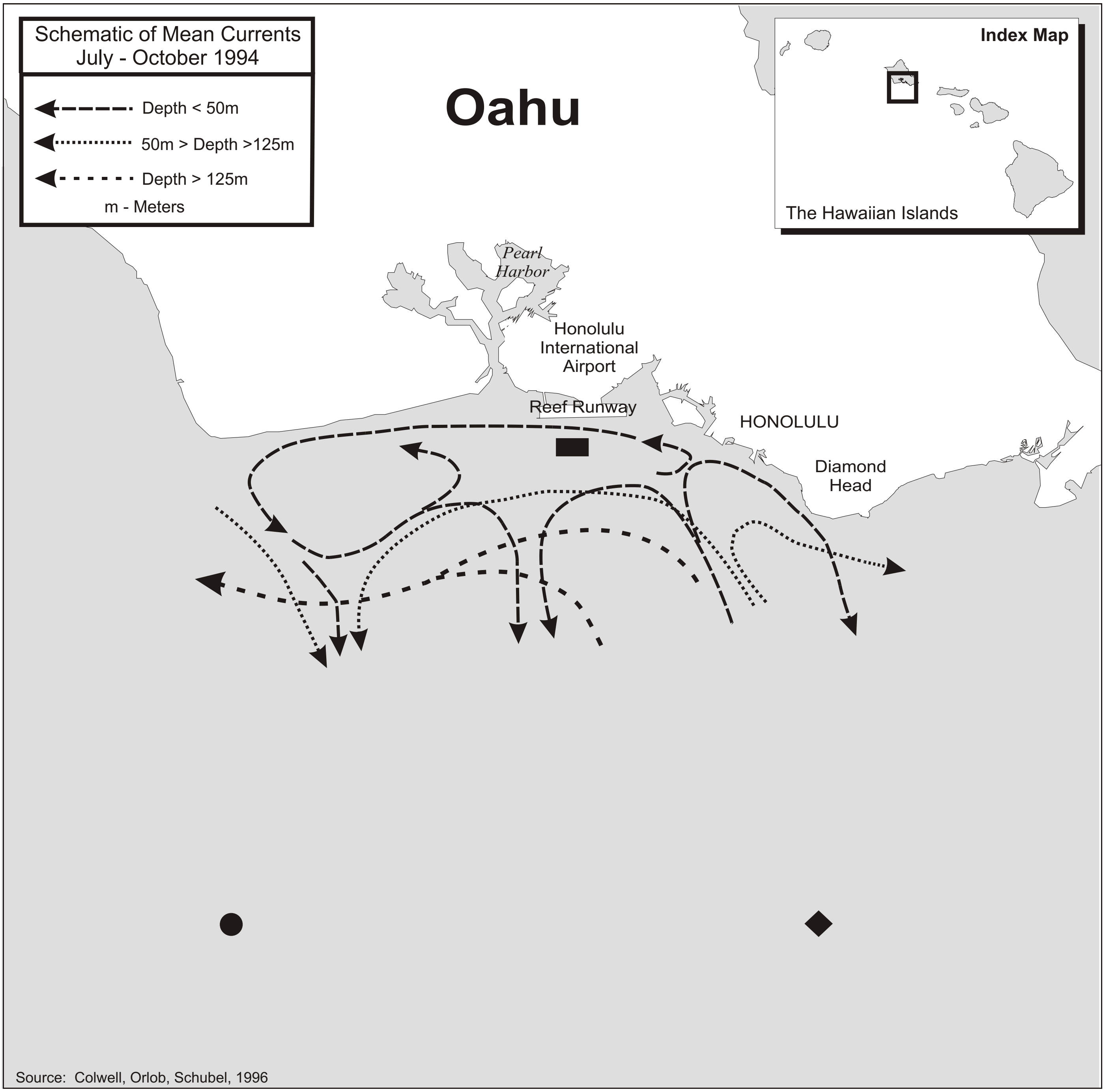
The Reef Runway shallow-water recovery site is near the center of Mamala Bay (see figure 2-9). Past studies of Mamala Bay have shown that near-shore marine water quality degradation frequently occurs at the mouths of streams and storm-drain outfalls following substantial rainfall. This degradation can include petroleum products and pathogenic organisms, the concentrations of which occasionally exceed state water quality standards (Teruya, 2001). Major sources of pollutants at the site are industrial activities in the area of, and streams that flow into, Honolulu Harbor, Pearl Harbor, and Keehi Lagoon.

Shore-based activities from non-maritime sources are the major cause of petroleum product releases into Oahu waters. Shoreline releases, although numerous, are generally "sheens." They typically occur from street or parking runoff, which is flushed by rainwater into a storm drain and then to the waterway (U.S. Coast Guard, 1998).

However, water quality typically recovers relatively rapidly following storm runoff because of dilution and dispersion. Ocean circulation in Mamala Bay is extremely complex, driven largely by tidal fluctuations with major components paralleling the shoreline, but influenced seasonally by thermal stratification and trade and Kona winds. Peak currents of about 20 inches per second (50 centimeters per second) were measured at the Sand Island wastewater treatment plant outfall located about 3 miles (4.8 kilometers) southeast of the Reef Runway shallow-water recovery site in approximately 250 feet (75 meters) of water. Figure 3-2 shows a schematic of the mean current circulation patterns in Mamala Bay from July to October 1994 (Colwell, Orlob, and Schubel, 1996).

3.1.4 TRANSIT ROUTE TO THE DEEP-WATER RELOCATION SITE

Water quality at the shallow-water recovery site, at the beginning of the transit route, is subject to the man-made pollutants described in section 3.1.3, but water quality is expected to be relatively high along the transit route away from the shallow-water site toward the deep-water relocation site.



LEGEND

◆ Current Location

■ Reef Runway Shallow-water Recovery Area

● Deep-water Relocation Site (Beyond the 1,000-fathom contour)

NORTH

No Scale

Schematic of Mean Circulation Patterns off Southern Oahu

Figure 3-2

3_2MeanCurrent060101

3.1.5 DEEP-WATER RELOCATION SITE

Water quality at the deep-water relocation site should be similar to water quality at the current location described in section 3.1.1. Current velocity is expected to be about 2 inches per second (5 centimeter per second) or less at the deep-water relocation site.

3.2 MARINE BIOLOGICAL RESOURCES

Complex marine ecosystems occur in Hawaiian waters to depths of 16,500 feet (5,000 meters) and extend inland from the coasts to include coastal marine ponds. Several factors control the variety, distribution, and abundance of marine life, including geographic isolation, subtropical climate, storm waves, and human-caused pollution and development.

Region of Influence

The biological resource affected environment sections emphasize the existing marine biological conditions in the areas around the current location, the transit route to the shallow-water recovery site, the shallow-water recovery site, the transit route to the deep-water relocation site, and the deep-water relocation site.

Marine Environment

All of the activities necessary to implement the Proposed Action would be conducted in the nearshore marine environment. Therefore, the emphasis in this section is on marine ecosystems and biota, including seabirds, shorebirds, and coastal waterbirds. Terrestrial biological resources are not addressed since those areas where elements of the Proposed Action would take place onshore are already developed and disturbed. The existing marine biological environment addresses four principal attributes: (1) marine fish and Essential Fish Habitat (EFH); (2) marine mammals; (3) migratory birds associated with the marine environment; and (4) threatened and endangered species. Shorebirds are addressed, just for the shallow-water recovery site. In addition, a brief discussion on biological diversity in the marine environment is provided for context.

Biological Diversity

Although oceans have fewer species of plants and animals than terrestrial and fresh water environments, an incredible variety of living things reside in the ocean. Marine life ranges from microscopic one-celled organisms to the world’s largest animal, the blue whale. Ocean plants and plant-like organisms use sunlight and the minerals in sea water to grow. Sea animals eat these organisms and one another. Marine plants and plant-like organisms can live only in the sunlit surface waters of the ocean, the photic zone, which extends to only about 330 feet (100 meters) below the surface. Beyond the photic zone, the light is insufficient to support plants and plant-like organisms. Animals, however, live throughout the ocean from the surface to the greatest depths.

Marine biological communities can be divided into two broad categories: pelagic and benthic. Pelagic communities live in the water column and have little or no association with the bottom, while benthic communities live within, upon, or associated with, the bottom (Thorne-Miller & Catena, 1991).

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton includes larvae of benthic species, so a pelagic species in one ecosystem may be a benthic species in another. The plankton consists of plant-like organisms (phytoplankton) and animals (zooplankton) that drift with the ocean currents, with little ability to move through the water on their own. The mostly one-celled phytoplankton float in the photic zone, where the organisms obtain sunlight and nutrients, and serve as food for the zooplankton and for some larger marine animals. The zooplankton consists of many kinds of animals, ranging from one-celled organisms to jellyfish up to 6 feet (2 meters) wide, which live in both surface and deep waters of the ocean. Crustaceans make up about 70 percent of all zooplankton. While some zooplankton float about freely throughout their lives, many spend only the early part of their lives as plankton. As adults some become strong swimmers and join the nekton; others settle to the seafloor or attach themselves to it and become part of the benthos.

The nekton consists of animals that can swim freely in the ocean. They are strong swimmers and include fish, squids, and marine mammals. Most species of nektonic animals live near the sea surface, where food is plentiful, but many others live in the deep ocean. Fish are the most important nekton, with over 13,000 kinds of fish living in the ocean. Squids are free-swimming mollusks that live in both surface and deep waters. Nektonic mammals, including porpoises and whales, remain in the ocean for their entire lives. Other marine mammals, such as the Hawaiian monk seal, spend time on land.

It is thought that pelagic systems are controlled primarily by physical factors, including temperature, nutrients, amount of light in the surface waters, and disturbances in the water structure. The latter occurs when winds and other atmospheric conditions drive changes in the circulation patterns of ocean waters. As a result, there are vertical changes in the temperature and nutrient distribution, which in turn affect the vertical distribution of species. There is no clear evidence of biological factors controlling species diversity in these ecosystems, but species interactions have not been well studied (Thorne-Miller & Catena, 1991).

Benthic communities, or the benthos, are made up of marine organisms that live on or near the seafloor. They may burrow in the seafloor, attach themselves to the bottom, or crawl or swim about within the bottom waters. Where sunlight reaches the seafloor, the benthos includes plants and plant-like organisms, such as seagrass, which become anchored to the bottom. Among the common animals that live on the seafloor are clams, crabs, lobsters, starfish, and several types of worms. Bottomfish are fish that have adapted to life on the seafloor. Barnacles, clams, oysters, and various snails and worms are among the animals that begin life as zooplankton, but on reaching maturity sink to the seafloor and become part of the benthos.

The greatest known diversity of marine species exists in benthic communities, especially in coral reefs. The benthic environment includes the intertidal shore; the shallow subtidal shelf; the deep abyssal plains; and isolated ecosystems such as coral reefs, seamounts, and deep-sea trenches. The substrate may vary considerably, with distinct differences between hard-bottom and soft-bottom communities. The type of bottom has a big effect on the nature of the community that lives there. Beyond that single physical factor, species diversity is maintained by biological mechanisms—competition, predation, larval recruitment, and biological structuring of the substrate—and/or physical mechanisms, such as nutrients, light, waves, and currents (Thorne-Miller & Catena, 1991).

Marine Fish, Essential Fish Habitat, and Coral

Much of what is known about the biology of the deep ocean waters surrounding the Hawaiian Islands is based on limited information gleaned from studies on sport and commercial fisheries. Pelagic ocean and deep seafloor (benthic) ecosystems occur in the deep open waters beyond the neritic shallow-water zone around all the islands and on, and above, the seafloor at depths greater than 660 feet (200 meters). Pelagic ocean waters are exposed to swells, currents, and winds from all directions, generally beyond the sheltering effects of the islands. Deep currents and eddies are also associated with this zone. Sunlight is absent on the deep seafloor. Basalt and carbonate rock substrates are common on slopes, with sediments prevalent on flatter surfaces. Bottom sediments surrounding Oahu are composed largely of muds washed as organic matter (detritus) from the adjacent islands, and sand and gravel of shallow-water origin.

Phytoplankton are the only abundant plants in the pelagic zone; living plants are rare or absent on the deep seafloor. Zooplankton, fishes, squids, sea turtles, marine mammals, and various seabirds forage in neritic or pelagic waters. At depths in excess of 330 feet (100 meters), many benthic organisms live where there is little or no light and maintain themselves on detritus and planktonic organisms in the water column.

The Magnuson-Stevens Act defines EFH as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. "Waters," when used for the purpose of defining EFH, include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include historical areas of use where appropriate. Substrate includes sediment, hard bottom, underlying structures, and associated biological communities. The designation of EFH by the Western Pacific Regional Fishery Management Council was based on the best scientific data available. Careful judgment was used in determining the extent of EFH that should be designated to ensure that sufficient habitat in good condition is available to maintain a sustainable fishery and the managed species contribution to a healthy ecosystem.

National Marine Fisheries Service guidance governing implementation of the EFH amendments calls for the identification of habitat areas of particular concern. Habitat areas of particular concern could need higher levels of protection than other habitat from adverse effects, including impacts from non-fishing related activities as well as from fishing and activities supporting fishing industries. Habitats that are limited geographically or are unusually productive may be designated as reserves or sanctuaries where appropriate. Identifying potentially threatening activities to habitat areas of particular concern is a complex task, since impacts from different activities, or from the same activity repeated over time, can be cumulative throughout the ecosystem.

To manage the EFH areas, the National Marine Fisheries Service has placed the managed species in four categories: bottomfish management unit species, pelagic management unit species, crustacean management unit species, and precious coral management unit species.

Except for major commercial species, little is known about the life histories, habitat utilization patterns, food habits, or spawning behavior of most adult bottomfish and seamount groundfish species. Furthermore, very little is known about the distribution and habitat requirements of juvenile bottomfish.

The distribution of adult bottomfish is closely linked to suitable physical habitat. Unlike the U.S. mainland with its continental shelf ecosystems, Pacific islands are primarily volcanic peaks with steep drop-offs and limited shelf ecosystems. The bottomfish management unit species under the Western Pacific Regional Fishery Management Council's jurisdiction are found concentrated on the steep slopes of deep-water banks. The approximately 660-foot (200-meter) isobath is commonly used as an index of bottomfish habitat. Adult bottomfish are usually found in habitats characterized by a hard substrate of high structural complexity. Bottomfish populations are not evenly distributed within their natural habitat; instead they are dispersed in a non-random, patchy fashion.

There is regional variation in species composition, as well as a relative abundance of the bottomfish management unit species of the deep-water bottomfish complex. The target species are generally found at depths of approximately 160 to 890 feet (50 to 270 meters).

The Western Pacific Regional Fishery Management Council has designated this area as bottomfish EFH. The species designations include deep-slope bottomfish (shallow- and deepwater) and seamount groundfish complexes. Shallow-water species are those in the 0- to 330-foot (0- to 100-meter) depths. Deep-water species are those in the approximately 330- to 1,300-foot (100- to 400-meter) depths. Because of the known depth and bottom types preferred by bottomfish, and the pelagic nature of their eggs and larvae, the Western Pacific Regional Fishery Management Council has designated the water column and all bottom habitats from the shoreline to a depth of 1,300 feet (400 meters) around the Hawaiian Islands as EFH. The Western Pacific Regional Fishery Management Council has also designated all escarpments and slopes between approximately 130 to 920 feet (40 to 280 meters) as habitat areas of particular concern.

The life histories of most of the commercial, recreational, and other fish species (marketable, non-marketable, and sharks) are not well known. Most are pelagic spawners. However, the National Marine Fisheries Service has designated the marine environment from the shore to the 12-nautical-mile (22-kilometer) limit as EFH. Areas of most concern in Hawaii are escarpments, locations of high structural complexity, live coral heads and reefs, and nursery areas. Examples include coral reefs, fringing reefs, lagoons, estuaries, tidal mangrove vegetation, and seagrass beds. There are large gaps in the scientific knowledge of the basic life histories and habitat requirement for many of the species that make up the pelagic management unit species. Therefore the Western Pacific Regional Fishery Management Council has adopted a 3,300-foot (1,000-meter) depth as a lower boundary of the EFH for pelagic management unit species, and 660 feet (200 meters) from the shoreline to the outer limit of the Exclusive Economic Zone (EEZ) as the upper limit of the EFH covering the eggs and larvae of the pelagic management unit species. The EEZ extends from seaward of the state's boundary out to 200 nautical miles (370 kilometers) from land.

Spiny lobsters are found throughout the Indo-Pacific Region. All spiny lobsters in the western Pacific region belong to the family Palinuridae. The slipper lobsters belong to the family Scyllaridae. The Hawaiian spiny lobster (*Panulirus marginatus*) is endemic to Hawaii and is the primary species of interest in the Northwestern Hawaiian Islands fishery. In Hawaii, adult spiny lobsters are typically found on rocky substrate in well-protected areas, in crevices, and under rocks. The reported depth of the Hawaiian spiny lobster is from approximately 10 to 660 feet (3 to 200 meters), but is generally most abundant in waters of 300 feet (90 meters) or less. The Kona crab, family Raninidae, is taken in low numbers in the Northwestern Hawaiian Islands fishery. The Western Pacific Regional Fishery Management Council has designated the EFH for crustacean management unit species based on complexes or assemblages. The two complexes are the spiny and slipper lobster complex and the Kona crab complex.

For spiny lobster larvae, the EFH is the water column from the shoreline to the outer limit of the EEZ down to a depth of 450 feet (150 meters). The EFH for juvenile and adult spiny lobster is designated as the bottom habitat from the shoreline to a depth of 330 feet (100 meters). The Council has also designated all banks with summits less than 95 feet (30 meters) in the Northwestern Hawaiian Islands as habitat areas of particular concern for spiny lobster.

Black, pink, gold, and bamboo corals, collectively referred to as precious corals, occur in deep inter-island channels and off promontories at depths between 50 and 4,920 feet (15 and 1,500 meters). These coral species are included as management unit species in the Precious Corals Fisheries Management Plan. The Council has designated the six known beds of deep-water precious coral (pink, gold, and bamboo) as EFH for precious coral management unit species. The six known precious coral beds are located at Keahole Point, Makapuu, Kaena Point, Wespac, Brooks Bank, and 180 Fathom Bank. In addition, the agency has also designated the three black coral beds in the main Hawaiian Islands as EFH for precious coral management unit species. The three black coral beds are located between Milolii and South Point on Hawaii, Auau channel between Maui and Lanai, and the southern border of Kauai. The Council has designated three of the six known deep-water precious coral beds (Makapuu, Brooks Bank, Wespac) are designated as habitat areas of particular concern. For black corals, the Council has designated Auau channel as habitat areas of particular concern.

Marine Mammals

Both the Endangered Species Act and the Marine Mammal Protection Act protect the marine mammals present in the waters around the Hawaiian Islands. Table 3-2 identifies those species that are not listed as threatened or endangered, but are protected by the Marine Mammal Protection Act. The listed species are discussed under the heading Threatened and Endangered Species below.

Table 3-2: Protected Marine Mammals Found in Hawaiian Waters

Type	Common Name	Scientific Name
Odontocetes		
Toothed Whale	Bottlenose Dolphin	*Tursiops truncatus*
Toothed Whale	Hawaiian Spinner Dolphin	*Stenella longirostris*
Toothed Whale	Spotted Dolphin	*Stenella attenuata*
Toothed Whale	Striped Dolphin	*Stenella coeruleoalba*
Toothed Whale	Blainville's Beaked Whale	*Mesoplodon densirostris*
Toothed Whale	Cuvier's Beaked Whale	*Ziphius cavirostris*
Toothed Whale	False Killer Whale	*Pseudorea crassidens*
Toothed Whale	Killer Whale	*Orcinus orca*
Toothed Whale	Melon-headed Whale	*Peponocephala electra*
Toothed Whale	Risso's Dolphin	*Grampus griseus*
Toothed Whale	Rough-toothed dolphin	*Steno bredanensis*
Toothed Whale	Short-finned Pilot Whale	*Globicephala macrorhynchus*
Toothed Whale	Pygmy Sperm Whale	*Kogia breviceps*
Toothed Whale	Dwarf Sperm Whale	*Kogia simus*
Mysticetes		
Baleen Whale	Bryde's Whale	*Balaenoptera edeni*

Source: U.S. Fish and Wildlife Service 2001, unpublished tables.

Migratory Birds

Thirty-nine species of migratory seabirds are known to occur in the Hawaiian Island chain. Twenty-two of these species breed in Hawaii. The foraging range of some of these species is estimated to be between 98 and 300 miles (159 and 480 kilometers). Seabirds (e.g., red-footed boobies (*Sula sula*), masked boobies (*Sula dactylatra*), white-tailed tropicbirds (*Phaethon lepturus*), red-tailed tropicbirds (*Phaethon rubricauda*), sooty terns (*Sterna fuscata*), brown noddies (*Anous stolidus*), and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands. The short-tailed albatross (*Phoebastria albatrus*) has been observed on Pacific Missile Range Facility, Kauai.

Migratory shorebirds and waterbirds are also relatively common (table 3-3) in the Hawaiian Islands, although within the ROI, the number of species present is limited and is potentially associated with the shallow-water recovery site only.

Table 3-3: Migratory Birds in the Hawaiian Islands

Scientific Name	Common Name	Status
Migratory Seabirds		
Phoebastria albatrus	Short-tailed Albatross	Vo E
Phoebastria nigripes	Black-footed Albatross	Bi
Phoebastria immutabilis	Laysan Albatross	Bi
Fulmarus glacialis	Northern Fulmar	Vo
Pterodroma phaeopygia	Hawaiian Petrel	Bes E
Pterodroma externa	Juan Fernandez Petrel	Vo
Pterodroma cervicalis	White-necked Petrel	Vo
Pterodroma inexpectata	Mottled Petrel	Vo
Pterodroma hypoleuca	Bonin Petrel	Bi
Pterodroma nigripennis	Black-winged Petrel	Vo
Bulweria bulwerii	Bulwer Petrel	Bi
Puffinus carneipes	Flesh-footed Shearwater	Vo
Puffinus pacificus	Wedge-tailed Shearwater	Bi
Puffinus griseus	Sooty Shearwater	Vr
Puffinus tenuirostris	Short-tailed Shearwater	Vo
Puffinus nativitatis	Christmas Shearwater	Bi
Puffinus newelli	Newell's Shearwater	Be T
Oceanodroma leucorhoa	Leach Storm-Petrel	Vr
Oceanodroma castro	Band-rumped Storm-Petrel	Bi
Oceanodroma tristrami	Tristram Storm-Petrel	Bi
Phaethon lepturus	White-tailed Tropicbird	Ri
Phaethon rubricauda	Red-tailed Tropicbird	Bi
Sula dactylatra	Masked Booby	Ri
Sula leucogaster	Brown Booby	Ri
Sula sula	Red-footed Booby	Ri
Fregata minor	Great Frigatebird	Ri
Stercorarius pomarinus	Pomarine Jaeger	Vr
Larus atricilla	Laughing Gull	Vo
Larus philadelphia	Bonaparte Gull	Vo
Larus delawarensis	Ring-billed Gull	Vo
Larus argentatus	Herring Gull	Vo
Larus glaucescens	Glaucous-winged Gull	Vo

Table 3-3: Migratory Birds in the Hawaiian Islands (Continued)

Scientific Name	Common Name	Status
Migratory Seabirds (Continued)		
Sterna antillarum	Least Tern	Vo
Sterna lunata	Gray-backed Tern	Bi
Sterna fuscata	Sooty Tern	Bi
Anous stolidus	Brown Noddy	Ri
Anous minutus	Black Noddy	Res
Procelsterna cerulea	Blue-gray Noddy	Ri
Gygis alba	White Tern	Ri
Migratory Waterbirds		
Dendrocygna bicolor	Fulvous Whistling-Duck	Ri
Branta bernicla	Brant	Vo
Brantacanadensis	Canada Goose	Vo
Anas crecca	Green-winged Teal	Vr
Anas platyrhynchos	Mallard	Vo
Anas acuta	Northern Pintail	Vc
Anas querquedula	Garganey	Vo
Anas discors	Blue-winged Teal	Vo
Anas clypeata	Northern Shoveler	Vc
Anas americana	American Wigeon	Vr
Aythya collaris	Ring-necked Duck	Vo
Aythya afinis	Lesser Scaup	Vr
Gallinula chloropus sandvicensis	Hawaiian Moorhen	Be E
Anas uyvilliana	Hawaiian Duck	Be E
Himantopus mexicanus knudseni	Hawaiian Black-necked Stilt	Be E
Fulica alai	Hawaiian Coot	Be E
Migratory Shorebirds		
Egretta caerulea	Little Blue Heron	Vo
Nycticorax nycticorax	Black-crowned Night-Heron	Ri
Pluvialis squatarola	Black-bellied Plover	Vr
Pluvialis dominica	Lesser Golden-Plover	Vc
Charadrius semipalmatus	Semipalmated Plover	Vo
Tringa flavipes	Lesser Yellowlegs	Vr
Heteroscelus incanus	Wandering Tattler	Vc

Table 3-3: Migratory Birds in the Hawaiian Islands (Continued)

Scientific Name	Common Name	Status
Migratory Shorebirds (Continued)		
Numenius tahitiensis	Bristle-thighed Curlew	Vr
Limosa lapponica	Bar-tailed Godwit	Vo
Arenaria interpres	Ruddy Turnstone	Vc
Calidris alba	Sanderling	Vc
Calidris mauri	Western Sandpiper	Vo
Calidris minutilla	Least Sandpiper	Vo
Calidris melanotos	Pectoral Sandpiper	Vr
Calidris acuminata	Sharp-tailed Sandpiper	Vr
Calidris alpina	Dunlin	Vr
Philomachus pugnax	Ruff	Vo
Limnodromus griseus	Short-billed Dowitcher	Vo
Limnodromus scolopaceus	Long-billed Dowitcher	Vr
Gallinago gallinago	Common Snipe	Vo
Phalaropus tricolor	Wilson Phalarope	Vo

Source: U.S. Fish and Wildlife Service 2001, unpublished tables.

Symbols for Status:
E = Endangered. **T** = Threatened. **Be** = Breeder; species breeds only in Hawaii. **Bes** = Breeder; Species also breeds elsewhere; Hawaiian subspecies breeds only in Hawaii. **Bi** = Breeder; Hawaiian also breeds elsewhere. **Res** = Resident; indigenous species; Hawaiian subspecies is endemic. **Ri** = Resident; indigenous species; Hawaiian form is not endemic. **Vo** = Visitor; occasional to frequent migrant to Hawaii. **Vr** = Visitor; regular migrant to Hawaii in small numbers.

Threatened and Endangered Species

An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Endangered marine mammals found in Hawaii include the Hawaiian monk seal, humpback whale, blue whale, fin whale, and sperm whale (table 3-4). The Marine Mammal Protection Act also protects all of these endangered marine mammals.

Also listed are two turtles: the green sea turtle (*Chelonia mydas*) and the hawksbill sea turtle (*Eretmochelys imbricata*). There are six endangered migratory bird species in the Hawaiian Islands: short-tailed albatross, Hawaiian petrel (*Pterodroma phaeopygia*), Hawaiian moorhen (*Gallinula chloropus sanvicensus*), Hawaiian duck (*Anas wyvilliana*), Hawaiian coot (*Fulica alai*), and Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*). There is also one threatened seabird: Newell's shearwater (*Puffinus newelli*). The threatened and endangered species are discussed below.

Table 3-4: Threatened and Endangered Marine Mammals, Turtles, Seabirds, and Waterbirds found in Hawaiian Waters

Type	Common Name	Scientific Name	Status
Toothed Whale	Sperm Whale	*Physeter macrocephalus*	Endangered
Mysticete Whale	Humpback Whale	*Megaptera evangelae*	Endangered
Mysticete Whale	Blue Whale	*Balaenoptera musculus*	Endangered
Mysticete Whale	Fin Whale	*Balaenopter physalus*	Endangered
Seal and Sea Lion	Hawaiian Monk Seal	*Monachus schauinslandi*	Endangered
Sea Turtle	Green Sea Turtle	*Chelonia mydas*	Threatened
Sea Turtle	Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered
Seabird	Hawaiian Petrel	*Pterodroma phaeopygia*	Endangered
Seabird	Short-Tailed Albatross	*Phoebastria albatrus*	Endangered
Seabird	Newell's Shearwater	*Puffinus newelli*	Threatened
Waterbird	Hawaiian Moorhen	*Gallinula chloropus sandvicensis*	Endangered
Waterbird	Hawaiian Duck	*Anas wyvilliana*	Endangered
Waterbird	Hawaiian Coot	*Fulica alai*	Endangered
Waterbird	Hawaiian Black-Necked Stilt	*Himantopus mexicanus knudseni*	Endangered

Source: U.S. Fish and Wildlife Service 2001, unpublished tables.

Humpback Whale

During the months of January through April, humpback whales are the most common marine mammal species found in the Hawaiian waters (Mobley, 1997). Most humpback whales depart Hawaii for the northern feeding grounds before June. The original population of humpback whales may have been as high as 120,000 worldwide. By the 1970s, the population has been reduced to about 10,000 to 12,000 worldwide. The major cause for the decline was commercial whaling, which was banned in 1966 and stopped entirely during the 1970s. Since then, the population in the Hawaiian Islands has risen slowly from under 1,000 to between 3,000 and 4,000. Humpback whales generally migrate to the Hawaiian Islands each winter from northern feeding grounds. The whales are primarily seen between December and May of each year. The humpback whale is the only animal that has an entire marine sanctuary dedicated to its survival. The Hawaiian Islands Humpback Whale National Marine Sanctuary covers areas off the shorelines of all the major Hawaiian Islands, with an emphasis on areas generally within the 600-foot (183-meter) contour (isobath) between the islands of Molokai, Lanai, and Maui, including the Penguin Bank. The sanctuary area encompasses 1,300 square miles (3,370 square kilometers), much of it within 3 miles (4.8 kilometers) of the shoreline.

Sperm Whale

Sperm whales are listed as endangered, but in fact are considered to be the most abundant of the large whale species, with an estimated 1.9 million animals worldwide (Rice, 1989). Sperm whales migrate to the higher latitudes during the summer with the mature males migrating much farther north than females and the younger males. In the Pacific Ocean, females and younger whales usually remain in tropical and temperate waters. Males may continue north to the Gulf of Alaska and the Aleutians. Females and younger animals may be restricted in their migrations by warmer waters, and many of the larger males return during the winter months to breed. Historically, sperm whaling grounds in the Pacific Ocean south of 40 degrees North latitude were located around the Hawaiian Islands. Sperm whales are deep-diving animals and are generally found in deep waters. All sperm whales sighted in 1993 to 1998 aerial surveys were found in waters deeper than 6,000 feet (1,800 meters). When they have been found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling likely occurs and biological productivity is high. They can dive to depths exceeding 6,500 feet (2,000 meters) and may remain submerged for more than an hour.

Fin Whale

At 70 feet (21 meters) long, the fin whale is the second largest whale in the world. Listed as endangered, the fin whale lives in all oceans and seas of the world from tropical to polar latitudes. They tend to be very nomadic and migrate several thousand miles to equatorial waters. During the winter, they fast almost completely, living off their fat reserves. Mating occurs throughout the winter, and young are born a year later between December and April. The fin whale often feeds by coursing through the water on its side, straining out small fish and krill between its baleen plates. They are one of the fastest of the large whales, cruising at an average speed of 12 knots (22 kilometers per hour). These whales avoid noisy boats, but will swim up beside a stopped vessel. Fin whales migrate into Hawaiian waters mainly in autumn and winter and are rare in Hawaiian waters. The status of fin whales in Hawaiian waters is unknown and there is insufficient data to evaluate trends in abundance. (National Oceanic and Atmospheric Administration, 2000)

Blue Whale

The blue whale is currently one of the world's most endangered whales and is extremely rare in Hawaii. The blue whale, with lengths up to 100 feet (30 meters), is the largest animal on earth. Blue whales are found in open oceans from the waters of the extreme Southern Hemisphere to the Aleutian Islands off Alaska at the northern boundary of the Pacific Ocean. They spend their summers in polar waters because food production (krill) is higher there. In the winter blue whales migrate several thousand miles to warmer tropic and subtropic areas to breed and calve. During the winter they fast; the fat on their body is enough to see them through the winter. The status of fin whales in Hawaiian waters is unknown and there is insufficient data to evaluate trends in abundance. (National Oceanic and Atmospheric Administration, 2000)

Hawaiian Monk Seal

While in previous times it was assumed that the endangered Hawaiian monk seal only inhabited the Northwestern Hawaiian Islands, they have recently been observed near the main Hawaiian Islands. Data from the Hawaiian Islands Humpback Whale National Marine Sanctuary Final Environmental Impact Statement indicated that as many as 39 sightings near the island of Oahu may occur in a single year. Although the seals must obviously swim between the islands, they are most often seen close to the islands, including one early observation near the entrance to Pearl Harbor in July 1978. The seal's breeding season tends to occur from spring to early summer, with most births occurring during March to May. Pupping occurs on beaches, including at least one pup born on Oahu.

Green Sea Turtle

The green sea turtle is found throughout the tropical Pacific. Although found mostly in the Northwestern Hawaiian Islands (over 90 percent), they are seen around Oahu. No nesting occurs on Oahu. Hatchlings emerge after an incubation period on sandy beaches and then lead a pelagic existence for 3 years. The 3-year-old juveniles then come near shore, mainly on the leeward side of islands, and begin feeding on benthic algae and seagrass for the next 2 years or so. After reaching sexual maturity (20 to 25 years) they migrate to French Frigate Shoals in the Northwestern Hawaiian Islands to breed.

Hawksbill Sea Turtle

The Hawksbill sea turtle is a medium-sized turtle found in tropical waters, often on coral reefs. It is known infrequently in the waters off the Hawaiian Islands. It is a solitary nester and is known to use isolated beaches on the islands of Hawaii and Maui.

Short-tailed Albatross

The short-tailed albatross is a large pelagic bird with long, narrow wings adapted for soaring just above the water surface. The large-beaked birds are long-lived and slow to mature. Nesting habitat is generally flat or sloped sites with sparse or full vegetation on isolated windswept offshore islands with restricted human access. The normal diet is fish, crustaceans, and squid, which come to the ocean's surface at night. Short-tailed albatross once ranged throughout most of the North Pacific Ocean and Bering Sea, with no known nesting colonies on numerous western Pacific Islands in Japan and Taiwan. The short-tailed albatross is currently found on the Izu Islands; Senkaku Islands; and Midway Atoll, Northwestern Hawaiian Islands. Since the mid-1970s about thirty-five sightings of short-tailed albatrosses have occurred during the breeding season on Midway Atoll. The short-tailed albatross was listed on 2 November 2000 as endangered throughout its range. (U.S. Fish and Wildlife Service, 2001)

Hawaiian Petrel

The Hawaiian petrel has a dark gray head, wings, and tail, and a white forehead and belly. Its stout bill is hooked at the tip. The Hawaiian petrel are residents of the central subtropical Pacific Ocean and are known to breed only within the major Hawaiian Islands, where they have well established breeding populations. The largest breeding colony is at Haleakala Crater on Maui. The species is currently known to nest only at elevations above

7,200 feet, where vegetation is sparse and the climate is dry. Nesting burrows are commonly located among large rock outcrops or other areas with suitable underlying soil. The Hawaiian petrel breeds between March and November and spends most of its time in pelagic habitat during the non-breeding season, feeding on fish, crustaceans, and squid. Based on their very limited present distribution and the marginal status of known breeding populations, the Hawaiian petrel was listed as endangered in 1967. (U.S. Fish and Wildlife Service, 1983)

Hawaiian Moorhen

The Hawaiian moorhen, known as the most secretive native waterbird, can generally be found in freshwater marshes, taro patches, irrigation ditches, reedy margins of watercourses, reservoirs, and wet pastures. They favor dense vegetation near open water and floating or barely emergent mats of vegetation. Moorhen do not frequent brackish water and are not generally present in saline habitats. The Hawaiian moorhen generally nests in areas of standing freshwater depths of less than 24 inches (60 centimeters). Hawaiian moorhen nest year-round, but the active season is March through August. The Hawaiian moorhen inhabits the islands of Kauai and Oahu. The Kauai population is distributed in lowland wetlands and valleys. Hawaiian Moorhens are widely distributed on Oahu, mostly between Haleiwa and Waimanalo. The Hawaiian Moorhen is listed as endangered by the U.S. Fish and Wildlife Service. (U.S. Fish and Wildlife Service, 1999)

Hawaiian Duck

The endangered Hawaiian duck uses a wide variety of natural wetland habitats for nesting and feeding including freshwater marshes, coastal ponds, flooded grasslands, streams, and forest swamplands from elevations ranging from sea level to 9,900 feet (3,000 meters). Artificial wetlands (taro, lotus, shrimp, and fish ponds) supplement existing habitat and provide important feeding habitat. Hawaiian ducks eat mollusks, insects, and freshwater vegetation. They nest year-round, but the main breeding season is between January and May. Nests are on the ground near water. The current population, estimated to be 2,500, is found on Niihau, Kauai, Oahu, Maui, and Hawaii. The estimated population on Oahu is 300. On Oahu, Hawaiian ducks frequent wetland complexes on the windward coast and north shore. In addition, several individuals have been reported from the wetlands near Pearl Harbor. (U.S. Fish and Wildlife Service, 1999)

Hawaiian Coot

The Hawaiian coot is a federally listed endangered waterbird endemic to the Hawaiian Islands. They are generally found in the coastal plain, usually found below 1,320 feet (400 meters), and prefer wetland habitats with suitable emergent plant growth interspersed with open water. Hawaiian coots prefer freshwater wetlands and taro patches, but will frequent freshwater reservoirs, brackish wetlands, or rarely saline water. Coots nest in open fresh and brackish ponds, irrigation ditches, on shallow reservoirs, and small openings of marsh vegetation, where they construct floating nests of aquatic vegetation in open water or semi-floating nests anchored to emergent vegetation, or in clumps of wetland vegetation. Although some nesting takes place year-round, nesting mostly occurs from March through September. The Hawaiian coot population of between 2,000 and 4,000 birds currently inhabits all of the main Hawaiian Islands except

Kahoolawe. On Oahu, the Hawaiian coot is regularly recorded at wetlands along the east west, and north shores, and less frequently at wetlands along the south shore and interior reservoirs. (U.S. Fish and Wildlife Service, 1999)

Hawaiian Black-necked Stilt

The endangered Hawaiian black-necked stilt is a wading bird that is found on all main Hawaiian Islands except Kahoolawe. Hawaiian black-necked stilts use a variety of aquatic habitats but are limited by water depth and vegetation cover. They require early successional marshlands with water depth less than 9 inches (24 centimeters), perennial vegetation that is limited and low growing, or exposed tidal flats. Hawaiian black-necked stilts generally forage and nest in different wetland sites, moving between these areas daily. Feeding habitat consists of shallow water that is fresh, brackish, or saline. Nesting occurs on freshly exposed mudflats, interspersed with low-growing vegetation. The nesting season normally extends from March through August, and peaks in May and June. The current population is estimated between 1,200 and 1,600. Oahu has the largest population with the majority of the Hawaiian black-necked stilts found on the north and windward coasts. Isolated populations also exist in Pearl Harbor and along the leeward coast. (U.S. Fish and Wildlife Service, 1999)

Newell's Shearwater

The Newell's shearwater has a glossy black top, white bottom, and black bill that is sharply hooked at the tip. The bird feeds primarily on squid. Newell's shearwater breeds in dense fern habitat with steep mountainous terrain between 500 and 2,300 feet (150 and 700 meters) in elevation.   During their nine-month breeding season from April through November, Newell's shearwaters live in burrows. Although they are capable of climbing shrubs and trees before taking flight, it needs an open downhill flight path through which it can become airborne. Newell's shearwaters are residents of the central subtropical Pacific Ocean and are known to breed only within the major Hawaiian Islands. The Newell's shearwater is believed to have had well-established breeding populations on all of the major Hawaiian Islands. Based on their very limited present distribution and the marginal status of breeding populations, the Newell's shearwater was listed as a threatened species in 1975 by the U.S. Fish and Wildlife Service. (U.S. Fish and Wildlife Service, 1983)

3.2.1 CURRENT LOCATION

Marine Fish, Essential Fish Habitat, and Coral

The current location ROI is characterized as a pelagic marine environment, with the Penguin Bank providing a relatively shallow 140-foot (36-meter) environment to the southeast. The pelagic environment is described in detail in section 3.2.

The Western Pacific Regional Fishery Management Council has adopted a 3,281-foot (1,000-meter) depth as a lower boundary of the EFH for pelagic management unit species and 660 feet (200 meters) from the shoreline to the outer limit of the EEZ as the upper limit of the EFH covering the eggs and larvae of the pelagic management unit species.

Therefore, the current location is in this EFH for pelagic management unit species. No known major precious coral beds are located in the current location ROI.

Marine Mammals

While the protected, but not endangered, marine mammal species listed in table 3-2 are not regularly sighted in the current location ROI (Mobley, 1997; Mobley et al., 2000) any of the protected marine mammals could occur in the ROI.

Migratory Birds

The current location is within the potential foraging range of a number of the seabird species. The foraging range of some of these species is estimated to be between 98 and 300 miles (159 and 480 kilometers). Seabirds (e.g., red-footed boobies, masked boobies, white-tailed tropic birds, red-tailed tropic birds, sooty terns, brown noddies, and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands. The short-tailed albatross has been observed on Pacific Missile Range Facility, Kauai.

Threatened and Endangered Species

It is unlikely that any of the endangered Hawaiian Island marine mammal species would be found in the current location ROI. Humpback whales, will be out of the area on their annual migration to north Pacific waters from June to December. Sperm whales are not often seen around the current location ROI (Mobley et al., 2000). Blue whales and fin whales are extremely rare in Hawaiian waters. Hawaiian monk seals are most often found closer to land. The remaining protected, but not endangered, marine mammal species listed in table 3-2 are not regularly sighted in the ROI (Mobley, 1997; Mobley et al., 2000). Given the wide-ranging transitory nature of the animals, any of them could theoretically be present in the current location ROI.

Three seabird species that occur in the Hawaiian Islands and may occur in the ROI are on the U.S. Fish and Wildlife Service list of threatened and endangered wildlife. The endangered short-tailed albatross is expected to forage in the ROI. Another species that could forage in the ROI is the Hawaiian petrel (*Pterodroma phaeopygia*), an endangered species. One other species, the Newell shearwater (*Puffinus newelli*), is listed as threatened and could also forage in the ROI. The latter two listed species breed in Hawaii.

3.2.2 TRANSIT ROUTE TO THE SHALLOW-WATER RECOVERY SITE

Marine Fish, Essential Fish Habitat, and Coral

The Western Pacific Regional Fishery Management Council has adopted a 3,281-foot (1,000-meter) depth as a lower boundary of the EFH for pelagic management unit species and approximately 660 feet (200 meters) from the shoreline to the outer limit of the EEZ as the upper limit of the EFH covering the eggs and larvae of the pelagic management unit species. The current location is in this EFH, and the transit route would initially start within this EFH and would pass through portions of the EFH until shallower waters are reached near Oahu.

Deep-water bottomfish species exist in the approximately 330- to 1,300-foot (100- to 400-meter) depths. These species make up the bottomfish management unit species. Because of the known depth and bottom types preferred by bottomfish, and the pelagic nature of their eggs and larvae, the Western Pacific Regional Fishery Management Council has designated the water column and all bottom habitats from the shoreline to a depth of approximately 1,300 feet (400 meters) as EFH. The transit route passes through the pelagic management unit species area and enters the EFH for the bottomfish management unit species closer to Oahu.

Black, pink, gold, and bamboo corals, collectively referred to as precious corals, occur in deep inter-island channels and off promontories at depths between 50 and 4,920 feet (15 and 1,500 meters). These coral species are included as management unit species in the Precious Corals Fisheries Management Plan. No known major precious coral beds are located in the ROI along the transit route to the shallow-water recovery site.

Marine Mammals

The probability of the occurrence of protected marine mammals in the transit route corridor is low. Marine mammals aerial surveys conducted between 1993 and 1998 within the 1,000-fathom isobath (6,000 feet, or approximately 1,800 meters) around the Hawaiian Islands sighted the following species of toothed (odontocete) dolphins and whales: striped dolphin, spotted dolphin, spinner dolphin, rough-toothed dolphin, bottlenosed dolphin, Risso's dolphin, short finned pilot whale, false killer whale, melon-headed whale, and various beaked whales (Mobley et al., 2000). None of these were sighted in the transit corridor ROI.

The probability of sighting the Hawaiian spinner dolphin increases as the depth decreases. The areas in shallow waters, however, will likely contain Hawaiian spinner dolphins. This species regularly (on a daily basis) visits the shallow areas on the lee side of all of the Hawaiian Islands and is particularly well known to occur on the lee side of Oahu. The dolphins are believed to spend the nights off the coast diving and feeding but spend the days in shallow-water areas resting (Norris et al, 1994).

Migratory Birds

The transit corridor between the current location and the shallow-water recovery site are within the potential foraging range of many of the seabird species. The foraging range of some of these species is estimated to be between 98 and 300 miles (159 and 480 kilometers). Seabirds (e.g., red-footed boobies, masked boobies, white-tailed tropicbirds, red-tailed tropicbirds, sooty terns, brown noddies, and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands. The short-tailed albatross has been observed on Pacific Missile Range Facility, Kauai.

Threatened and Endangered Species

The likelihood of encountering any threatened or endangered marine mammal in the transit route corridor is quite low. Humpback whales are in the ROI between the months of

January and May. The blue whale and fin whale are extremely rare in Hawaiian waters. The endangered Hawaiian monk seal would only be in the area of the transit corridor as transients between islands. The sperm whale would be expected only in the deeper areas of the transit route corridor ROI. However, the potential for their being present would be very low.

The threatened green sea turtle and the endangered hawksbill turtle also occur in the transit route corridor as individuals travel between the Hawaiian Islands.

Three seabird species that occur in the Hawaiian Islands, and may occur in the transit route corridor, are on the U.S. Fish and Wildlife Service list of threatened and endangered wildlife. The endangered short-tailed albatross is expected to forage in the ROI. Another species that could forage in the ROI of the transit corridor, between the current location and the shallow-water recovery site, is the Hawaiian petrel, an endangered species. One other species, the Newell shearwater, is listed as threatened and could also forage in the ROI. The two latter listed species breed in Hawaii.

3.2.3 REEF RUNWAY SHALLOW-WATER RECOVERY SITE

Marine Fish, Essential Fish Habitat, and Coral

Water depths at the Reef Runway shallow-water recovery site range from approximately 50 feet (15 meters) on the north (landward) side, to 300 feet (91 meters) on the south (seaward) side. The seaward reef slope ranges from 5 to 8 percent at depths between 70 and 120 feet (21 and 37 meters). Between 120 and 250 feet (37 and 76 meters) the slope increases to 10 percent on the west and up to 16.5 percent on the east side of the site. A submarine terrace dominated by sand and coral rubble is the most conspicuous physical feature along the north half of the site. The terrace occurs between the 60- and 70-foot (18- and 20-meter) depth contours and ranges from 500 to 1,400 feet (152 to 427 meters) in width. The seaward slope along the terrace has vertical relief estimated at less than 2 feet (0.6 meters).

Limestone rubble, sand, and occasional live corals dominate the substrate at depths above 70 feet (21 meters). Surface relief is about 3 feet (1 meter) or less and results from mounds of coral rubble and live coral. Between depths of 90 and 95 feet (27 and 29 meters) sand is abundant and interspersed with patches of limestone rubble and occasional live coral outcrops. Surface relief is about 2 feet (0.6 meters) or less. Between 95 feet (29 meters) and 130 feet (40 meters) the substrate is dominated by limestone rubble, sand, or sand-veneered limestone with little surface relief (appendix J, part 1). Deep unconsolidated sand comprises the principal substrate at depths between 130 and 300 feet (40 and 90 meters).

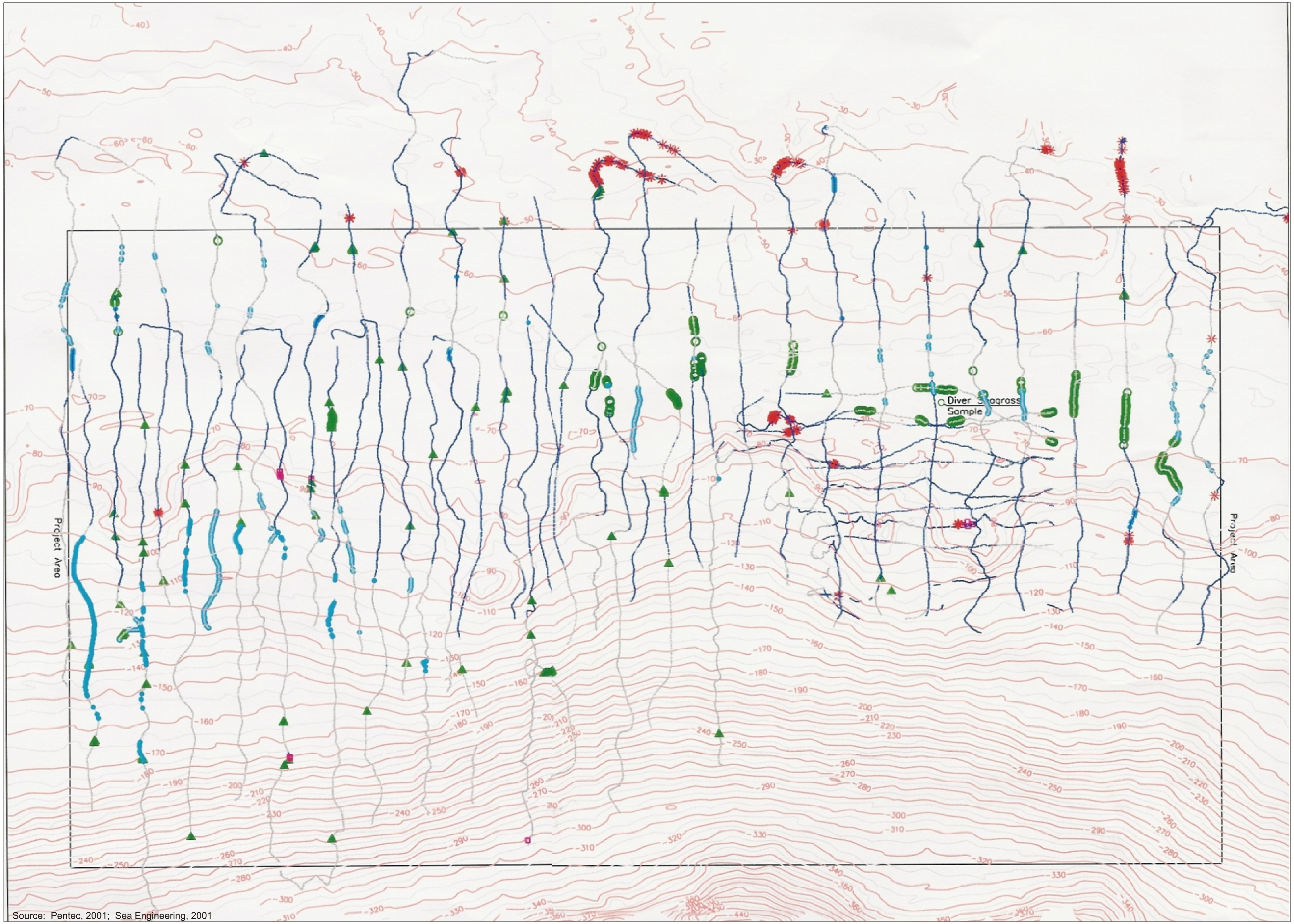
The broad terrace that occurs at depths between 60 and 70 feet (18 and 20 meters) demonstrates a variety of habitats, including coral rubble, sand, sand-veneered limestone, and corals. Habitat coverage differs significantly along the terrace and is likely due to the location of fringing reef surge channels in shallower waters to the north. During periods of heavy wave action, rubble and corals are likely transported onto the terrace from shallower, more diverse, inshore waters. Locations on the terrace located in proximity to surge channels therefore demonstrate a greater abundance of limestone rubble. Live corals are generally associated with the areas of rubble. Areas of the terrace that are at some distance from the surge channels are characterized by expansive unconsolidated sand deposits and a general absence of rubble or live coral.

At the time of the surveys, corals were common on the upper reaches of the Reef Runway shallow-water recovery site, but the overall population density is generally low (figure 3-3). The highest coral densities are associated with the seaward face of the ledges and steeper slopes that occur at depths less than 100 feet (30 meters). Cauliflower coral (*Pocillopora meandrina*) was the most common coral present with highest densities occurring in waters of 130 feet (40 meters) or less. Overall coral coverage was generally less than 1 percent in waters of 100 feet (30 meters) or less, although localized areas along the ledges and drop-offs occasionally demonstrated coverage of about 30 percent. An exception to the latter is found on the narrow escarpment located between the 80- and 90-foot (24- and 27-meter) contours where coral coverage ranges from an estimated 40 to 90 percent in localized areas. Other corals present, although generally uncommon, were lobe coral (*Porites lobata*), antler coral (Pocillopora eydouxi), and finger coral (*Porites compressa*). Pockets of coral rubble were often dominated by dead and fragmented finger coral colonies. Bracket-forming coral, possibly *Porites rus* or *Montipora capitata*, is present in 90 feet (27 meters) of water and is occasionally found in deeper waters (appendix J, part 1). Earlier studies off the Reef Runway have identified the coral *Pavona duerdeni* and the zooanthid *Palythoa tuberculosa* as common on the upper reef slope. The same study also identified finger coral as the dominant coral at a depth of 65 feet (20 meters) (U.S. Army Corps of Engineers, 1979).

The fish fauna is generally limited to small coral-associated species that were generally found in or adjacent to live coral outcrops. Fish families identified in the Reef Runway shallow-water recovery site ROI include muraenids (moray eels), aulostomids (trumpetfish), holocentrids (squirrelfishes), lutjanids (snappers), mullids (goatfishes), chaetodontids (butterfly fishes), pomacentrids (damselfishes), labrids (wrasses), scarids (parrotfishes), acanthurids (surgeonfishes), balistids (triggerfishes), ostraciids (trunkfishes), tetraodontids (puffers), carangids (jacks/trevally), sphyraenids (barricuda), and the zanclid *Zanclus cornutus.* Large schools of the Hawaiian dascyllus (*Dascyllus albisella*), occur in, or hover in, proximity to antler and cauliflower coral colonies. A yellowmargin moray (*Gymnothorax flavimarginatus)* and several introduced grouper are also present on the site. Two surveys, conducted on April 25 and May 2, 2001 by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Department of Land and Natural Resources, confirms the general characteristics of the seafloor of the site, and the organisms present (appendix J, part 2).

Earlier studies have reported a moderately diverse fish fauna off the reef face. Species identified as abundant in the area included convict tang (*Acanthurus triostegus)*, brown surgeonfish (*A. nigrofuscus),* goldring surgeonfish (*Ctenochaetus strigosus),* saddle wrasse *(Thalassoma duperreyi),* multiband butterflyfish *(Chaetodon multicinctus),* blacktail chromis *(Chromis vanderbilti),* Pacific gregory (*Stegastes fasciolatus),* Hawaiian whitespotted toby *(Canthigaster jactator),* and parrotfish (*Scarus* sp.) (U.S. Army Corps of Engineers, 1979).

Expanded Area Reef Runway Benthic Habitats



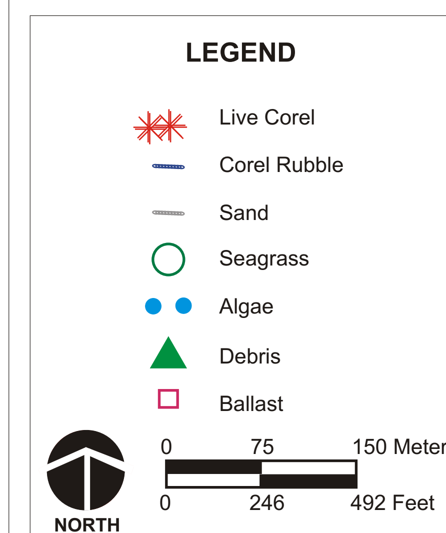


Figure 3-3

At depths of 100 feet (30 meters) and greater, the invertebrate fauna associated with the sand-veneered limestone terrace is dominated by the black sea urchin (*Diadema paucispinum*). Unidentified black sea cucumbers (*Holothuria* spp.) were also common in rubble or sand patches below a depth of 90 feet (27 meters) (appendix J, part 1). A very dense assemblage of black sea urchins, with densities of an estimated 100 per square meter, occurred in a band at a depth of 70 feet (21 meters). Several crown-of-thorns starfish (*Acanthaster planci)* were also observed on live coral at water depths of 65 to 70 feet (20 to 21 meters).

Seagrass (*Halophila discipiens*) is present in the general vicinity of the site. This species may provide forage for the threatened green sea turtle (appendix J, part 1). A small endemic gastropod (*Smaragdia bryanae*) has been observed on the blades of this seagrass.

At depths between 130 and 170 feet (40 and 52 meters) the seaward reef slope is dominated by sand, algae patches, scattered rubble, and rarely, live coral. Corals at this depth are uncommon because of limited sunlight and lack of hard substrates necessary for coral larval attachment. Corals are limited to an occasional cauliflower coral or bracket-forming *Montipora* spp. The deepest live coral recorded in the vicinity of the Reed Runway shallow-water recovery area was a single bracket-forming *Montipora* spp. colony that was observed at a depth of 165 feet (50 meters). Fish are also uncommon at depths between 130 and 170 feet (40 and 62 meters) because of the lack of live coral and limestone rubble habitats. Fishes recorded in this zone included various acanthurids (surgeonfishes), pomacentrids (damselfishes), balistids (triggerfishes), and labrids (wrasses). The Hawaiian dascyllus is the most common fish associated with live coral colonies at these depths.

A tube-dwelling, mound-building, nocturnal terebellid (family Terebellidae) polychaete worm dominates the infauna at water depths between 170 and 260 feet (52 and 79 meters). Although individual worms were not observed during diurnal surveys, the presence of this polychaete is conspicuous in the form of tentacle tracks in bottom sediments that radiate out from an elevated cone in a spoke-like pattern. Worm densities typically averaged 1 to 3 per square meter.

Fish were generally absent between waters depths of 170 and 260 feet (52 and 79 meters), though a mixed assemblage of *Zanclus cornutus* (moorish idol) and *Chaetodon fremblii* (bluestripe butterflyfish) were recorded at a depth of 170 feet. A single adult barracuda (*Sphyraena barracuda*) was recorded at a depth of 230 feet.

The Reef Runway shallow-water recovery site is within the EFH area for bottomfish management unit species, including eggs, larvae, juveniles, and adult bottomfish. The site is not within the habitat areas of particular concern because of the site's shallower water depths.

The Western Pacific Regional Fishery Management Council has adopted an approximately 3,300-foot (1,000-meter) depth as a lower boundary of the EFH for pelagic management unit species area, and approximately 660 feet (200 meters) from the shoreline to the outer limit of the EEZ as the upper limit of the EFH covering the eggs and larvae of the pelagic management unit species. The Reef Runway shallow-water recovery site would be in this EFH.

Black, pink, gold, and bamboo corals, collectively referred to as precious corals, occur in deep inter-island channels and off promontories at depths between 50 and 4,920 feet (15 and 1,500 meters). These coral species are included as management unit species in the Precious Coral Fisheries Management Plan. No known major precious coral beds are located in the ROI for the site.

The Western Pacific Regional Fishery Management Council has designated EFH for spiny lobster larvae as the water column from the shoreline to the outer limit of the EEZ down to a depth of 450 feet (150 meters). The EFH for juvenile and adult spiny lobster is designated as the bottom habitat from the shoreline to a depth of 330 feet (100 meters). Therefore, the Reef Runway shallow-water recovery site is within the EFH for crustacean management unit species. The Council has also designated all banks in the Northwestern Hawaiian Islands with summits less than 95 feet (30 meters) as habitat areas of particular concern for juvenile spiny lobster. The site is not within one of these areas.

Marine Mammals

A variety of marine mammals could be expected to occur in the Reef Runway shallow-water recovery site ROI. The more common ones would be those species that use the shallower marine waters of the Hawaiian Islands, namely the spinner, spotted, and bottlenose dolphins. These marine mammals are described below.

Hawaiian Spinner Dolphins

In Hawaii, spinner dolphins (*Stenella longirostris*) are the most abundant species of marine mammal sighted in shallow waters of less than approximately 660 feet (200 meters) (Mobley, 1997). Spinner dolphins generally occur in large groups of 20 to 100 animals. They forage almost exclusively at night on a mesopelagic community of prey that moves vertically and horizontally along the slopes of the islands on a nightly basis (Bird and Au, in press). Feeding usually begins in the early evening hours and continues until shortly after dawn on the following day (Norris et al., 1994). Daytime spinner dolphin behavior is characterized by periods of social activity and travel in the early morning and late afternoon hours, and resting behavior during the middle of the day. Most daytime activities are restricted to shallow waters less than approximately 131 feet (40 meters) deep.

Spinner dolphins are known to occur with regularity in waters adjacent to the Reef Runway. A recent survey effort conducted along the Ewa/Honolulu coast reported sightings of spinner dolphins on 67 percent of surveys (Lammers et al., 2000). All spinner dolphin groups that occur in this area exhibited a general tendency to travel from west to east over the course of the day. This pattern reflects a general daytime preference by spinner dolphins in Hawaii for waters protected from the predominant trade winds. The movements observed suggest that spinner dolphins may forage near Barbers Point at night and then move towards the leeward waters off Diamond Head to rest during the day.

Spinner dolphin groups tracked visually often spent several hours in the shallow waters off the Reef Runway. More than 70 spinner dolphins have been observed to remain directly in front of the airport for over 3 hours. A similar pattern was observed on three other occasions (out of six tracks) (Lammers, unpublished data).

Spotted Dolphins

Pantropical spotted dolphins (*Stenella attenuata*) are the second most commonly sighted species of dolphin in Hawaii (Mobley, 1997). Like the spinner, spotted dolphins normally occur in large groups of 15 to 100-plus animals. Spotted dolphins are generally considered to be daytime foragers (Norris and Dohl, 1980), but have recently also been observed feeding at night (Robin Baird, personal communication). Unlike the spinner, spotted dolphins are not known to occur with regularity in shallow waters less than 600 feet (200 meters) deep.

Recent line-transect vessel surveys conducted off the Ewa/Honolulu coast as well as the Barbers Point area yielded only four sightings of spotted dolphins over a total effort of more than 30 surveys (Lammers et al., 2000; Lammers, unpublished data). All sightings were of animals traveling in deep (greater than approximately 660 feet [200 meters]) water or presumably foraging along the steep slopes of the Barbers Point bank. Spotted dolphins do sometimes associate with resting groups of spinner dolphins in other parts of the world (Perrin and Hohn, 1994), but such associations are relatively rare in Hawaii and have not been observed with regularity along the south and west shores of Oahu.

Bottlenose Dolphins

Bottlenose dolphins (*Tursiops truncatus*) have a varied distribution in Hawaii, occurring with regularity in both deep (greater than approximately 660 feet [200 meters], 67 percent) and shallow (less than approximately 660 feet [200 meters], 33 percent) waters (Mobley, 1997). The diet of bottlenose dolphins consists of a variety of fish, squid, shrimp, and crab. This variety in diet is probably responsible for their mixed dispersal pattern. Generally, bottlenose dolphins occur in small groups of 1 to 15 animals, although much larger aggregations are not uncommon. A recent survey effort along the Ewa/Honolulu coast reported six bottlenose dolphin sightings on 19 surveys (a 32 percent encounter rate) (Lammers et al., 2000). Of these, one was in waters deeper than 600 feet (200 meters), one in waters between 300 and 600 feet (100 and 200 meter) and four occurred in waters less than 60 feet (20 meters) deep. Two of these sightings were made within 1 nautical mile (2 kilometers) of the Reef Runway shallow-water recovery site.

Migratory Birds

The Reef Runway shallow-water recovery site is within the potential foraging range of many of the seabird species. The foraging range of some of these species is estimated to be between 98 and 300 miles (approximately 160 and 480 kilometers). Seabirds (e.g., red-footed boobies, masked boobies, white-tailed tropicbirds, red-tailed tropicbirds, sooty terns, brown noddies, and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands. Common shorebirds in the area of the Reef Runway shallow-water recovery site include the Pacific golden plover *Pluvialis fulva*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), and the wandering tattler (*Heteroscelus incanus*). The black-bellied plover (*Pluvialis squatarola*) may also use the Reef Runway shallow-water area.

Threatened and Endangered Species

The threatened green sea turtle is a common forager along the Ewa to Waikiki coastline. There is some seagrass that may be used by the sea turtle in the vicinity of the Reef Runway shallow-water recovery site. A single adult green sea turtle was observed on May 19, 2001 resting on the bottom in 70 feet (21 meters) of water within the Reef Runway shallow-water recovery site. A number of green sea turtles are known to use the Pearl Harbor Channel in the area of the Fort Kamehameha sewer outfall pipeline as a resting place. Occurrence of the endangered hawksbill turtle is uncommon in the near-shore areas.

While the humpback whale may come into the outer waters of the ROI during the winter months, they will have left the area in June due to the annual northward migration. The endangered sperm whale, blue whale, fin whale, and Hawaiian monk seal would not be expected to occur in the vicinity of the Reef Runway shallow-water recovery site. The ROI would extend about 1 nautical mile (2 kilometers) seaward of the site and may be shallower than the preferred depths of the sperm whale. Sperm whales almost never occur in shallow waters. Hawaiian monk seals, while seen in the area once in 1978, are extremely rare in that area. Blue whales and fin whales are extremely rare in Hawaiian waters. The Hawaiian monk seal would not be expected to use the edges of the Reef Runway as a haul out area.

Three seabird species that occur in the Hawaiian Islands and may occur in the area of the Proposed Action are on the U.S. Fish and Wildlife Service list of threatened and endangered wildlife. The endangered short-tailed albatross is expected to forage in the ROI. Another species that could forage in the ROI of the Reef Runway shallow-water recovery site is the Hawaiian petrel, an endangered species. One other species, the Newell's shearwater, is listed as threatened and could also forage in the site ROI. The latter two listed species breed in Hawaii.

The endangered Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*) is known to occur in Pearl Harbor on mud flats near Fort Kamehameha, and in Keehi Lagoon to the east of the site. The endangered Hawaiian coot (*Fulica alai*) may also occur in the more brackish areas.

3.2.4 TRANSIT ROUTE TO THE DEEP-WATER RELOCATION SITE

From a marine biological resources perspective, the affected environment is essentially identical to that described in section 3.2.2.

3.2.5 DEEP-WATER RELOCATION SITE

Marine Fish, Essential Fish Habitat, and Coral

The deep-water relocation site is located in the pelagic management unit species EFH area. Black, pink, gold, and bamboo corals, collectively referred to as precious corals, occur in deep inter-island channels and off promontories at depths between 50 and 4,920 feet (15 and 1,500 meters). These corals are included as management unit species in the Precious Corals Fisheries Management Plan. The known locations of major precious coral beds are not in the ROI for the deep-water relocation site. No other EFH area is in the vicinity of the deep-water relocation site.

Marine Mammals

The probability of the presence of protected marine mammals in the deep-water relocation site ROI is low. Aerial surveys for marine mammals conducted between 1993 and 1998 within the 1,000-fathom (6,000-foot or approximately 1,800-meter) isobath around the Hawaiian Islands, sighted the following species of odontocete dolphins and whales in the area around the Hawaiian Islands: striped dolphin, spotted dolphin, spinner dolphin, rough toothed dolphin, bottlenosed dolphin, Risso's dolphin, short finned pilot whale, false killer whale, melon-headed whale, and various beaked whales (Mobley et al., 2000). None of these species were sighted in the area of the deep-water relocation site. The probability of sighting the Hawaiian spinner dolphin decreases as the depth increases.

Migratory Birds

The deep-water relocation site is within the potential foraging range of a number of seabird species. The foraging range of some of these species is estimated to be between 98 and 300 miles (160 and 480 kilometers). Seabirds (e.g., red-footed boobies, masked boobies, white-tailed tropicbirds, red-tailed tropicbirds, sooty terns, brown noddies, and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands.

Threatened and Endangered Species

The occurrence of threatened or endangered marine mammals at the deep-water relocation site is quite low. The humpback whales would not be expected to be in the area, because they would have migrated to their northern feeding grounds. Blue whales and fin whales are extremely rare in Hawaiian waters. The endangered Hawaiian monk seal would only be in the area as transients between islands, and the sperm whale would be expected only in the deeper areas of the deep-water relocation site ROI.

As with the current location, green and hawksbill sea turtles could transit the area, but there is no foraging or resting habitat in the deep-water relocation site ROI.

Three seabird species that occur in the Hawaiian Islands may occur in the area of the deep-water relocation site ROI. The endangered short-tailed albatross is expected to forage in the ROI. Another species is the Hawaiian petrel, an endangered species. One other species, the Newell's shearwater, is listed as threatened and could also forage in the deep-water relocation site ROI. The latter two listed species breed in Hawaii.

3.3 HEALTH AND SAFETY

Health and safety issues associated with underwater recovery operations include worksite and diver safety, diving and boating mishaps, weather, control of public access, damage to public recreation areas, and risks of diesel fuel and lubricating oil release.

Region of Influence

The ROI for health and safety includes the area immediately around the current location, the transit route to the shallow-water recovery site, the shallow-water recovery site itself, the transit corridor to the deep-water relocation site, and the deep-water relocation site. In addition, any shore area that could potentially be impacted by the release of diesel fuel and lubricating oil is included. The ROI also includes the airspace above all of the sites identified. The ROI for airspace is identified in section 3.5.

Health and Safety Environment

The Navy Supervisor of Salvage and Clean Islands Council maintains a Site Safety and Health Plan focusing on the protection of personnel from serious risks to their physical safety and health while responding to a marine discharge. The Hawaiian Area Contingency Plan identifies health and appropriate personnel protective equipment requirements essential for worker safety. The Plan also identifies site control and security requirements, along with site characterization and monitoring requirements. There are standard procedures for reporting medical and fire emergencies, including a medical plan that identifies nearby hospitals and clinics.

Hospitals capable of responding to health and safety issues include Queens Medical Center and Kuakini Hospital in downtown Honolulu, and Airport Urgent Care at Honolulu International Airport. A Safety Officer, field operators, and group supervisors are identified in the Site Safety and Health Plan. For divers, close-by decompression chambers are at Pearl Harbor, and a public decompression chamber is at Kuakini Hospital.

The operational phase of a diesel fuel and lubricating oil release is often characterized by changing conditions at or near the release site. Accordingly, responders are trained to recognize and monitor hazard conditions and implement standard operating procedures and response strategies to protect themselves while effectively responding to the emergency.

Hazardous weather conditions could pose a safety hazard. The National Weather Service and the Navy Meteorological Office at Pearl Harbor are the primary sources for obtaining weather information. Adverse weather conditions include high wind and sea conditions and hurricanes.

Public Safety

This section provides an overview of the existing activities that could affect public health and safety. Additionally, those public recreational areas at risk from a mishap in the ROI are identified.

There are a large variety of ocean and coastal activities in the nearshore and offshore waters of the Hawaiian Islands. These activities include commercial ship traffic (container ships, tugs, barges, and tour vessels), recreational boating (sailboats and motorboats), recreational and commercial fishing, swimming, board and body surfing, scuba diving, shell collecting, and aquarium fish collecting. There are a large number of public recreation areas and natural resource management areas (state parks, wildlife reserves, etc.) along Hawaii's coastal areas. These areas draw visitors from all over the world and are a driving force behind the state's economy. In addition, the nearshore and coastal waters are highly productive areas for the commercial fishing industry. Thus, Hawaiian waters and shorelines have an unusually high level of environmental and economic sensitivity. Generally, nearshore and offshore areas are open to commercial and recreational users at all times and are not restricted. Presently, the only nearshore and offshore waters on Oahu that are off limits to public access are those areas surrounding DoD facilities (e.g., Pearl Harbor and Kaneohe Bay). The U.S. Coast Guard enforces sea surface security outside the Naval Defense Sea Area. Special activities that might result in the temporary restriction of access into otherwise open waters are promulgated through a weekly NOTMAR. Security within the Naval Defense Sea Area is maintained by the U.S. Navy.

Existing public health and safety risks in the ROI are associated with recreational activities, commercial boating, and potential hazardous materials release from shipping and industrial activities. Hazardous materials releases are managed in accordance with appropriate federal, state, and local regulations.

The existing shoreline near the shallow-water recovery site has existing waste water outfalls and petroleum product off-loading facilities at designated anchorage areas.

Diver Safety

The U.S. Navy conducts diving activities in accordance with *The U.S. Navy Diving Manual*. This manual provides the latest procedures and equipment for conducting safe diving activities. *The U.S. Navy Diving Manual* identifies the required equipment and procedures for conducting underwater construction and salvage using surface-supplied diving equipment as well as the requirements for emergency gas supply equipment that is used for enclosed space diving. (U.S. Navy, 1999)

3.3.1 CURRENT LOCATION

The current location is an open-ocean area within U.S. territorial waters. It is not a restricted use area. The primary activities in this area are commercial and recreational fishing. There are no existing public health and safety concerns in this ROI.

3.3.2 TRANSIT ROUTE TO THE SHALLOW-WATER RECOVERY SITE

The transit route ROI would be entirely within U.S. territorial waters. Ocean activities occurring within the ROI along this transit route are commercial and recreational fishing until near-shore waters are reached, where the activities become more oriented towards coastal recreation. There are no known existing public health and safety concerns in this ROI.

3.3.3 REEF RUNWAY SHALLOW-WATER RECOVERY SITE

To minimize public safety concerns, the Naval Defense Sea Area was established by Executive Order 8143 to prohibit civilian watercraft within Pearl Harbor and the area immediately surrounding the entrance to Pearl Harbor unless authorized by the U.S. Navy. The Reef Runway shallow-water recovery site lies entirely within the Naval Defense Sea Area.

Because the U.S. Navy has jurisdiction over the Naval Defense Sea Area, the Pearl Harbor Entrance Channel and Hickam Harbor are restricted to vessels owned and operated by military and DoD personnel. Several commercial fishing and tour boats have been authorized to operate in the Pearl Harbor vicinity. Civilian watercraft are not allowed inshore of the Reef Runway. (U.S. Navy, 2001)

Ocean and nearshore activities occurring in the ROI of the shallow-water recovery site include personal consumptive, commercial, and recreational undertakings. Such activities as net fishing, pole and line fishing, tropical fish collecting, surfing, scuba diving, paddling, kayaking, and shelling occur in this area. Sand Island State Park is about 2.6 nautical miles (4.75 kilometers) to the east, and recreational boating occurs at Kalihi Channel, 1.75 nautical miles (3.2 kilometers) to the east (U.S. Department of the Interior, 1998a). An existing finfish (moi) aquaculture operation is located west of the Pearl Harbor channel about 120 feet (37 meters) deep. A proposed aquaculture farm is 0.75 nautical miles (1.4 kilometers) northeast on the inshore side of the reef along the east and south edges of the runway. (Naughton, 2001) DoD personnel, their family members, and guests may fish recreationally in certain Navy-owned and Air Force-owned areas without a fishing pass. (U.S. Navy, 2001)

3.3.4 TRANSIT ROUTE TO THE DEEP-WATER RELOCATION SITE

Ocean activities occurring within the transit route corridor ROI are commercial and recreational fishing. There are no known public health and safety concerns in this ROI.

3.3.5 DEEP-WATER RELOCATION SITE

The deep-water relocation site lies outside U.S. territorial waters. The water is 6,000 feet (1,800 meters) or more in depth. Ocean activities occurring within the ROI include commercial and recreational fishing. There are no known public health and safety concerns in this ROI.

3.4 HAZARDOUS MATERIALS AND HAZARDOUS WASTES

The affected environment for hazardous materials and hazardous waste includes the sensitive resource areas that could potentially be affected by an unplanned release of diesel fuel or lubricating oil, and any existing hazardous waste areas that may occur in the ROI.

Two existing organizations have the capability to respond to releases of petroleum products. They are the U.S. Navy Emergency Ship Salvage Material (ESSM) and the Clean Islands Council.

The ESSM system on Hickam Air Force Base, Hawaii, is part of a worldwide network of warehouses that stores and maintains a significant stockpile of oil pollution abatement equipment. The ESSM system pollution abatement equipment includes open ocean boom and skimming systems, specialized inland response systems, floating storage, and offload systems.

All equipment is available for immediate deployment and is available to all federal agencies. Equipment is capable of containment and recovery of many grades of refined and crude oils, including heavy residual oils, and marine and jet fuels. The ESSM system includes a range of equipment as listed in table 3-5. (U.S. Navy, 2001c)

Table 3-5: ESSM System Equipment

Released Oil Recovery	Casualty Off-Loading	Ancillary Support Equipment
Containment booms	Oil transfer pumps and hoses	Personnel support vans
Open-ocean skimmers	Floating hose systems	Maintenance vans
Small skimmers	Hot tap systems	Support vessels
In-situ burning equipment	Portable generators	Cleaning equipment
Sorbent materials	Portable fire-fighting pumps	Command vans
Vacuum recovery systems	Hydraulic power packs	Communications systems
Floating storage bladders	Salvage equipment	Small boats All-terrain vehicles Material handling equipment

Source: U.S. Navy, 2001c

The Clean Islands Council is a consortium of regular and associated members working together with the entire Hawaii community to foster, train, and demonstrate safe work practices related to responding to an oil spill. The Hawaii Area Committee is an oil spill preparedness and planning body made up of industry, federal, state, and local agency representatives including the Clean Islands Council. The federal OSC coordinates the activities of the Area Committee and assists in the development of a comprehensive Area Contingency Plan that is consistent with the National Contingency Plan.

The Hawaii Area Contingency Plan provides guidance in the preparation of a proper Site Safety and Health Plan for all IAPs related to oil spills. During a spill event the Clean Islands Council Spill Response Operations Center is essentially a well-outfitted strategic and tactical response management center. Communications include 35 phone lines, 9 fax machines, 2 Local Area Networks, radio and internet capability, as well as video and digital imagery capability. (Clean Islands Council, 2001)

The Honolulu Area Planning Committee has been working to define Geographical Response Strategies that should serve in most cases as the "first strike" move to protect the environment from an accidental release of oil. Most existing Geographical Response Strategies are designed around "first strike" immediate containment of oil at identified transfer points or other areas that are the more probable spill locations. Much of the Clean Islands Council's equipment is deployed in accordance with these well-proven strategies. Training in the strategies and the deployment of equipment usually occurs twice a year. Companies are well practiced in immediate response.

Additional Geographical Response Strategies are currently being developed within the Shoreline subcommittee of the Honolulu Area Planning Committee to address additional strategies to protect sensitive areas along Hawaii's coastlines.

Equipment

The U.S. Navy Supervisor of Salvage recovery capability is 57,000 gallons (approximately 215,800 liters) per day. The Clean Islands Council has equipment capable of recovering approximately 62,000 gallons (approximately 235,000 liters) of oil per day. The response equipment includes vessels and skiffs, skimmers, pumps and skimmer accessories, containment equipment, and booms and other equipment packages, all of which are available (table 3-6). In the unlikely event they should be required, dispersants would also be available. Since 1997 the Hawaiian Area Planning Committee, along with the State of Hawaii, the U.S. Coast Guard, and the Clean Islands Council, have worked together to further enhance their dispersant application capabilities. The current dispersant capacity is 37,260 gallons (approximately 141,000 liters) of Corexit 9500, which can be applied by two 242-gallon (920-liter) helicopter application buckets, one oil release response vessel with twin 40-foot spray arms and capable of traveling at speeds of 10 knots, and another 5,000-gallon (approximately 19,000-liter) system. (Clean Islands Council, 2001)

There are no known hazardous waste or material disposal sites, or Installation Restoration Program sites near any of the sites or locations in the ROI.

Region of Influence

The areas potentially affected by the Proposed Action include the seafloor, the ocean surface, and the beaches and reefs around the Proposed Action sites, discussed below, particularly the shallow-water recovery site.

Table 3-6: Available Response Equipment

Skimmers	Pumps And Skimmer Accessories	Containment	Boom	Vessels and Skiffs	Packages
Diesel Powered Peristaltic Hose Pump With Skim Pack 4200 Package With Hoses (3)	Pneumatic Double Diaphragm Pumps W/Hose (3)	20,000-gallon Storage Bladder (4)	Spectrum Trailer With 1,000-foot 8 by 12 Inch Acme Boom (3)	10-foot Under Pier Skiff with Oars	Large Personnel Zone Control/Decon Station (3)
Oela Four Float Weir Skimmers (3)	Gas Single Diaphragm Pump	5-cubic-meter Ro-Tank - Tsbs	1,800 Feet of 42-inch Expandi Boom	9-foot Under Pier Skiff with Oars	Large Fishtote Workvest Pack 50 Sets (2)
GT 185 Ocean Skimmer With ASI 16TSO Power Pack, Hoses, and Hyd. Control Table (2)	Karcher Steam Pressure Washer	2,500-gallon Fast Tanks (4)	180 Feet of 42-inch Troil Boom	8-foot Under Pier Skiff with Paddle	Ppe Overpack 50 Sets (3)
Mini Walosep	Acme Floating Circulation Pump		100 Feet of 44-inch Troil Boom	24-foot Pontoon Boat with O/B	Arge Heat Stress Shade Station (2)
Slickbar Slurp Wier	Acme Floating Washdown Pump			17-foot Boom Boat with O/B	Multi Person Hand Washing Basin
Oil Mop OMI 1-4D				15- foot Boston Whaler with O/B	Foss 25 by 50 foot Large Decon Pool
Oil Mop OMI 11-4D Trailer Mounted				15- foot Fiberglass Under Pier Boat with O/B	Small Personnel Decon Station (5)
Oil Mop OMI 11-9D					Shoreline Cleanup Tools Package
Aquaguard Rbs-10 Brush/Disc/Drum Skimmer with 24-Foot Aqua Cat Vessel					Versitek API Separator (4)
Lori 4 Brush Side Mounted Skimmer with DOP 250 Pump Package					Skid Mounted Fiberglass 2500 Gallon API Separator
					Diesel Powered Light Trailer

Source: Clean Islands Council, 2001.

3.4.1 CURRENT LOCATION

Of the original 65,000 gallons (approximately 246,000 liters) on board, post-collision estimates indicated that up to 60,000 gallons (up to 227,000 liters) of diesel fuel were released from *Ehime Maru* after the incident (see chapter 2).

Approximately 1,200 gallons (4,540 liters) of more persistent lubricating oil and 46 gallons (182 liters) of kerosene were present at the time of the accident. This lubricating oil displays some toxic characteristics. It is not known how much lubricating oil is still present on *Ehime Maru*. Other hazardous materials that may have been on board *Ehime Maru* include hydraulic oil, refrigerants, paint, and solvents. Water quality conditions are addressed in section 3.1.1.

3.4.2 TRANSIT ROUTE TO THE SHALLOW-WATER RECOVERY SITE

There are no known hazardous materials and hazardous wastes present in the transit route corridor. Water quality conditions are addressed in section 3.1.2.

3.4.3 REEF RUNWAY SHALLOW-WATER RECOVERY SITE

This section provides an overview of potential hazardous wastes in the vicinity of the shallow-water recovery site. Sensitive public and commercial resources near the site are described in section 3.3 (Health and Safety).

Unexploded ordnance may be found at the Reef Runway shallow-water recovery site. Unexploded ordnance was found on three occasions during the construction of the Reef Runway (1973 through 1977). There are no other known hazardous materials and hazardous wastes present at the site. Water quality conditions are addressed in section 3.1.3.

3.4.4 TRANSIT ROUTE TO DEEP-WATER RELOCATION SITE

There are no known hazardous materials and hazardous wastes present in the transit route corridor to the deep-water relocation site. The South Oahu Ocean Dredged Material Disposal Site (ODO912) is the only active dredged material disposal site in Mamala Bay and services Pearl, Honolulu, and Barbers Point harbors. The site has been receiving dredged material since its designation by the U.S. Environmental Protection Agency in 1980. Approximately 12 million cubic yards (9.2 million cubic meters) of sediments have been generated by harbor dredging projects from 1959 through 1994. The deposited material within the site is primarily silt/clays mixed with coarse carbonate rubble. These deposits have been clearly delineated by sidescan sonar and video by a U.S. Environmental Protection Agency/U.S. Army Corps of Engineers monitoring program. Bottom video of this site shows the seafloor is littered with a variety of human-caused debris including military ordnance. Water quality conditions in the transit route corridor are discussed in section 3.1.4.

3.4.5 DEEP-WATER RELOCATION SITE

There are no known hazardous materials and hazardous wastes present at the deep-water relocation site. Water quality conditions at the deep-water relocation site are discussed in section 3.1.5.

3.5 AIRSPACE

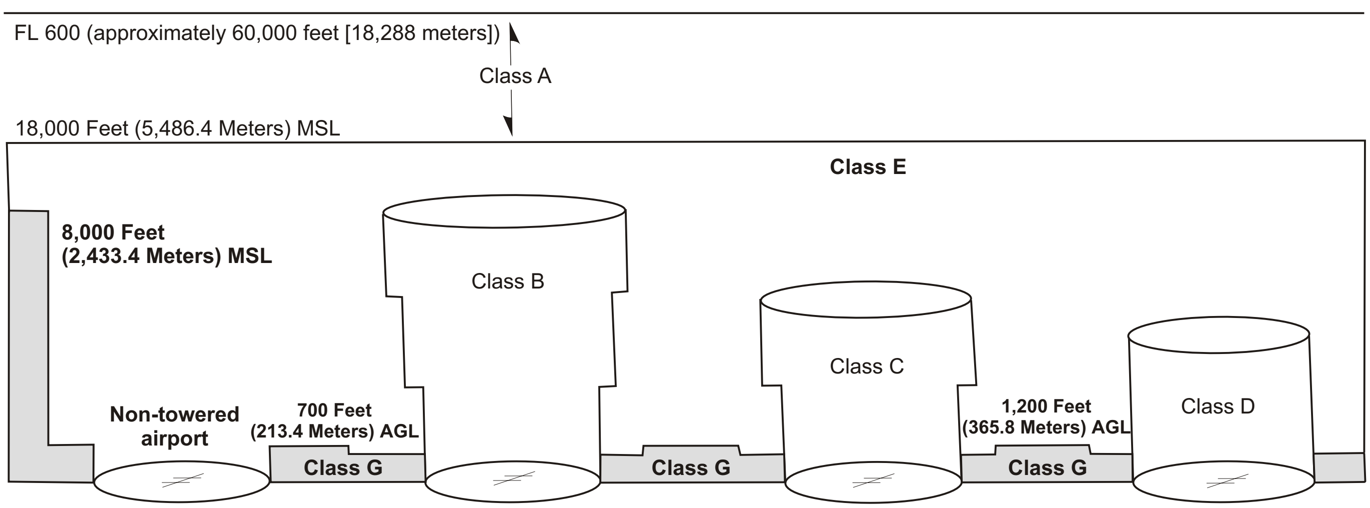
Airspace is generally viewed as being unlimited. However, it is a finite resource that can be defined vertically and horizontally, as well as temporally, when describing its use for aviation purposes. Scheduling is a very important factor in airspace management and air traffic control.

The FAA is charged with the safe and efficient use of the nation's airspace and has established certain criteria and limits to its use. The method used to provide this service is the National Airspace System. This system is " . . . a common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information and manpower and material" (Spence, 2001).

Controlled and uncontrolled airspace is divided into six classes, dependent upon location, use, and degree of control (figure 3-4). These classes are:

- Class A airspace, which is not specifically charted, is generally that airspace from 18,000 feet (5,486 meters) mean sea level up to and including flight level 600 (approximately 60,000 feet or 18,288 meters). Unless otherwise authorized, all aircraft must be operated under instrument flight rules.
- Class B airspace is generally that airspace surrounding the nation's busiest airports in terms of instrument flight rules operations or passenger volume. An air traffic control clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace.
- Class C airspace is generally that airspace surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of operations or passengers.
- Class D airspace is generally that airspace surrounding those airports that have an operational control tower.
- Class E airspace is controlled airspace that is not Class, A, Class B, Class C, or Class D airspace.
- Class G, or uncontrolled airspace, has no specific definition but generally refers to airspace not otherwise designated, and operations below 1,200 feet (366 meters) above ground level. No air traffic control service to aircraft operating under either instrument or visual flight rules is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established (Illman, 1993).

The distinction between controlled and uncontrolled airspace is important. Within controlled airspace, air traffic control service is provided to aircraft in accordance with the airspace classification. Aircraft operators are also subject to certain pilot qualifications, operating rules, and equipment requirements. Whereas within uncontrolled airspace, no air traffic control service to aircraft is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established (Illman, 1993).



Approximate maximum ceilings:
Class B: 8,000 Feet (2,433.4 Meters) AGL
Class C: 4,000 Feet (1,219.2 Meters) AGL
Class D: 2,500 Feet (762 Meters) AGL

Source: Illman, 1993.

LEGEND

AGL = Above Ground Level
FL = Flight Level
MSL = Above Mean Sea Level

Non-Military Airspace Classes

Figure 3-4

No Scale

3_4AirspaceClasses060101

Region of Influence

The general ROI is the airspace within and below the 20-nautical-mile (37-kilometer) radius Class B Airspace associated with Honolulu International Airport on, and off, the south coast of Oahu This general ROI encompasses the current location of *Ehime Maru*, the transit route to the shallow-water recovery site, the shallow-water recovery site, the transit route to the deep-water relocation site, and the deep-water relocation site.

Airspace Use

The overall airspace use environment in the ROI is described below in terms of its principal attributes, which are: controlled and uncontrolled airspace; enroute low-altitude airways; airports and airfields; and air traffic control. Other airspace use attributes, such as special use airspace, military training routes, and high-altitude jet routes, are not relevant here because the jet routes, all above 18,000 feet (5,486 meters), are well above the activities proposed, and because there is no special use airspace, and no military training routes in the ROI. The airspace use over the individual sites associated with the Proposed Action is described in following sections.

Controlled/Uncontrolled Airspace

The ROI is dominated by the Class B airspace that lies above and around Honolulu International Airport. It consists of a "core" surface area that extends from the surface up to 9,000 feet (2,743 meters) above sea level out to a 5-nautical-mile (9-kilometer) radius.

Below the Class B layers, between the 5-nautical-mile (9-kilometer) radius "core" area and 15 nautical miles (28 kilometers) out, is Class E controlled airspace with a floor 700 feet (213 meters) above the surface. This layer of controlled airspace is itself underlain with uncontrolled (Class G) airspace from the surface to 700 feet (213 meters). Further out to 20 nautical miles (37 kilometers), the underlying airspace is also uncontrolled (Class G) airspace, with varying altitudes (see figure 3-4 for details).

Enroute Airways

A number of low altitude enroute airways enter or transect the ROI. These airways are referred to as Class E airspace, established in the form of a corridor. The corridor's centerline is defined by radio navigational aids. They form a network serving aircraft up to, but not including, 18,000 feet (5,486 meters) above sea level. The sections below identify the nearest enroute airways.

Airports and Airfields

Honolulu International Airport and Hickam Air Force Base lie on the northern edge of the airspace use ROI. Honolulu International Airport is Hawaii's principal airport, with approximately 1,000 operations (departures and arrivals) per day in the year 2000 (Schlapak, 2001a). A total of 22.3 million passengers arrived in fiscal year 1999 (Hawaii Department of Transportation, 2001). Figure K-1 in appendix K shows the precision instrument approach zone slopes for both runways at Honolulu International Airport. These show the standard instrument approach procedure flight paths for arriving aircraft.

Figures K-1 through K-8 in appendix K show the various instrument approach patterns for the different runways at the airport. There are no temporary flight restrictions currently used at the airport.

In addition to the fixed-wing operations at Honolulu International Airport, commercial tour operator helicopters account for approximately 30 operations per day. Their normal flight routes hug the coast of Oahu east of the airport toward Makapuu Point. They typically either circle the entire Koolau Range returning to the airport over Kamehameha Highway, down the central part of Oahu to Pearl Harbor and the airport, or fly over the Pali Pass. The U.S. Coast Guard and local fire and ambulance helicopters are also based at the airport (Schlapak, 2001a, b).

Kalaeloa Airport (John Rodgers Field) just east of Barbers Point on the coast west of Honolulu had approximately 440 operations (departures and arrivals) per day in the year 2000, primarily touch-and-go training takeoffs and landings by light-plane pilots, the U.S. Coast Guard, the National Guard, and others (Schlapak, 2001a). Figures K-8 and K-9 in appendix K show the instrument approach patterns for the airport.

Air Traffic Control

The Honolulu Control Facility manages air traffic in the ROI within the U.S. territorial waters. The airspace beyond these territorial waters is in international airspace; therefore, the procedures of the International Civil Aviation Organization are followed (International Civil Aviation Organization, 1985, 1994). The FAA acts as the United States agent for aeronautical information to the International Civil Aviation Organization, and the Honolulu Control Facility and the Oakland Air Route Traffic Control Center manage air traffic in the ROI.

3.5.1 CURRENT LOCATION

The immediate airspace use ROI is a 3-nautical mile (5.5-kilometer) radius area covering the current location of *Ehime Maru*. The sections below highlight any differences with the general ROI airspace use description provided above, particularly the specific nature of the overlying controlled/uncontrolled airspace, and the nearest enroute low altitude airways.

Controlled/Uncontrolled Airspace

The airspace above the current location is uncontrolled airspace from the surface to 700 feet (213 meters) above sea level, and controlled (Class E and B) airspace above that (figure 3-4).

Pilots in uncontrolled (Class G) airspace have the responsibility to see and avoid other aircraft when flying and are required to remain at least 1,000 feet (305 meters) above the highest obstacle within a horizontal distance of 4 nautical miles (7.4 kilometers) from the course to be flown under certain FAA flight rule requirements. Pilots in the controlled (Class E) airspace immediately above the uncontrolled airspace have no specific arrival or through flight entry requirements. However, an air traffic control clearance is required for all aircraft to operate in the Class B (controlled) airspace from 1,000 to 9,000 feet (305 to 2,743 meters) above sea level. All aircraft that are cleared receive separation services within the airspace. (Spence, 2001)

Enroute Airways

Two low altitude enroute airways enter or transect the ROI: V2 between Oahu and Lanai, and V20 between Oahu and Kona on the island of Hawaii.

3.5.2 TRANSIT ROUTE TO THE SHALLOW-WATER RECOVERY SITE

The sections below highlight the details of the overall general airspace use ROI described above, particularly the specific nature of the overlying controlled/uncontrolled airspace and the nearest enroute low altitude airways.

Controlled/Uncontrolled Airspace

The transit route between the current location and the shallow-water recovery site lies under two separate layers of Class B airspace, with two distinct altitude floors (U.S. Department of Transportation, 2000). Between the current location and 5 nautical miles (9.3 kilometers) from Honolulu International Airport, the layer has a floor of 1,500 feet (457 meters) above sea level. Lying under this is another layer of controlled (Class E) airspace and a layer of uncontrolled (Class G) airspace from the surface to 700 feet (213 meters) (figure 3-4).

Enroute Airways

One low altitude airway (V20) lies to the east of the transit route to the shallow-water recovery site. Another airway (V8-21) lies to the west of the transit route.

3.5.3 REEF RUNWAY SHALLOW-WATER RECOVERY SITE

The sections below highlight the details of the overall general ROI airspace use description provided above, particularly the specific nature of the overlying controlled/uncontrolled airspace, and the nearest enroute low altitude airways.

Controlled/Uncontrolled Airspace

The Reef Runway shallow-water recovery site lies under the “core” Class B airspace surrounding Honolulu International Airport. This “core” area of controlled airspace extends out to a 5-nautical mile (9.3-kilometer) radius, with a ceiling of 9,000 feet (2,743 meters) above sea level, and a floor that extends to the surface (U.S. Department of Transportation, 2000).

Enroute Airways

There are no enroute low altitude airways within the airspace immediately above the Reef Runway shallow-water recovery site. Within 5 nautical miles (9.3 kilometers) of Honolulu International Airport, arriving aircraft move from the network of airways serving aircraft operations to start their final approach. Departing aircraft follow departure procedures before they join the network of airways. The site is close to, but well below, the approach zone for one of the runways. The airport's precision instrument approach zone slopes for both runways at Honolulu International Airport are shown in figure K-1 in appendix K.

Airports/Airfields

Honolulu International Airport is immediately to the north of the shallow-water recovery site, which lies just offshore of one of the airport's runways.

3.5.4 TRANSIT ROUTE TO THE DEEP-WATER RELOCATION SITE

The airspace that lies over the transit route to the deep-water relocation site is essentially identical to the airspace described in section 3.5.2. However, the different types of airspace along the transit route are reversed.

3.5.5 DEEP-WATER RELOCATION SITE

Controlled/Uncontrolled Airspace

The airspace use affected environment is identical to that described in section 3.5.1, with the exception that the overlying controlled (Class B) airspace is 1,500 feet (457 meters), not 1,000 feet (305 meters) above sea level (U.S. Department of Transportation, 2000).

Enroute Airways

There is one low altitude enroute airway, V8-21, in the vicinity of the deep-water relocation site.