UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Finavera Renewables Ocean Energy, Ltd. Project No. 12751-000
Washington

NOTICE OF AVAILABILITY OF ENVIRONMENTAL ASSESSMENT

(May 31, 2007)

In accordance with the National Environmental Policy Act of 1969 and the Federal Energy Regulatory Commission's (Commission) regulations, 18 CFR Part 380 (Order No. 486, 52 F.R. 47897), the Office of Energy Projects has reviewed the application for an original license for the Makah Bay Offshore Wave Energy Pilot Project to be located in part in Makah Bay of the Pacific Ocean in Clallam County, Washington and in part on the Makah Indian Reservation near Neah Bay, Washington, and has prepared an Environmental Assessment (EA) for the project. The EA contains the staff's analysis of the potential environmental impacts of the project and concludes that licensing the project, with appropriate environmental protective measures, would not constitute a major federal action that would significantly affect the quality of the human environment.

A copy of the EA is available for review at the Commission in the Public Reference Room or may be viewed on the Commission's website at http://www.ferc.gov using the "eLibrary" link. Enter the docket number excluding the last three digits in the docket number field to access the document. For assistance, contact FERC Online Support at FERCOnlineSupport@ferc.gov or toll-free at 1-866-208-3676, or for TTY, (202) 502-8659. You may also register online at http://www.ferc.gov/docs-filing/esubscription.asp to be notified via email of new filings and issuances related to this or other pending projects. For assistance, contact FERC Online Support.

Any comments should be filed within 30 days from the date of this notice and should be addressed to: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street, NE, Washington, D.C. 20426. Please affix Project No. 12751-000 to all comments. Comments may be electronically filed via the Internet in lieu of paper. The Commission strongly encourages electronic filings. See 18 CFR § 385.2001(a)(1)(iii) and the instructions on the Commission's web site (http://www.ferc.gov) under the "e-Filing" link.

For further information, contact Nicholas Jayjack at (202) 502-6073.

Kimberly D. Bose
Secretary

ENVIRONMENTAL ASSESSMENT FOR HYDROPOWER LICENSE

Makah Bay Offshore Wave Energy Pilot Project

FERC Project No. 12751-000

Washington

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, D.C. 20426

May 2007

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

On November 8, 2006, AquaEnergy Group, Ltd. (AquaEnergy) filed an application for a minor license to construct and operate the Makah Bay Offshore Wave Energy Pilot Project (Makah Bay Project or project). The 1.0-megawatt (MW) ocean wave energy conversion project consisting of four wave energy conversion buoys (AquaBuOYs or buoys), a submarine transmission line, and a shore station, would be located in Makah Bay of the Pacific Ocean, about 1.9 nautical miles offshore of Waatch Point in Clallam County, Washington. The project would occupy about one acre of land on the Makah Indian Reservation and about seven acres of lands, collectively, of the Olympic Coast National Marine Sanctuary (Sanctuary) administered by the National Oceanic and Atmospheric Administration (NOAA); Flattery Rocks National Wildlife Refuge administered by the U.S. Fish and Wildlife Service; and state-owned aquatic lands administered by the Washington Department of Natural Resources. The project would generate an average of about 1,500 megawatt-hours (MWh) of energy annually.

On May 2, 2007, Finavera Renewables Ocean Energy, Ltd. (Finavera) filed a letter informing the Federal Energy Regulatory Commission (Commission) that they officially changed their name from AquaEnergy to Finavera.

In this EA, we assess the environmental and economic effects of constructing, operating, and maintaining the project under the following alternatives: (1) the applicant's proposal (Proposed Action); (2) the applicant's proposal with our recommended measures (Staff Alternative); and (3) the Staff Alternative with mandatory conditions submitted by NOAA's National Marine Sanctuary Program (NMSP) (Staff Alternative with Mandatory Conditions). We also consider the effects of the no-action alternative. Important issues that are addressed in this EA include project effects on marine resources, aesthetics, cultural resources, recreation, ocean uses, and land uses.

NO-ACTION ALTERNATIVE

Under the no-action alternative, the Commission would deny a license for the proposed Makah Bay Project. The project would not be built, and there would be no change to the existing environment.

PROPOSED ACTION

Finavera proposes the following measures during project construction and operation for the protection of environmental resources:

- develop and implement a detailed project design and installation plan, including provisions for: (1) determining the final design and installation methods for the buoy and submarine transmission line anchoring systems; (2) using horizontal directional drilling

(HDD) to deploy the transmission line from the shore station out to a depth of 10 to 30 feet below mean low tide; and (3) designing the buoys to be a closed-system and to prevent seal and sea lion haul-out and seabird roosting;

- conduct an eelgrass survey for purposes of determining the depth to which to deploy the submarine transmission line using horizontal directional drilling (HDD) in order to avoid disturbing macroalgae/eelgrass beds;

- develop and implement a project facilities inspection and maintenance plan that includes provisions for: (1) at least bi-annual visits to the AquaBuOYs for purposes of retrieving entangled derelict fishing gear from the buoys mooring and anchoring system and (2) notifying the Sanctuary within 24 hours of becoming aware of the need for any emergency response or repair to project facilities, providing 24-hour updates to the Sanctuary of the progress of any response, and providing a written report summarizing the emergency response within 30 days;

- install acoustic deterrent devices ("pingers") on the buoys to warn marine mammals of anchoring and mooring lines to avoid collision and entanglement;

- conduct an engineering, laboratory, or literature based assessment of noise at the proposed project;

- conduct an engineering, laboratory, or literature based assessment of electromagnetic fields (EMF) generated by the project;

- develop and implement an anti-fouling paint effectiveness plan to determine the type of anti-fouling paint to use on the buoys to avoid marine growth while at the same time protecting nearby, non-target marine resources from the toxic effects of the paint;

- develop and implement plans for: (1) monitoring for marine mammal entanglement and collision; (2) continuous cetacean acoustic monitoring; (3) assessing the effectiveness of the buoy seal and sea lion excluder device; and (4) monitoring seabird use and behavior around the buoys;

- develop and implement a plan for a project exclusion zone to protect the project facilities from fishing, trawling, and other in-water disturbances that could snag project cables or the submarine transmission line;

- develop and implement an interpretive and education plan to provide information regarding the proposed project and use of the area by the Makah Tribe;

- develop and implement a cultural resources management plan (CRMP); and

- improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.

Under Finavera's proposal, the project would cost $874,088 annually to operate, have annual power benefits of $60,000, and have a net annual benefit of -$814,088. The project's average annual generation would be 1,500 megawatt-hours (MWh).

STAFF ALTERNATIVE

After evaluating Finavera's proposed action and the recommendations from the resource agencies and other interested parties, we considered what, if any, additional or modified protection measures would be necessary or appropriate with continued operation of the project. The Staff Alternative consists of the proposed action with modified and additional environmental measures, which include agency recommendations and conditions made pursuant to sections 10(j) and 4(e) of the Federal Power Act (FPA), respectively. Additional staff-recommended measures include:

- develop and implement a water quality monitoring plan for in-water project construction activities, including provisions to monitor the HDD process for any seepage of drilling fluid and take corrective actions to avoid continued seepage of the drilling fluid into the surrounding bed stratum and water column;

- develop a fuel and oil spill control, prevention, and countermeasures plan to be implemented during proposed project construction, operation, and maintenance activities and including provisions for: (1) inspecting vessels and equipment used during construction and maintenance for fuel and hydraulic leaks on a daily basis while at the project; and (2) containing and removing petroleum or other oil products in the event of a spill or leak;

- develop and implement a plan to conduct an on-site noise assessment of the proposed project buoys and associated anchoring and mooring equipment to be conducted within one year of the start of project operations and including a provision for determining potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals or fish;

- develop and implement a plan to conduct a baseline and post-installation hard substrate benthic community survey along the proposed submarine transmission line route;

- develop and implement a plan to conduct continuous acoustic cetacean monitoring for 10 years commencing with the start of project operations;

- develop and implement a plan to conduct an on-site EMF assessment at the submarine transmission line and buoys within one year of the start of project operations;

- notify the Sanctuary of project emergencies consistent with Condition 9 of the NMSP's conditions submitted under section 4(e) of the FPA;

- include in the proposed detailed design engineering and installation plan, a provision for a marine mammal observer to be present during in-water construction and installation activities;

- develop and implement a shore station erosion control, revegetation, and noxious weed control plan for land-based project construction activities;

- develop and implement a recreation use monitoring plan for the project;

- remove existing marine debris and derelict fishing gear from the immediate project area prior to project construction and installation;

- include in the proposed Interpretive and Education Plan, a map depicting marine habitats and associated species within the proposed project area, and a provision for an interpretive display to be located at the shore station;

- include in the proposed plan for a project exclusion zone, provisions to: (1) mark the four proposed buoys with low-intensity navigation or hazard lights visible to 1.0-nautical mile, and (2) consult with the U.S. Coast Guard and the Sanctuary on the painting of the project buoys in a way that considers the aesthetic character of the Sanctuary as well as the safety of the public and project facilities; and

- develop and implement a plan for a cultural resource monitoring program with a provision to have a Makah tribal monitor present during all ground-disturbing activities to detect archaeological sites that might be disturbed.

The Staff Alternative does not include: (1) Finavera's proposal for conducting an engineering, laboratory, or literature based assessment of project noise and EMF; (2) Finavera's proposal to develop and implement a CRMP for the project; (3) Washington Department of Fish and Wildlife's recommendation for a plan to mitigate for fishing loss resulting from the establishment of a project exclusion zone; and (4) the Sanctuary Advisory Council's recommendation for project inspections and maintenance to take place every 60 days rather than biannually as proposed by Finavera.

Under the Staff Alternative, the project would cost $895,346 annually to operate, have annual power benefits of $60,000, and have a net annual benefit of -$835,346. The project's average annual generation would be 1,500 MWh.

STAFF ALTERNATIVE WITH MANDATORY CONDITIONS

In addition to the measures included under the Staff Alternative, the Staff Alternative with Mandatory Conditions would include the following measures submitted by the NMSP pursuant to section 4(e) of the FPA:

- obtain prior written approval from NMSP for any project changes (Condition 7);

- purchase and maintain a bond to cover the entire costs of project removal at the end of the service life of the project, and submit a decommissioning plan to the NMSP at least 12 months prior to commencing any removal activities associated with decommissioning (Condition 8);

- reserve the authority of the NMSP to prescribe additional conditions under section 4(e) of the FPA (Condition 10).

Under the Staff Alternative with Mandatory Conditions, the project would cost $913,058 annually to operate, have annual power benefits of $60,000, and have a net annual benefit of -$853,058. The project's average annual generation would be 1,500 MWh.

ENVIRONMENTAL EFFECTS

Under all of the action alternatives, there would be the following short-term effects associated with project construction and installation: (1) disruptions of a very small area of the seabed would result in turbidity increases in the immediate vicinity of the proposed submarine transmission line and buoy array; (2) there would be a very minor risk of an accidental release of bentonite (a type of clay) into the water column during drilling activities used to bury a small portion of the submarine transmission line; (3) there would be a very minor risk that construction and drilling equipment could leak or spill petroleum products in the project area waters; (4) immobile or slowing-moving marine organisms (e.g., clams, snails, and worms) over a very small area would be covered, disturbed, or injured during the installation of the submarine transmission line and project mooring lines, anchors, and chains; (5) algae growing on a very small number of rocks could be scraped by the submarine transmission line; (6) ships or barges used for construction and installation would result in a minor disturbance of fish, marine mammals, and seabirds; (7) dust and noise from shore-based construction activities on the Makah Indian Reservation would result in a temporary disturbance to the public; and

(8) land-disturbance and construction activities would temporarily disturb the project area viewshed.

Under all of the action alternatives, there would be the following long-term effects associated with project operations and maintenance: (1) there would be a very minor risk that paint sloughing or chipping from the project buoys due to aging or collision with a vessel could cause a localized build-up of anti-fouling toxins in the underlying sediments; (2) the submarine transmission line would occupy a very minor amount of marine benthic habitat, including 0.25 acre of sand and silt, 0.042 acre of rocky habitat, and a minimal area of isolated large rocks; (3) a minor amount of marine waters (a narrow strip of about 95 surface acres) would be excluded from fishing and crabbing activities, which could adversely affect tribal fishing and associated revenue; (4) once installed, there would be a minor risk that the buoy mooring lines and chains and the submarine transmission line mounted on the seabed could contact the seabed and scrape benthic marine organisms, especially if the mooring and anchoring system would be loosened due to such an event as an inadvertent boat anchor or fishing line catching and dragging the mooring cables or transmission line; (5) there would be a minor risk that sharks, skates, and rays could become temporarily disoriented upon passing through electromagnetic fields emitted from the project's electrical lines, or ultimately avoid the area altogether; (6) periodic maintenance of the in-water project facilities would likely result in a minor disturbance to marine mammals and seabirds in the area of the project buoys; (7) there would be a minor risk that marine mammals and seabirds would collide with the project's mooring and anchor lines/cables; (8) there would be a minor risk that the project's mooring and anchor lines/cables would collect derelict fishing gear that would "ghost fish" for fish and crabs in the project area and pose an entanglement threat to marine mammals and seabirds; and (9) there would be a minor risk that increased visitation to the project area as a result of the installation and operation of the new generation technology would adversely effect other environmental resources in the project area.

Generation of electricity using wave energy technology is a relatively new and emerging segment of the renewable energy industry. As such, relatively little information is available regarding the environmental effects associated with the installation, operation, and maintenance of wave energy technology. Accordingly, all three action alternatives include provisions for monitoring the effects of the construction, operation, and maintenance of the project on environmental resources in the project area. Although this environmental assessment analyzes the potential effects of the project on these resources using the best available information, additional information collected by the monitoring activities would be used to determine the ultimate extent of these effects and the need for any further protection or mitigation measures.

CONCLUSION

We selected the Staff Alternative, as the preferred option. We recommend this option because: (1) issuance of a hydropower license would allow Finavera to demonstrate the potential of an emergent renewable energy industry segment with the goal of bringing clean, competitively-priced electricity to commercial and residential consumers in Washington State and other coastal states; (2) the power produced by the proposed project would contribute to a diversified generation mix that would help meet a need for power in the region, the Clallam County PUD service territory, and the Makah Nation Indian Reservation during the short and long term; (3) the 1-MW project would eliminate the need for an equivalent amount of fossil-fueled derived energy and capacity, which helps conserve these nonrenewable resources and limits atmospheric pollution; (4) the public benefits of this alternative would exceed those of the no-action alternative; and (5) the recommended measures would protect marine resources, wildlife, recreation, aesthetic resources, and cultural resources in the project area.

We view NMSP's Conditions 7 and 10 under the Staff Alternative with Mandatory Conditions as being entirely administrative in nature and not directly related to the licensing of the project. These two measures relate more to future actions that ultimately may require an amendment of any license issued for the project. We, therefore, do not adopt the Staff Alternative with Mandatory Conditions as the preferred alternative, but do recognize that if section 4(e) of the FPA gives NMSP the authority to impose conditions on any license issued by the Commission for a project in the Sanctuary, then all of NMSP's appropriately filed conditions must be included in any license issued for the project.

With regard to NMSP's Condition 8, we briefly discuss the potential costs of decommissioning the project in this EA. Further discussion on project decommissioning, including any need for Finavera to make financial provisions for the unexpected early retirement of the project, will follow in the order for Finavera's license application.

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, DC

Makah Bay Offshore Wave Energy Pilot Project
FERC Project No. 12751-000-Washington

I. APPLICATION

On November 8, 2006, AquaEnergy Group, Ltd. (AquaEnergy) filed an application for a minor license to construct and operate the Makah Bay Offshore Wave Energy Pilot Project (Makah Bay Project or project). The 1.0-megawatt (MW) ocean wave energy conversion project consisting of four wave energy conversion buoys (AquaBuOYs or buoys), a submarine transmission line, and a shore station, would be located in Makah Bay of the Pacific Ocean, about 1.9 nautical miles offshore of Waatch Point in Clallam County, Washington. The project would occupy about one acre of land on the Makah Indian Reservation and about seven acres of lands, collectively, of the Olympic Coast National Marine Sanctuary (Sanctuary) administered by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA); Flattery Rocks National Wildlife Refuge administered by the U.S. Department of the Interior (Interior), U.S. Fish and Wildlife Service (FWS); and state-owned aquatic lands administered by the Washington Department of Natural Resources (DNR). The project would generate an average of about 1,500 megawatt-hours (MWh) of energy annually.

On May 2, 2007, Finavera Renewables Ocean Energy, Ltd. (Finavera) filed a letter informing the Federal Energy Regulatory Commission (Commission) that they officially changed their name from AquaEnergy to Finavera. To avoid confusion, from this point forward in this environmental assessment (EA), we will use the name Finavera in all references to the applicant.

II. PURPOSE OF ACTION AND NEED FOR POWER

A. Purpose of Action

The Commission must decide whether to issue a license to Finavera to construct, operate, and maintain the project and what conditions should be placed in any licensed issued. Issuing a license for the project would allow Finavera to generate electricity at the project for the term of the license, making electric power from a renewable resource available to their customers.

This EA assesses the effects associated with construction, installation, and operation of the proposed project and project alternatives, and makes recommendations to the Commission on whether to issue a license, and if so, on what terms and conditions to become a part of any license issued.

In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing the waterway. In addition to the power and developmental purposes for which licenses are issued (*e.g.*, flood control, irrigation, and water supply), the Commission must give equal consideration to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality.

In this EA, we assess the environmental and economic effects of constructing, operating, and maintaining the project under the following alternatives: (1) Finavera's proposal (Proposed Action); (2) Finavera's proposal with our recommended measures (Staff Alternative); and (3) the Staff Alternative with mandatory conditions submitted by NOAA's National Marine Sanctuary Program (NMSP) (Staff Alternative with Mandatory Conditions). We also consider the effects of the no-action alternative. Important issues that are addressed include project effects on marine resources, aesthetics, cultural resources, recreational resources, ocean uses, and land uses.

B. Need for Power

With a maximum output of 1 MW, the Makah Bay Project would provide approximately 1,500 MWh annually of clean renewable ocean energy. Clallam County Public Utility District (PUD), based in Port Angeles, Washington would provide connection to its electrical distribution system and purchase the generated electricity for its delivery within the Clallam County PUD service territory, which includes the Makah Indian Reservation and its total load demand of about 5 MW.[1] The ocean wave energy conversion power plant would help Clallam County PUD meet its customers' power needs. Over the period 2005 to 2015, Clallam County PUD projects an annual increase of one percent for both energy growth and net peak load, with the latter increasing from the 1995 level of about 144 MW to 159 MW in 2015 (personal communication between Finavera and Fred Mitchell, Clallam County PUD, September 16, 2005, as cited in the license application).

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[1]The Clallam County PUD service area extends from the Washington coast east approximately 100 miles to Olympia.

The renewable power produced by the project would contribute to diversification of the generation mix in the region. This energy source also aligns with Clallam County PUD's objective to provide clean energy to customers.

The successful installation of the Makah Bay offshore power generating plant would demonstrate the potential of an emergent renewable energy industry segment with the goal of bringing clean, competitively-priced electricity to commercial and residential consumers in Washington State and other coastal U.S. states. The future use of the project's power, its displacement of non-renewable fossil-fueled generation, and its contribution to a diversified generation mix demonstrate that the project would help meet a need for power in the region, the Clallam County PUD service territory, and the Makah Nation Indian Reservation during the short and long term.

III. PROPOSED ACTION AND ALTERNATIVES

A. Proposed Action

1. Project Facilities

The project would consist of: (1) four, 250-kilowatt (kW), steel wave energy conversion buoys ("AquaBuOYs") and an associated mooring/anchoring and electrical connection system placed 3.7 miles offshore (from Hobuck Beach) in water depths of about 150 feet;[2] (2) a metal shore station that would be about 15 feet long by 15 feet wide by 10 feet high and located just inland of Hobuck Beach (on the Makah Indian Reservation near Neah Bay, Washington) adjacent to an existing power line for interconnection – the shore station would contain equipment necessary to connect to the electrical grid; (3) a driveway and parking area at the metal shore station; and (4) a 3.7-mile long, direct current (DC) submarine transmission line connecting from one of the buoy's ("collection buoy") power cable to the metal shore station (figure 1).

Each AquaBuOY would have a float diameter of 19.5 feet and float height of 16.4 feet (about 6.6 feet of which would be above water) and would contain the following components:

- two single-acting hose pumps, 35 feet in length with an inner diameter 16 to 18 inches, mounted vertically inside of an acceleration tube attached to the bottom of the buoy float. The acceleration tube would have a length of 98 feet and a diameter of

[2] The buoys would be spaced about 60 feet apart in a line approximately parallel to the wave front.

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

Figure 1. Project location map. (Do not scale) (Source: Finavera, 2006)

15 feet. The hose pumps would be configured in a closed-loop hydraulic system filled with 1,850 gallons of fresh water (there would be no interaction between the closed-loop freshwater system and the outside seawater). The maximum output from both hose pumps would be 34 gallons per second (125 liters) at 215 pounds per square inch (PSI);

- one Pelton turbine with a maximum water capacity of 34 gallons per second at 215 PSI and housed within the float portion of the buoy. The turbine rotation speed (revolutions per minute [rpm]) would vary based on incoming water pressure. Pressure nozzles regulating the turbine would be automatic or remotely controlled via an electro-hydraulic system;

- one 200- to 400-liter water accumulator connected to the hydraulic system on the pressure side; its role would be to even out the pressure and flow rate of the water feeding into the Pelton turbine;

- one 480-volt (V), alternating current (AC) variable speed synchronic generator, with a maximum output of 250 kW and an estimated average output of about 46 kW (assuming an average wave resource of 8.5 kW per foot [28 kW per meter] wave front).

- controls, sensors, RF data link, radar reflector, and sealed/foamed chambers to insure positive buoyancy. Sensing instruments would monitor: wave height and period; buoy heave; piston position in the acceleration tube; piston force; mooring forces; water flow (nozzle); water pressure in different parts of the hydraulic loop; turbine rpm; generator output, volts, and amps; accumulator pressure; and inside buoy temperature. All sensing equipment would be RF capable to allow for wireless internet connection. All instruments would be equipped with a battery backup system in the event of primary power failure; and

- navigational instruments, including a navigational light with battery backup and radar reflector, and a global positioning system (GPS) transmitter in case of break away.

The buoy closest to the shore, referred to as the collection buoy or hub, would collect electricity generated from the other three buoys. In addition to the equipment previously described for each AquaBuOY, the collection buoy would hold: (1) a 1-MW, 480V/12 kilovolt (kV) transformer; and (2) a 1-MW, 12-kV rectifier. From the hub, a tethered riser umbilical power cable—dimensioned to handle the maximum combined electric output of 1 MW at 12 kV—would deliver the energy to the DC submarine transmission line. The transmission line would lead from the tethered riser to the shore connection.

Each AquaBuOY hull would be tethered by a tension cable to four surface floats, each approximately 4 feet in diameter. The ocean surface occupied by the total of 4 AquaBuOYs and 10 surface floats would be about 60 feet by 240 feet (figure 2). The

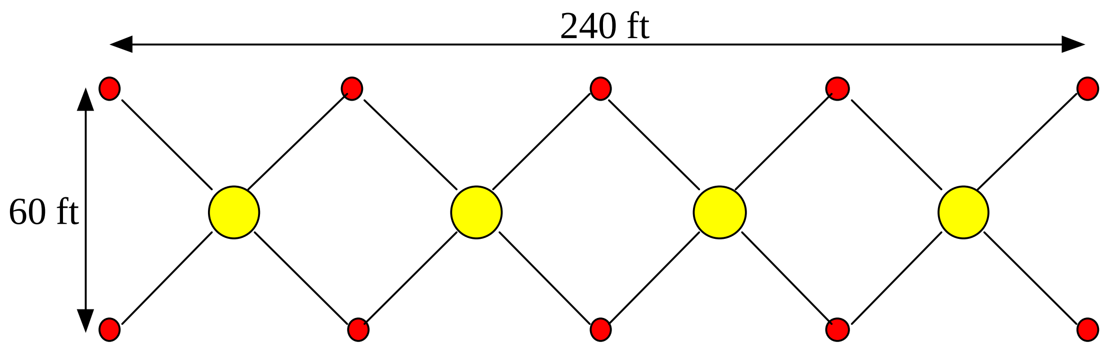

Figure 2. Schematic of Finavera's proposed AquaBuOY array and associated mooring surface floats. The larger circles represent the AquaBuOYs and the smaller circles represent the surface floats. (Source: Finavera, 2006)

surface floats would be connected to sub-surface mooring buoys, located just above the seafloor, by a cable fastened to a chain. The mooring system for each buoy would terminate with a chain running from the sub-surface buoy to a connection to the sea-bed placed approximately in a square pattern on the ocean floor with the AquaBuOY approximately centered on the surface above (figure 3). Heave forces acting on the surface floats and mooring buoys would be dampened by lifting the chain slack between the two, which would provide ample mooring in storm conditions. The sub-surface floats would also serve to prevent chain scouring of the seafloor.

Finavera would use vertical load anchors (VLA's) with a near vertical leg connection to the sub-surface mooring buoy that in turn would be connected to the buoy array. VLAs are a recent development in the off-shore industry, developed to withstand the major loads associated with floating offshore production systems.[3] The mooring system would cover a rectangular area of approximately 625 by 450 feet on the ocean floor.

The transmission line would be anchored to the ocean floor until it approaches the shoreline. From 10 to 30 feet in depth below mean low tide to shore (a distance of about 1,200 feet), the transmission line would be buried using horizontal directional drilling (HDD), a technique frequently used for other cable projects. HDD is often preferred to open trenching, especially in intertidal areas, because it does not expose the surface of the seabed and intertidal zone to wave action, and thus, minimizes erosion and suspension of sediment.

[3]VLA's are frequently used for mooring oil drilling platforms when in vertical (normal) loading mode. VLA's can withstand tremendous horizontal and vertical loads.

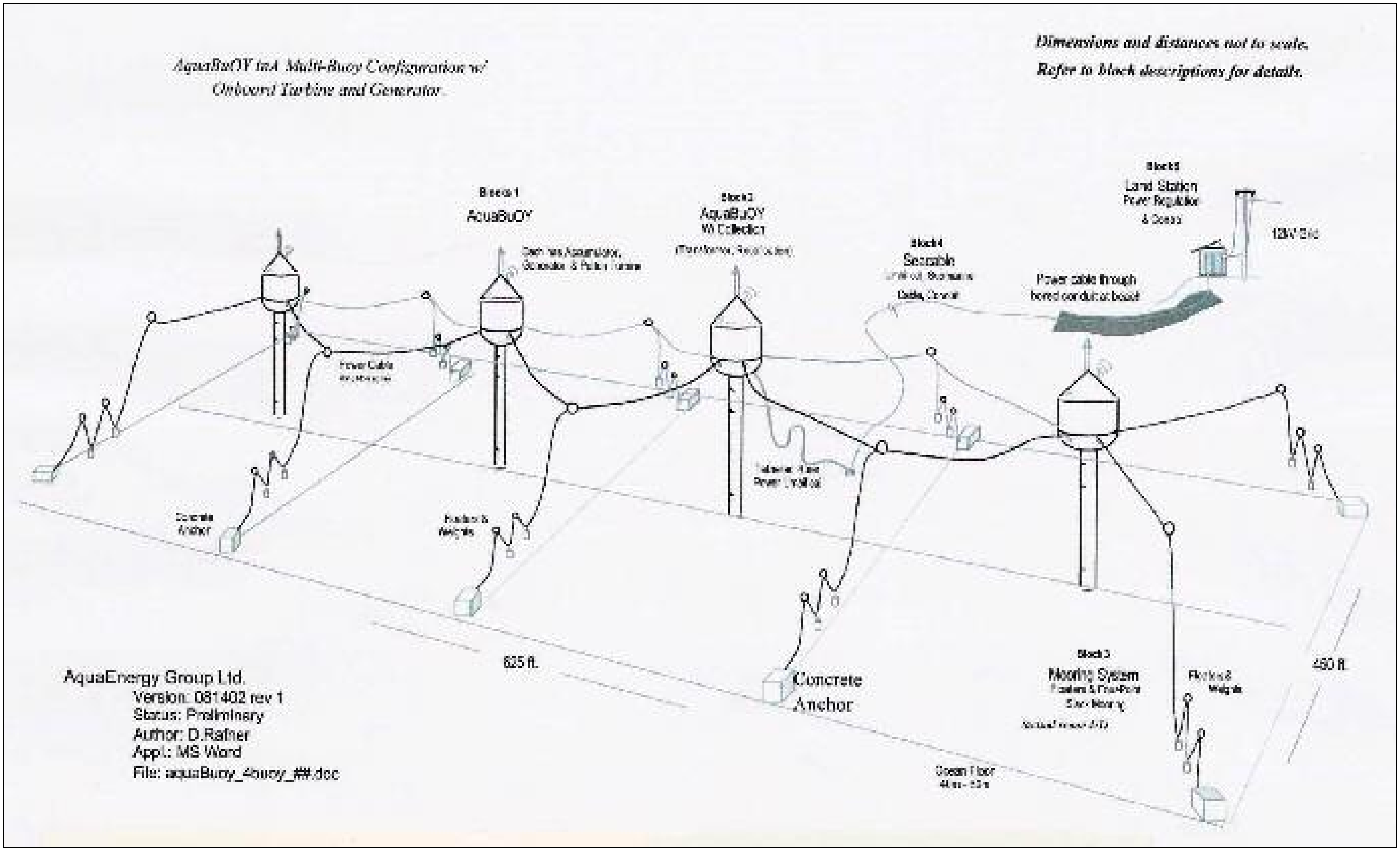

Figure 3. Configuration of Finavera's proposed AquaBuOY mooring and anchoring system. In place of the concrete anchors shown in the figure, Finavera proposes to use vertical load anchors (VLA's). (Source: Finavera, 2006)

The shore station would house the electrical conditioning equipment necessary to connect to the utility grid. This equipment would include a 1-MW, 0.4-kV rectifier; a 1-MW, 0.4-kV inverter; 0.4 kV/12 kV transformer; 12-kV, 50 amp switchgear with a connection to the transmission cable; and 12-kV, 50-amp switchgear with a connection to the primary distribution line. From this station, the power would be directly connected to the nearby existing Clallam County PUD 12-kV distribution line. The electrical interconnection would be located in close proximity to Makah Passage Road.

All of the generating components of the project (including buoy hulls, anchors and mooring auxiliaries, energy converters, and turbine-generator housing) would be fabricated in off-site shipyards and machine shops. Members of the local community would participate in the installation, monitoring and testing. While in machine shops, the buoys would be fitted with internal systems, such as hose pumps, and hydraulic and electronic controls.

2. Project Operation

The acceleration tube of the buoy houses an internal piston (a neutrally buoyant disk) at the vertical midpoint of the acceleration tube. Two steel-reinforced rubber hoses filled with freshwater connect the top and bottom of the piston to the top and bottom of the acceleration tube. As the buoy rises in response to a wave, the top rubber hose stretches, causing the volume of the hose to decrease and the water inside to come under pressure. The pressurized water is directed by a high-pressure water accumulator to the nozzles of the Pelton turbine and associated generator. When the buoy falls in response to the passing wave, the bottom hose elongates, which again results in a pressurized flow of water being directed to the nozzles of the Pelton turbine and associated generator.

Electricity generated by the AquaBuOYs would be collected at the collection buoy, converted to DC, and transmitted to the shore station via the 3.7-mile long submarine transmission cable.

The AquaBuOYs would operate passively. Finavera would visit the AquaBuOYs about two to five times per year by boat out of Neah Bay for maintenance. At all other times, the buoys would be monitored using online buoy telemetry equipment. The land-based station would be visited about six times per year by vehicle.

3. Project Construction and Installation

The AquaBuOYs would consist of fabricated modular components. Construction activities involving hazardous processes or materials (*e.g.*, metal cutting, oil, or paint) would be accomplished in existing shore-based shops and shipyards. Most of the system interconnections would be preassembled. Using boats designed to deploy anchoring systems, placement of the seabed components (VLAs) would be fairly standard and non-intrusive. The VLA is a special design of drag embedment anchor that can be triggered so that the angle of the load line through the centroid of its fluke (the centroid angle) increases from about 65° to a final angle of 90° "vertical" to its fluke. When its final centroid angle is reached, the VLA is at its ultimate holding capacity for a given depth of embedment. In addition to its minimal ocean floor impact, VLAs are designed to be retrieved by use of an unlocking device, a chain shank, and a streamlined fluke.

Once buoys, anchors, hoses, and transmission cables would be assembled, boats or barges would be used to ferry the buoys and other hardware to the site approximately 3.7 miles offshore where water depth is about 150 feet. The buoy launch would be accomplished either by towing the buoys or transporting them to the site aboard crane-equipped buoy tender vessels.

Installing the sea-to-shore transmission line is a specialty job that would be subcontracted to a marine construction firm. The line would be anchored securely to the ocean floor to prevent movement along the sea floor. The actual anchoring method would be determined with input and agreement from the transmission cable installation company, the Sanctuary, and Washington DNR prior to installation. From depths of 10 to 30 feet below mean low tide to the shoreline, the transmission cable would be bored horizontally under the beach using HDD methodology. The transmission cable would continue through the surf zone and underground to the grid interconnection behind Hobuck Beach.

The HDD contractor would use specialized equipment to drill in a pipe conduit along the route of the transmission cable below the seabed. Boring would be done with a track-based horizontal boring rig that would incrementally add sections of pipe as the shaft or "drill string" would progress into the ground. When the shaft would come out at its destination, the bit would be removed from the end and the transmission cable would be attached at that end. The shaft would then be pulled back the way it came towards the drilling rig, thereby allowing the cable or conduit to be pulled back with it.

Typically with HDD, water, mud, or gel is pumped into the drilling shaft while drilling. In the case of putting in an electrical or fiber cable through a beach or even in a suburban neighborhood, pressurized water can greatly speed the drilling process. With some rigs water is immediately recovered, filtered, and put back into a reservoir tank. The precise process that would be used for this project would be determined once a contractor specializing in HDD is selected.

Most of the shore station equipment would be housed in a fabricated metal building (approximately 10 feet high with a floor plan measuring 15 feet by 15 feet) that would be erected with small equipment. The construction of the shore station would occur at the same time as the placement of the in-water components. Construction of the shore facilities would require some earthwork (foundation preparation); however, this work would not occur within 200 feet of the water line and no fill would be required. The shore station would be landscaped to blend with the local flora. The only impervious surface would be about 200 square feet for the shore station.

The AquaBuOYs would be deployed in phases. First, a single buoy would be launched and tested for survivability. Subsequently, the three additional power buoys and the transmission cable would be deployed over a period of approximately two months. Once all subsystems would be in place and interconnected, system integration and testing would commence and continue until the power plant would be declared operational.

4. Project Safety

As part of the licensing process, the Commission would review the adequacy of the proposed project facilities. Special articles regarding project safety and operation would be included in any license issued, as appropriate. Commission staff would inspect the licensed project both during and after construction. Inspection during construction would concentrate on adherence to Commission-approved plans and specifications, special license articles relating to construction, and accepted engineering practices and procedures. Operational inspections would focus on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

For the purposes of evaluating potential environmental impact, the Makah Bay Project safety concerns would involve the operation of the buoys during a peak meteorological event, the potential severance of the submarine transmission cable, and facility recovery in the event of detachment from its anchor. Each of these items would be a central focus of Commission review prior to construction. Finavera has proposed to install GPS transponders in the buoys to assist in monitoring and retrieval should there be device drift or detachment, and has indicated that it intends to follow industry standard cable installation procedures, which typically trip off power transmission when the circuit is disconnected.

5. Proposed Environmental Measures

Finavera proposes the following measures during project construction and operation for the protection of environmental resources:

- develop and implement a detailed project design and installation plan, including provisions for: (1) determining the final design and installation methods for the buoy and submarine transmission line anchoring systems; (2) using HDD to deploy the transmission cable from the shore station out to a depth of 10 to 30 feet below mean low tide; and (3) designing the buoys to be a closed-system and to include a heavy-duty plastic conical attachment to be placed over the above-water portion of the buoys to prevent seal and sea lion haul-out and seabird roosting;

- conduct an eelgrass survey for purposes of determining the depth to which to deploy the submarine transmission line using HDD in order to avoid disturbing macroalgae/eelgrass beds;

- develop and implement a project facilities inspection and maintenance plan that includes provisions for: (1) at least bi-annual visits to the AquaBuOYs for purposes of retrieving entangled derelict fishing gear from the buoys mooring and anchoring system and (2) notifying the Sanctuary within 24 hours of becoming aware of the need for any emergency response or repair to project facilities, providing 24-hour updates to the Sanctuary of the progress of any response, and providing a written report summarizing the emergency response within 30 days;

- install acoustic deterrent devices ("pingers") on the buoys to warn marine mammals of anchoring and mooring lines to avoid collision and entanglement;

- conduct an engineering, laboratory, or literature-based assessment of noise at the proposed project;

- conduct an engineering, laboratory, or literature-based assessment of electromagnetic fields (EMF) generated by the project;

- develop and implement an anti-fouling paint effectiveness plan to determine the type of anti-fouling paint to use on the buoys to avoid marine growth while at the same time protecting nearby, non-target marine resources from the toxic effects of the paint;

- develop and implement plans for: (1) monitoring for marine mammal entanglement and collision; (2) continuous cetacean acoustic monitoring; (3)

assessing the effectiveness of the buoy seal and sea lion excluder device; and (4) monitoring seabird use and behavior around the buoys;

- develop and implement a plan for a project exclusion zone to protect the project facilities from fishing, trawling, and other in-water disturbances that could snag project cables or the submarine transmission line;

- develop and implement an interpretive and education plan to provide information regarding the proposed project and use of the area by the Makah Tribe;

- develop and implement a cultural resources management plan (CRMP); and

- improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.

B. Staff's Recommended Alternative

Under our alternative, the project would include Finavera's proposal for the following measures: (1) detailed design and installation plan; (2) eelgrass survey; (3) inspection and maintenance plan; (4) acoustic deterrent devices; (5) anti-fouling paint effectiveness plan; (6) a marine mammal entanglement and collision monitoring plan; (7) project exclusion zone; and (8) an interpretive and education plan.

Our preferred alternative would also include the following measures:

- develop and implement a water quality monitoring plan for in-water project construction activities, including provisions to monitor the HDD process for any seepage of drilling fluid and take corrective actions to avoid continued seepage of the drilling fluid into the surrounding bed stratum and water column;

- develop a fuel and oil spill control, prevention, and countermeasures plan to be implemented during proposed project construction, operation, and maintenance activities and including provisions for: (1) inspecting vessels and equipment used during construction and maintenance for fuel and hydraulic leaks on a daily basis while at the project; and (2) containing and removing petroleum or other oil products in the event of a spill or leak;

- develop and implement a plan to conduct an on-site noise assessment of the proposed project buoys and associated anchoring and mooring equipment to be conducted within one year of the start of project operations and including a provision for determining potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals or fish;

- develop and implement a plan to conduct a baseline and post-installation hard substrate benthic community survey along the proposed submarine transmission line route;

- develop and implement a plan to conduct continuous acoustic cetacean monitoring for 10 years commencing with the start of project operations;

- develop and implement a plan to conduct an on-site EMF assessment within one year of the start of project operations;

- notify the Sanctuary of project emergencies consistent with Condition 9 of NMSP's conditions submitted under section 4(e) of the FPA;

- include in the proposed detailed design engineering and installation plan, a provision for a marine mammal observer to be present during in-water construction and installation activities;

- develop and implement a shore station erosion control, revegetation, and noxious weed control plan for land-based project construction activities;

- develop and implement a recreation use monitoring plan for the project;

- remove existing marine debris and derelict fishing gear from the immediate project area prior to project construction and installation;

- include in the proposed Interpretive and Education Plan, a provision for placing a interpretive display within the proposed project boundary at the shore station with the following information: (1) a map depicting marine habitats and associated species within the proposed project area; (2) the type of marine debris potentially present in the project area, the effects such debris has on the marine environment and commercial/recreational fishing vessels, and solutions that Finavera is implementing to limit the amount of debris at the project; and (3) information informing the public of the exclusion zone and its purpose;

- include in the proposed plan for a project exclusion zone, provisions to: (1) mark the four proposed buoys with low-intensity navigation or hazard lights visible to 1.0-nautical mile, and (2) consult with the U.S. Coast Guard and the Sanctuary on the painting of the project buoys in a way that considers the aesthetic character of the Sanctuary as well as the safety of the public and project facilities; and

- develop and implement a plan for a cultural resource monitoring program with a provision to have a Makah tribal monitor present during all ground-disturbing activities to detect archaeological sites that might be disturbed.

C. Staff's Recommended Alterative with Mandatory Conditions

On February 16, 2007, NMSP submitted 10 conditions under section 4(e) of the FPA. Conditions 1 through 6 and 9 provide for Finavera to implement environmental measures related to the construction, installation, operation, and maintenance of the project. We recommend all of these measures under the Staff Alternative. Conditions 7, 8, and 10 are either administrative in nature or pertain to a separate, future decommissioning action, and therefore, are not analyzed in any detail in this EA. These conditions are:

- obtain written approval from NMSP prior to changing any element of the project installation, including the location of any project equipment within the Sanctuary, and obtain written approval from NMSP for any action that is inconsistent with the authorizations and project description provided in the license application or project inspection plan submitted as NMSP Condition 2 (NMSP Condition 7);

- purchase and maintain a bond, or equivalent financial assurance, to cover the entirety of costs in the event any portion of the project is no longer in compliance with a license for the project, costs associated with any emergency response and restoration of any injured sanctuary resources, and the costs of removal of all project components from the Sanctuary at the end of the service life of the project, and submit a project decommissioning plan at least 12 months prior to commencing any removal activities associated with decommissioning (NMSP Condition 8); and

- reserve NMSP's authority to require Finavera to implement such modifications or additional conditions for the adequate protection and utilization of the Sanctuary as may be provided by the Secretary of Commerce pursuant to section 4(e) of the FPA (Condition 10).

Although we make no determination in this EA, if section 4(e) of the FPA gives NMSP the authority to impose conditions on any license issued by the Commission for a project in the Sanctuary, then all of NMSP's conditions for this project must be included in such license.

D. No-action Alternative

Under the no-action alternative, the Commission would deny a license for the proposed Makah Bay Project. The project would not be built, and there would be no change to the existing environment.

IV. CONSULTATION AND COMPLIANCE

A. Consultation

The Commission's regulations (18 C.F.R. §§ 4.38 and 16.8) require that applicants consult with appropriate resource agencies and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, the Endangered Species Act, the National Historic Preservation Act, and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

1. Scoping

On July 10, 2003, Finavera requested approval to use the Alternative Licensing Process (ALP) to prepare their license application for the project. We granted approval to use the ALP on September 4, 2003. Finavera filed a scoping document (SD1) on August 6, 2003, and subsequently, on August 8, 2003, we issued a notice soliciting comments on the SD1. On August 26 and 27, 2003, Finavera conduct three public scoping meetings: two at the Makah Tribal offices in Neah Bay, Washington, and one in Port Angeles, Washington. In addition to receiving comments at the scoping meetings, the following entities filed written comments with the Commission:

Commenting Entity	Date Filed
FWS	September 26, 2003
Ian Miller on behalf of the Surfrider Foundation	September 29, 2003
Olympic Park Associates	September 29, 2003

Finavera issued a revised scoping document (SD2), addressing these comments in May 2005 (see License Application, Preliminary Draft Environmental Assessment [PDEA] at p. 4-4).

Finavera sent a draft PDEA to the stakeholders on December 6, 2005. On January 3, 2006, Finavera received written comments from the following entities:

Commenting Entity	Date Filed
Sanctuary	January 3, 6, and 16, 2006
Washington DNR	January 3, 2006
Washington Department of Fish and Wildlife (Washington DFW)	January 3, 2006

Finavera finalized their PDEA and submitted it to the FERC as part of the application on November 8, 2006.

2. Interventions

On December 18, 2006, the Commission issued a notice accepting Finavera's application to license the project and soliciting motions to intervene and protest. The notice set February 16, 2007, as the deadline for filing protests and motions to intervene. In response to the notice, the following entities filed motions to intervene:

Commenting Entity	Date Filed
Washington DFW	January 5, 2007
Washington State Department of Ecology (Ecology)	January 11, 2007
Washington DNR	January 31, 2007
Makah Tribe	February 13, 2007
NMSP and National Marine Fisheries Service (NMFS), jointly	February 16, 2007

No protests or interventions in opposition were filed.

3. Comments on the Application

On December 18, 2006, the Commission issued a notice finding the license application ready for environmental analysis and requesting comments, recommendations, terms and conditions, and prescriptions. The following entities responded with written filings:

Commenting Entity	Date Filed
Interior	February 15, 2007
Makah Tribe	February 16, 2007
U.S. Department of Commerce, NMSP, and NMFS, jointly	February 16, 2007
Washington DFW	February 16, 2007
Ecology	February 16, 2007
Washington DNR	February 16, 2007
Sanctuary on behalf of the Sanctuary Advisory Council	March 23, 2007
FWS ("clarification" of Interior's February 15, 2007 filing)	April 25, 2007

B. Compliance

1. Water Quality Certification

On February 15, 2007, Finavera applied to Ecology and the Makah Tribe for water quality certification pursuant to section 401 of the Clean Water Act for the Makah Bay Project. Both Ecology and the Makah Tribe received the request on February 15, 2007.

2. Section 4(e) Conditions

Interior submitted the following condition under the provisions of section 4(e) of the FPA for the protection and utilization of the Flattery Rocks National Wildlife Refuge:

> *Authority is reserved for the Department of the Interior to require the Licensee to implement such conditions for the protection and utilization of Department of Interior reservations as may be provided by the Secretary of the Interior, pursuant to Section 4(e) of the Federal Power Act, 16 U.S.C. § 797(e).*

NMSP submitted 10 conditions under the provisions of section 4(e) of the FPA. In summary, these conditions are as follows:

- develop and implement a construction plan and conduct eelgrass and epibenthic surveys (Condition 1);

- develop and implement a project facility inspection plan (Condition 2);

- develop and implement an antifouling compound study plan (Condition 3);

- conduct a project facility noise assessment (Condition 4);

- conduct an EMF analysis of the submarine transmission line (Condition 5);

- develop and implement a marine mammal entanglement and collision prevention plan (Condition 6);

- obtain prior written approval from NMSP for any project changes (Condition 7);

- purchase a bond for the cost of project removal and submit a decommissioning plan for the project prior to commencing removal activities associated with decommissioning (Condition 8);

- notify the Sanctuary of any emergencies and associated response action (Condition 9); and

- reserve the authority of the NMSP to prescribe additional conditions under section 4(e) of the FPA (Condition 10).

3. Endangered Species Act

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Species listed under the ESA that could occur in the project area along with our analysis of project impacts on threatened and endangered species are presented in section V.C.6, and our recommendations are included in section VII, Comprehensive Development and Recommended Alternative.

In summary, we find that licensing the project would not affect the blue whale, fin whale, sei whale, sperm whale, short-tailed albatross, green sea turtle, loggerhead sea turtle, leatherback sea turtle, olive ridley sea turtle; may affect but would not be likely to adversely affect bald eagle and brown pelican; and may adversely affect the humpback whale, killer whale, steller sea lion, marbled murrelet, and all of the salmonids listed in table 5.

We recommend several measures that would minimize adverse effects on these species: using a marine observer during installation operations to alert the vessel operator of marine mammals in the vicinity of the moving vessel; clearing derelict fishing gear and marine debris from the buoy and cable area prior to installation; biannual monitoring to ensure the integrity of the project components and to remove any fishing gear and debris caught on the anchor and mooring lines; installation of a cone barrier to prevent an AquaBuOY from being used as a haul-out for seals and sea lions; installation of pingers to alert killer whales to the AquaBuOY and mooring lines; and acoustic monitoring to verify that noise from project operations is not adversely affecting marine mammal behavior. We will enter into formal consultation with NMFS and FWS for our "may adversely effect" findings for the humpback whale, killer whale, steller sea lion, marbled murrelet, and all of the salmonids listed in table 5, and seek FWS's concurrence on our "not likely to adversely affect" findings for the bald eagle and brown pelican.

4. 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendation, expertise, and statutory responsibilities of such agency.

Washington DFW included eight section 10(j) recommendations in their comments filed on February 16, 2007.[4] Table 12 in section VIII of this EA lists each of the recommendations subject to section 10(j) and whether the recommendations are recommended for adoption under the staff alternative. Recommendations that we consider outside of the scope of section 10(j) have been considered under section 10(a) of the FPA. All recommendations are addressed in the specific resource sections of this EA.

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[4]Washington DFW noted generally that its preliminary terms and conditions were being submitted pursuant to its jurisdiction under sections 10(a) and 10(j) of the FPA. When an agency fails to specify which FPA section applies to each recommendation, all recommendations are considered under 10(a). *See PP&L Montana LLC*, 92 FERC ¶ 61,261 at P 61 (2000). But, because the text of the first eight conditions submitted by Washington DFW noted that each was a fish and/or wildlife protection measure, we treat the conditions as if Washington DFW had specified that FPA section 10(j) applies. Because Washington DFW did not mention that the ninth condition (mitigation for fishing area loss) was a fish and/or wildlife protection measure, we treat it as a section 10(a) recommendation.

5. Coastal Zone Management Act

Section 301(c)(3) of the Coastal Zone Management Act (CZMA), 16 U.S.C. §1456 (c)(3)(A), requires that all federally licensed and permitted activities be consistent with approved state coastal zone management programs. If a project is located within a coastal zone boundary or if a project affects a resource located in the boundaries of the designated coastal zone, the applicant must certify that the project is consistent with the state's coastal zone management program.

Ecology has the responsibility to certify that a hydroelectric project is in compliance with the CZMA. Although Finavera states it has consulted with Ecology, we are unable to determine when, or if, Finavera submitted a request for coastal zone determination to Ecology. We note that at the time of such a request, Ecology would have 6 months to act upon the request.

6. Essential Fish Habitat

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to consult with the Secretary of Commerce regarding all actions or proposed actions that are authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH).

EFH is defined as:

> *"…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (Magnuson-Stevens Act, 16 U.S.C. 1801 et seq). For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and spawning, breeding, feeding, or growth to maturity covers a species' full life cycle (EFH Interim Final Rule, 62 FR 66531)."*[5]

The proposed project area (*i.e.*, Makah Bay) contains EFH for 38 rockfish species and 3 salmonid species. We address the proposed project's effects on EFH in section V.C.6. In summary, we conclude that licensing the project would likely

[5] See http://www.nmfs.noaa.gov/habitat/efh/ (accessed May 10, 2007).

adversely affect EFH of all 38 rockfish and 3 salmonid species located in the project area. We will initiate EFH consultation with NMFS with regard to our findings.

7. Marine Mammal Protection Act

The 1972 Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and the high seas,[6] and the importation of marine mammals and marine mammal products into the United States. Take includes harassment.[7] In 1986, Congress amended both the MMPA, under the incidental take program, and the ESA to authorize takings of depleted (and endangered or threatened) marine mammals, provided the taking (lethal, injurious, or harassment) was small in number and had a negligible impact on marine mammals.

Our analysis of project impacts on marine mammals is presented in section V.C.4, and our recommendations in section VII, Comprehensive Development and Recommended Alternative. In summary, our analysis finds that a few individuals of the following marine mammals may be subject to level B harassment associated with ship noise and HDD and ship movements during construction: gray whale, killer whale (southern resident and transient stocks), harbor porpoise, California sea lion, stellar sea lion, harbor seal, and northern sea otter. Operational noise is not expected to rise to a level that results in harassment; monitoring would verify potential impacts. As discussed above for listed species, a number of protective measures would be implemented that would minimize the possibility of serious injury or mortality or alteration of subsistence use. Consequently, an incidental harassment authorization will be required for construction of the project.[8]

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[6]The high seas prohibition applies to U.S. citizens only.

[7]Harassment: Under the 1994 Amendments to the MMPA, harassment is statutorily defined as, any act of pursuit, torment, or annoyance which—

(Level A Harassment) has the potential to injure a marine mammal or marine mammal stock in the wild; or,

(Level B Harassment) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. (50 CFR § 216.3).

[8]In 1994, MMPA section 101(a)(5) was amended to establish an expedited process by which citizens of the U.S. can apply for an authorization, referred to as

8. National Historic Preservation Act

The National Historic Preservation Act (NHPA) (16 U.S.C. 470 *et seq*.) (as amended) requires federal agencies to manage cultural resources under their jurisdiction and authorizes the Secretary of the Interior to maintain a National Register. The law also provides for the creation of State Historic Preservation Officers (SHPO) to facilitate the implementation of federal cultural resource policy at the state level, and for the responsible federal agency (*i.e.*, agency official) to consult with Native American tribes who attach religious or cultural importance to cultural resources under their jurisdiction. When Indian reservation lands are involved, a designated Tribal Historic Preservation Officer (THPO) takes the place of a SHPO. Section 106 of the NHPA requires federal agencies to take into account the effect of any proposed undertaking on properties listed, or eligible for listing, in the National Register. If the agency official determines that the undertaking may have adverse effects on properties listed in or eligible for listing in the National Register, the agency official must afford an opportunity for the Advisory Council on Historic Preservation (ACHP) to comment on the undertaking.

As discussed in section V.C.10, we conclude that: (1) the proposed project would not have an effect on historic properties on the Makah Indian Reservation provided that a tribal monitor be present during ground-disturbing activities to insure that no archeological sites would be affected by this project; and (2) the proposed project would not have an effect on historic properties in the offshore portion of the APE. We will seek the concurrence of the THPO and SHPO on our findings.

V. ENVIRONMENTAL ANALYSIS

A. General Description of the Project Area

The Olympic coast is sparsely populated with almost the entire coastline being undeveloped (NMFS, 2005). Most of the Olympic Coast is either wilderness, part of the Olympic National Park (48 miles [NMFS, 2005]), or Makah Indian Reservation land. The Makah Tribe occupies 47 square miles on the tip of the Olympic Peninsula. Other Olympic Coast tribes, which are located to the south of the project site, are the Quileute, Hoh and Quinault.

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an Incidental Harassment Authorization or IHA, to incidentally take small numbers of marine mammals by harassment.

The offshore project facilities would be located within the Olympic Coast National Marine Sanctuary. The Sanctuary is administered by the NMSP and lies between the western Strait of Juan de Fuca and the Copalis River, located to the north of Grays Harbor. The Sanctuary extends 20 to 40 miles into the Pacific Ocean from the coast, covering 3,300 square miles.

The Flattery Rocks National Wildlife Refuge is administered by the FWS and extends from the northern tip of the Olympic Peninsula over 20 miles south, where it abuts the Quillayute Needles National Wildlife Refuge. These two refuges, along with the Copalis National Wildlife Refuge, located along the southern end of the Sanctuary, are referred to as the Washington Islands National Wildlife Refuge. Exposed rocks, sea stacks, and islands that occur in the Sanctuary are part of the Washington Islands National Wildlife Refuge (NMFS, 2005).

Western Washington has relatively mild winters and dry cool summers. Sanctuary (2005) further characterizes the project area climate as follows:

> *Most air masses reaching the coast originate over the Pacific Ocean and exert a moderating influence throughout the year. In late spring and summer, westerly to northwesterly winds associated with the North Pacific high pressure system produce a dry season. In late fall and winter, southwesterly and westerly winds associated with the then dominant Aleutian low pressure system provide ample moisture and cloud cover for the wet season which begins in October.*
>
> *The rising and cooling of moist air along the windward slopes of the Willapa Hills and Olympic Mountains produces an area of heavy precipitation from the coast to the crests. Annual amounts range from 70 to 100 inches over the southern coastal plains and from 125 to 200 inches in the "rain forest" area on the western slope of the Olympic Mountains (op. cit.). Afternoon temperatures near the coast during the summer are generally in the upper 60's (°F). In an average winter, maximum temperatures range from 38° to 45° and minimums from 28° to 35°.*
>
> *Ocean surface water temperature near the coast averages about 48° in February, 52° in May, 57° in August, and 50° in November. The temperature range offshore is slight throughout the year, thus inshore-offshore migrations of biota associated with seabed temperature changes do not occur.*

Typically, rough seas and large waves occur off of the Olympic Coast. Wave heights ranging from 50 to 90 feet have been documented off of the continental shelf (Sanctuary, 2005).

B. Cumulative Effects

According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR § 1508.7), an action may cause cumulative impacts on the environment if its impacts overlap in space and/or time with the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

The effects of other actions occurring in the area relative to the proposed project resources can be derived from the following environmental documents and are incorporated by reference per 40 CFR §1502.20:

• Olympic Coast National Marine Sanctuary, Final Environmental Impact Statement, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Sanctuaries and Reserves Division, Washington, DC. November 1993.

• Draft Comprehensive Conservation Plan/Environmental Assessment, U.S. Fish and Wildlife Service, Port Angeles, Washington. May 31, 2005.

• Port Angeles-Juan de Fuca Transmission Project, Draft Environmental Impact Statement, U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability and Bonneville Power Administration. Portland, Oregon. Washington, DC. March 2007.

• Remediation for the Pacific Crossing - 1 North and East Submarine Fiber Optic Cables in the Olympic Coast National Marine Sanctuary, Environmental Assessment, National Oceanic and Atmospheric Administration and U.S. Army Corps of Engineers. Silver Spring, Maryland. Seattle, Washington. November 4, 2005.

Based on information in the proposed license application, PDEA, agency comments, other filings related to the proposed project, and our independent analysis, we have identified marine fishery resources, marine mammals, and recreation as resources having the potential to be cumulatively affected by the proposed Makah Bay Project in concert with other activities in the proposed project area.

1. Geographic Scope

The geographic scope of analysis defines the physical limits or boundaries of the proposed action's effects on the resources. Because the proposed action would affect the resources differently, the geographic scope for each resource may vary.

In this case, the geographic scope for the cumulatively affected resources encompasses the northern tip of the Olympic Peninsula (Washington) from the Strait of Juan de Fuca (at the mouth of Puget Sound) 135 miles south to the Copalis River, located to the north of Grays Harbor. We chose this geographic scope because the proposed Makah Bay Project in combination with other planned activities (*e.g.*, tribal, commercial, and recreational fisheries) within this geographic scope would cumulatively affect marine fisheries, marine mammals, and recreation resources.

Washington DFW states that 13 marine energy projects are currently proposed within Washington State waters (letter by Gary R. Sprague, Washington DFW, Olympia, Washington, filed on February 16, 2007). Although the proposed Makah Bay Project is one of several future actions to be constructed in the potentially same geographic area as those identified by Washington DFW, it is difficult for us to predict which of the 13 marine energy projects might become viable in the reasonably foreseeable future. These 13 proposed projects are in a preliminary stage where prospective developers are determining whether the projects would be technically or economically viable; consequently, we cannot reasonably determine which, if any, of these proposed 13 marine energy projects would ever be constructed and operated.

The Makah Tribe (2005) conducted a study to determine the technical feasibility, economic viability, and potential impacts of installing and operating a wind power station and/or small hydroelectric generation plants on the Makah Indian Reservation, located on the northwestern tip of the Olympic Peninsula (Washington). The report finds there is little likelihood that a commercially-viable wind power station would be constructed at this time, and the potential for hydroelectric development on the reservation is quite limited due to the small size of the streams and existence of significant salmon runs in the larger streams.

2. Temporal Scope

The temporal scope of analysis in the EA includes a discussion of the past, present, and future actions and their possible cumulative effects on marine and recreation resources. Based on the term of the proposed license, we look 30 to 50 years into the future, concentrating on the effect on the resources from reasonably foreseeable future actions. The historical discussion is limited, by necessity, to the amount of available information for each resource. We identified the present resource conditions based on the license application, agency and public comments, and federal and state comprehensive plans.

C. Proposed Action and Action Alternatives

In this section, we discuss the effects of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure effects. We then discuss and analyze the specific environmental issues.

1. Geology and Soils

Affected Environment

The seafloor within the project area consists primarily of fine-grained sand and silt surrounding large rock outcrops and smaller groups of scattered rock (Thales GeoSolutions, Inc., 2002). The seabed in the project area descends gently from the shore to a water depth of about 150 feet at the location of the proposed buoy deployment site. Several rock outcrops cross the area, and the relief across these outcrops is very steep locally, with some pinnacles rising over 5 meters (m) from the otherwise relatively flat seabed (Thales GeoSolutions, Inc., 2002).

The general slope of the marine portion of the proposed project area is about 1.5 percent. For the entire proposed project area, sand- to silt-sized sediment covers approximately 60 percent of the seafloor; the remaining 40 percent consists of rock outcrop. The nearshore bottom surface is sandy out to a water depth of approximately 70 feet. There are large areas of modern sediment surrounding rock outcrop (Thales GeoSolutions, Inc., 2002). Coarse-grained, angular sediment blankets much of the rock in a shallow layer and extends minimally beyond the edge of the outcrop. Sub-bottom profiler data are consistent with this finding (Thales GeoSolutions, Inc., 2002). Ripples are seen locally in the coarse-grained, angular sediment covering the rock. Their wavelength is less than 6.5 feet, and they occur in an area approximately 165 feet by 660 feet at the 50-foot water depth (Thales GeoSolutions, Inc., 2002).

Rock outcrops are likely crystalline rock and mafic in nature based on the regional geology. Gabbro and diorite faulted against pillow basalts and Cretaceous sedimentary layers have been mapped immediately south of the survey area, a good indication as to the nature of the rocks seen here. Northwest trending layers in the rock have been fractured, creating the blocky appearance seen throughout the outcrops. The shape of the western rock outcrop combined with the overall northwest trend of the outcrops together would suggest that tectonic activity has occurred in the area. Straight, sharp contact between rock and sediment exists along the seaward edge of the rock (Thales GeoSolutions, Inc., 2002).

The regional geology represents the unique end member of the Cascadia subduction zone, where the Juan de Fuca plate is sliding beneath the North American plate. A large amount of folding and faulting has occurred in the rocks of this area, and a large accretionary complex exists offshore of northern Washington. The Callawah fault (left-slip) is a major fault that has been mapped both onshore and offshore, and trends northwest through the nearby Makah Indian Reservation and Cape Flattery (Thales GeoSolutions, Inc., 2002).

In 2002, Evans-Hamilton (2006) collected bottom sediment samples for analysis of grain size at eight locations in the proposed project area, with sample locations from nearshore (water depths of 26 feet) to the area of the proposed buoy placement (depths of about 150 feet). The purpose of the sediment samples was to understand the bottom sediment conditions, and assess the potential for sediment resuspension and scouring around the proposed buoy anchors and submarine transmission line. The grain size distribution showed that the sample area has a high sand concentration (greater than 85 to as high as 97 percent of the grain sizes) (Evans-Hamilton, 2006). Silt was the second most prominent sediment, followed by clay. Gravel was negligible at all sites except for a site nearshore, where it was still less than two percent (Evans-Hamilton 2006).

Review of the multi-beam backscatter data collected during the study indicates that there is no distinct boundary between the grain sizes. But the grain size (0.04 inches) and water depth together indicate that the boundary between the lower beach and inner shelf occurs within the survey area (most likely in water around 50 to 80 feet deep) (Thales GeoSolutions, Inc., 2002).

Sub-bottom profiler data reveal a sediment layer varying in thickness from less than 1.6 feet at the edges of rock outcrop to 36 feet at the western extent of the survey area where the AquaBuOYs would be placed. At the eastern extent of the survey area (near shore along the proposed submarine transmission line route), sediment is thickest (23 feet) in a small, buried basin lying between two rock outcrops. The basin is asymmetrical, deepening steeply from the north and gently from the south. Further to the west along the proposed submarine transmission route (specifically, within the interior of the survey area) where rock and scattered rock are abundant, sediment thickness is not greater than 6.5 feet. Further to the west, sediment gently thickens to 16 feet, and then shoals steeply to the edge of another rock outcrop. At the westernmost edge of rock, sediment thickens sharply to about 13 feet, and then begins to thicken gradually to the west to a depth of 36 feet in the area of proposed AquaBuOY placement (Thales GeoSolutions, Inc., 2002).

The geology of the terrestrial portion of the project areas consists of non-glacial deposits, including beach deposits along Hobuck Beach and alluvium inland of the beach. The beach deposits are Holocene in age, consist of sand and (or) gravel with minor shell fragments deposited along shorelines, and locally includes back-beach dune fields and minor estuarine deposits. Rock fragments are typically well rounded (Schasse, 2003).

The alluvium is Holocene and Pleistocene in age and includes sorted combinations of silt, sand, and gravel deposited in stream and river beds. The surface is relatively undissected by streams and locally includes sand and gravel of low-lying river terraces, alpine drift, and lacustrine and landslide deposits (Schasse, 2003).

Environmental Impacts and Recommendations

Buoy Anchor Area

The four AquaBuOYs would occupy a rectangular area of 60 feet by 240 feet on the water surface. The anchor system, consisting of a total of 10 VLA's and 10 surface floats, would cover a rectangular area of approximately 625 by 450 feet on the ocean floor. A main objective for designing a mooring system for the project was to reduce impact on the ocean floor and eliminate drag and scouring potential. The initial design used slack mooring with gravity anchors (concrete blocks). In response to agency concern about impacts of chain sweep from mooring lines on the benthic community around each anchor, Finavera proposed to utilize VLA's. Each VLA would be installed like a conventional drag embedment anchor, but would penetrate much deeper. The resulting configuration would minimize the chance of chain sweep between mooring buoys and the surface floats. Because the VLA's would be deployed completely below the seafloor, the footprint of each anchor on the seafloor surface would be equal to the diameter of the cables attached to the VLA's.

Evans-Hamilton (2006) determined that current speeds of at least 35 centimeters per second (cm/s) are required to suspend the dominant sediment type

(+3 Phi size [sand]) in the proposed location of the AquaBuOYs (table 1). Current speeds near bottom (2.4 m above the seabed) exceed this threshold speed about 4.3 percent of the time in a southward direction and 6.1 percent of the time in a northward direction (table 1) (Evans-Hamilton 2006).

Table 1. Current speeds required to suspend various sediment sizes and the percent of time and direction such current speeds would be reached in the proposed AquaBuOY placement area. (Source: Finavera, 2006)

Current speed	Sediment transported	Percent of sediment at buoy site	Bottom Currents (2.4 m above bottom)			
			Northward flow	Southward flow	Eastward flow	Westward flow
(cm/s)			Percent of time met or exceeded	Percent of time met or exceeded	Percent of time met or exceeded	Percent of time met or exceeded
<20	+6 phi (mud)	<0.1	16.6	19.5	12.2	8.6
>20	+5 phi (mud)	2.4	21.8	16.9	1.7	2.6
>25	+4 phi (sand)	15.8	15.5	11.4	<1	1.6
>35	+3 phi (sand)	76.7	6.1	4.3	<1	<1
>40	+2 phi (sand)	0.7	3.2	2.3	<1	<1

Certain characteristics related to sediment transport can also be estimated using wave data along with the sediment grain sizing data. Depth of closure relates to the depth in the nearshore zone below which major changes in bathymetry do not occur due to onshore/offshore sediment cycling. It is a calculated quantity that indicates the depth at which cross-shore processes cease to modify the bottom profile. Typically, the vertical change is greatest nearshore and diminishes farther offshore. The depth of closure (d) can be approximated using the relationship:

$$d = 2.28\,He$$

where He is the largest wave occurring over a 12-hour duration in the nearshore region (personal communication between Finavera and Richard Sternberg, University of Washington, July 25, 2005, as reported in the PDEA at p. 5-13). Using wave data recorded at Cape Elizabeth Station, Finavera estimated that the maximum wave height occurring over a 12-hour duration in the proposed project area is 25 feet, resulting in an estimated closure depth of about 56 feet (see PDEA at p. 5-13).

Finavera estimates that any waves with 15-second periods can mobilize sediment to a 295-foot depth in the proposed project area, and during individual storm periods, the erosion depths can be high (see PDEA at p. 5-13). Therefore, existing wave conditions and storm events would likely result in erosion throughout the entire project area as the AquaBuOYs would be located in waters

150 feet deep. While shifting sands can occur to a great depth, substantial changes in bathymetry are unlikely at depths greater than the closure depth, because, as mentioned above, beyond this depth, cross-shore processes cease to modify the bottom profile. While some resuspension of sediment in the buoy anchor area would occur due to ocean currents (table 1), substantial changes in bathymetry would not likely result because the anchors would be located in waters deeper than the closure depth (56 feet).

The buoy array would have no potential to affect the movement of sediment along the shore or dampen nearshore waves due to its extremely small size and distance from shore. Unutilized wave energy would pass through the buoy array and wave energy from adjacent waters would move into the lower energy water to the lee of the buoys by diffraction, thereby negating any effect (EPRI, 2004).

Submarine Transmission Line Route

The applicant's Proposed Action includes installation of a submarine transmission line that would transmit power from the collector buoy to the shore station. Submarine power cables are typically installed by burying the cable by trenching, jet plowing, or HDD or attaching the cable to the seabed with anchors made of different materials. Finavera proposes to anchor the power cable to the ocean floor, except for the nearshore section, which would be installed using the HDD method.

HDD is a trenchless method for installing a product that serves as a conduit for liquids, gasses, or as a duct for pipe, cable, or wire line products. For the Makah Bay Project, the transmission cable would be buried using this technique from the shoreline to a depth of 10 to 30 feet (about 1,200 feet out from shore)[9] in order to eliminate impacts to the surf zone and Hobuck Beach. HDD is a multi-stage process typically consisting of site preparation, equipment setup, and drilling a pilot bore along a predetermined path and then pulling the product back through the drilled space. When necessary, enlargement of the pilot bore hole may accommodate a product larger than the pilot borehole size. This process is referred to as "back reaming" and is done at the same time the product is being pulled back through the pilot borehole.

The HDD method would require two pits: the thrust pit where the power cable would make landfall and the reception pit where it emerges from the seabed. On the day of installation, a vessel would be anchored offshore with a four-point

[9]Finavera would finalize the design depth for HDD after completing an eelgrass survey.

mooring at the reception pit. The HDD contractor would use specialized equipment to drill in a pipe conduit along the route of the power cable which is to be passed below the seabed. Boring can be accomplished with a track-based horizontal boring rig that incrementally adds sections of pipe as the shaft or “drill string” progresses into the substrate along its predetermined alignment. When the shaft comes out at the receiving pit, the bit is removed from the end and the power cable is attached. The shaft is then pulled back the way it came towards the drilling rig, pulling the cable or conduit back with it.

In many cases, water, mud, or bentonite is pumped into the drilling shaft while drilling to act as a drilling fluid. The primary purpose of the drilling fluid is to remove the cuttings from the borehole, stabilize the borehole, and act as a coolant and lubricant during the drilling process. In the case of putting in an electrical or fiber cable through a beach or even in a suburban neighborhood, pressurized water can greatly speed the drilling process. With some drill rigs, water is immediately recovered, filtered, and put back into a reservoir tank.

The HDD method has the potential for loss or seepage of drilling fluid into the geologic formation through which the drill passes. In some cases, the drilling fluid may be inadvertently forced to the surface resulting in what is commonly referred to as a “frac-out.” The frac-out is typically caused by pressurization of the drill hole beyond the containment capability of the overburden material. Providing adequate depth of cover for the installation is a design consideration intended to mitigate this potential. In some cases, an inadvertent release of drilling fluid can be caused by existing conditions in the geologic materials (*e.g.*, fractures) even if the downhole pressures are low. Drilling fluid is typically made up primarily of water and bentonite to act as the drilling lubricant. Bentonite is a naturally-occurring, non-toxic, inert substance and is frequently used for drilling potable water wells. Therefore, the main environmental impacts of an inadvertent release of drilling fluid in a waterbody from a geological perspective would be a temporary increase in local turbidity until the drilling fluid dissipates with the current or settles.

Prevention of drilling fluid release is a major design consideration when determining the profile (or path) of a HDD crossing. Some of the driving factors in selecting the crossing profile are the type of subsurface material and the depth of cover material. Typically, cohesive soils, such as clays, dense sands, and competent rock are considered ideal materials for HDD. Based on the sub-bottom profile survey of the proposed transmission line route, the existing composition of sand and rock is favorable for the HDD technique.

HDD is a technically-advanced process involving skilled operators. The detection of drilling fluid seepage is highly dependant upon the skills and experiences of the drilling crew. Each drilling situation is unique in that the behavior of the subsurface material is highly variable and difficult to predict. There is no known in-hole monitoring equipment that can detect if drilling fluid is seeping into the surrounding formation. Instead, drilling experts use a combination of factors, which must be properly interpreted, and may indicate conditions that can have the potential for causing a frac-out. Finavera and the drilling contractor would take all necessary preventative and responsive measures in case of a frac-out.

The portion of the transmission cable not buried by HDD would be anchored to the seafloor. According to Oregon crab fishermen, northern Oregon sea floor sand levels at fishing locations (crab pots) fluctuate from 15 to 20 feet and vary considerably within sandy zones inshore of 70 feet in depth (see PDEA at p. 5-14). As mentioned above, shifting sands can occur to a great depth, but substantial changes in bathymetry are not expected beyond the closure depth, calculated to be about 56 feet at the project. We do note, however, that it is likely that portions of the transmission cable would be naturally buried by sand while other portions could be scoured, especially in areas of 56 feet or less of depth. A potential result of the scour could be exposure of some of the submarine transmission line anchors, should screw-type anchors be utilized, and the resulting freeing of the transmission line from the seafloor. Temporary sweeping of the seafloor by the transmission line could occur until Finavera could reattach the anchors during periodic inspections and repairs. In section V.C.3, we discuss recommendations for anchoring and maintaining the line.

Unavoidable Adverse Impacts

Short-term impacts to a very minor amount of seabed area would be associated with installation of the VLA's and the submarine transmission line. There would also be a minor, long-term risk that the transmission line would sweep and scrape the seabed if the transmission line anchors would be freed by the scouring of the surrounding seabed by ocean currents or wave action.

2. Water Resources

Affected Environment

In this section, we describe the existing conditions in the proposed project area with respect to wind speed and direction; wave height, speed and other attributes; ocean currents; and water quality. The sources of the wind and wave information are four meteorological monitoring stations as described below.

■ **Station 46206 - La Perouse Bank -** Station 46206 consists of a moored meteorological weather buoy located in Canada about 70 miles northwest of the project area. The station is owned and maintained by Environment Canada. The buoy was deployed in November 1988 and provides historical meteorological data to the present (Fisheries and Oceans Canada [FOC], 2005).

Latitude/longitude: 48°50’2” N 126°0’0” W
Site elevation: sea level
Water depth: 73 m
Relevant parameters monitored: wind speed (WS), wave height (WH), and wave period (WP)

■ **Station 46087 - Neah Bay, Washington (Traffic Separation Lighted Buoy “JA”) -** Station 46087 consists of a moored, 3-m discus meteorological weather buoy. The buoy is located in the Strait of Juan de Fuca about 11 miles north of the project area and is owned and maintained by the National Data Buoy Center (NDBC). The buoy was recently deployed and only contains historical data from 2004 to present. Physical information for Station 46087 (NDBC, 2005a) consists of the following:

Latitude/longitude: 48°29'38" N 124°43'38" W
Site elevation: sea level
Air temp height: 4 m above site elevation
Anemometer height: 5 m above site elevation
Barometer elevation: sea level
Sea temp depth: 0.6 m below site elevation
Water depth: 260.6 m
Watch circle radius: 233 m
Relevant parameters monitored: WS, WH, and WP

■ **Station TTIW1 - Tatoosh Island, Washington -** Station TTIW1 consists of a Coastal Marine Automated Network (C-MAN) station located on Tatoosh Island just northwest of the project area. Station TTIW1 is owned and maintained by the NDBC. Station TTIW1 contains meteorological historical data from 1984 to present. Physical information for Station TTIW1 (NDBC 2005b) consists of the following:

Latitude/longitude: 48°23'30" N 124°44'06" W
Site elevation: 30.8 m above mean sea level
Air temp height: 15.5 m above site elevation
Anemometer height: 25.3 m above site elevation
Barometer elevation: 47.5 m above mean sea level
Relevant parameters monitored: maximum WS

■ **Station 46041 - Cape Elizabeth -** Station 46041 consists of a moored 3-meter discus climatological weather buoy. The buoy is located about 85 miles south-southeast of the project area near Aberdeen, Washington. The buoy is owned and maintained by the NDBC. Station 46041 contains meteorological historical data from 1987 to present. Physical information for Station 46041 (NDBC 2005c) consists of the following:

Latitude/longitude: 47°20'24" N 124°45'00" W
Site elevation: sea level
Air temp height: 4 m above site elevation
Anemometer height: 5 m above site elevation
Barometer elevation: sea level
Sea temp depth: 0.6 m below site elevation
Water depth: 132.0 m
Watch circle radius: 154 m
Relevant parameters monitored: WS, WH, and WP

The source of the current information is a current meter deployed by Finavera at the location of the proposed AquaBuOY array in about 150 feet (46 m) of water. The meter was set to measure currents at about 1 m depth increments from about 2 m above the bottom to within about 5 m of the water surface. The meter collected profiles every 20 minutes from October 30, 2002, through February 12, 2003.

Wind

Differential solar heating of the atmosphere produces winds, which in turn produce waves and surface currents (Sumich, 1988). Because of this link to waves and surface currents, wind in the project area is assessed in this water resources section. Finavera collected wind data from the existing stations listed above in order to assist with engineering and design of buoys, cables, and associated anchoring mechanisms and to determine maximum wind speeds in the project area. A summary of the wind speed data from several stations is presented in table 2.

Table 2. Wind speed and wave information for three sites located in the region of the proposed project. (Source: Finavera, 2006)

	Cape Elizabeth			La Perouse Bank			Neah Bay			TI*
	Max WS m/s	Max WH m	Max WP s	Max WS m/s	Max WH m	Max WP s	Max WS m/s	Max WH m	Max WP s	Max WS m/s
5-yr interval										
2001-2005	21.1	10.3	14.1	22.7	10.6	16	16.6	7.6	12.2	28.4
1996-2000	21.8	9.6	14.5	22.4	10.6	16	no data	no data	no data	30.9
1991-1995	20.1	9.9	13.8	20.1	10.4	19.7	no data	no data	no data	31.9
1986-1990	19	9.2	14.9	19.4	8.7	16	no data	no data	no data	29.3
1981-1985										27.3
10-yr interval										
1996-2005	21.8	10.3	14.5	22.7	10.6	16	no data	no data	no data	30.9
1986-1995	20.1	9.9	14.9	20.1	10.4	19.7	no data	no data	no data	31.9
25-yr interval										
1980-2005	21.8	10.3	14.9	22.7	10.6	19.7	no data	no data	no data	31.9

*Tatoosh Island
WS – Wind Speed in meters/second averaged over an eight-minute period for buoys and a two minute period for land stations (reported hourly).
WH – Significant wave height in meters calculated as the average of the highest one-third of all wave heights recorded during a 20-minute sampling period (reported hourly).
WP – Dominant wave period (*i.e.*, period with the maximum wave energy) in seconds (reported hourly).

Waves

Sanctuary (2005) characterized the wave environment off the Olympic Coast as follows:

> *The Washington outer coast is known for its rough seas and large waves. Extremes of wave height ranging from 50 ft (15m) to 90 ft (29 m) have been recorded on and beyond the continental shelf.*

The height and direction of waves vary seasonally. During summer, waves are lower in height and predominately from the northwest. This results in longshore currents and sediment transport to the south. In winter, waves are generally higher and from the southwest, causing north-flowing currents and sediment transportation along the coast. The most severe wave conditions are caused by winter storms originating near Japan that move onto the U.S. Pacific coast. Storm winds ahead of warm fronts generate waves with wave heights up to 19-23 ft (6-7m); winds associated with cold fronts generate waves of 26-33 ft (8-10m).

Information presented in Finavera's PDEA[10] shows that maximum heights recorded at Cape Elizabeth (table 2) provide a good estimate of maximum wave heights at Makah Bay, although higher waves (*i.e.*, waves greater than 4 m) occur more frequently at the Cape Elizabeth station than they do in Makah Bay.

Currents

Sanctuary (2005) characterized the currents off of the Olympic Coast as follows:

> *The oceanic current system off the coast of Washington is comprised of the California Current, Davidson Current, and California Undercurrent. The California Current flows southward beyond the continental shelf throughout the year. This current is approximately 1,000 km wide with a typical velocity of 10 cm/second. It brings water low in temperature and salinity, with high oxygen and phosphate contents. The California Current is strongest in July and August in association with westerly to northwesterly winds. The California Undercurrent, a narrow (20 km) subsurface countercurrent, flows northward along the upper continental slope with its core at a depth of about 200m. This current is also strongest in the summer with a mean velocity of about 10 cm/second. It brings warmer water with [a higher salinity], and less oxygen and phosphate. An additional southward flowing bottom current (the Washington Undercurrent) flows deeper along the slope at about 400m depth during the winter. During winter, the California current either moves offshore or is replaced by the northward flowing Davidson Current. The Davidson Current flows during winter and early spring in association with southerly or southwesterly winds. It flows at a mean velocity of 20 cm/second and is associated with water masses with the same characteristics as the California Undercurrent. Currents over the continental shelf tend to follow the seasonal pattern of the oceanic currents, but are also strongly influenced by*
>
> - *local winds*
> - *bottom and shoreline configuration*
> - *freshwater input*
>
> *...Local currents are highly variable and are dependent on passing weather systems, or large scale weather effects such as El Niño. While currents are*

[10] See pp. 5-21 through 5-24.

flowing south along the coast during spring and summer months, the forces of northwesterly winds and the earth's rotation combine to push the surface waters offshore. As these waters move offshore they are replaced from below by cold and nutrient-rich waters. This process is called upwelling. It introduces nitrates, phosphates, and silicates that are essential for high plant based plankton (phytoplankton) production that forms the basis for the oceanic food chain. The majority of this upwelling occurs within 20-50 miles (10-20 km) off the coast.

Downwelling, or sinking of surface waters, occurs along the coast during winter when southwest winds push surface waters onshore. Tides on the Washington coast and Strait of Juan de Fuca occur with two high and low tides each day. A highest high and a lowest low tide are followed by a moderate high tide and a moderate low tide. Tidal changes along the coast are large, averaging about 12 ft (3.5m). This ensures a rich intertidal community.

Consultants for Finavera measured ocean currents in the proposed project area using a SonTek ADP profiling current meter (Evans-Hamilton 2006). The meter measured currents throughout the water column by transmitting sound signals from three transducers and measuring the Doppler shift of the returning sound signals. The meter measured currents at 1-m (3.3-foot) depth intervals from about 2 m (6.6 feet) above the seabed[11] to near the water surface from October 29, 2002, through March 12, 2003.[12]

The results of the study show that tidal currents in the proposed project area are strong, reaching 75 cm/sec near the surface and 50 cm/sec near the bottom during periods of weaker winds (Evans-Hamilton 2006). The tidal currents are semi-diurnal, and vary in strength due to periods of spring and neap tides. Currents are generally uniform in direction with depth, and run predominantly north and south.

Table 3 presents information on the average, minimum, maximum, and net current speeds and associated directions versus depth at 5-m intervals recorded during the study. These data represent current statistics of five different storm events within the data collection period. The table also shows that the maximum

[11] At the point of measurement, the seabed was 150 feet below the water surface.

[12] The study period coincided with the largest tide ranges and strongest tidal currents, both of which normally occur during late December to January and June of each year.

and net current speeds were normally highest near the surface and lowest near bottom. The maximum current speeds generated during the storms were 142 cm/sec on a near-surface northward heading. The net current speed reached 17 cm/sec near surface and 2 cm/sec near bottom, again directed generally northward.

Table 3. Average, minimum, maximum, and net current speeds and directions recorded at 5-meter depth intervals during five storm events between November 2002 and January 2003 (Source: Finavera, 2006).

Height Above Bottom (m)	Avg Spd (cm/s)	Max Spd (cm/s)	Dir of Max (deg w/respect to N)	Min Spd (cm/s)	Dir of Min (deg w/respect to N)	Net Spd (cm/s)	Net Dir (deg w/respect to N)
43.41	27.6	141.8	18.9	0.2	108.5	17.1	12.1
40.41	26.2	129.4	19.0	0.1	198.5	11.7	17.1
35.41	25.5	120.9	5.3	0.1	18.5	7.8	21.5
30.41	25.6	118.0	1.7	0.1	108.5	4.9	24.4
25.41	25.8	112.1	355.8	0.1	198.5	3.2	21.7
20.41	26.4	107.0	353.1	0.0	0.0	2.1	9.0
15.41	26.6	104.2	349.5	0.0	0.0	1.7	341.5
10.41	26.1	106.0	348.6	0.4	198.5	1.7	315.0
5.41	23.8	100.0	345.8	0.0	0.0	1.6	305.1

The current direction during storm events was also the predominant current direction during the entire measurement period. Surface flow was predominantly north-northeast (between 320° and 40°). For the entire study period, 45 percent of the time, surface currents were greater than 25 cm/s, 10 percent of the time currents exceeded 50 cm/s, and 1.4 percent of the time currents exceeded 75 cm/s. Bottom flow was predominantly north-northwest and south-southeast. Twenty-eight percent of the time, currents were greater than 25 cm/s, and 1.3 percent of the time currents exceeded 50 cm/s.

Current speeds at the site are quite rapid, even near bottom, and especially when influenced by winter storms. The strongest currents were northward during the measurement period, as was the overall net current (Evans-Hamilton 2006).

Water Quality

The Water Quality Standards for Surface Waters of the State of Washington Chapter 173-201A WAC (amended November 20, 2006) establishes the following designated uses for marine surface waters in the proposed project area: aquatic life uses, shellfish harvesting, recreational uses, and "miscellaneous marine water uses," which include: "wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics."

The Makah Tribe Water Quality Standards for Surface Waters establish the following designated uses for marine surface waters of, on, flowing through, or flowing over the Makah Indian Reservation: ceremonial and religious use; cultural use; excellent quality salmonid and other fish rearing, migration, and harvesting; clam, oyster, and mussel spawning, rearing, and harvesting; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) spawning, rearing, and harvesting; wildlife habitat; primary contact recreation; and commerce and navigation.

Washington State and Makah Tribe water quality standards for marine waters in the project area establish that turbidity must not: (1) exceed 5 nephelometric turbidity units (NTU) over the background turbidity when the background is 50 NTU or less; or (2) increase by more than 10-percent above the background turbidity when the background turbidity is more than 50 NTU. Washington state water quality standards stipulate that the turbidity thresholds may be temporarily exceeded during in-water construction provided that: (1) the construction activity has received all necessary state and local permits and approvals; (2) appropriate best management practices to avoid or minimize the disturbance of sediments and exceedance of the turbidity criteria have been implemented by the permittee; and (3) the turbidity exceedance is limited to the area within a 150-foot radius of the in-water construction activity (defined as the "mixing zone") (see WAC 173-201A-210). Similarly, the Makah Tribe's water quality standards allow for the turbidity thresholds to be temporarily exceeded within a "mixing zone" designated by a section 401 water quality certificate (see Part IV, section 17 of the Makah Tribe's water quality standards [September 30, 2006 version]).[13]

Environmental Impacts and Recommendations

Drilling and Facility Installation and Maintenance Effects on Water Quality

Finavera proposes to use HDD[14] to bury the submarine transmission line from shore to a depth of about 10 to 30 feet, depending upon the results of an

[13]Additional Washington and Makah Tribe water quality standards for the project area can be viewed at http://www.ecy.wa.gov/pubs/0610091.pdf and http://www.makah.com/images/Makah_WQS_060930_final1.pdf, respectively.

[14]See section V.C.1 for a detailed description of the HDD method.

eelgrass survey[15] and the suitability of sediment for using HDD. In locations where HDD would not occur, Finavera would place the submarine transmission line on and anchor it to the seabed to prevent movement.

Each of the project buoys would be tethered by a tension cable to four surface floats that in turn would be connected to two sub-surface mooring buoys located just above the seabed. The sub-surface mooring buoys would be tethered by a chain connected to a vertical load anchor embedded in the seabed. In total, there would be 10 surface floats, 10 sub-surface floats, and 10 anchors.

NMSP submitted a condition (Condition 2) under section 4(e) of the FPA stipulating that Finavera conduct periodic site inspections at a minimum of biannually (or more frequently as deemed necessary by the NMSP) to, in part, ensure the integrity and performance of the mooring and anchoring system.

Washington DFW recommends that Finavera develop and implement a plan with provisions for identifying the types and quantities of oil products associated with the project and the steps that would be taken to prevent or contain a spill.

Finavera states that they are working with the agencies toward “formalization of a robust maintenance plan” for the project (letter by Mary Jane Parks, Senior Vice President, Finavera, Mercer Island, WA, filed on April 3, 2007).

Staff Analysis

Offshore installation of the submarine transmission line and anchors would disturb the seabed, resulting in localized increases in turbidity due to the suspension of sediments and formation of sediment plumes.[16] The adverse effect would be unavoidable, but short-term, as underwater currents and wave turbulence would quickly dissipate the sediment plumes.[17]

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[15] Finavera proposes to use the results of the eelgrass survey to determine how far offshore to bury the transmission cable to avoid eelgrass disturbance. Eelgrass may be present to a depth of as much as 30 feet.

[16] The seabed within the project area consists primarily of fine-grained sand and silt surrounding rock outcrops and scattered groups of rock. See section V.C.1 for more information on geological resources within the proposed project area.

[17] As discussed in the water resources affected environment subsection, bottom currents in the project area are substantial, and therefore, we expect the current to limit plume sizes to no more than the footprint of the immediate area of

Although drilling using HDD techniques would prevent the disruption of bottom sediments in nearshore areas, a plume of bentonite (a drilling lubricant) could form in the surrounding waters during the HDD process in the event of an unintended release or "frac-out" (*i.e.*, a pressurized release of bentonite through a fracture in the seabed or a blow-out of the overburden material). Bentonite is a naturally-occurring, non-toxic, inert clay frequently used for the drilling of potable wells; therefore, if released, we do not expect long-term (persistent) adverse effects on water quality in the area.

There is no practical way to contain a bentonite release should one occur; however, the risk of "frac-out" can be greatly reduced by avoiding drilling in areas where shallow fractures in the seabed occur (*e.g.*, rocky areas) and by drilling deep enough so that the weight of the overburden contains the pressure within the drilling core. Monitoring of the drilling process could aid in the detection of any seepage of the fluid and identification of any corrective measures (*e.g.*, rerouting the drill route). Such a monitoring plan could also include a provision dictating the steps the drill operators would take to avoid leaking drilling fluid into the surrounding bed stratum and water column.

Once installed, movement of the submarine transmission line due to failure of the anchors caused by erosive processes or human events (*e.g.*, trawling) could cause the release of sediments into the water column. Additional suspension of sediments could occur if the transmission line would need to be detached and lifted for repair and then re-deployed back on the seabed. Such increases in turbidity would be short-term and confined to the immediate area of the footprint of the transmission line. Periodic inspection of the transmission line for detachment of the anchoring system and movement across the seabed at least bi-annually would provide information to assess any adverse effects caused by the presence of the transmission cable on the seabed and whether there would be a need to retroactively bury or armor the cable with grout or concrete blankets to address any adverse effects on environmental resources, including water quality.

The potential would exist for the construction and drilling equipment and associated vessels to leak or spill petroleum or other chemicals into the surrounding waters. A Spill Control, Prevention, and Countermeasures Plan could be developed and implemented by Finavera during construction and installation to

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drilling or the laying of the submarine cable on the seabed (on the order of tens of meters). Because of the rapid dissipation of the plume, it would be very difficult to accurately measure turbidity concentrations along the footprint of the submarine cable.

reduce or eliminate the potential for spills or leaks. The plan could include measures to: (1) inspect construction and drilling vessels and equipment daily for fuel and hydraulic leaks; and (2) contain and remove petroleum or other oil products in the event of a spill or leak.

We discuss the costs associated with developing and implementing a water quality ("frac-out") monitoring plan, a project inspection and maintenance plan, and a spill control, prevention, and countermeasures plan in section VI and make our recommendations in section VII.

Antifouling Compounds

Seaweed, algae, barnacles, and other marine organisms can grow on and sink buoys, create drag on moving vessels, foul fishing nets, and corrode submerged structures. Antifouling paints can be applied to vessels, buoys, and piers or other in-water structures in the marine environment to prevent or reduce such marine growth and associated adverse effects.

Antifouling paints work by very slowly leaching toxic compounds into the water column, thereby creating a toxic layer around the working surface of a structure or vessel (MMS, 2007). Antifouling paints available for recreational vessels are typically copper-based and are effective for about one year (MMS, 2007). The U.S. Navy uses tri-butyl tin (TBT) coatings, which are effective for up to six or seven years (MMS, 2007).

Although TBT is highly effective at preventing marine growth on ship hulls, TBT is highly toxic to non-target organisms at relatively low levels, causing such effects as abnormalities of oyster shells and the formation of male sexual characteristics in female snails (EPA, 2003). Excessive concentrations of copper that leach into the water column from antifouling paints can also be harmful to non-target marine organisms, especially in enclosed, sheltered areas such as marinas where boats congregate and dissolved copper concentrations can build to high concentrations and persist over a period of time (EPA 2007; California Regional Water Quality Control Board [CRWQCB], 2005). Both TBT and copper readily adsorb to sediments (EPA, 2003; CRWQCB, 2005).

Due to its adverse effects on marine life, use of TBT coatings on vessels less than 82 feet in length (25 m) is prohibited by the Organotin Antifouling Paint Control Act of 2005 (33 USC §2401).[18] Exceptions are made for the outboard

[18]In their letter filed on February 16, 2007, NMSP stated that pursuant to a joint environmental advisory issued on April 28, 1999, Washington Ecology and Washington DNR made a finding that "cleaning and manual scraping of vessels

motor or lower drive unit of the vessel or the hull of the vessel if it's made of aluminum.

Finavera proposes to use antifouling paints and materials on all project-related equipment. Finavera states that it would study the effectiveness of and seek agency-approval for the type of paint that would be used to coat in-water equipment (letter by Mary Jane Parks, Senior Vice President, Finavera, Mercer Island, WA, filed on April 9, 2007). NMSP submitted a condition (Condition 3) under section 4(e) of the FPA stipulating that Finavera develop and implement an antifouling study plan before installation of any in-water project facilities and equipment. The plan would include a description of proposed antifouling compounds and methods, analysis of compliance with state and federal laws, a maintenance schedule, an experimental design for monitoring the effectiveness of the paints, and a reporting schedule for the study. The plan would include a methodology for monitoring and reporting to the NMSP any effects on sanctuary resources that would result from the use of antifouling compounds.

Staff Analysis

Strong currents in the project area would prevent the situation of a localized water column build-up of toxins leached from the anti-fouling paints used on the proposed project buoys. Paint sloughing or chipping due to aging or collision of a buoy with a vessel could cause a localized build-up of the toxins in the sediments, however, which could adversely affect marine benthic organisms located below the buoy array.[19]

Development and implementation of a site-specific antifouling paint study plan prior to installation of any in-water project facilities and equipment would effectively ensure the selection of a paint that would be effective at preventing antifouling of the project facilities while at the same time limiting any adverse effects on marine resources specific to the project area (*i.e.*, a site-specific study would be more beneficial than simply choosing a paint based on a simple literature

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painted with sloughing and ablative (or soft) antifouling paints and those vessels painted with tin-based compounds while the vessel is afloat violates water quality standards and is prohibited by state law."

[19] The buoy array and associated mooring and anchoring components would occupy a rectangular area of 60 feet by 240 feet on the water surface and 625 feet by 450 feet on the ocean floor.

search). Development and implementation of schedule for maintaining the painted, underwater surfaces of the buoys would help to limit or prevent paint chipping and sloughing and associated adverse effects on water quality, sediment quality, and benthic organisms.

We discuss the costs associated with developing and implementing an antifouling paint study and a project inspection and maintenance plan in section VI and make our recommendation in section VII.

Buoy Detachment

The proposed project buoys could become dislodged from their mooring systems due to collision with a vessel, release of the anchoring system due to seabed material movement, or breakage of the mooring lines/anchoring system due to very large waves produced by extreme storm events. During summer, waves are lower in height and predominately from the northwest, so that surface currents would likely carry a dislodged buoy in a southerly direction. In winter, waves are generally higher and from the southwest, so that surface currents would likely carry the buoy in a northerly direction. If a dislodged buoy would strike rocks on or near the mainland or islands, the buoy could become damaged and leak internal fluids into the surrounding waters.[20] Potential sensitive areas where the buoys could strike shore include the Makah Indian Reservation, the Olympic National Park located south of the Makah Indian Reservation, and any number of islands located in the project area within the Flattery Rocks National Wildlife Refuge.

To reduce the chance that the buoys would be struck by a vessel, Finavera proposes to establish an exclusion zone within and around the buoy array and submarine transmission line. The zone would be established in consultation with the U.S. Coast Guard, the Makah Tribe, and NMSP. Finavera also proposes to develop and implement a maintenance plan for the proposed project with a provision to inspect the buoys two to five times per year by boat out of Neah Bay. At all other times, the buoys would be monitored using online buoy telemetry equipment, and the proposed shore station would be visited by vehicle about six times per year.

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[20]Each buoy would have an attached 15-foot diameter by 98-foot long submerged acceleration tube that would house freshwater, high pressure hoses, and a piston. The submerged tube could contact the seabed or rock formations in shallower waters and slow the movement of the buoy or prevent it from reaching shore.

NMSP submitted a condition (Condition 2) under section 4(e) of the FPA stipulating that Finavera conduct periodic site inspections at a minimum of biannually (or more frequently as deemed necessary by the NMSP) to, in part, ensure the integrity and performance of the mooring and anchoring system.

Staff Analysis

Finavera states that the internal workings of the buoys would contain no petroleum products (letter by Mary Jane Parks, Senior Vice President, Finavera, Mercer Island, WA, filed on April 9, 2007); therefore, collision of a buoy and its related components with a vessel, the shoreline, the seabed, or underwater rock formations would not introduce petroleum products to the marine environment. Fresh water used to generate electricity within the buoy could be spilled into the marine environment in the event of a collision; however, we find no reason to suspect that this would have any adverse effects on or otherwise impair marine water quality within the project area.[21]

Development and implementation of an exclusion zone around the buoys and underwater transmission line and periodic inspections of the mooring and anchoring system would assist in providing for the safety of the equipment as well as recreationists utilizing the project area. We discuss these benefits in more detail in section V.C.7.

Unavoidable Adverse Impacts

Short-term, minor adverse effects on water quality would inevitably occur during project drilling and installation where bottom sediments would likely be disrupted and suspended within the water column. Drilling fluids such as bentonite could be unintentionally released in the event of a “frac-out;” however, the risk could be minimized by avoiding areas with fractured rock as much as possible and drilling deep enough to allow the overburden to withstand pressures generated during the drilling process. Ocean currents and turbulence generated from wave activity would dissipate any suspended sediment or bentonite plumes.

A very minor potential would exist for the construction and drilling equipment and associated vessels to leak or spill petroleum or other chemicals into the surrounding waters. Development and implementation of a spill control, prevention, and countermeasures plan would minimize the risk that a spill or leak would occur and would outline the steps to take in the event of a fuel or other

[21] The total volume of fresh water within each buoy would be about 1,850 gallons.

chemical spill so that such countermeasures could be implemented quickly to minimize any adverse effects.

Paint sloughing or chipping due to aging or collision of a buoy with a vessel could cause a localized build-up of anti-fouling toxins over a very small area of the seabed underneath the buoy array. Development and implementation of a schedule for maintaining the painted, underwater surfaces of the buoys would help to limit or prevent paint chipping and sloughing and associated adverse effects on water quality, sediment quality, and benthic organisms.

3. Marine Fishery Resources

Affected Environment

The Pacific Ocean off of the Olympic Peninsula is characterized by a productive upwelling zone, which in turn provides rich habitat for a wealth of aquatic species including marine mammals, fish, seabirds, invertebrates, and algae (NOAA, 2005a). The attraction to the area of foraging marine wildlife and important fisheries yields significant economic benefits to state and tribal economies (NMFS, 2001).

Fish

The cold waters of the Olympic Coast represent some of the most productive fish habitat in the world and contain an abundant and diverse assemblage of marine species (Sanctuary, 2005). NMFS (2001) reported that shellfish, groundfish, and Pacific salmon are the most commercially-important species located off the northern Washington coast.

Extending from the sandy Hobuck Beach, the general slope of the marine portion of the project area is flat with the ocean bottom having a slope of about 1.5 percent (Thales GeoSolutions, Inc., 2002). Over the entire project area, sand- to silt-sized sediment covers about 60 percent of the seafloor while the remaining 40 percent consists of rock outcrop. The nearshore bottom surface is sandy out to a water depth of about 70 feet.

NMSP characterizes the fish community in the Sanctuary by habitat (sandy intertidal, shallow rocky reefs/kelp beds, and rocky intertidal) as well as general area (sublittoral and offshore) (Sanctuary, 2005). Fish that may inhabit or use sandy intertidal habitats in the project include starry flounder, staghorn sculpin (*Leptocottus armatus*), sand lance (*Ammodytes spp*.), sand sole (*Psettichthys melanostictus*), surf smelt (*Hypomesus pretiosus*), redtail surfperch (*Amphistichus rhodoterus*), and sanddab (*Citharichthys sordidus*) (Sanctuary, 2005).

Fish associated with shallow rocky reef areas and kelp beds include the numerous rockfish species as well as lingcod (*Ophiodon elongatus*), kelp greenling (*Hexagrammos decagrammus*), cabezon (*Scorpaenichthys marmoratus*), kelp perch (*Brachyistius frenatus*), wolf eel (*Anarrhichthys ocellatus*), and red Irish lord (*Hemilepidotus hemilepidotus*) (Sanctuary, 2005).

Species inhabiting rocky intertidal areas include tidepool sculpin (*Oligocottus maculosus*), wolf eel, juvenile lingcod and greenling (*Hexagrammos spp*.), gunnels (family Pholidae), eelpouts (family Zoarcidae), and pricklebacks, cockcombs and warbonnets (family Stichaeidae) (Sanctuary, 2005).

Typical species inhabiting the sublittoral areas off of the Olympic Coast include albacore tuna (*Thunnus alalunga*), Pacific halibut (*Hippoglossus stenolepis*), starry flounder (*Platichthys stellatus*), arrowtooth flounder (*Atheresthes stomias*), petrale sole (*Eopsetta jordani*), Dover sole (*Microstomus pacificus*), English sole (*Parophrys vetulus*), numerous rockfish species, Pacific cod (*Gadus macrocephalus*), Pacific hake (*Merluccius productus*), lingcod, sablefish (*Anoplopoma fimbria*), thresher shark (*Alopias vulpinus*), Pacific herring (*Clupea pallasii*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), pollock (*Pollachius virens*), spiny dogfish (*Squalus acanthias*), green sturgeon (*Acipenser medirostris*), white sturgeon (*Acipenser transmontanus*), and Pacific salmon (*Oncorhynchus* spp.) (Sanctuary, 2005). In addition, bull trout within the Coastal-Puget Sound Distinct Population Segment are known to migrate between freshwater and the marine environment in proximity to the proposed project.[22]

Offshore areas are inhabited by Pacific ocean perch (*Sebastes alutus*), lingcod, English sole, Dover sole, Pacific cod, and sablefish (these species represent two-thirds of the 1987 to 1988 annual harvest along the outer coast) (Sanctuary, 2005).

The Sanctuary identifies salmon and groundfish species as being the most significant in the Sanctuary. The waters offshore of the northern Olympic Peninsula are potentially used by migrating salmon from British Columbia to California.

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[22]See http://www.fws.gov/pacific/bulltrout/final/pdf/BT_combined_revised100605.pdf

Invertebrates

The project area consists primarily of sandy intertidal, sandy/mud, and rock sublittoral habitats as well as offshore/pelagic areas, in which a variety of invertebrates can be found. The sandy intertidal area is inhabited by razor clams (Siliqua), isopods, mysids (opossum shrimp), sand dollars, purple olive snails, several species of clam (*e.g.*, *Macoma secta* and *Tellina bodegensis*), Dungeness and mole crabs, amphipods, and worms. In sublittoral soft sediments, mud shrimp (Upogebia), brittle stars, and several species of clams and polychaete worms typically occur. Barnacles, limpets, amphipods, isopods, sea snails (Lacuna and Tegula), several species of crabs, the sea squirt (Clavelina), and various species of edible clams (butter clams, littleneck clams, and horse clams) live on or under sublittoral boulder and cobbles. Squid, octopi, jellyfish, salps, heteropods, shrimp, and euphausiids are species that typically occur in more pelagic areas (Sanctuary, 2005).

The Dungeness crab lives in bays, inlets, around estuaries, and on the continental shelf to depths of approximately 180 m. It is typically found on sand bottoms and frequently among eelgrass (NMFS, 2005). Washington DFW marine resources maps indicate that the entire project area represents Dungeness crab habitat.

Butter clam (*Saxidomus giganteus*), littleneck clam (*Protothaca staminea*), and Japanese littleneck clam (*Tapes philippinarum*) are commonly characterized as hard shell subtidal clams. Butter clams can live up to 20 years. They inhabit intertidal habitat to 40 m in depth, bury to 30 cm, and prefer quiet bays and estuaries having muddy sand or muddy/sandy gravel. Littleneck clams occur in intertidal areas inhabiting coarse sand though they may be found in cobble or coarse shell mixed with gravel mud or sand. They bury to depths of 80 mm and primarily occur in estuaries, but occasionally occur along the open coast. Japanese littleneck clams are an introduced species that occur in intertidal habitat to depths of 10 m. This species prefers shelly or gravely mud or sand in low energy, stable beach environments (Kegel, 1998). Washington DFW marine resources maps indicate that hardshell subtidal clams occur in Makah Bay, but to the south of the project, within about one mile from shore.

Marine Vegetation/Algae

A variety of seaweeds occur in the Sanctuary and the project vicinity including, black pine (*Neorhodomela larix*), bottlebrush algae (*Endocladia muricata*), bull kelp (*Nereocystis leutkeana*), coralline algae (Order: Corallinales), giant kelp (*Macrocystis pyrifera*), laver or nori (*Porphyra spp*.), rockweed (*Fucus spp*.), sea cauliflower (*Leathesia difformis*), sea lettuce (*Ulva spp*.), sea palms

(*Postelsia palmaeformis*), sea staghorn or dead man's finger (*Codium fragile*), surfgrass, (*Pyllospadix spp.* - actually a true plant), and winged kelp (*Alaria marginata*) (Sanctuary, 2005). The Sanctuary (2005) described the algae off of the Olympic Peninsula as follows:

> *Both microalgae and macroalgae are abundant and diverse on the outer coast. Over 120 species of algae have been identified in the rocky intertidal areas of the outer coast of the Olympic National Park. Microalgae are primarily composed of benthic diatoms which are found as thin coatings on rocks or living within the sediment. These diatoms are an important part of the "algal film" forming diatom slicks on rocks and providing a principal food source for many grazing animals such as gastropods and chitons. Marine lichens are found as thin veneers on rocks in the highest intertidal areas on exposed rocky areas.*
>
> *Macroalgae are seaweed that grow attached to a firm substrate from the intertidal region down to as deep as 40 m. The seaweeds are composed of three main phyla: red algae (Rhodophyta), brown algae (Phaeophyta), and green algae (Chlorophyta). Kendrick and Moorhead (1987) present a summary of the algal species found, or expected to occur, at three intertidal sites along the coast of the Olympic National Park. ... The red algae are the most diverse of the macroalgae in terms of number of genera (about 115) and species (at least 265) in the Pacific Northwest (Waaland, 1977). In intertidal and shallow subtidal areas, red algae often occupy the understory of the larger kelps.*
>
> *Less common in the exposed areas of the outer coast, green algae inhabit the more protected marine and estuarine areas in Washington. These algae reside primarily in tidepools and rocky intertidal areas.*
>
> *Brown algae include the largest marine plants and are probably the most important macroalgal group in terms of primary productivity and direct economic value. Brown algae vary from the large kelps to the less conspicuous forms that encrust rocks or form filaments on other algae. The Pacific Northwest coast supports the highest diversity of kelps in the world. Two species of brown algae dominate the extensive kelp forests of the outer coast: the bull kelp ... which is found in relatively protected waters; and the giant kelp ... which prefers more exposed areas ….*

Kelp beds grow in dense aggregations, reach up to 60 feet or more in height, and are important habitat for rockfish and a variety of pelagic and demersal fish species, providing important nursery areas and spawning habitat for small fish. Numerous fish species, as well as sea otter, closely associate with giant kelp forests (Sanctuary, 2005).

The dominant vegetation types along the Olympic Coast in Jefferson and Clallam Counties are kelp habitats with eelgrass and surfgrass also locally abundant (North Olympic Peninsula Lead Entity [NOPLE], 2005). Areas of sea grass, which include eelgrass, surfgrass, and kelp, are considered HAPC (PFMC, 2005). Giant kelp and bull kelp are the primary species of kelp forests that extend from Alaska to northern California (Sanctuary, 2005). A review of the Washington State Shore Zone Inventory database (covers from the intertidal to a depth of a few meters) and Floating Kelp Inventory database indicates that kelp and surfgrass were present along Waatch Point and to the north away from Makah Bay, and absent along Hobuck Beach south to the outlet of the Sooes River. In their PDEA, Finavera reports that kelp beds do not occur along the proposed transmission cable route and power plant site.

Environmental Effects and Recommendations

Submarine Transmission Line Effects on Marine Aquatic Habitats

Finavera proposes to locate the 12-kV transmission cable along sand and silt substrate, avoiding all rock outcroppings out to a depth of 98 feet. The cable would then continue to the buoy array over rock and sand substrate to a depth of about 150 feet. The total length of the cable would be about 3.7 miles, of which about the first 1,200 feet from shore would be buried utilizing HDD. The diameter of the cable has not been determined by Finavera; however, a similar type of 12-kV submarine transmission line used in the oil and gas industry for heating a pipeline has an outer diameter of about 210 mm (8.3 inches) (Scarr *et al.*, 2001). Therefore, assuming a footprint of 8 inches wide by 18,300 feet long (*i.e.*, 3.7 miles of total cable minus 1,200 feet of cable that would be buried), the portion of the submarine transmission line that would rest on the seabed would occupy about 12,200 square feet (0.3 acre) of benthic habitat.

Based on Finavera's survey of seabed features along the proposed transmission route,[23] about 85 percent of the transmission line would rest on fine-grained sand and silt habitat, 14 percent on hard substrates, and 1 percent on or around isolated rocks less than 10 m in diameter. This equates to about 0.25 acres of sand and silt habitat, 0.042 acres of rock habitat, and a minimal area of isolated large rocks.

[23] See figure 5-2 of the PDEA.

While placing the power cable on the seabed, the turbulence created by the displaced seawater at the seabed would likely spread out over an area on the order of a few feet from the centerline of the cable. Due to the small size of the cable (about 8 inches in diameter) and the fact that the cable would be placed on the surface of the seabed rather than trenched, we do not expect the depth of sediments disturbed and suspended into the water column to be more than a few centimeters. Suspended sediments would quickly fall back at or near the disturbed swath.

Immobile or slow moving benthic organisms in the path of the power cable such as clams, snails, and worms could be covered, disturbed, or injured during installation. Algae growing on rocks (*e.g.*, diatoms) would likely be covered or scraped by the movement of the cable. Larger, mobile organisms such as crabs would sense the approach of the cable and likely escape any harm. Fish would likely sense the sound of the vessel installing the cable and avoid the area, likewise escaping any harm from the cable installation.

Finavera has not specifically identified the type of anchoring system that they propose to stabilize the power cable. If Finavera would use gravity-type anchors such as rock or concrete mats, immobile marine organisms would be covered. Once deployed, however, the mats/blankets or portions of the cable would serve as substrate for recolonization by species that utilize hard surfaces (*e.g.*, diatoms and sea urchins). If a combination of screw-type anchors and chains would be used to secure the submarine transmission line, burrowing organisms could be struck by the deployment of the anchors. Although the footprint of the screw-type anchors on the seabed would be less than that for gravity anchors, screw-type anchors would penetrate the seabed and disturb burrowing organisms such as clams and polychaete worms.

The spacing of the anchors would determine the area to which the power cable would be free to sweep about the centerline of the cable path due to bottom currents or infrequent physical contact with boat anchors, fish equipment, and the like.[24] Finavera proposes to consult with the various agencies with fish and wildlife management responsibilities in the project area to determine the anchor spacing. We would expect that the distance of the sweep could be many feet from the centerline of the transmission path. Adverse effects on marine organisms would include disturbance and the potential for injury or death. We would expect the significance of the effect to be somewhat minimized by the relatively small

[24] As discussed in section V.C.1, additional sweeping events could occur if natural erosion processes would scour the sands under the submarine transmission line anchors located in depths less than 56 feet.

size of the cable (about 8 inches in diameter). Additionally, burial of portions of the cable due to natural sand movements could limit the occurrence or spatial extent of the affected area.

Once the installation of the power cable and anchors would be complete, bottom currents would rapidly redistribute disturbed sediments along the cable route. Benthic organisms would quickly resettle along the cable route and disturbed groundfish and other mobile fish would once again utilize the immediate area within a matter of hours of the laying of the cable and passage of the installation vessel.

Burial of the nearshore portion of the power cable utilizing HDD would limit adverse effects on benthic organisms, except in the area where the drill bore hole would exit the seabed. At this location, contractors would excavate a small exit cavity for the cable. Organisms present at the area of the exit would be disturbed, injured or killed by the temporary turbidity increases in the immediate area of the exit as well as potential strike by the drill bit and the excavator utilized to create the exit hole. Wave action and currents would rapidly redistribute disturbed sediments and marine organisms would quickly recolonize the area. Prior to project installation, Finavera proposes to conduct an eelgrass survey to determine how deep they need to go with the HDD to avoid the eelgrass.

In order to protect benthic marine life as much as possible from the adverse effects of installation of the submarine transmission line on the seabed, NMSP submitted a condition under section 4(e) of the FPA (Condition 1) stipulating that Finavera conduct a baseline study of the existing epibenthic (surface dwelling) community located on hard substrates along the proposed transmission cable route. Condition 1 also stipulates that if the baseline study reveals the presence of important marine life or habitat, Finavera should develop and implement a plan to monitor the post-installation effects of the transmission cable where it traverses hard substrate.

In order to protect macroalgae/eelgrass located in the nearshore area of the proposed transmission cable, NMSP's Condition 1 specifies and Washington DFW recommends that Finavera conduct a macroalgae/eelgrass survey of the nearshore section of the propose transmission route. The purpose of the survey would be to inform the determination of the specific transmission cable route for purposes of limiting adverse effects on the macroalgae/eelgrass.

To protect fish habitat from the effects of cable sweep and associated abrasion effects, Washington DFW recommends that Finavera prepare a detailed anchoring plan for the transmission cable. To ensure that the installed cable would remain stabilized once anchored, NMSP's Condition 1 includes a provision for

Finavera to develop and implement a transmission cable and anchoring system monitoring plan. Washington DFW makes a similar recommendation.

Finavera proposes to conduct an eelgrass survey and develop and implement a maintenance plan for the project.

Staff Analysis

The plans proposed by Finavera and recommended by Washington DFW and NMSP would be beneficial in that their implementation would provide a means of limiting adverse effects on important marine resources located along the proposed transmission line route. Surveys of important biological communities along the transmission route have not been conducted, and would help to inform a final design for the project.

We discuss the costs associated with developing and implementing plans to conduct an eelgrass and epibenthic survey and develop and implement a transmission cable and anchoring system monitoring plan in section VI and make our recommendation in section VII.

Effects of Buoy Anchoring and Mooring Systems on Marine Habitats

The buoy array and associated mooring and anchoring components would occupy a rectangular area of 60 feet by 240 feet on the water surface and 625 feet by 450 feet on the ocean floor. Each buoy would be a closed system, and as such, seawater and associated fish or other marine life would not be drawn into the buoy during electrical generation.

The buoys anchors (VLA's) would be deployed completely below the seafloor. Each VLA would be installed like a conventional drag anchor, but would penetrate much deeper. Following construction, only the area of the seafloor equal to the diameter of the cables leading from the VLA's to the mooring floats would be occupied by the buoy array.

The effects of the installation of the buoy anchoring and mooring system on fish and benthic marine life would be the same as that described above for the installation of the submarine transmission line and anchoring system. Similar to that which would occur with the submarine transmission line, the mooring lines and chains could potentially contact the seabed and scrape benthic marine plants and animals, especially if the anchoring system would be loosened due to such an event as an inadvertent boat anchor or fishing line catching and pulling on the mooring cables and chains and associated anchors. The result would be disturbance, injury, or mortality. The area of disturbance would be confined to the buoy array's footprint on the ocean floor (450 feet by 625 feet or about 6.5 acres). This area predominately consists of fine grained silts and sands.[25]

Once the mooring cables would be installed, the potential would exist for abandoned commercial or recreational fishing gear to become entangled around the cables. Such entangled gear could continue to fish without human control and result in the unintended catch and subsequent mortality of fish.[26]

In order to ensure that the buoy mooring lines and chains would not hang down and contact the seabed, NMSP includes a condition under section 4(e) of the FPA (Condition 1) providing for Finavera to visually inspect the lines, chains, floats, and anchors to make sure that the anchors would be properly set into the seabed and that the chains and mooring cables would not hang down and contact the seabed at maximum slack periods.

To limit the occurrence of fishing gear entanglement with the mooring lines and to ensure that the mooring lines and anchors continue to function as designed, Washington DFW recommends that Finavera develop and implement a monitoring plan for the buoy mooring and anchoring system.

Staff Analysis

The plans recommended by Washington DFW and NMSP would be beneficial in that their implementation would provide a means for limiting adverse effects on important marine resources utilizing habitats located at the proposed buoy array (as described above).

We discuss the costs associated with developing and implementing plans to monitor and inspect the buoy mooring and anchoring system in section VI and make our recommendation in section VII.

Effects of Noise on Marine Fish and Other Aquatic Life

Ambient noise in the marine environment originates from a variety of both natural and manmade intermittent and continuous sources including: marine life, shipping and other boating, breaking waves and associated surface turbulence, aircraft, dredging activities, and earthquakes (MMS, 2007). Intermittent noises such as those produced by underwater explosions can create sound intensities

[25] *Id*. For information on the thickness of sand deposits along the proposed submarine transmission line route, see section V.C.1.

[26] This event is commonly referred to as "ghost fishing."

greater than 200 decibels (dB) (re: 1 μPa)[27] (Ross, 1976). Continuous (prevailing) noises such as those generated by distant oceanic traffic (100 to 1,000 hertz [Hz]) and wave-dependent bubble and spray (100 to 10,000 Hz) can range in intensity from about 35 to 80 dB (re: 1 $\mu Pa^2/Hz$) (ACS, 2007).[28]

Ambient ocean noise has not been measured by Finavera within the proposed project area; however, we expect that the prevailing ambient noise is primarily associated with breaking waves and secondarily with distant shipping, resulting in ambient sound intensities generally below 90 dB (re: 1 μPa). We would expect sound intensities to be higher than 90 dB during storms and high winds (*i.e.*, generally, during the winter) when waves would be taller and crash against the project area shorelines with much greater intensity.

Ship and barge noise and vibrations associated with the installation and maintenance of offshore project facilities would likely disturb fish and other marine organisms. The sound intensity underwater would be no more than 130-160 dB (re: 1 μPa) over a frequency range of 250-2,000 Hz (Thomsen et al., 2006; LGL, 1991), which is the peak sound intensity of a barge fully underway.[29] The predominance of the sound would originate from the vessels' propellers (MMS, 2007). Additional above water engine and construction noise (*e.g.*, noise produced by compressors, machinery, and hand tools) during installation and maintenance could transmit underwater; however, we expect such sounds to be largely dampened by ambient ocean noise on all but the calmest of days.

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[27] In the context of measuring sound intensity, a decibel (dB) is a logarithmic ratio between pressure generated by a sound source and a reference pressure. The reference pressure used to measure sound intensity in air is typically 20 micropascals (μPa) and in water is 1 μPa. The conversion from dB measured in air to dB measured in water is +62 dB. See http://www.fas.org/man/dod-101/sys/ship/acoustics.htm for more information on measuring sound intensities.

[28] Andrew et al. (2002) reported that peak median low frequency (10 to 100 Hz) ambient noise levels off of Point Sur, California have increased from about 80 dB during the period 1963-1965 to about 90 dB (re: 1 $\mu Pa^2/Hz$) during the period 1994-2001. Andrew et al. (2002) attribute this increase in ambient noise to an increase in commercial shipping.

[29] A barge used to install the proposed submarine cable would not be fully underway during cable installation but would be minimally above idle. We would only expect the barge to be fully under way, and thus sound intensities to be near their peak of 130-160 dB, while traveling to the site. Most of the time, the sound intensity would be much less.

During proposed project operations, we expect noise to primarily originate from waves impacting the float portion of the generating buoy and internal fresh water striking the Pelton turbine. The turbine would be housed in the steel float portion of the generating buoy, which would mostly be located above the water surface. Noise originating above water would be transmitted underwater through the buoys' mooring lines and acceleration tubes.

There has been very little study on the amount of noise generated by wave energy buoys (MMS, 2007); however, we can get a general idea of the sound intensity and frequencies that might result during project operations by reviewing other mechanical sources of underwater sound that have been studied and documented. As noted previously, the propellers of ships and barges under full power generally create peak sound intensities of 130-160 dB (re: 1 µPa) at frequencies of between 250-2,000 Hz. Wind turbines have been reported to transmit noise underwater at intensities ranging from 90 to 115 dB (re: 1 µPa) over a frequency range of 20-1,200 Hz at a distance of about 360 feet from the turbine (Thomsen et al., 2006). Based on this information, and considering that the wave energy generation uses relatively low-intensity wave to electrical energy conversion technologies (MMS, 2007), we expect the sound intensities generated by the wave buoys to be much less than 130-160 dB (re: 1 µPa) and likely closer to ambient ocean or wind turbine-generated sound intensities of about 90-115 dB (re: 1 µPa).

Hastings and Popper (2005) provide a very good overview of published and gray literature studies that have evaluated the effects of sound on fish species. They report that: (1) the majority of Pacific fish species studied are "hearing generalists," (*i.e.*, the fish have no special adaptations to enhance their hearing) capable of detecting sounds at intensities of between 75 and 150 dB (re: 1 µPa) and frequencies of between 30 and 2,000 Hz; (2) there are no reliable sound response data for mackerels or rockfish; (3) plaice and other similar species of flatfish have poor hearing (high thresholds of sound intensity) over a narrow frequency range likely due to a lack of a swim bladder; and (4) Atlantic salmon, which have similar auditory systems to that of Pacific salmonids, generally can detect sounds between about 95 and 130 dB (re: 1 µPa) at frequencies between about 30 and 300 Hz. The studies reviewed by Hastings and Popper (2005) generally show that fish are not adversely affected by sound levels less than about 160 dB (re: 1 µPa), and at greater levels, fish exhibit avoidance responses, stress responses, temporary and permanent hearing loss, auditory and non-auditory tissue damage, egg damage, reduced growth rates, or mortality.

NMSP includes a condition under section 4(e) of the FPA (Condition 4) providing for Finavera to develop and implement a plan to assess the sound generated by the buoy array once operational and determine whether there is potential for a detectable response by marine mammals and fish. The program would assess the sound frequency, amplitude, and attenuation over unspecified distances from the project site. If the analysis indicates that noise levels would exceed a disturbance threshold of 120 dB for marine mammals, Finavera would develop and implement a "more extensive" monitoring program to evaluate and document any occurrence of behavioral change, disturbance, or injury to marine life, particularly marine mammals and fish.

Finavera proposes to conduct an engineering, lab, or literature-based assessment of sound levels (noise) produced by the project.

Staff Analysis

We discuss the effects of noise on marine mammals in section V.C.4. With regard to fish, given that the greatest sound intensities that would be produced by the proposed project during construction/installation, operation, and maintenance would likely be less than 130-160 dB (re: 1 µPa) and that adverse effects on fish are typically not seen at levels below 160 dB, we do not expect fish in the project area to be adversely affected by underwater noise associated with the project. NMSP's recommended noise assessment would have the benefit of documenting noise levels produced specifically by the proposed wave energy technology and providing a means of verifying our analysis. Such site and technology-specific information is not presently available and would provide a greater benefit than Finavera's proposal to estimate noise levels, which is essentially what we've done here in this EA. Any noise assessment plan could be of greater benefit if the plan would also include a provision for determining potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals or fish.

We discuss the costs associated with developing and implementing a plan to measure noise levels during project operations in section VI and make our recommendation in section VII.

Effects of Electromagnetic Fields on Marine Fish Species and Other Marine Life

The proposed 12-kV transmission cable would transmit direct current (DC) of up to 1 MW with an average of 0.184 MW. The cable would contain a metal sheath to prevent or limit the emission of electric (E) fields. Additional electrical cables would transmit alternating current (AC) from the proposed generating buoys to the proposed collector buoy. The cables would be fastened to the mooring lines and would transmit a maximum of 250 kW each.

The flow of electric current through a submarine transmission line results in the generation of an electromagnetic field (EMF). EMFs consist of electric (E) and magnetic (B) field components. The metallic sheathing of transmission cables coupled with burial into the seabed is typically used to prevent E fields from being emitted into the surrounding aquatic environment; however, such sheathing materials fail to prevent the emission of B fields. Movements of seawater or organisms through B fields, either natural (*e.g.*, the earth's magnetic field) or anthropogenic, results in the generation of a weak electric field commonly referred to as an induced electric (iE) field.

Gill et al. (2005) provide a good overview of existing sources of information regarding the significance of EMFs to marine organisms. They note that studies have shown that elasmobranches (sharks, skates, and rays) are physiologically adapted to detect electric fields, and use such abilities to detect iE fields of prey items. They suggest that the E-field threshold between attraction and repulsion is 100 microvolts per meter (μV/m); however, it's not entirely clear how they derived this estimate.

Gill et al. (2005) also report that other species that can detect electric fields but do not possess specialized "electroreceptors," include Atlantic salmon, cod, plaice, and certain eels and lampreys. Gill et al. (2005) speculate that these species likely respond to iE fields of a magnitude comparable to that occurring during peak tidal movements (8-25 μV/m), presumably inducing a feeding response in the fish. With regard to E-fields emitted from anthropogenic sources, Gill et al. (2005) conclude that there have been too few studies from which to draw any hard conclusions on whether or not electric fields have any adverse effects on fish.

Marine organisms that are able to detect magnetic fields include the elasmobranches, European eel, Atlantic salmon, plaice, sea trout, yellowfin tuna, lobsters, crabs, shrimps, prawns, snails, bivalves, and squid (Gill et al., 2005). Gill et al. (2005) report that studies have shown that: (1) certain elasmobranches can differentiate localized B-field emissions from the earth's magnetic field; (2) certain shrimp species (*e.g.*, brown shrimp) are attracted to B-fields "expected around wind farms;" (3) static B-fields have not been conclusively shown to adversely effect certain crustaceans, bivalves, and teleost fish (*e.g.*, flounder); and (4) B-fields of 1-100 microtesla (μT) have been shown to delay embryonic development in sea urchins and fish. Gill et al. (2005) conclude that available information is limited, but that which is available suggests that B-field emissions "of the order likely to be associated with wind farm [power] cables," could have adverse effects on marine organisms.

In an overview of wind industry generation reports assessing the potential for EMF effects on marine organisms, Gill et al. (2005) report that the consensus was that magnetic fields emitted by submarine transmission lines likely do not adversely affect fish such as salmonids and eels because: (1) in offshore areas, the fish migrate in open water as opposed to along the seabed and (2) once reaching nearshore areas, they rely on olfactory rather than geomagnetic cues.

There also appeared to be a consensus that burying the cable would be enough to prevent significant B-fields and associated iE fields from forming and adversely affected marine organisms at or near the seabed; however, Gill et al. (2005) caution that their studies show that this may not always be the case, and that modeling or field testing may ultimately be needed to be certain.

The U.S. Army Corps of Engineers (Corps) (2004) used an Electric Power Research Institute (EPRI) model ("ENVIRO") to estimate the peak intensities of magnetic fields that would be emitted by 33-kV and 115-kV transmission cables buried to a depth of 6 feet in the seabed and transmitting up to 454 MW. In all cases, the magnetic fields were strongest at the seafloor directly over the buried cables, but quickly attenuated to about 10 percent of peak intensity within 10 to 20 feet directly above the seafloor and 20-30 percent of peak intensity within 10 feet horizontally from the centerline of the buried cable. The model predicted that the largest of the transmission cables (115 kV, 454 MW) would produce a magnetic field with an intensity of 60 milligauss (mG). For comparative purposes, the earth's magnetic field ranges between 470 and 590 mG in the United States (Corps, 2004).

NMSP includes a condition under section 4(e) of the FPA (Condition 5) providing for Finavera to conduct an "engineering analysis" of EMF strength associated with the 3.7-mile long submarine transmission line prior to project construction. If the engineering analysis could not be conducted prior to project installation, then Finavera would conduct a post-installation, field test of EMF emissions from the submarine transmission line. The results of the engineering analysis or field testing (whichever is performed) would be compared to published literature to assess the potential for project effects on marine organisms. A report of the results would be filed with the Commission and sent to NMSP within three months of the commencement of project operation. If the report would show that marine organisms would potentially be harmed by the emission, Finavera would then develop and implement a monitoring plan to assess the impacts of EMF emissions from the submarine transmission line on marine organisms utilizing "in-field" monitoring studies. If any effects would be documented, Finavera would then develop and implement a plan for mitigating all "measurable" effects.

Washington DFW recommends that Finavera monitor EMF around the project buoys and submarine transmission line.

Finavera proposes to estimate EMF emissions at the project using engineering calculations, lab measurements, or vendor specifications (i.e., literature) for project electrical equipment.

Staff Analysis

Because the proposed submarine transmission line would contain a metallic sheath, we do not expect the cable to emit E-fields.

Of a total of 3.7 miles, about 0.2 mile of the submarine transmission line would be buried using HDD techniques. The remaining 3.5 miles of transmission cable would lie over sand and silt on the seabed; therefore, we expect at least portions of the cable to be buried by shifting sands. Overall, because of the variable degree of burial, we expect the intensity of the B-field to likewise be variable along the length of the cable, ranging from lower levels near shore where the cable would be buried to relatively higher levels in areas offshore near the buoy array where the cable would cross over hard substrates.

Of the marine fish and invertebrates in the area, the most likely to detect and potentially be affected by magnetic fields emitted from the submarine transmission and buoy electric lines would be the elasmobranches. Based on the research summarized above, the effects would most likely be temporary disorientation or avoidance of the submarine transmission line and buoy array. Given that magnetic fields rapidly attenuate within 10-30 feet of the source, even the worst case situation of avoidance of the cable and array by elasmobranches would represent a negligible footprint within the proposed project area, and therefore, we expect the impact to be low.

NMSP Condition 5 and Washington DFW's recommended EMF monitoring plan would have the benefit of documenting EMF produced specifically by the proposed wave energy technology under actual site conditions and could be used to verify our finding of low impact. Such site and technology-specific information is not presently available.

In the event that such a monitoring plan would indicate high levels of EMF being emitted from the project's electric cables along with a documented effect on marine organisms, a potential mitigation measure could include burial of the transmission cable.

We discuss the costs associated with developing and implement a plan to assess or monitor EMF during project operations in section VI and make our recommendation in section VII.

Effects of the Exclusion Zone on Fish Abundance

As discussed in section V.C.7, a likely exclusion zone would be 100 feet on either side of the centerline of the submarine transmission line and 100 feet around the buoy array. The total area that would be excluded from fishing, anchoring, trawling, and similar underwater activities where there could be contact with the transmission cables, mooring lines, and buoys would be about 95 surface acres. Given the mobility of fish and crabs and the realization that fishing could still occur adjacent to the mostly narrow strip of the exclusion zone, we do not anticipate any significant changes in fish abundances in the Makah Bay area.

Unavoidable Adverse Impacts

The transmission line would occupy a very minor amount of marine benthic habitat, including about 0.25 acres of sand and silt habitat, 0.042 acres of rock habitat, and a minimal area of isolated large rocks. This very minor loss of habitat would be mitigated somewhat depending upon how much of the submarine transmission line would be buried by sand transport processes. Marine organisms would likely colonize any areas of buried cable.

During installation of the project, immobile or slow moving benthic organisms (*e.g.*, clams, snails, and worms) over a very small area could be covered, disturbed, or injured. Algae growing on a very small number of rocks (*e.g.*, diatoms) would likely be covered or scraped by the movement of the submarine transmission line. Ship and barge noise and vibrations associated with the installation and maintenance of offshore project facilities would likely result in a minor disturbance of fish and other marine organisms.

Once installed, there would be a very minor risk that the project's mooring lines and chains would contact the seabed if the anchoring system would be loosened, resulting in the scraping of benthic marine life. The result would be temporary disturbance or injury and mortality. There would be a minor risk that derelict fishing gear would become entangled on the mooring lines and continue to fish and result in the mortality of project area fish. There would be a minor risk that sharks, skates, and rays would become temporarily disoriented upon passing through EMF emitted from the project's electric lines or altogether avoid the area in the immediate vicinity of the submarine transmission line because of EMF emissions.

4. Marine Mammals, Reptiles, and Seabirds

Affected Environment

The project would be located in an area that represents one of the most diverse marine mammal assemblages in North America. Twenty-nine species of marine mammals inhabit or migrate through the Sanctuary including cetaceans (both toothed and baleen whales), pinnipeds (seals and sea lions), and fissipeds (northern sea otters) (Sanctuary, 2007). All marine mammals in the area of the project receive federal protection under the MMPA with additional species also covered by the ESA. Federally listed species are also discussed in section V.C.6.

Cetaceans

Thirteen species of whales, dolphins, and porpoises may occur in the project area (letter from NMFS and NMSP filed February 16, 2007). These include several belonging to the suborder Mysticeti (or baleen whales): gray whale, humpback whale, blue whale, fin whale, and sei whale; and several belonging to the suborder Odontoceti (toothed whales): sperm whales, three stocks of killer whale (or orcas), harbor porpoise, Dall's porpoise, Pacific white-sided dolphin, and Risso's dolphin.[30] Although NMFS did not identify the minke whale as occurring in the project area, the Sanctuary (2007) indicates that it occurs regularly within the waters of the Sanctuary. Therefore, for completeness we have included this species in our analysis.

Gray whales are the most frequently seen cetacean off the Olympic Coast. They forage almost exclusively by benthic suction in areas having mud, sand, silt, or gravel bottoms. Amphipods are the primary component of their diet; however, their nonselective foraging ensures a varied diet (Washington DFW, 1997).

Two stocks of gray whales have been recognized in the North Pacific for management purposes: the Eastern North Pacific stock, which lives along the west coast of North America and the Western North Pacific or "Korean" stock which lives along the coast of eastern Asia (NMFS, 2005). The current minimum population estimate for the eastern North Pacific stock which occurs in the project area is 17,752 and has been increasing for several years while being subject to known subsistence/native harvests. In 1997, the International Whaling Commission approved a 5-year quota (1998-2002) of 620 gray whales, with an annual cap of 140 for Russian and U.S. (Makah Tribe) aboriginals based on the

[30] The baleen whales are filter feeders that feed on zooplankton, while the toothed whales are predators feeding on fish and other marine mammals.

aboriginal needs statements of each country.[31] Under the MMPA, the Potential Biological Removal (PBR)[32] for this stock is 417 animals. This stock is not classified as a "strategic" stock because the estimated annual level of human-caused mortality and serious injury (130.4), which includes mortalities from commercial fisheries (7.4), Russian harvest (122), and ship strikes (1), does not exceed the PBR.

Gray whales are the most coastal of the baleen whales. Gray whales migrate up and down the Pacific coast between their Alaskan feeding waters (summer) and Mexican breeding grounds (winter). The northbound migration occurs offshore of Washington from March through May and the southbound migration occurs in December and January (Washington DFW, 1997). Some studies suggest that gray whales migrate farther offshore of Washington during the southward migration. Green et al. (1995) reported that the mean distance offshore for southbound migrants off Washington was 15.7 miles compared to 7.3 miles offshore during the northward migration. Shelden et al. (2000) reported southward migrating gray whales as far as 29 miles offshore of Washington. NOAA (2001) reports that "there has been relatively little effort off Washington to document the timing of the migration because ... during their southward migration,

[31] NMFS is currently reviewing a February 14, 2005, request of the Makah Tribe to waive the protections of the MMPA to allow the tribe to continue treaty right subsistence hunting of the eastern North Pacific gray whales. The tribe would conduct treaty ceremonial and subsistence harvest of up to 20 gray whales from the stock in any five-year period, with a maximum of five whales per year, corresponding with aboriginal harvest subsistence quotas granted to the United States by the International Whaling Commission and implemented domestically by NMFS through the Whaling Convention Act, 16 U.S.C. 916 et seq, and occurring in usual and accustomed hunting grounds (http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpise/Gray-Whales/Request-for-MMPA-Waiver.cfm).

[32] Potential Biological Removal or PBR is the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population [16 U.S.C. § 1362(20)]. A total level of human-caused mortality that is less than the PBR is considered sustainable and consistent with the MMPA's goal of managing marine mammal stocks to achieve their optimum sustainable population level. Under 16 U.S.C. § 1362(2), the PBR for a particular marine mammal stock is calculated by taking the product of the following factors: the minimum population of the stock; one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and a recovery factor between 0.1 and 1.

gray whales travel well offshore through this area....” A few gray whales are known to reside in nearshore waters off of Washington during the summer (Washington DFW, 1997); these are referred to as the Pacific Coast feeding aggregation (letter from the Sanctuary to Finavera dated January 3, 2006, as reported in the PDEA at p. 5-32). NOAA (2001) states that “...these whales (1) move widely within and between areas on the Pacific coast to feed in the summer and fall, (2) are not always observed in the same area each year, and (3) may have several year gaps between resightings in studied areas.”

There are multiple populations of humpback whale in the North Pacific (NMFS, 2005c). The humpback forages by filtering their food (krill, sardines, anchovies, cod, sardines, mackerel, capelin, and others sorts of schooling fish) through baleen. Humpback whales are generally considered to inhabit waters over continental shelves, along their edges, and around some oceanic islands (NMFS, 1991). Migration paths are not completely known, but include open ocean and coastal waters (NMFS, 1991). The eastern North Pacific stock may migrate through the project area from its winter/spring calving and mating areas off the coast of Central America to its summer/fall feeding areas off coast of California to southern British Columbia. They are considered to occur regularly in the Sanctuary (Sanctuary, 2007). The minimum population estimate for this stock is approximately 1,158 (NMFS, 2005c); there is evidence that this population was growing in the 1980s and early 1990s at about 8 percent per year. Potential threats to this population include historical whaling (whaling ceased in 1966), entanglement and injury from fishing/trawling, ship strikes, and other human-caused mortality. The eastern North Pacific stock is considered a “depleted” and “strategic” stock under the MMPA because this stock is formally listed under the ESA. The estimated annual mortality and injury due to entanglement (1.2/yr), other anthropogenic sources (0.2/yr), plus ship strikes (0.2/yr) is less than the PBR allocation of 2.3 for U.S. waters (NMFS, 2005c). Annual human-caused mortality (>0.2 whales) is less than the 1.9 whales allowed under the PBR (NMFS, 2005c).

The blue whale is often found in coastal waters, but also inhabits and feeds far offshore in deep water; however they are thought to occur generally more offshore than northern right and humpback whales (NMFS, 1998). Its principal prey is euphausiids. There are thought to be as many as five populations of blue whales (NMFS, 2005b); however the eastern North Pacific stock feed in California waters in summer/fall (June to November) and migrate south to productive areas off Mexico in winter/spring. Blue whales are occasionally seen or heard off Oregon, but sightings are rare. The Marine Mammal Stock Assessments do not report any sightings off the coast of Washington. Collisions with vessels, entanglement in fishing gear, reduced zooplankton production due to habitat degradation, and disturbance from low-frequency noise are the most obvious potential indirect threats (NMFS, 1998). No population estimates have been established for the "eastern" stock, but this stock is believed to have been depleted by whaling. Because this species is listed as endangered under the ESA, it is automatically considered a depleted and strategic stock under the MMPA (NMFS, 2005b). The population appears to be growing.

Fin whales occur in the major oceans of the world and tend to be more prominent in temperate and polar waters. The MMPA stock assessment recognizes three stocks of fin whales in the North Pacific. Acoustic signals from the California/Oregon/Washington stock of fin whales have been detected year-round off northern California, Oregon, and Washington, with a concentration of vocal activity between September and February (NMFS, 2003b). The fin whale occurs rarely off the Sanctuary (Sanctuary, 2007). The minimum population of fin whales is estimated at 2,541 (NMFS, 2003b). Fin whales in the entire North Pacific are estimated to be at less than 38 percent (16,625 out of 43,500) of historic carrying capacity. Because fin whales are listed as endangered, the California to Washington stock is considered a "depleted" and "strategic" stock under the MMPA. Total fishery mortality due to fishery entanglement rates (1.0/yr) and ship strikes (0.4/yr) appears to be less than the calculated PBR (15). Increasing levels of anthropogenic noise has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound (NMFS, 2003b). They probably do not make large-scale migrations and feed on krill and small pelagic fish such as herring (Reeves et al., 2002).

Sei whales occur in subtropical and tropical waters and into the higher latitudes. Sei whales are known worldwide for their unpredictable occurrences, with a sudden influx into an area followed by disappearance and subsequent absence for years or even decades (Reeves et al., 2002). The MMPA stock assessment treats sei whales in the eastern North Pacific (east of longitude 180°) as a separate stock. Sei whales are distributed far out to sea in temperate regions of the world and do not appear to be associated with coastal features (NMFS, 2003c). They are rare off Washington, Oregon, and California, and there are no estimates of abundance or population trends for this stock. They are listed as rarely occurring in the Sanctuary (Sanctuary, 2007). Only two confirmed sightings and five possible sightings were made in California, Oregon, and Washington during extensive ship and aerial surveys in 1991, 1992, 1993, 1996, and 2001; none were reported from aerial surveys of Oregon and Washington between 1989 and 1990 (NMFS, 2003c). The abundance estimate for California, Oregon, and Washington waters out to 300 nautical miles is 56 whales; the minimum population estimate is 35. Because this species is listed as endangered, this stock is considered depleted and strategic under the MMPA. Sei whales usually travel alone or in small groups; little else is known of their behavior. They breed and calve in winter after an 11- to 12-month gestation period. They forage on small fish, squid, krill, and copepods.

Sperm whales are the largest of the odontocetes (toothed whales). Because sperm whales spend most of their time in deep waters, their diet consists of many larger organisms that also occupy deep waters of the ocean. Sperm whales feed near the ocean bottom, diving as deep as one mile to eat large squid (including giant squid), octopuses, rays, sharks, and fish (Reeves et al., 2002). Sperm whales tend to inhabit areas with a water depth of 1,968 feet (600 m) or more, and are uncommon in waters less than 984 feet (300 m) deep. Female sperm whales are generally found in deep waters (at least 3280 feet, or 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land (NMFS, 2003h). They are rarely observed in the Sanctuary (Sanctuary, 2007). The MMPA stock assessments divide sperm whale populations into three discrete, non-contiguous areas; the California, Oregon, and Washington waters are relevant to this analysis (NMFS, 2003h; Carretta et al., 2001; Dohl et al., 1983). Sperm whales have been seen in every season except winter (December – February) in Washington and Oregon; they are found year-round in California waters (NMFS, 2003h). A combined visual and acoustic line transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 sperm whales based on visual sightings, and 39,200 based on acoustic detections and visual group size estimates (Carretta et al., 2001). The minimum population estimate for this stock is 885. Because the species is listed as endangered, the California to Washington stock is considered depleted and strategic. The annual rate of kill and serious injury (1.0/yr) is less than the PBR (1.8).

Killer whales are the most widely distributed cetacean species in the world. Killer whales, also called orcas, occur seasonally and year-round off of the Washington coast and are thought to be composed of distinct ecotypes: resident, transient, and offshore (NMFS, 2006c, 2003e, and 2000; Carretta et al., 2005; ACS, 2003). These three “ecotypes” are different populations of killer whales that vary in morphology, ecology, behavior, and genetics. All three ecotypes of killer whales share at least part of a home range, yet they are not known to intermix with one another. Resident killer whales in the North Pacific consist of the following groups: Southern, Northern, Southern Alaska, and Western Alaska North Pacific Residents. They occur in small highly stable social units known as matrilines, in which all individuals are maternally related. Pods are larger social groups composed of several matrilines and typically hold about 10 to 60 whales (Wiles, 2004). The Southern Resident killer whale (SRKW) population, applicable to this analysis, contains three pods (or stable family-related groups)--J pod, K pod, and

L pod (totaling between 80 and 100 animals)--and is considered a stock under the MMPA. Their range during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. These pods have been seen in inland Washington waters and off the coast of Washington (as far south as Grays Harbor) and southern British Columbia. Little is known about the winter movements and range of the Southern Resident stock. In the eastern North Pacific, the "resident" killer whale populations mainly feed on salmonids such as Chinook and chum salmon (NMFS, 2007a). The eastern North Pacific southern resident stock population is estimated at a minimum of 91 animals. NOAA reports that the southern resident population has experienced a 20 percent decline in the 1990s and that this population is at risk from "...vessel traffic, toxic chemicals and limits on availability of food, especially salmon. It has only a small number of sexually mature males. Because the population historically has been small, it is susceptible to catastrophic risks, such as disease or oil spills." Because this stock is listed as endangered, it is automatically considered a depleted and strategic stock under the MMPA. The estimated annual level of human-caused mortality and serious injury (primarily ship strike of one individual) is 0.2 animals, which exceeds the PBR (0.18) (NMFS, 2006c).

Transient killer whales occur throughout the eastern North Pacific, primarily in coastal waters. Their geographical range overlaps that of the resident and offshore killer whales. Individual transient killer whales have been documented as traveling great distances, reflecting a large home range. Pod structure is small (*e.g.*, fewer than 10 whales) and dynamic in nature. Transient killer whales feed exclusively on other marine mammals such as dolphins, sea lions, and seals (NMFS, 2007a). The minimum population estimate for eastern North Pacific transient stock of killer whales is 346, which includes animals found in Canadian waters. Killer whales are not federally listed nor are they listed as a depleted stock under the MMPA. Because the estimated annual level of human-caused mortality and serious injury (0.8/yr) is below the PBR (2.8), the transient stock is not classified as a strategic stock (NMFS, 2000).

Offshore killer whales have the largest geographic range of any killer whale community in the northeastern Pacific and usually occur 9 miles (15 km) or more offshore, but also visit coastal waters and occasionally enter protected inshore waters. Animals typically congregate in groups of 20-75 animals with occasional sightings of larger groups up to 200 whales, and are presumed to feed primarily on fish (NMFS, 2007a). The total number of offshore killer whales off the U.S. west coast, Canada, and Alaska is 211. They are not listed under ESA, or depleted under the MMPA. There is no documented human-caused mortality of this stock; therefore it is not classified as a strategic stock under the MMPA (NMFS, 2003e).

Harbor porpoise are found in the eastern North Pacific Ocean in coastal and inland waters from Alaska to California. They occur year-round in the inland waters of Washington and along the Oregon/Washington coast. Harbor porpoise, are considered common off the Olympic Coast (Sanctuary, 2007). DNA research and aerial survey efforts suggest two distinct stocks: Oregon/Washington coast stock found between Cape Blanco, Oregon and Cape Flattery, Washington and Washington Inland Waters stock (in waters east of Cape Flattery); the Oregon/Washington coast stock is applicable here. The minimum population estimate for this stock is 27,705. Principal sources of mortality are associated with gillnet fishing. Harbor porpoises are not listed as endangered or as depleted stocks under the MMPA. Current data indicate that the level of human-caused mortality and serious injury (0.6/yr) does not exceed the PBR (2.7); therefore, it is not classified as strategic (NMFS, 2006d).

Dall's porpoise are endemic to temperate waters of the North Pacific Ocean. They are commonly seen in shelf, slope, and offshore waters. Dall's porpoise are considered rare off the Olympic Coast (Sanctuary, 2007). Dall's porpoise off the coast of California, Oregon, and Washington exhibit a north-south movement between the states as oceanographic conditions change, both on a seasonal and inter-annual time scale. For management purposes, the MMPA stock assessments divided the Dall's porpoise into two discrete non-contiguous areas: waters off California, Oregon, and Washington (applicable to this analysis), and Alaskan waters. The minimum population estimate for this stock is 75,915. The status of the stock is unknown and there is insufficient data to evaluate population trends. No habitat issues are known to be a concern for this species. The species is not listed under the ESA, or classified as depleted under the MMPA. The average annual human-caused mortality in 1997-2001 (7 animals) is estimated to be less than the PBR (729); therefore, it is not classified as a strategic stock (NMFS, 2003g).

Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean; they have been observed mostly in shelf and slope waters (NMFS, 2003f). White-sided dolphins are considered accidental in the Sanctuary (Sanctuary, 2007). Aerial and shipboard surveys suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer (NMFS, 2003f). Pacific white-sided dolphins are known to consume hake, anchovies, squid, and sardines. The minimum population estimate for this stock is 39,822 (NMFS, 2003f). The status of this stock is unknown. No habitat issues are known to be of concern to this stock. This stock is not listed under the ESA, and it is not considered depleted or a strategic stock under the MMPA (NMFS, 2003f).

In the Pacific Northwest, Risso's dolphin is commonly seen off the continental shelf in the Southern California Bight and in slope and offshore waters of California, Oregon and Washington. NMFS (2003a) divides the populations of Risso's dolphin into two discrete, non-contiguous areas. This analysis is concerned with the California/Oregon/Washington stock. The distribution of Risso's dolphin off the coast of California, Oregon, and Washington is variable, and apparently changes in response to oceanographic conditions on a seasonal and inter-annual time scale. They are found off the coast of Oregon/Washington in the late spring and summer as water temperatures increase (NMFS, 2003a). They occur regularly in the Sanctuary (Sanctuary, 2007). The diet of Risso's dolphin consists of mainly of cephalopods (especially squid), crustaceans and occasionally small fish (NMFS, 2007b). The minimum population estimate for this stock is 12,748. The status of the species is unknown. No habitat issues are known to be of concern to this stock. This stock is not listed under the ESA, and it is not considered depleted or a strategic stock under the MMPA (NMFS, 2003).

Minke whales are one of the most widely distributed of baleen whales, ranging from South America to Alaska. They regularly occur in the Sanctuary (Sanctuary, 2007). For management, NMFS (2003d) recognizes a California, Oregon, and Washington stock. The minimum population estimate for the stock is 585. They are not endangered or threatened under the ESA, or depleted under the MMPA. The stock is not listed as strategic under the MMPA, and total human-caused mortality (zero) is less than the four minke whales allowed under the PBR formula. Little is known of their reproductive biology; presumably they calve in winter in tropical waters after about a ten-month gestation (Reeves et al., 2002). Some migrate as far north as the ice edge in summer. The diet of Minke whales consists of plankton, krill, and small fish, including schools of sardines, anchovies and herring. They have occasionally been caught in coastal gillnets off California (Hanan et al., 1993), in salmon drift gillnets in Puget Sound, Washington, and in drift gillnets off California and Oregon (Carretta et al., 2001). There have been no recent takes in groundfish fisheries off California, Oregon, or Washington (Carretta et al., 2001).

Harbor porpoises are common along coastal Washington, with the exception of southern Puget Sound (NOAA, 2001). They occur with regularity in the Sanctuary (Sanctuary, 2007). They typically travel singly or in small groups ranging from two to 10 animals (ACS, 2004*a*). This species frequents nearshore waters of depths less than 600 feet, with a preference for 25 fathoms (150 feet) or less. They are frequently seen in shallow bays, estuaries, and harbors. Harbor porpoises are present year-round, though seasonal changes in abundance occur along the state's west coast. This species is characterized by low movement and genetic analysis suggests that numerous stocks may occur (Carretta et al., 2005). Harbor porpoises give birth in Washington from May through July (NOAA, 2001). The population for coastal Oregon, north of Cape Blanco and Washington was 39,586 in 1997 and 26,175 in 1991. The only known source of human-caused mortality to harbor porpoises is from the gillnet fishery, which was estimated to result in a mortality of 3.2 harbor porpoises per year for the Oregon/Washington coast stock. This level of mortality is considered insignificant (Carretta et al., 2005).

Pinnipeds (Seals and Sea Lions) and Fissipeds (Sea Otter)

Seals and sea lions forage at sea, but come ashore for mating, birthing, nursing, and molting. Five pinniped species occur off of Washington: California sea lion, Steller sea lion, northern fur seal, harbor seal and elephant seal (Sanctuary, 2007; Jeffries et al., 2000).

California sea lions are seasonal inhabitants of Washington waters. The migrants consist mainly of adult and subadult males (greater than four to five years old) coming north from California and Mexico to feed (NOAA, 2001; Jeffries et al., 2000). They start arriving in August following the summer breeding season, staying throughout the winter, and returning to California during May and June. Small numbers of California sea lions are sighted in Makah Bay with larger concentrations occurring in Neah Bay and off of Cape Flattery (NOAA, 2001). California sea lion haul-out sites nearest to the project area are on Tatoosh Island and neighboring islands off of Cape Flattery (about five miles to the north of the project area); one site is used by up to 500 animals, and the other two identified sites are used by less than 100 (Jeffries et al., 2000). Jeffries et al. (2000) state that prior to the 1950s, this species was rarely seen in Washington; today, peak numbers of 3,000 to 5,000 occur in the northwest. NOAA (2001) reports that groups numbering 50 to 100 are commonly sighted off of Cape Flattery and Cape Alava (approximately 11 miles to the south of the project area); 4,000 to 5,000 California sea lions have been observed around the Bodelteh Islands, offshore of Cape Alava. The minimum population of the U.S. stock is 138,381 (NMFS, 2003j). California sea lions are not federally listed, and are not considered to be a depleted stock under the MMPA (NMFS, 2003j).

Steller sea lions live throughout the year in Washington, primarily along the outer coast, with highest numbers present from late summer through winter (NOAA, 2001; Jeffries et al., 2000). Steller sea lions do not breed in the state though there are rookeries in northern British Columbia and central Oregon where pupping occurs in May and June. Their population numbers have declined significantly during the last 15 years, and this species is listed as threatened under the ESA along the west coast of the U.S. (NOAA, 2001; Jeffries et al., 2000). The reasons for the population decrease are unknown (North Pacific Universities, 2005). Haul-out sites include jetties, offshore rocks, and coastal islands (Jeffries et al., 2000). In the project area, Steller sea lions frequently use several haul-out sites in the Makah usual and accustomed fishing and hunting area (Gearin and Scordino, 1995) with the haul-out sites nearest the project area being on Tatoosh Island and neighboring islands off of Cape Flattery (Jeffries et al., 2000). They are observed around Neah Bay throughout the year, but are most common from late August through April. Further to the south, off of Cape Alava (about 11 miles south of the project), more than 1,000 Steller sea lions have been seen on the Bodelteh Islands and on Guano Rock (NOAA, 2001). This species is considered to be common in the Sanctuary (Sanctuary, 2007). The minimum population level for the eastern U.S. stock, which occurs from southeast Alaska to California, is 44,555 (NMFS, 2006b). The eastern U.S. stock is stable or increasing throughout the northern portion of its range (southeast Alaska and British Columbia), but declining in its southern end, where habitat concerns are associated with reduced prey availability, contaminants, and disease. This stock is a depleted and strategic stock under MMPA.

Northern fur seals occur from southern California to the Bering Sea and west to Japan (NMFS, 2006a). The northern fur seal seasonally migrates through Washington waters an average of 10 miles and beyond offshore (NOAA, 2001). Jeffries et al. (2000) do not identify any northern fur seal haul-outs in Washington. Some northern fur seal have been observed in the Strait of Juan de Fuca and Puget Sound, but these instances are rare. Northern fur seal do not breed in the state, but rather in the Pribilof Islands in the Bering Sea with a lesser number breeding in the Channel Islands in California. Adult males stay in Alaska; females and juveniles will migrate as far south as southern California and northern Baja, Mexico. Most northern fur seals migrate northward in the middle of spring and reach the breeding ground in early summer (NOAA, 2001). This species is considered to be rare in the Sanctuary (Sanctuary, 2007).

Harbor seals are the most common marine mammal in Washington and are frequently sighted by boaters along the Washington coast. This non-migratory species lives year-round in Washington’s coastal waters (NOAA, 2001; Jeffries et al., 2000). The pupping season occurs from May through July along the Olympic Coast. Harbor seals use a variety of areas to rest or haul-out. Harbor seal densities can vary from groups numbering a few animals on some intertidal rocks to thousands of animals congregating seasonally in estuaries (Jeffries et al., 2000). In the project vicinity, harbor seal numbers are variable with lowest numbers occurring along the western Strait of Juan de Fuca while the highest densities occur at Cape Alava (NOAA, 2001). Jeffries et al., (2000) identified the following haul-out areas, each used by less than 100 harbor seals, in the project vicinity: 1) rocks and reef areas off Waatch Point; 2) areas around Skagway Rocks and Fuca Pillar (about three miles north of the project); and 3) reef areas off Portage Head (about three miles south of the project).

Northern elephant seals are the largest pinniped found off Washington. Breeding occurs in winter in California and Mexico with individuals migrating along Oregon and Washington following the breeding season and annual molt cycles. Males typically migrate to feeding areas south of the Aleutian Island while females feed in deep offshore areas off of Oregon and California. The population of northern elephant seals has grown significantly in recent years and now numbers more than 100,000 animals (Jeffries et al., 2000). However, this species is considered to be rare in the Sanctuary (Sanctuary, 2007).

Available information suggests that northern sea otters may occur in the project area; therefore, we have included this species in our analysis. Northern sea otters spend their entire lives in the water. Over-hunting led to extirpation of sea otters in the early 1900s. A successful reintroduction of Alaskan sea otters in 1969 and 1970 has allowed a sustaining population to develop.

During annual surveys conducted from 2000 to 2004, counts ranged from 500 to 743 sea otters (Lance et al., 2004). The majority of otters occur off the Olympic Coast, though some have been observed in the Strait of Juan de Fuca and off of Vancouver Island (Lance et al., 2004; Sanctuary, 2007). Most of the growth in the Washington sea otter population has occurred to the north of La Push, located about 30 miles south of the project area near the Clallam County and Jefferson County line, and around Destruction Island, located off the middle of the Jefferson County coast (Lance et al., 2004; NOAA, 2001). Washington DFW reports that sea otters occur off of Waatch Point, with five reported during Washington DFW's 1999 survey (letter and PHS resource maps from Washington DFW to Finavera, October 4, 2005, as reported in the PDEA at p. 5-35). The sea otter population is well established along the Olympic Coast and the range is slowly extending northward (NOAA, 2001).

In 1991, the range extended north to the proposed project area when a large group of sea otters established itself in Makah Bay (Jameson, 1998). NOAA (2001) reports that breeding and pupping of sea otters generally occur from Point of Arches (about six miles south of the project area) to the south, with a large concentration of sea otters near Cape Alava. In addition, sea otters are generally concentrated in areas with large quantities of kelp and generally stay in water that is quite shallow, usually 20 feet or less. Lance et al. (2004) reports that in Washington waters, sea otters generally remain in nearshore waters (seldom more than 0.5 to 1.5 miles from shore) up to 20 fathoms (60 feet) deep. However, sea otters are seen in nearshore open water in the area between Point of Arches and Cape Alava, where there is no rocky substrate, and therefore, little kelp.

Sea otters pup in late winter and early spring, and wean the pups in late summer and early fall. The Makah Tribe has expressed concerns about the effects of the expanding sea otter population on the Tribe's sea urchin fishery, but to date no actions have been taken. Laidre et al. (2002) described sea otter habitat use along the Washington coast using radio telemetry and resight data collected from 68 individuals. Adult males foraged deeper than juvenile males (52.5 and 46 feet, respectively), but the mean distance from shore for foraging was greater for juveniles than adults (0.9 and 0.7 miles, respectively). In contrast, juvenile females foraged deeper than adult females (12 m [39.3 feet] and 10 m [32.8 feet], respectively) and also foraged at mean distance from shore greater than adults (3,100 and 2,352 feet, respectively) (Lance et al., 2004).

Reptiles

Sea turtles that may occur off Washington are the leatherback sea turtle, green sea turtle, loggerhead sea turtle, and Pacific olive ridley sea turtle (NOAA, 2001). In Washington, the leatherback sea turtle is federally listed as endangered, and the green, loggerhead, and olive ridley sea turtles are federally listed as threatened.

The Pacific olive ridley sea turtle may be the most numerous sea turtle in the Pacific Ocean; however, "...ocean temperature restricts olive ridleys to waters well south of Washington. The state has only a single olive ridley record, a turtle that was found dead in Grays Harbor County" (Washington DFW, 2005*a*). It has been concluded that the olive ridley's range does not include Washington coastal waters (Richardson, 1997). In fact, all of these sea turtle species prefer warmer waters, and their occurrence off Washington is uncommon, though higher numbers of sea turtles occur during El Niño periods when currents warm off the Northwest (NOAA, 2001).

Seabirds

NOAA Sanctuaries and Reserves Division (1993) and FWS (2005) provide a detailed review of the seabirds, shorebirds, and other land birds using the Sanctuary and Flattery Rock National Wildlife Refuge. Seabirds, such as alcids, shearwaters, and gulls, feed in open waters from the shoreline and estuaries to the open ocean. Fourteen species of seabirds nest and rear their young on isolated and severe landscapes (such as rocky islands, sea stacks, and cliff sides) associated with refuge islands of the Washington Islands National Wildlife Refuge system, of which Flattery Rocks is part. These include: fork-tailed storm petrel, Leach's storm petrel, double-crested cormorant, Brandt's cormorant, pelagic cormorant, black oystercatcher, glaucous-winged/western gull, common murrie, pigeon guillemot, ancient murrelet, Cassin's auklet, rhinocerous auklet, and tufted puffin.

A large number of other seabird species use the area during migration and winter; during migration, over one million seabirds may use the area. Documented, non-breeding seabirds and other marine waterbirds include red-throated loon, Pacific loon, common loon, western grebe, brown pelican, sooty shearwater, white-winged scoter, surf scoter, black scoter, Caspian tern, common tern, parasitic jaeger, Heermann's gull, and California gull (FWS, 2005).

Some seabirds are strictly pelagic (generally forage far offshore over the continental shelf, continental slope, and in oceanic waters), while others prefer the nearshore environment (NOAA Sanctuaries and Reserves Division, 1993). Pelagic species come ashore to breed, but otherwise rarely visit land. Pelagic seabirds known to occur in the Sanctuary include northern fulmar, five species of shearwaters, black-footed albatross, arctic tern, pomarine jaeger, fork-tailed storm-petrel and Leach's storm-petrel. Nearshore seabirds feed within sight of land and include Pacific and red-throated loons, western grebes, brown pelicans, several species of gulls and cormorants, tufted puffins, common murres, and red-necked phalaropes. Common gulls in the project vicinity include Bonaparte's, mew, ring-billed, California, herring, Thayer's, western, and glaucous-winged.

Environmental Effects and Recommendations

Project effects would include direct and indirect contact and disturbance of marine life during project construction and periodic site maintenance; the creation of haul-outs for seals and sea lions and roosts sites for seabirds; noise effects on marine mammals and sea birds; marine mammal and seabird entanglement and collision with the buoy mooring system and the transmission cable; and electromagnetic fields effects on marine mammal behavior and migration. Because of their rarity in project waters, no impacts to sea turtles are expected. We discuss each of the above effects in turn below.

Direct and Indirect Contact During Construction

Potential construction effects from installing the AquaBuOYs and transmission cable include direct or indirect contact with vessels and equipment and general disturbance from construction presence.

Finavera provided conceptual procedures for deploying the buoys and transmission line cable. Finavera intends to work with NMFS, NMSP, Washington DFW, FWS, and the Makah Tribe on the final design and installation procedures. NMSP conditions submitted under section 4(e) of the FPA include developing final engineering, design, and cable route selection in consultation with, and subject to, NMSP approval.

Staff Analysis

The use of a barge or other special ship would be needed to deploy the AquaBuOYs, VLA's, mooring systems, and the transmission cable. Construction is expected to occur during the summer months (June through September) when the ocean is calmest. Based on migration patterns, distribution, preferred habitats, seasonal use (summer months) and rarity, we find that of the 29 marine mammals that inhabit or migrate through the Sanctuary, nine may be present in the area of the buoys and transmission line cable during installation (table 4).

Ship noise and vibrations are likely to be heard by marine mammals and may cause them to leave the immediate construction area. Marine mammals are already exposed to some commercial/recreational fishing that occurs in the Sanctuary, so they may be somewhat habituated to human presence.

To ensure accurate placement of the transmission cable and installation of the VLA's, ship speed should be slow enough for any marine mammals that may be present to avoid contact with the vessels. Some species (sea otter, California sea lion, minke whale) commonly exhibit elusive behaviors to disturbance. Consequently, as the vessel(s) deploy the transmission line cable, AquaBuOYs, and the buoy's anchoring and mooring systems, there is a slight chance that marine mammals could be hit by the ship or struck by equipment.

Gray whales have been known to exhibit curiosity toward boats. Construction of the project is anticipated to occur during the summer, when gray whales will not be migrating through the area. Therefore, no interference to migrating whales associated with the deployment of the buoys and cable laying operations is expected. If the Pacific coast feeding aggregation that summer off the Washington Coast[33] occurs off the Makah Bay during installation, they could be struck by the vessel or equipment. However, given their rarity and the variability in the occurrence in any given year, the possibility of collision is small.

[33]As discussed earlier, a few gray whales are known to reside in nearshore waters off of Washington during the summer (Washington DFW, 1997; letter from Sanctuary to Finavera, dated January 3, 2005, as reported in the PDEA at p. 5-32). NOAA (2001) points out that Calambokidis and Quan (1999) and Quan (2000) found that "...these whales 1) move widely within and between areas on the Pacific coast to feed in the summer and fall, 2) are not always observed in the same area each year, and 3) may have several year gaps between resightings in studied areas."

Table 4. Potential marine mammal occurrence in the proposed project area.

Species/stock	Status	Likely to occur in project area	Potential Project Effects
Gray whale (*Balaena glacialis*)/Eastern North Pacific	E, SE	Yes; regular; between March and May, but most average 7 miles or more from shore; some summer residents	Exposure to low intensity noise; low potential for collision and entanglement with mooring lines and marine debris
Humpback whale (*Megaptera novaeangliae*)/Eastern North Pacific	E, SE	Yes; regular; summer and fall	Exposure to low intensity noise; some potential for collision and entanglement with mooring lines and marine debris
Blue whale (*Balaenoptera musculus*)/Eastern North Pacific	E, SE	No; rare; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Fin whale (*Balaenoptera physalus*)/California-Oregon-Washington	E, SE	No; rare, year-round	No effect due to lack of habitat and rarity
Sei whale (*Balaenoptera borealis*)/ Eastern North Pacific	E, SE	No, rare; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Sperm whale (*Physeter macrocephalus*)/ California-Oregon-Washington	E, SE	No; rare; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Minke whale (*Balaenoptera acutorostrata*)/California-Oregon-Washington	--, --	No; likely rare off coast of Washington	No effect due to lack of habitat and rarity
Killer whale (*Orcinus orca*)/southern resident	E, SE	Yes; regular; spring-fall	Ship strike, exposure to low intensity noise, entanglement and collision with mooring lines and

Table 4. Potential marine mammal occurrence in the proposed project area.

			marine debris
Killer whale/transient	--, SE	Yes; regular; year-round in coastal waters	Ship strike, exposure to low intensity noise, entanglement and collision with mooring lines and marine debris
Killer whale/offshore	--, SE	No; Prefers deeper, offshore habitats	No effect due to lack of habitat
Harbor porpoise (*Phocoenoides phocoena*)/Oregon-Washington Coast	--, SC	Yes; common; year-round in coastal and in-land waters	Ship strike, exposure to low intensity noise, entanglement and collision with mooring lines, cable, and marine debris
Dall's porpoise (*Phocoenoides dalli*)/California-Oregon-Washington	--, --	No; rare; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)/ California-Oregon-Washington Northern stock	--, --	No; accidental; late spring/summer; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Risso's dolphin (*Grampus griseus*)/California-Oregon-Washington	--, --	No; regular; late spring and fall on slope/off shore waters	No effect due to lack of habitat and rarity
California sea lion(Zalophus californianus)/U.S. stock	--, --	Yes; regular; August through May	Not likely to be present during construction; during operation—exposure to low intensity noise entanglement with mooring lines and marine debris
Steller sea lion (*Eumetopias*	T, ST	Yes; regular; year-round	Ship strike, exposure to low

Table 4. Potential marine mammal occurrence in the proposed project area.

jubatus)/U.S. stock			intensity noise; entanglement and collision with mooring lines and marine debris
Northern fur seal (*Callorhunus ursinus*)/Eastern North Pacific	--, --	No; rare; usually ≥10 miles off coast of Washington; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Harbor seal (*Phoca vitulina*)/Oregon-Washington Coast	--, --	Yes; common; year-round	Ship strike, exposure to low intensity noise, entanglement and collision with mooring lines, cable, and marine debris
Northern elephant seal (*Mirounga angustirostris*)/California	T, --	No; rare; prefers deeper, offshore habitats	No effect due to lack of habitat and rarity
Sea otter (*Enhydra lutris*)/Washington	--, SE	Yes; regular; year-round in near shore waters	Ship strike, entanglement and collision with cable and marine debris

E= Federally Endangered; T= Federally Threatened; SE= Washington Endangered; ST: Washington Threatened; SC: Washington Species of Concern

Because of the low level of vessel traffic and slow speeds that would occur during construction, the likelihood of a ship strike with marine mammals is low. Exposure to ship strikes and construction disturbance would be short-term in nature. Deployment of buoys would occur in two phases. During the first phase, Finavera would install and monitor one buoy for survivability. The second phase would follow with the installation of the remaining three buoys. Finavera expects installation to be completed in 3 months.

California sea lions, harbor seals, and other pinnipeds haul out on islands and rocky outcrops nearshore. Although no known rookeries or haul-out areas occur in Makah Bay, Finavera reports that there are some rocky outcrops in Makah Bay that are exposed at low tide that could be used by pinnipeds as haul-out areas. Activities associated with the HDD could flush any pinnipeds using these outcrops and displace them from the haul-out sites for the duration of the drilling, which we estimate to be no more than 20 days.

The potential for encountering marine mammals during installation would be greatest during the laying of 3.5 miles of transmission cable. We estimate that the cable could be laid and anchored within 3 to 5 days. The potential for adverse effects to marine mammals during these activities could be minimized through the use of a trained marine mammal observer that would follow defined protocols if, and when, marine mammals are observed. For example, the observer could record an individual or group of animals' behavior and notify the vessel operator when marine mammals are observed within a defined distance of the vessel (say, 1000 yards); if they move closer (say, 500 yards), the observer would notify the vessel operator and the cable-laying operations could be reduced to half-speed; if the individual or group comes closer (say, 100 yards), the operations would cease until the animals had moved beyond a specified distance. Cable laying operations are likely to continue 24 hours a day until completed. Thus, during the night, low-light binoculars would be needed to make observations. These procedures could be incorporated into the final design and installation plans required by NMSP.

The presence of, and noise associated with, the construction vessel could also disrupt seabirds foraging near the project area. Seabirds in the project area are routinely exposed to commercial and recreational fishing vessels; thus, they are likely to be somewhat habituated to similar disturbances. Seabirds are expected to return to the project area shortly after passage of the vessel and would not be permanently displaced from the project area. Thus, any effects of construction would be short-term and localized.

We discuss the costs associated with developing and implementing project design and installation plans in section VI and make our recommendation in section VII.

Marine Mammal and Seabird Entanglement and Collision during Operation

Washington DFW, NMFS, NMSP, FWS, and Washington DNR are concerned that resident and migrating whales and dolphins may not detect the array of cables associated with the AquaBuOY mooring system and subsequently strike the lines and become injured or become disoriented. Additionally, NMFS, NMSP, FWS and Washington DFW are concerned that abandoned fishing gear or other debris may snag the mooring system and create a trap that could harm marine mammals and seabirds. FWS also expressed concern that the buoy and anchor system may affect surface feeding and diving seabirds.

Washington DFW, NMFS, NMSP, FWS, Washington DNR and the Sanctuary Advisory Council recommend that Finavera develop a mitigation and monitoring plan to determine the extent of interactions between marine mammals and the anchoring system. NMSP conditions stipulate implementation of an installation inspection plan that would include, at a minimum, biannual site inspections (more frequently as additional data becomes available and if NMSP determines necessary) to ascertain the physical condition of the installation (all buoys, anchors, and mooring cables), to ensure the integrity and performance of the installation, to determine the risks to marine mammals and other Sanctuary resources, and to search for and address marine debris caught on project components. The inspection plan would define the scheduling, tasks, observations, and reporting by Finavera. NMSP conditions also provide for Finavera to develop and implement a mitigation and monitoring plan to: (1) prevent marine mammal entanglement; (2) notify NMFS of any documented entanglement of marine mammals; and (3) make available to NMFS boats and contractors to assist NMFS in recovering entangled marine mammals.

FWS recommends that Finavera monitor seabirds at and near the offshore project site; however, FWS does not explain what it expects Finavera to monitor or how. The Sanctuary Advisory Council recommends that Finavera visit the buoys at intervals of no less than 60 days and monitor the anchoring system, cables and transmission cable by Remotely Operated Vehicle (ROV) or SCUBA diver to assess project integrity as well as potential entanglement of fishing gear and marine mammals.

Washington DFW recommends that visual or acoustic monitoring be employed continually for a minimum of ten years to help determine how marine mammals interact with the project. Washington DFW recommends that underwater real-time monitoring be used. Remote monitoring would be accomplished by installing detectors on the anchors or buoys, which would only record the project area when a sound or sight of significance is detected.

Finavera proposes to develop a monitoring plan for review and approval of the agencies. During a March 15, 2007, agency meeting Finavera proposed to install "pingers" to deter marine mammals from approaching the buoy portion of the project (see letter filed by Finavera on April 3, 2007).

Staff Analysis

Of the marine mammals that may occur in the Sanctuary (table 4), eight (gray whale, humpback whale, killer whales [resident and transient stocks], harbor porpoise, California sea lion, Steller sea lion, and harbor seal) have the potential come in contact with the buoy mooring and anchoring system. The other marine mammals prefer deeper water habitats on the outer continental shelf and slope further out to sea than the project (*i.e.*, greater than 3.7 miles from the coast). All the above marine mammals have been documented to forage at depths equal to or greater than those found in the project area, thus they could encounter all project components. For example, harbor seals, northern sea lions, and California sea lions have been documented to forage at depths >328 feet (Stewart and DeLong, 1994; Small et al., 2001). The majority of migrating gray whales should not pass close to the project site.[34] Any gray whales migrating nearer to shore or some of the few (Washington DFW, 1997) Pacific coast feeding aggregation that summer off the Washington Coast could encounter the project. Because gray whales regularly forage along the seafloor by plowing sediment for invertebrates, they may be particularly susceptible to encounters with the mooring lines and unburied portions of the submarine transmission line. Because sea otter prefer nearshore waters, they are likely to only come in contact with the submarine transmission line.

The exposed transmission cable and the buoy's mooring system can catch derelict fishing gear—lost or abandoned fishing nets, lines, and pots that are sometimes called "ghost nets" because they continue to indiscriminately fish—and other marine debris. Derelict fishing gear is a common problem off the coast of Washington and has been implicated in the death and injury of harbor seals, sea birds and a variety of fish species. A derelict gear survey in Clallam County recovered 52 derelict crab pots (Northwest Straights Evaluation Panel, 2004). There is no information on the amount of derelict gear found in the Sanctuary, but this area is used for some types of commercial/recreational fishing (predominately gill netting and long-line fishing). In addition, fish caught in derelict gear can attract foraging seals, sea lions, and seabirds, placing these animals at risk of entanglement.

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[34] Green et al. (1995) reports the mean distance offshore for southbound gray whale migrants off Washington was 15.7 miles compared to 7.3 miles offshore during the northward migration. Shelden et al. (2000) reported southward migrating gray whales as far as 29 miles offshore of Washington. NOAA (2001) reports that "there has been relatively little effort off Washington to document the timing of the migration because ... during their southward migration, gray whales travel well offshore through this area (Pike, 1962; Green et al., 1995; Shelden et al., 2000)...."

Because the buoy anchoring system and mooring lines would extend from the surface to seabed, a variety of pelagic seabirds could encounter the buoys, surface mooring lines and power cables, subsurface mooring lines, and any derelict fishing gear that may be suspended from the mooring lines. Several species of seabirds found in the area of the buoys and transmission cable are capable of diving to depths in excess of 150 feet. For example, common murres are known to regularly dive to a depth of 230 feet, with occasional dives as deep as 590 feet (Piatt and Nettleship, 1985, Bryant and Jones, 1999). Other divers that could encounter project mooring lines include several species of shearwaters and the tufted puffin. Surface feeders, such as fork-tailed storm petrel, Leaches storm petrel, northern fulmars, and several gull species are less likely to encounter the subsurface buoy mooring lines, but may encounter the surface mooring lines and power cables during foraging. All the above seabirds should see the mooring lines and take avoidance measures. Some of the divers may not notice derelict fishing gear trapped on the mooring lines and become entangled and die. The potential for seabird conflict with project components may be greater for fish-eating birds (*i.e.*, tufted puffin and ancient murrelet), because the buoys may have a "reef" effect attracting some prey.

Because the transmission cable would be buried for about the first 1,200 feet to avoid sea grass beds, most shorebirds (*e.g.*, sandpipers, turnstones, several species of waterfowl) and nearshore surface- to shallow-feeding seabirds (*e.g.*, pigeon guillemot, gulls, brown pelican) would not likely encounter the approximately 8-inch diameter transmission cable. Some divers, however, may still encounter the transmission cable.

Although marine mammals and seabirds are subject to entanglement with the mooring system and transmission cable, particularly where they are suspended above the seabed, the risk of entanglement is reduced by certain aspects of the system. To assess the potential for entanglement, it is helpful to review the mooring system. The mooring system for each AquaBuOY would consist of four VLA's placed approximately in a square pattern on the ocean floor with the AquaBuOY approximately centered on the surface above. From buoy to anchor, each mooring consists of a tension cable attached to a surface float followed by a cable fastened to a chain, which is fixed to a float just above the seafloor to prevent chain scouring, followed by chain fixed to the VLA. Each AquaBuOY hull would be tethered to four floats used to lift the mooring chain from the seafloor to prevent harm to the seafloor. The mooring chains would be about 6 inches in diameter, and floats would each be about 4 feet in diameter. Heave forces acting on the surface floats and seafloor floats would be dampened by lifting the chain from the VLA.[35] Each VLA would be installed like a conventional drag embedment anchor, but

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[35] Finavera's decision to use VLAs instead of concrete anchors would eliminate excess cable associated with a concrete block anchoring system, resulting in reduced potential for entanglement.

penetrate much deeper. The anchor system, consisting of a total of 10 VLA's and 10 surface floats, would cover a rectangular area of approximately 625 by 450 feet on the ocean floor.

Due to the mass of the buoys and the VLA's, combined with the strength/resistance of the mooring cables and chains, the mooring system is expected to have adequate tension to preclude forming loops or to twist around a passing animal. The spacing of the buoys and chains (60 feet apart from each other) further minimizes the likelihood of entanglement by providing room for cetaceans and other marine life to pass between the buoys and the mooring lines. The portion of the transmission cable that is anchored to the seafloor would be deployed in such a way as to provide maximum contour to the seafloor to minimize spaces where marine mammals and seabirds could become trapped. The 8-inch cable would be under sufficient tension (*i.e.*, taut enough) to prevent standing loops that could entangle marine mammals and birds. While currents may cover (and uncover) the transmission line to varying degrees, suspensions off the sea floor should be minimal, which reduces the likelihood of animal entanglement. Therefore, the risk of entanglement is remote.

NOAA says the biannual anchor inspections would serve to determine if marine mammals have become entangled in project components. Biannual visual inspections would also be adequate to ensure that the integrity of the transmission cable and project mooring system is maintained and that no derelict and abandoned fishing gear is being captured, minimizing the risk of marine mammals and diving seabirds to entanglement. Such visual monitoring efforts would likely require the use of a SCUBA diver or remotely-operated vehicle (ROV). More frequent sampling as recommended by the Sanctuary Advisory Council would provide greater assurance that entangled marine mammals and birds are documented and recovered. However, available information suggests that the risk of entanglement is low, thus more frequent inspections are not warranted at this time.

Even though we believe that the mooring system is not likely to represent an entanglement hazard for marine mammals for the reasons discussed above, feeding and migrating cetaceans could still collide with the mooring cables and chains if they are not detected and avoided. Washington DFW believes that this could result in cuts, abrasions, or other injury if the collision occurs at high speeds, noting that many marine mammals can reach speeds faster than 30 miles per hour.

Many cetaceans use echolocation for long distance navigation, feeding, group interactions, and prey tracking. Washington DFW believes that based on the size of the anchor lines, it is likely that only focused short frequency soundings by marine mammals would detect the lines. Washington DFW notes that cetaceans may use these frequencies intermittently, and thus may not detect the mooring lines until it is too late to avoid them. Some recent acoustic studies of dolphins around fishing nets found that they do not appear to always echolocate.[36] Additionally, echolocation is mainly used in odontocetes (*e.g.*, killer whale); mysticetes (*e.g.*, gray whale) are not known to echolocate (Ketten, 2007).

Because of the small area occupied by the project relative to vastness of the open ocean, we believe that the potential for marine mammals to encounter the buoy array is small, unless there is a particular attraction such as a food source, in which case, the whale or dolphin may detect the anchor lines and avoid collision. We also suspect that because the project's cables would be similar in size and type to anchoring systems associated with navigation buoys, the potential for collisions and injury is low. We found no information that would suggest that navigation buoys have resulted in injury to marine mammals. While there would be an array of 10 such cables at the project compared to a single one associated with a navigation buoy, the spacing between the cables (60 feet) should be sufficient for most species to avoid hitting the cables.

Nonetheless, the ability of marine mammals and seabirds to detect and react to this new technology and its anchoring and mooring system is not well understood. Washington DFW believes that remote acoustic or visual monitoring of cetaceans for a period of ten years is needed to fill this knowledge gap. The monitoring efforts recommended by Washington DFW would use a hydrophone or visual methods to monitor cetacean interactions with the buoys, mooring lines, and transmission cable. However, we are unclear exactly how such systems would document a collision with a project component, and we have found no studies using these technologies for this purpose. Presumably, changes in echolocation signals or movement patterns picked up by the acoustic monitoring device would suggest that cetaceans have detected and are avoiding the project components. However, this may or may not be the case.

Nonetheless, acoustic monitoring has been used to look at environmental impacts of noise producing processes, cetacean habitat use, activity patterns, and behavior (Leeney and Tregenza, 2006). These studies aimed to detect substantial changes in cetacean activity, primarily through a before and after comparison, and therefore, do not directly answer whether cetaceans collide with project components. Similarly, monitoring of seabird use at and near the buoys may detect changes in foraging behaviors and flight patterns around the buoys; however, it is unlikely that monitoring would detect collisions.

Regardless, our understanding of how marine mammals will interact with the buoys and their mooring and anchoring system is not well understood. Monitoring of marine mammals could provide valuable insight to their behaviors around and any attraction to project components. Similarly, monitoring seabird use and behavior in the

[36] See http://www.chelonia.co.uk/html/fisheries.html

vicinity of the buoys and in nearby unaffected waters would help determine if the buoy and anchor/mooring lines are altering seabird foraging behavior and patterns. While site-specific baseline data requested by the Sanctuary Advisory Council is limited, there is sufficient information to assess the affected environment. The marine mammal and seabird monitoring recommended by Washington DFW and FWS would provide the necessary information to confirm project effects without additional baseline data.

Using "pingers" as proposed by Finavera may deter marine mammals from the project area, minimizing the potential risk of collision with the anchoring system. A "pinger" is an acoustic deterrent device that has been successfully used to prevent small cetaceans from becoming entangled in fishing nets. Pingers are usually small (hand-sized) devices that run for weeks, months or years on small batteries. The device is a relatively low intensity (source level: < 150 dB re 1 µPa at 1 m) sound generator that emits a signal in the middle to high frequencies (2.5 – 10 kilohertz [kHz; a thousand cycles per second]) with higher harmonic frequencies (up to 160 – 180 kHz) (Franse, 2005). Pingers (depending on type) emit pulses of sound. The pulses are emitted as sweeps—a tone which varies in frequency (Franse, 2005). Sweeps are unpleasant for most people and animals, thus making the pinger more effective (Franse, 2005).

While several studies have demonstrated that pingers are effective in reducing marine mammal entanglement in fish nets, how they work is still not completely understood (see Franse 2005 for a review). A number of hypotheses have been postulated. The most probable are annoyance, alert, or startle responses (Franse, 2005). The annoyance hypothesis suggests that cetaceans avoid the area the way humans avoid static or unpleasant noise. The alert hypothesis suggests that when cetaceans detect the sounds they investigate, detect the fishing net (in this case the anchor lines), and avoid it. The startle hypothesis suggests that cetaceans get startled and flee when hearing the sound of the pinger, a response that may diminish if animals become habituated to the sound.

A possible side-effect of the pinger is the exclusion of cetaceans from a significant or important portion of the environment. How much of an area that may be avoided would depend on the sound wave; the species; and the individual's age, sex, condition, and other factors (Franse, 2005; Thomsen et al., 2006). Similarly, detection of the sound wave and any effect on hearing will be species and individual specific. Pingers typically target dolphins and other toothed whales; thus, they may not be effective in deterring or alerting baleen whales (*i.e.*, humpback, gray).

If marine mammal injury or mortality is observed during operation and maintenance, having the established procedures defined by NOAA in a marine mammal entanglement and collision monitoring plan would aid working crews in quickly notifying appropriate authorities and defining appropriate corrective actions.

We discuss the costs associated with measures to avoid marine mammal entanglement and collision and to assess seabird use of the project area in section VI and make our recommendations in section VII.

AquaBuOYs as Pinniped Haul-outs and Seabird Roost and Nest Sites

It is believed that wave energy projects may provide artificial haul-outs for seals and sea lions, and result in the growth of populations of these species greater than would otherwise occur in the absence of the project (EPRI, 2004). While this is not necessarily an adverse effect, removal of the buoys could affect the increased populations that have become dependant on the haul-out sites. EPRI (2004) also believes they may serve as artificial nesting and roosting sites for seabirds.

In response to similar concerns raised by resource agencies (Finavera, 2005), Finavera has designed the above-water surface portion of the buoys to be conical in shape to prevent marine mammal haul-out on project equipment. NMFS, FWS, and Washington DFW support this design. Washington DFW recommends that the exclusion device be monitored in association with other maintenance activities to determine whether the exclusion devices are operating as intended. Finavera proposes to develop a monitoring plan that would address the effectiveness of the sea lion excluder device.

Staff Analysis

EPRI (2004) suggests that seals and sea lions may attempt to haul-out on any floating wave energy device that has a freeboard of less than 1 or 2 m (3 to 6 feet), at least in calm weather. The steel buoy containing the accumulator, generator, and Pelton turbine would be 16.4 feet high, and we estimate under calm seas would likely have sufficient freeboard (about 6.6 feet) to deter use by pinnipeds. However, Finivera states that the portion of the buoys above water is similar in size and shape to large navigational aids. Because seals and sea lions commonly use navigational buoys as haul-out sites to rest, it is reasonable to assume that they would attempt to use the buoys as haul-out sites. However, a heavy-duty plastic conical guard would be designed to cover the above-water portion of the buoy, eliminating flat surface areas on which the seals and sea lions could lay.

EPRI (2004) hypothesizes that a large scale development could create a significant amount of new hauling area, resulting in increased pinniped populations over the long-term relying on the artificial space. The Makah Project would not be of sufficient size to significantly influence populations.

EPRI (2004) also suggests that seabirds that commonly nest on offshore rocks and stacks may attempt to colonize caisson-based wave energy devices. The guard over the above water portion of the buoy would eliminate most surfaces (excluding the radar reflector and telemetry tower) upon which sea birds would roost or nest.

Sea lion excluder devices have been successfully used elsewhere. While we believe the conical guard would work as intended, periodic monitoring would identify any problems and needed corrective actions. Because such monitoring could coincide with routine inspections and operation and maintenance activities, the monitoring would not require a substantial amount of additional effort by Finavera.

Effects of Noise on Marine Mammals

Marine mammals would be exposed to both air and water-borne sources of noise during project construction and operation. If underwater noise in the marine environment from construction vessels and equipment exceeds background levels, noise could adversely effect marine mammals by disrupting migrations; interfering with or masking communications, prey and predator detection, and navigation; causing behavioral changes; causing habitat abandonment; or resulting in temporary or permanent hearing loss (Richardson et al., 1995).

NMSP conditions stipulate that Finavera design and implement a plan for measuring and monitoring project noise prior to deployment. The plan, to be developed in consultation with and approved by NMSP, would characterize the sound generated by the array and determine whether there is a detectable response by marine mammals. The monitoring program would measure the sound frequency and amplitude and attenuation over distance from the project site, and compare the results with Malme et al. (1984; 1988) and Moore and Clarke (2002) on acoustic disturbance to whales and other marine mammals. Field measurements of sound would be conducted, at a minimum, to a distance where values are below identified thresholds; NMFS has proposed 120 dB as a threshold from continuous noise sources for disturbance to marine mammals (70 FR 1871-1875, January 11, 2005). As noted earlier, Washington DFW recommends visual or acoustic monitoring for a minimum of 10 years to determine how marine mammals interact with the project. Ecology and the Sanctuary Advisory Council recommend an acoustic monitoring plan.

Finavera proposes to provide additional noise information based on either lab measurements, vendor specifications, or engineering calculations.

Staff Analysis

Marine mammals that may occur in the project area during construction include gray whale, humpback whale, killer whale (resident and transient stocks), harbor porpoise, California sea lion, Steller sea lion, harbor seal, and sea otter. All these species, except the sea otter which prefers inshore waters, would be exposed to operation noise on either a seasonal or regular basis.

Effects of noise on marine mammals are highly variable, and can be categorized as: (1) too weak to be heard (*i.e.*, lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both), thus no perceived response; (2) audible, but not strong enough to elicit any overt behavioral response; (3) eliciting reactions of variable conspicuousness and variable relevance to the well-being of the animal (*i.e.*, temporary alert responses to active avoidance of the area until the noise event ceases); (4) upon repeated exposure, diminishing responsiveness (habituation) to persistent disturbance effects (mostly associated with sounds that are highly variable, infrequent and unpredictable in occurrence and generally associated with perceived threats by the animal); (5) masking the ability of a marine mammal to hear natural sounds at similar frequencies, including calls of the same species and underwater environmental sounds such as surf noise; (6) inducing physiological stress (usually associated with chronic exposure to noise in areas where a mammal is reluctant to leave because the areas are important to breeding, feeding or other biological importance); and (7) temporary or permanent reduction in hearing sensitivity (*i.e.*, very strong sound levels that exceed the animals hearing threshold causing a temporary threshold shift in its hearing ability or in the case of intense acoustic (or explosive events) causing trauma to tissues and organs associated with hearing.

Sound induced effects on marine mammals are expected when the sound overlaps in frequency and level with the hearing capability of the species under consideration. There is considerable variation among marine mammals in both absolute hearing range and sensitivity. Their composite range is from ultrasonic (frequencies greater than 20 Hz) to infrasonic (frequencies less than 20 kHz). Marine mammals as a functional group have functional hearing ranges of 10 Hz to 200 kHz. Odontocetes and pinnipeds are most sensitive to higher frequencies and mysticetes are most sensitive to lower frequencies.

It is this variability that makes describing how marine mammals may respond physically and behaviorally to intense sounds and to long-term increases in ambient noise levels difficult. For example, high intensity sound may cause hearing threshold shifts. A temporary threshold shift study done on captive bottlenose dolphins and beluga exposed to 0.4, 4, and 30 kHz single underwater impulses from a seismic watergun showed no temporary threshold shifts in dolphins at the highest exposure condition of 229 dB, while the beluga whales exhibited masked temporary threshold shifts of 6 dB after exposure to 0.4 and 30 kHz impulses at 217 dB (Finneran et al., 2002). Behavioral responses to anthropogenic noise, such as changes in swimming speed and direction from a sound source was demonstrated by Malme et al (1984). Malme et al. (1984; 1988) exposed migrating gray whales to recordings of various underwater noise sources associated with oil and gas developments (helicopter overflights, drill ship operations, drilling and production platforms, semi-submersible drilling rig and tripping operations, and airgun arrays). Overall, Malme et al. (2003) concluded that a 0.5 probability of avoidance occurred when continuous noise levels exceeded about 120 dB and when intermittent noise levels exceeded about 170 dB.

Based on Malme et al. (1984; 1998), NMFS recognizes three general kinds of sounds: continuous (such as shipping sounds), intermittent (such as vibratory pile driving sounds), and impulse. NMFS uses a 160-dB threshold criterion as an estimate for Level B harassment for impulse sounds and 120-dB thresholds for both continuous and intermittent sources. NMFS uses 180 dB as a threshold for Level A harassment (*i.e.*, harassment that is likely to result in serious injury or death).

Ambient noise levels have not been measured at the project. They are expected to be high given the wave energy associated with the area. Existing anthropogenic sources of noise in the Sanctuary are limited to commercial fishing and recreation vessels. As described earlier in section V.C.3, we expect ambient sound intensities generally below 90 dB (re: 1 μPa) and likely higher during storms and high winds.

The major source of noise during construction includes barges or other vessels laying the transmission cable and towing and deploying the AquaBuOYs. No high intensity noises, such as pile driving, are expected to occur during construction or operation. Ship noise would be associated with ferrying workers and materials to offshore construction sites, laying underwater electrical cable, and providing work platforms for construction. Underwater ship noise is generated from three main sources; directly from turning propellers, indirectly from engine and other ship noises being projected though ships hulls, and directly from the interactions of waves with the ship's hull. Richardson et al. (1995) characterized noise signatures of common vessels; noise levels ranged from 156 dB (re: 1 μPa) at a frequency of 630 Hz for a small crew boat with an outboard engine to 171 dB (re: 1 μPa) at a frequency of 171 Hz for a tug pulling a barge. These sound levels likely represent ships fully underway. We expect ship and barge noise associated with installation and maintenance of offshore project facilities would be no more than 130-160 dB (re: 1 μPa) over a frequency range of 250-2,000 Hz (Thomsen et al., 2006), which is the peak sound intensity of a barge fully underway. We would expect to see lower sound intensity when project vessels are laying the transmission cable and deploying the buoys because they would likely be traveling at very slow speeds.

Additional sources of construction noise are likely from HDD. Using dredging as an approximation of the sound levels that may be produced during the excavation of entrance and exit pits and drilling noise, we expect sound intensities of no more than 150 to 180 dB (Greene, 1985; 1987). Sound levels are likely to be much less because of the dampening affect of the surf and the sand substrate.

These effects would be short term. Because the above sound levels exceed the 120-dB threshold level for continuous noise, construction activities may result in level B harassment taking under the MMPA. Neither the zone of ensonification emanating from these sources, nor the number of marine mammals that may be taken is known because there are no actual density estimates for the project area.

When in operation, the project is expected to produce low to mid-range noise levels. Sources of sound during operation include mechanical noise from generators and associate drive systems (*i.e.*, the hose pump and the pressurized water hitting the Pelton turbine), waves crashing against the buoys, tension against the mooring system, and periodic boat traffic associated with site inspections and operation and maintenance visits. Because most of the mechanical equipment (turbines and generators) would be above water and enclosed in a steel chamber, most noise should be damped by surrounding waves. EPRI (2004) speculates that "...noise from wave power plant machinery will generally increase in proportion to the ambient background noise associated with surface wave conditions, thus tending to minimize its noticeable effect." Likewise, the MMS (2007) expects operational noise from similar wave technologies to be generally low as a consequence of the low-intensity energy conversion mechanisms involved in these technologies.

As explained earlier (see section V.C.3), if we use noise generated from wind turbines as an estimate of what might be expected at the Makah Bay project, continuous operational noise between 90 and 115 dB (re: 1 μPa) at a frequency of 20 to 1,200 Hz might be experienced by marine mammals in the vicinity of the buoys. However, because the project represents a new technology, there is no information in the record explicit to this technology's sound production. In addition, there is no data on ambient noise levels in the project area. Thus, while we believe our estimates are reasonable, we cannot confirm that operational noise levels would remain under the 120 dB noise threshold level that constitutes Level B harassment under the MMPA and how far such sound levels would emanate for an array of four buoys. Therefore, we are conservatively assuming that harassment would occur to a small number of marine mammals from project operations.

Monitoring of ambient noise levels and project emissions during the first year of project operations would have the benefit of documenting noise levels produced specifically by the proposed wave energy technology. Such a monitoring plan would have a greater benefit if it also identified potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals. If monitoring demonstrates that sound thresholds exceed 120 dB, then additional monitoring of marine mammal behavior in the vicinity of the project and identification of possible corrective actions may be warranted.

We discuss the costs associated with assessing the level of noise produced by the proposed project in section VI and make our recommendation in section VII.

Effects of Electromagnetic Fields on Marine Mammals

Several marine mammals are thought to use geomagnetic fields for navigation (Walker et al., 1992; Kenney et al., 2001). Some agencies have expressed concern that the magnetic field component (B) of electromagnetic fields generated from undersea transmission cables may interfere with whale navigation.

NMSP conditions stipulate that Finavera provide, prior to deployment if possible, an engineering analysis of EMF strength associated with the transmission cable or bench testing of these properties of the cable. If such analysis cannot be conducted prior to deployment, Finavera would conduct post-deployment measurements of the cable's EMF strength. If predicted or measured EMF levels exceed 1000 µV/m, Finavera would develop a monitoring plan to assess the impacts of the EMF on marine mammals and other species sensitive to EMF, including field monitoring studies.

Finavera asserts that although direct current transmission lines do not emit EMFs, they would provide additional EMF information based on either lab measurements, vendor specifications, or engineering calculations.

Staff Analysis

We discuss the components and origin of electromagnetic fields and expected levels that may be generated by the Makah Bay Project in detail in section V.C.3. As noted previously, electric fields are shielded by the submarine transmission line materials, thus would have no effect on marine mammals. Here we focus on how magnetic field components of EMF may be perceived by and influence marine mammal behaviors.

Many phyla of marine organisms have been studied for their ability to detect magnetic fields in the natural environment. The principal focus of research has been to determine whether the earth's geomagnetic field can be detected and used in orientation and migration.

Gills et al. (2005) grouped organisms known (or presumed) to be able to detect magnetic fields into two groups based on their mode of magnetic field detection: induced electrical field detection and magnetite based detection. Those sensitive to electrical fields are mostly made up of elasmobranches (*e.g.*, skates and sharks) and appear to be the basis for NMSP and NMFS criteria for evaluating impacts. Magnetite-based organisms are those animals that are thought to be sensitive to magnetite deposits and use the earth's geomagnetic fields to navigate. These include birds, fish, and a number of cetaceans. Several cetaceans reported to respond to magnetic and or geomagnetic fields in United Kingdom waters (Gills et al., 2005) are also found off the Washington coast: harbor porpoise, Risso's dolphin, sperm whale, and fin whale. No pinnipeds were reported to be sensitive to magnetic fields.

Effects of magnetic fields from undersea transmission cables would depend on the field levels in combination with the species and life stages that would be exposed. A review was conducted of the potential environmental impacts of the Cross-Sound Cable project on marine species in Long Island Sound (Institute of Sustainable Energy, 2003). This study reached a conclusion that the DC magnetic field that could be generated by the 330 MW HVDC cable would cause the ambient DC magnetic field 1 m above the ground over the cable to increase or decrease within a range of about 31 percent, the change depending upon the orientation of the cable with respect to the earth's magnetic field. The study concluded that at the surface of the seabed, the maximum magnetic field produced by the cables would be approximately 0.16 Gauss. This level can be compared to the earth's natural magnetic field of 0.5 Gauss.

Based on the size of the project's transmission cable and small power output, the magnetic field produced by the project's cable would likely dissipate within a few feet above the seabed. Therefore, we conclude that the project's magnetic field would likely be indiscernible to marine mammals passing over the cable. Thus, the EMF generated from the project would not be likely to adversely affect any whales or other species.

Finavera has not developed sufficient specifications to determine the levels of EMF the Makah Bay Project cable would produce. Because the cable would not be buried as found in most cases reported in the above literature, our conclusions need to be verified. Verification could be accomplished by a site-specific assessment of EMF levels after the project would be operational.

We discuss the costs associated with assessing the level of EMF produced by the proposed project in section VI and make our recommendation in section VII.

Effects of Noise Seabirds

The ability of birds to discriminate between sounds of different frequencies and degrees of loudness appears to be no better than that of humans (Ehrlich et al., 1988). As a group, birds are most sensitive to sounds in the frequency range of 1-5 kHz, with an absolute upper limit (except for owls) of about 10 kHz. Even birds that use echolocation for maneuvering in the dark (Oilbirds and cave swiftlets) rely primarily on sounds in the 2-8 kHz range, in contrast to bats, which use ultrasonic frequencies (Ehrlich et al., 1988). As explained above, we expect most of the sound generated by the project to be low level, low frequency noise that would be shielded above water by the steel casing and dampened by ambient noise levels. Consequently, noise levels are not likely to be heard by seabirds and impacts on feeding or other behaviors would be negligible.

Unavoidable Adverse Impacts

Marine mammals and seabirds are likely to be disturbed by construction activities associated with the deployment of the buoys and laying the transmission cable. These impacts would be short-term.

Operation of the buoys would require periodic site inspections and maintenance which could result in a minor disturbance to marine mammals and seabirds in the area of the buoys. Although the project would create some noise during operation, operational noise levels are expected to be below harassment thresholds for marine mammals and seabirds. If monitoring shows otherwise, additional attenuation measures could be explored to mitigate the effect. The mooring and anchor lines could be a collision and entanglement hazard for marine mammals and seabirds; however, periodic inspections and monitoring would help identify the extent of this problem and any potential solutions.

5. Terrestrial Resources

Affected Environment

Plants

The land-based portion of the project would be located on Hobuck Beach. This area is within the Pacific Northwest Coast Ecoregion, which includes much of the Olympic Peninsula of Washington, the coast mountain ranges extending down to central Oregon, and most of Vancouver Island in British Columbia (Washington DNR, 2003).

Plant communities at the project site reflect natural and anthropogenic disturbances including coastal storms and flooding, roads, and an overhead transmission line. Three vegetation zones or cover types that correspond to increasing elevation above mean high water are found at the site: (1) beach; (2) dune; and (3) wooded.

The beach cover type includes areas periodically inundated by the tide along the gently sloping shoreline. This is the prevalent cover type within the project area. There is no urban development, and the most common vegetation is beach grass. Beaches furnish habitat for shorebirds, crows, gulls, and a host of other wildlife. The coastline forms an important migratory pathway for millions of birds that pass through each year, guiding ducks, geese, cranes and raptors toward northern breeding areas during the spring and southward, as winter approaches (Sanctuary, 2007). This cover type extends from mean high water to the aeolian[37] ramp (seaward side of the foredune). Common plant species occurring in this zone include Virginia glasswort and sea rocket. Washington DFW classifies Hobuck Beach as a marine wetland, which is considered a Priority Habitat (letter and PHS resource maps from Washington DFW to Finavera, October 4, 2005, as reported in the PDEA at p. 5-57).

The dune cover type includes the area from the aeolian ramp to the seaward edge of the wooded community. Plant species adapted to dunes must tolerate wind, sand burial, sand abrasion, salt spray, water deprivation, and salty shifting soils (Ecology, 2005). The foredunes in the project area are dominated by European beachgrass, whereas a greater variety of species were observed on the landward side of the dunes, including: American dunegrass, large-headed sedge, beach morning-glory, yellow sand verbena, northern dune tansy, smooth cats-ear, beach pea, American glehnia, seaside plantain, Labrador-tea, and western bracken fern. The dune cover type is well vegetated and no large areas devoid of vegetation were observed.

Woody vegetation begins to appear at slightly higher elevations on the landward side of the dune zone, first as scattered small shrubs, increasing to a low, shrubby thicket, and then small trees. Shrubs observed in this zone include wild blackberry, Himalayan blackberry, salmonberry, small red alder, willow, and rose. Sitka spruce is the dominant tree species, with occasional tree-sized red alder and red elderberry. A variety of herbaceous species were observed in this cover type roadside, including self-heal, orchard-grass, common horsetail, bracken fern, and occasional tansy ragwort. Because the project area only extends to Makah Passage Road, it does not encompass any heavily forested areas.

Finavera contacted Washington DNR to inquire about any plant species of state concern that occur in the proposed project vicinity. Washington DNR responded, in a letter dated September 13, 2005, (see PDEA at p. 5-58) that the following rare plants are currently or historically known to occur within one mile of the land portion of the project:

Common name	**Scientific name**	**Status**
Current species		
pink fawn-lily	*Erythronium revolutum*	state sensitive
western yellow oxalis	*Oxalis suksdorfii*	state threatened
Historical species		
pink sandverbena	*Abronia umbellata ssp.*	possibly extirpated

[37] A geomorphic process whereby soil forming material is transported and deposited by wind.

None of these species were observed during a June 26, 2005, site reconnaissance conducted by Finavera (see PDEA at p. 5-58).

Wildlife

The project vicinity supports over 100 species of marine seabird and shorebirds (Sanctuary, 2007). In addition, numerous mammal species and various species of amphibians, reptiles, mollusks, and insects may use the project area. The wildlife information in this section is based in part on visual observations that Finavera biologists conducted during various site investigations and from various reference sources.

The Sanctuary is a critical link in the Pacific flyway. Common waterfowl in the project vicinity include Eurasian wigeon, American wigeon, oldsquaw, black scoter, surf scoter, white-winged scoter, common goldeneye, and barrow's goldeneye (National Geographic Society [NGS], 1983).

Common shorebirds in the vicinity of the project area include black-bellied plover, pacific golden plover, killdeer, black oystercatcher, ruddy turnstone, black turnstone, red knot, sanderling, least sandpiper, rock sandpiper, dunlin, short-billed dowitcher, and common snipe (NGS, 1983). Other bird species that occur in the project vicinity include bald eagle, red-tailed hawk, and peregrine falcon.

Additional information on seabird species that inhabit or pass through the project area is presented in section V.C.4 and additional information on the marbled murrelet and bald eagle is presented in section V.C.6.

Mammals likely to occur in the project vicinity include coyote, black bear, Townsend's chipmunk, raccoon, striped skunk, mink, little brown myotis, beaver, deer mouse, and Townsend's vole (Audubon Society, 1980).

Environmental Effects and Recommendations

Project construction would involve vegetation clearing, use of heavy machinery for HDD, and a general construction presence. Vegetation and animal disturbance during project operations are expected to be minimal, localized, and limited to periodic site maintenance; therefore, this analysis focuses on construction effects.

No recommendations relative to potential effects on terrestrial resources were filed. Finavera proposes to landscape the shore station to blend with the local flora. HDD would be used to minimize disturbance to shoreline habitats and eel grass beds.

Staff Analysis

We estimate that construction of the shore station, driveway, parking area, and installation of the submarine transmission line would require clearing or disturbance of about 20,000 square feet of vegetation in the woody cover type, much of which has already been disturbed in association with the transmission line and other shoreline activities.

Construction of the shore station, the driveway, and the parking area would coincide with the placement of the in-water components. Construction of the shore facilities would require some earthwork (foundation preparation) that would be completed using small construction equipment; however, this work would not occur within 200 feet of the water line and no fill would be required to establish the foundation area.

The use of HDD would avoid disturbing sensitive beach and dune zone habitats; no wetlands would be disturbed. Finavera estimates that about 1,500 square feet of area would be used by the HDD contractor to dig the pilot hole, ream the pilot hole, and pull the cable through the drill hole. Specialized heavy construction equipment and trucks would be required to drill the hole and pull the cable. A staging area located approximately 0.25 mile southeast of the shore station (formerly used by the U.S. Air Force) would be used for preparing the transmission cable, electrical equipment, and any other construction-related activities to minimize disturbances to the terrestrial resources at the site. Based on estimates of constructing the Port Angles-Juan de Fuca Transmission Line Project (U.S. Department of Energy, 2007), which required about 1,340 feet of HDD, we estimate that the entire HDD operation would take less than 30 days.

All wildlife close to shore-based construction would likely be displaced for the entire construction period, but should return after completing construction. Thus, potential effects on terrestrial flora and fauna are considered low.

Upon completion, the shore station would be landscaped to blend with the local flora. To ensure that potential erosion and sedimentation impacts would be minimized, the Commission typically requires the development of an erosion and sediment control plan for Commission approval prior to construction. Such a plan would include details for vegetating disturbed areas and describing methods that would be used to control noxious weeds. Control of noxious weeds would ensure that wildlife habitats continue to remain productive.

Our assessment is based on the site locations described in Finavera’s application. Comments filed by the Makah Tribe on February 16, 2007, suggest that the shore station and staging area may now be occupied by recreation facilities. A site-specific construction plan that includes details of the locations of the drilling site, staging areas, and shore station, and a description of the vegetation to be removed would need to be filed prior to construction.

Unavoidable Adverse Impacts

Construction of the shore substation and HDD for the transmission cable would disturb about 20,000 square feet of vegetation in the woody cover type, much of which has already been disturbed in association with the Clallam PUD transmission distribution line and other shoreline activities. Revegetation and noxious weed control plans would help minimize adverse effects to sensitive near-shore and beach cover-type habitats. Construction equipment and personnel would disturb shorebirds and other wildlife during the initial construction phase. All of these effects would be short-term.

6. Threatened and Endangered Species and Essential Fish Habitat

Affected Environment

Finavera contacted NMFS and FWS and requested information regarding threatened or endangered species in the project area on May 14, 2002 (PDEA at p. 5-58). In a letter filed on February 16, 2007, NMFS identified seven federally listed marine mammals and four sea turtles that may occur in the project area. On March 28, 2007, FWS identified four federally listed birds and two sea turtles (also identified by NMFS). No federally listed plant species are thought to occur in the project area and none were observed during a June 26, 2005 site reconnaissance conducted by Finavera (PDEA at p. 5-60). Table 5 lists the threatened and endangered species that may occur in the proposed project area, and table 6 lists EFH located in the proposed project area.

The relevant distribution, habitat requirements, and biology for the whales and sea turtles are described in section V.C.4. Below, we discuss the relevant biological information for the other species that may occur in the proposed project area.

Table 5. Federally listed threatened and endangered species that may occur in the proposed project area.

SPECIES/STOCK	FEDERAL STATUS	DETERMINATION OF EFFECT
Mammals		
Blue whale (*Balaenoptera musculus)/*Eastern North Pacific	Endangered	No effect
Fin whale (*Balaenoptera physalus*)/ California/Oregon/Washington	Endangered	No effect
Humpback whale (*Megaptera novaeangliae)/*Eastern North Pacific	Endangered	Likely to adversely effect

Table 5. Federally listed threatened and endangered species that may occur in the proposed project area.

SPECIES/STOCK	FEDERAL STATUS	DETERMINATION OF EFFECT
Sei whale (*Balaenoptera borealis)*/Eastern North Pacific	Endangered	No effect
Sperm whale (*Physeter macrocephalus)*/ California/Oregon/Washington	Endangered	No effect
Killer whale (*Orcinus orca)*/Eastern North Pacific Southern resident	Endangered	Likely to adversely effect
Steller sea lion (*Eumetopias jubatus*)/Eastern U.S.	Threatened	Likely to adversely effect
Birds		
Brown pelican *(Pelecanus occidentalis)*	Endangered	Not likely to adversely effect
Short-tailed albatross (*Phoebastria albatrus)*	Endangered	No effect
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Not likely to adversely effect
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened	Likely to adversely effect
Reptiles (sea turtles)		
Green sea turtle (*Chelonia mydas*)	Threatened	No effect
Loggerhead sea turtle (*Caretta caretta*)	Threatened	No effect
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	No effect
Olive ridley sea turtle (*Lepidochelys olivacea*)	Threatened	No effect
Fish[38]		
Coho Salmon (*Oncorhynchus kisutch*)		
Southern OR/Northern CA Coasts ESU (Evolutionary Significant Unit)	Threatened	Likely to adversely effect
Oregon Coast ESU	Threatened	Likely to adversely effect
Central California Coast ESU	Endangered	Likely to adversely effect
Lower Columbia River ESU	Threatened	Likely to adversely effect

[38]Sources: NOAA Fisheries' Endangered Species Act Status of West Coast Salmon & Steelhead [updated June 8, 2006]; and retrieved from http://www.nwr.noaa.gov/Species-Lists.cfm on April 20, 2007, and the U.S. Fish and Wildlife Service's list of Endangered, Threatened, Proposed, and Candidate Species, Critical Habitat, and Species of Special Concern in Western Washington [Rev. November 30, 2006]; retrieved from: http://www.fws.gov/westwafwo/se/species%20list_Nov2006.pdf on April 20, 2007.

Table 5. Federally listed threatened and endangered species that may occur in the proposed project area.

SPECIES/STOCK	FEDERAL STATUS	DETERMINATION OF EFFECT
Chinook Salmon (*O. tshawytscha*)		
Snake River Fall-run ESU	Threatened	Likely to adversely effect
Snake River Spring/Summer-run ESU	Threatened	Likely to adversely effect
Puget Sound ESU	Threatened	Likely to adversely effect
Lower Columbia River ESU	Threatened	Likely to adversely effect
Upper Willamette River ESU	Threatened	Likely to adversely effect
Upper Columbia River Spring-run ESU	Endangered	Likely to adversely effect
California Coastal ESU	Threatened	Likely to adversely effect
Central Valley Spring-run ESU	Threatened	Likely to adversely effect
Sacramento Winter-run ESU	Endangered	Likely to adversely effect
Chum Salmon (*O. Keta*)		
Hood Canal Summer-run ESU	Threatened	Likely to adversely effect
Columbia River ESU	Threatened	Likely to adversely effect
Sockeye Salmon (*O. Nerka*)		
Snake River ESU	Endangered	Likely to adversely effect
Ozette Lake ESU	Threatened	Likely to adversely effect
Steelhead (*O. Mykiss*)		
Puget Sound Steelhead ESU	Threatened	Likely to adversely effect
Upper Columbia River ESU	Endangered	Likely to adversely effect
Snake River Basin ESU	Threatened	Likely to adversely effect
Lower Columbia River ESU	Threatened	Likely to adversely effect
Upper Willamette River ESU	Threatened	Likely to adversely effect
Middle Columbia River ESU	Threatened	Likely to adversely effect
Southern California ESU	Endangered	Likely to adversely effect
South Central California Coast ESU	Threatened	Likely to adversely effect
Central California Coast ESU	Threatened	Likely to adversely effect
California Central Valley ESU	Threatened	Likely to adversely effect
Northern California ESU	Threatened	Likely to adversely effect
Sea-run Cutthroat Trout (*O. clarki clarki*)		
Umpqua River ESU	Endangered	Likely to adversely effect
Bull Trout (*S. confluentus*)		
Coastal-Pugent Sound DPS	Threatened	Likely to adversely effect

Table 6. Essential Fish Habitat (EFH) for various fish species located within or near Makah Bay. (Source: NMFS, 2007)

Species	Adult EFH	Spawning/ Mating EFH	Eggs/ Parturition EFH	Larvae EFH	Juvenile EFH
Groundfish Species					
Longnose Skate	X	X	X		X
Soupfin Shark	X				X
Spiny Dogfish	X				X
Kelp Greenling	X			X	
Lingcod				X	X
Pacific Cod			X		X
Pacific Rattail		X	X	X	
Pacific Whiting (Hake)	X		X		
Sablefish	X		X		X
Spotted Ratfish	X				X
Arrowtooth Flounder	X	X	X	X	X
Butter Sole	X				
Curlfin Sole	X				
Dover Sole	X				X
English Sole	X	X	X	X	X
Flathead Sole	X				X
Pacific Sanddab	X				
Petrale Sole	X				X
Rex Sole	X				X
Rock Sole	X				
Sand Sole	X			X	X
Starry Flounder	X		X		X
Black Rockfish	X				X
Blue Rockfish	X			X	X
Bocaccio				X	X
Canary Rockfish	X				
Chilipepper					X
China Rockfish					X
Darkblotched Rockfish	X				X
Greenstriped Rockfish					X

Table 6. Essential Fish Habitat (EFH) for various fish species located within or near Makah Bay. (Source: NMFS, 2007)

Species	Adult EFH	Spawning/ Mating EFH	Eggs/ Parturition EFH	Larvae EFH	Juvenile EFH
Pacific Ocean Perch				X	
Rougheye Rockfish					X
Sharpchin Rockfish					X
Splitnose Rockfish	X	X	X		X
Stripetail Rockfish					X
Widow Rockfish					X
Yellowtail Rockfish	X				
Salmonid Species					
Chinook Salmon	X				X
Coho Salmon	X				X
Puget Sound Pink Salmon	X				X

Bald Eagle

A detailed account of the taxonomy, ecology, and reproductive characteristics of the bald eagle is provided in the Pacific States Bald Eagle Recovery Plan (Interior, 1986). Bald eagles can occur in Western Washington throughout the year as both resident and wintering populations. According to Washington DFW, there are 2,223 nesting territories currently documented throughout the state. Approximately 1,380 (62%) of these nesting territories are within one mile of marine water. In western Washington some adult eagles stay in their nesting territories year round, and territories have an average radius of 1.6 miles (2.5 km). Nesting activities can begin in January with nest establishment, pair bonding, and egg-laying. Hatching and fledging occur from April to August.

According to the FWS (see letter filed September 26, 2003), bald eagles are known to nest on the shorelines adjacent to the project location, and winter in Waatch Valley, a drainage that enters Makah Bay. According to the Makah Tribe and Washington DFW, there are three potential eagle nesting sites near the project (personal communication R. McCoy, Makah Tribal Forestry Wildlife Division Manager, July 8, 2005; letter and PHS resource maps received by Finavera from WDFW, October 4, 2005, as reported in the PDEA at p. 5-66). One nest is consistently active and fledged young in 2005. Another nest was active in 2004 and 2005 but failed to produce young both years. The third nest has never been documented as active since the discovery of an old nest structure in 1998 (personal communication R. McCoy, Makah Tribal Forestry Wildlife Division Manager, July 8, 2005 as reported in the PDEA at p. 5-66). None of the three sites are located within 0.5 mile of the proposed shore station (letter and PHS resource maps received from WDFW, October 4, 2005 as reported in the PDEA at p.5-66).

Marbled Murrelet

A detailed account of the taxonomy, ecology, and reproductive characteristics of the marbled murrelet is provided in the Recovery Plan for the Marbled Murrelet (FWS, 1997). Marbled murrelets nest in inland old growth forests but spend most of their lives foraging, loafing, preening and other activities in nearshore marine waters (0.6 to 1.2 miles); the average distance from shore during these activities is 0.29 miles (NOAA, 2001). During the summer, murrelets primarily use bays, inlets, fjords, and open ocean within 3.1 miles of shore, and usually occur in widely dispersed concentrations of singles and pairs of birds (Nelson, 1997). The main causes of the population decline of the marbled murrelet is loss of older forests as a result of timber harvesting, but other threats include oil pollution, entanglement in gill nets, and the species' low reproductive rate. As part of a continuing effort to estimate marbled murrelet population size and trends, Washington DFW conducted at-sea line transects within 4.9 miles of shore along the coast of Washington. The surveys included a primary sampling unit (PSU 2) that incorporated Makah Bay. Washington DFW observed 21, 0, and 22 birds during the May 17, June 6, and June 29 surveys, respectively (Lance and Peterson, 2007). The estimated population size for the stratum that includes Makah Bay was 2,381 birds. The population estimate for the Washington coast for 2006 was 2,381 birds (95% confidence interval = 1,672-3,430 birds).

Brown Pelican

Brown pelicans inhabit the West Coast from British Columbia to Central America. Historically, breeding colonies were found in California and Baja California, Mexico. Brown pelicans frequent coastal areas, including rocky shores and cliffs, sloughs, breakwaters, jetties, pilings, and sandbars. This species is still found throughout its original range; however, the breeding colonies are in decline. Following the banning of DDT in 1972, the population began to recover. The population is considered to be stable, though the availability of preferred prey, including Pacific mackerel, Pacific sardine, and the northern anchovy, are of concern due to the effects of over-fishing on these species. The primary threats to California brown pelicans are human development in coastal regions, entanglement in abandoned recreational fishing gear, and oil spills (NOAA, 2005a). While brown pelicans nest on small islands along the coast, they are rarely sighted as far north as Makah Bay. In fact, there are no nesting sites documented in the state. In the summer, brown pelicans roost in high numbers at the mouth of the Columbia River and offshore of the town of Tahola (located at the mouth of the Quinault River approximately 70 miles south of the project area) (NOAA, 2001). Sanctuary (2007) reports brown pelicans are present in the Sanctuary during the summer.

Short-tailed Albatross

Short-tailed albatross breeding grounds are located in Japan and possibly in Hawaii. It spends most of its life over the northern Pacific Ocean and the Bearing Sea. In Washington state, sightings are extremely rare, with only three or four recent sightings, all occurring 20 to 30 miles offshore (Thompson, personal communication in NOAA, 2001).

Salmon, Steelhead, and Cutthroat Trout

Each of the four species of Pacific salmon, federally listed as threatened or endangered (under ESA) and representing 17 evolutionarily significant units (ESU's), may occur in proximity to the proposed project during their migration as juveniles or adults (table 5) when in the marine environment (Groot and Marcolis, 1991). Knowledge of the migration patterns and marine distribution of the 11 ESU's of steelhead, federally listed as threatened or endangered, is limited (Pauley et. al., 1986; Quinn, 2005). Although adult steelhead habitat utilization in the ocean is poorly known, Moyle (2002) contends that it is likely that most California steelhead do not move far from the California coast. Conversely, Quinn (2005) reports that steelhead tend to migrate to marine areas distant from their natal streams before returning as adults to spawn after several years, and Sheppard (1972) found that steelhead from British Columbia spent at least part of their ocean residency in the Alaskan gyre with steelhead stocks from Washington, Oregon, Idaho, and California (as cited in Pauley et. al., 1986).

NOAA Fisheries' 2005 updated status reviews of federally listed ESU's of West coast salmon and steelhead[39] provide details on the status of salmon and steelhead ESU's identified in table 5. Additionally, as discussed below, the federally listed threatened Coastal-Puget Sound Bull Trout Distinct Population Segment (DPS) may migrate between freshwater and marine environments in proximity to the proposed project.

Bull Trout

Bull trout is federally listed as threatened throughout its range in the coterminous United States (64 CFR §58910). Some bull trout populations are migratory, spending portions of their life cycle in larger rivers or lakes before returning to smaller streams to spawn, while others complete their entire life cycle in the same stream. Although rarely found in the marine environment, bull trout within the Coastal-Puget Sound Distinct

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[39]The documents were retrieved on April 20, 2007, and May 10, 2007 from: http://www.nwr.noaa.gov/Publications/Biological-Status-Reviews/upload/SR2005-allspecies.pdf and http://www.nwr.noaa.gov/Publications/Biological-Status-Reviews/upload/SR2005-steelhead-2.pdf

Population Segment are known to migrate between freshwater and the marine environment in proximity to the proposed project.[40] On September 26, 2005, FWS designated 419 miles of shoreline along the Olympic Peninsula and 566 miles of shoreline within Puget Sound as critical habitat for bull trout.

Environmental Effects and Recommendations

We discuss in detail project effects on marine fish, including EFH, in sections V.C.2 and V.C.3 and marine mammals and sea turtles in section V.C.4. We summarize those conclusions and make our ESA and EFH determinations below.

Marine Mammals

Project construction and operation would not affect the blue whale, fin whale, sei whale, or sperm whale because these whales frequent and prefer deeper offshore waters (ACS, 2004*b*; 2004*c*; Carretta et al., 2005) than found at the project site and rarely occur in the Sanctuary (Sanctuary, 2007).

Project construction and operation may adversely affect the humpback whale, killer whale and steller sea lion. While the humpback whale is generally considered to prefer deeper waters over continental shelves (NMFS, 1991), they may occur in coastal waters; therefore, we have assumed their presence at the project.

Each of the above species would be exposed to ship strike during installation of the buoys and transmission cable; low-level noise and harassment during construction; low-level operational noise; potential entanglement and collision with the buoy and anchor systems; and potential entanglement with derelict fishing gear that may become trapped on the buoy mooring lines and transmission cable. Construction noise could reach levels that could harass marine mammals for the short-term; however, we expect operational noise to be below NMFS' defined criteria of 120 dB. Potential construction effects would be short-term (estimated 3 months); while operational effects would occur for the life of any license issued for the project (30-50 years).

A number of measures could be used to negate the potential risk for serious injury and mortality. Ship strike impacts would be minimized during installation through the use of a marine observer that would alert the vessel operator of marine mammals that may be endanger of crossing the vessel path. Operational noise is expected to be below 120 dB and masked by ambient ocean noise. Monitoring would verify impacts and identify corrective actions. The use of pingers would likely help alert the killer whale

[40] This document was retrieved on April 20, 2007, from: http://www.fws.gov/pacific/bulltrout/final/pdf/BT_combined_revised100605.pdf

(and possibly other marine mammals) to the presence of the buoys and anchor lines reducing the potential for collision and entanglement with the anchor and mooring lines. The project would be designed to exclude the buoy as a haul-out site for seals and sea lions. Removal of any derelict fishing gear and other marine debris from the cable and buoy area prior to installation would reduce the chances of marine debris becoming entangled with project components. Biannual inspections and maintenance of the buoys and cable would ensure that the project anchor lines remain taught and that no derelict fishing gear or other marine debris has become entangled with the mooring lines and transmission cable, reducing the potential for injury or death from entanglement.

While these measures are likely to minimize impacts on humpback whale, killer whale and steller sea lion, we can not conclude that some form of take will not occur; therefore, we conclude that the project is likely to adversely affect these species.

Birds

Project construction and operation would not affect the short-tailed albatross, because they are extremely rare and are generally found 20 to 30 miles offshore.

Project construction and operation may affect, but is not likely to adversely affect, the bald eagle. HDD for the transmission cable and construction of the shore facilities would require the use of heavy equipment and clearing of some vegetation. Construction noise and human activity could disturb bald eagles that could be foraging nearby. However, no nest or roost sites are known to occur within one-half mile of the project construction site. Finavera proposes to not damage or remove any large trees which would be used by eagles for resting or nesting. Any disturbance associated with construction activities or subsequent periodic boat activity associated with project maintenance, would be temporary and short-term, and therefore, would be unlikely to significantly disturb bald eagles visiting the project area. Because bald eagles forage primarily near land and islands, they would not be affected by the portions of the project located 3.7 miles offshore.

Project construction and operation may adversely affect the marbled murrelet. On-water activities associated with the installation of the buoys, mooring lines, and transmission cables could disturb foraging or resting murrelets. Because marbled murrelets rarely occur in waters beyond 1.2 miles from shore, most disturbances would be associated with the laying of the transmission line cable. Construction would occur during the summer (June through September) when the seas are calmest, which overlaps the breeding season of the marbled murrelet (late March to late-September). Disturbance that takes place during the breeding season can have a larger effect on murrelets than at other times. Turbidity caused by project construction could also potentially affect forage fish. These effects, however, would be temporary (the cable should be laid and anchored in about 3-5 days) and localized. Construction vessels would move at slow speeds, limiting startle and flee responses and drains on energy reserves. NOAA (2001) reports that murrelets "...can readily move short distances away from vessels to less disturbed areas and continue feeding."

Once operational, little boat activity would be required for operations and maintenance. It is expected that the buoys would be visited two to five times per year by boat out of Neah Bay. Therefore, potential effects during operation would be limited to potential entanglement with the derelict fishing gear that could become entangled with the transmission cable. Removal of any derelict fishing gear and marine debris from the cable area, prior to laying the cable, and subsequent biannual monitoring would limit the probability of such hazards from occurring.

Project construction and operation may affect, but not likely to adversely affect brown pelicans. While brown pelicans would be subject to the same disturbance as described above for the murrelet, brown pelicans are rarely sighted as far north as Makah Bay (NOAA, 2001). Because of their rarity and the short-term, temporary character of construction activities and subsequent maintenance activities, disturbance levels would not be expected to significantly affect foraging and resting behaviors of any brown pelicans that may occasionally visit the project area. As discussed above, while the entanglement with derelict fishing gear or other marine debris trapped on the buoy mooring lines and transmission cable is possible, the possibility of this occurring is likely to be low with biannual inspections and removal of any debris. For the reasons described above, it is unlikely that brown pelicans would become entangled in moorings.

Salmon, Steelhead, and Cutthroat Trout

Proposed project construction and operation is likely to adversely affect all of the Chinook salmon, coho salmon, chum salmon, sockeye salmon, steelhead, and sea-run cutthroat trout ESU's listed in table 5. Salmonids migrating past and feeding at the site of the submarine transmission line and buoy array during construction and installation activities would likely be exposed to disturbances such as increased turbidities, boat traffic, noise, and vibrations. Once the buoy mooring cables would be installed, the potential would exist for abandoned commercial or recreational fishing gear to become entangled around the cables. Such entangled gear would continue to fish without human control and potentially result in the unintended catch and subsequent mortality of salmon, steelhead, and trout. Although development and implementation of plans to diligently remove derelict fishing gear from the mooring lines and exclude fishing from the immediate project area would minimize the effect, incidental take of at least a very few number of salmon, steelhead, and trout would be unavoidable.

Bull Trout

Proposed project construction and operation is likely to adversely affect the Coastal-Puget Sound bull trout DPS. Bull trout migrating past and feeding at the site of the submarine transmission line and buoy array during construction and installation activities would likely be exposed to disturbances such as increased turbidities, boat traffic, noise, and vibrations. Once the buoy mooring cables would be installed, the potential would exist for abandoned commercial or recreational fishing gear to become entangled around the cables. Such entangled gear would continue to fish without human control and potentially result in the unintended catch and subsequent mortality of bull trout. Although development and implementation of plans to diligently remove derelict fishing gear from the mooring lines and exclude fishing from the immediate project area would minimize the effect, incidental take of at least a very few number of bull trout would be unavoidable.

Essential Fish Habitat

Proposed project construction, including the laying of the submarine transmission line, installation of the buoys, and anchoring or mooring the facilities would result in the disruption of about 300,000 square feet of marine benthic habitat consisting predominantly of fine-grained sands and silts with lesser amounts of hard (rock) substrates. This marine benthic habitat is potential habitat for the groundfish species listed in table 6.

The submarine transmission line would occupy about 12,200 square feet of benthic habitat consisting of 85 percent fine-grained sand and silts and 15 percent hard substrate. Immobile or slow moving benthic organisms in the path of the cable, including groundfish prey items such as clams, snails, and worms, could be covered, disturbed, or injured during installation.

Finavera has not specifically identified the type of anchoring system that they propose to stabilize the cable. If Finavera would use gravity-type anchors such as rock or concrete mats, immobile marine organisms would be covered. Once deployed, however, the mats/blankets or portions of the cable would serve as substrate for recolonization by species that utilize hard surfaces (*e.g.*, diatoms and sea urchins), and thereby, contribute to EFH in the proposed project area. If a combination of screw-type anchors and chains would be used to secure the submarine transmission line, burrowing organisms could be struck by the deployment of the anchors. Although the footprint of the screw-type anchors on the seabed would be less than that for gravity anchors, screw-type anchors would penetrate the seabed and disturb burrowing organisms such as clams and polychaete worms.

Increased turbidity caused by construction would likely occur in the immediate area of project construction. Groundfish and schools of juvenile and adult salmonids could be adversely affected by the increased turbidity, including such effects as temporary disruption of feeding and impaired respiration; however, the adverse effect would be short-term and localized, because the sediment plumes would be quickly dissipated by strong water currents in the project area.

Paint sloughing or chipping due to aging or collision of a buoy with a vessel could cause a localized build-up of paint anti-fouling toxins in the sediments, which could adversely affect marine benthic organisms located below the buoy array. Development and implementation of a project maintenance plan with provisions to minimize paint sloughing and chipping would limit the adverse effect.

Bottom sweep of the transmission line could occur if the anchors would be freed from the seabed by such causes as scouring or inadvertent dredging of the line by a boat anchor or trawl. Adverse effects on marine organisms would include disturbance and the potential for injury or death. We would expect the significance of the sweep to be somewhat minimized by the relatively small size of the cable (about 8 inches in diameter). Additionally, burial of portions of the cable due to natural sand movements could limit the occurrence or spatial extent of the affected area. Development and implementation of a plan for a boat exclusion zone would limit the potential for an anchor line or trawl to pull the transmission line free.

The buoy mooring lines and chains could hang down and contact the seabed during slack-water periods. Visually inspecting the lines, chains, floats, and anchors to make sure that the anchors would be properly set into the seabed and that the chains and mooring cables would not hang down and contact the seabed at maximum slack periods would limit the effect.

As discussed in section V.C.3, we do not expect fish in the project area to be adversely affected by underwater noise associated with the project. NMSP's recommended noise assessment would have the benefit of documenting noise levels produced specifically by the proposed wave energy technology and providing a means of verifying our analysis. The results of that documentation could be used to assist in identifying measures to mitigate any adverse effects noise would have on EFH.

EMF emitted from the submarine transmission line and associated AC electric lines linking the buoys with the submarine transmission line may cause temporary disorientation or avoidance of the submarine transmission line and buoy array by elasmobranches. Given that magnetic fields rapidly attenuate within 10-30 feet of the source, even the worst case situation of avoidance of the cable and array by elasmobranches would represent a negligible footprint within the proposed project area, and therefore, we expect the impact to be low. Nonetheless, the EMF would adversely affect groundfish EFH in the immediate project area.

Based on our analysis of the effects of proposed project construction and operation on marine habitats as described in sections V.C.2 and 3 and summarized above, we conclude that the proposed project may adversely affect EFH of the groundfish and salmon species listed in table 6.

7. Recreation, Ocean Use, and Land Use

Affected Environment

Based on the best available information, we identify the regional recreation resource as the northern tip of the Olympic Peninsula (Washington) from the Strait of Juan de Fuca (at the mouth of Puget Sound) 135 miles south to the Copalis River, located to the north of Grays Harbor. Within this setting, the Olympic Coast National Marine Sanctuary, Washington Islands NWR, Olympic National Park, Olympic National Forest, and various state and county parks occur. Our literature review indicates that natural areas can provide both opportunities and constraints for Washington residents and visitors to participate in recreational activities. Opportunities include boating, fishing, hiking, camping, wildlife observation, beachcombing, and scuba diving. Constraints involve area closures to the public to protect environmental resources.

Existing major commercial ports (*e.g.*, Port Angeles, Port of Grays Harbor) contribute to the recreational and economic vitality of the region.[41] The City of Port Angeles' two ferry terminals transport tourists and business people between the United States and British Columbia, Vancouver Island. Between 1997 and 2002, the number of passengers ranged from 529,000 in 1997 to 504,000 in 2002 (Clallam County, Economic Development Council, 2005). Recreational harvest of salmon and shellfish is a contributor to the City of Port Angeles economy (Department of Energy and Bonneville Power Administration, 2007). Tourism is an important component of Grays Harbor economy; over 4 million people visited Grays Harbor in 2005. The Grays Harbor seafood processing industry has five major companies (Columbia-Pacific Resource Conservation & Economic Development District, 2006). For further discussion, see section V.C.8.

The Interagency Committee for Outdoor Recreation (2002) finds that Washington State's population has increased about 20 percent since the last statewide recreation survey, which was completed in 1990. Both residents and visitors contribute to a

[41]For example, a visitor can view lumber being sorted and cargo loaded or unloaded onto a ship docked at the Port of Grays Harbor.

beneficial effect on the economy in terms of earnings, employment, and tax revenue. In this case, the natural areas and applicable portions of the Pacific Ocean are an integral part of the tourism; our literature review reveals the associated economic significance. For example, from 1991 to 2005, Clallam County showed a 3.8 percent increase in travel spending (Washington Department of Community, Trade and Economic Development, 2006; 2006a). For further discussion see section V.C.8.

The proposed project area, located in Clallam County, Washington, offers numerous water- and land-based recreational opportunities. Some of the most popular water-based activities include surfing, fishing, boating, crabbing, whale and wildlife observation, and scuba diving. Some of the most popular land-based activities include bird watching, hiking, beachcombing, hunting, visiting public parks and the Makah Museum, located on the approximate 27,000-acre Makah Indian Reservation, Neah Bay, Washington. The Makah Indian Reservation borders the Pacific Ocean on the west; the Strait of Juan de Fuca on the north; and the Olympic National Park on the east and south. Mountainous terrain between 500 and 1,900 foot-elevation is evident. Sandy beaches occur along its shoreline (Makah Tribe, 2005).

The proposed land distribution station (or shore station) would be located on approximately 1-acre of the Makah Indian Reservation and adjacent to Hobuck Beach. The 17-acre Hobuck Beach, known for its rocky bluffs and wildlife observation, has 75 campsites, 40 recreational vehicle hook-ups, and 20 cabins. Other proposed project facilities would be located in the Pacific Ocean (Makah Bay), and within an estimated 7 acres of the Sanctuary, the Flattery Rocks NWR, and Washington State (Washington DNR) submerged lands.

The aquatic portion of the proposed project would occur within the Makah Tribe's usual and accustomed fishing grounds.[42]

The Washington Islands NWR, located along 100 miles of the Olympic Peninsula outer coast, encompasses more than 800 islands, rocks, and reefs. The total land area above the line of mean high water is 486 acres. To protect seabird nesting sites and other species, the Washington Islands NWR is closed to the public. The Flattery Rocks NWR

[42]The Makah Tribe has off-reservation access to "usual and accustomed grounds" for activities reserved by treaties (fishing, shell-fishing, whaling, and sealing) (FWS, 2005). Under the 1855 Treaty of Neah Bay, the Makah Tribe has the right to take fish in its usual and accustomed fishing grounds that include the waters of the Pacific Ocean off the northern coast of Washington and extending over 30 miles offshore. In addition, the Treaty guarantees the tribe the right of hunting whales in the proposed project area (Motion to Intervene filed February 13, 2007, Brian C. Gruber, Ziontz, Chestnut, Varnell, Berley & Slonim, Seattle, Washington).

is part of the Washington Islands NWR and includes Makah Bay. The refuge is managed to preserve and protect habitat for seabirds and other wildlife. Boaters are instructed to maintain a 200-yard buffer zone. Interior states that during migration the total population of seabirds, waterfowl, and shorebirds may exceed one million birds.

The Sanctuary, designated on May 11, 1994,[43] encompasses 2,111,992 acres of marine waters and extends along 135 miles of coastline. It supports unique and nationally significant flora and fauna communities, which occur on and/or within the seastacks, cliffs, small offshore islands, kelp beds, sand and cobble beaches, tidepools, and submarine canyons. Nutrient-rich waters and diverse habitat types result in an abundance and diversity of marine life (National Oceanic and Atmospheric Administration Sanctuaries and Reserves Division, 1993). The Olympic Coast Discovery Center, on the Port of Angeles waterfront, provides visitor information about the Sanctuary. At the center, visitors can view relics of sailing ships and read about shipwrecks off the coast of Washington.

The NMSP and NMFS state the Sanctuary functions as essential habitat for a variety of marine mammals and birds that reside in or migrate through the sanctuary (*i.e.*, sea bird colonies; the migration route of the California gray whale). The sanctuary is "one of the more dramatic natural wonders of the United States."[44] The Sanctuary provides protection for archaeological sites and culture of the Quinault, Hoh, Quileute, and Makah Indian Tribes (MMS, 2007).

Clallam County manages eight public recreation facilities that offer camping, fishing, hiking, boating, picnicking, and scuba-diving. One of these sites, Salt Creek Recreation Area, is designated as a Marine Life Sanctuary and has 90 campsites, three barrier-free restrooms (two with showers), hiking trails, and other amenities. In the county, Washington DNR owns and operates seven public recreation facilities that consist of campgrounds, beach access, trailheads and trails.

Water-Based Recreation Opportunities and Uses

Sport fishing and boating opportunities occur in the project area. Sport fishing for salmon and fishing for bottom fish in the saltwater which surrounds the Makah Indian Reservation, is considered to be the best in the contiguous U.S. (Makah Tribe, 2007). Charter boats and private fishing and pleasure craft dot Neah Bay's picturesque harbor during the busy summer months. Hobuck Lake and the Waatch and Sooes Rivers are

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[43]The Sanctuary was designated for the purpose of protecting and managing the conservation, ecological, recreational, research, educational, historical and aesthetic resources and qualities of the area. See 59 Federal Register 24603 (1994).

[44]See Sanctuary Designation Document, 59 Fed. Reg. at 24586 (1994).

located near the project and are popular fishing sites for rainbow and cutthroat trout. Clams, mussels, and oysters are found along the beaches and flats of the Washington coast, including Clallam County. The Clallam County shoreline supports forage fish (*e.g.*, Pacific herring), rockfish, and various Pacific salmonids (*e.g.*, Chinook, chum, coho, and steelhead) (Department of Energy and Bonneville Power Administration, 2007). When in season, steelhead can be taken from the rivers (Makah Nation, 2007). A spawning run of 13,000 Chinook salmon was reported in the Waatch River, which enters Makah Bay at the north end of Hobuck Beach (personal communication between Finavera and Russ Svec, Makah Tribe, August 2, 2005, as reported in the PDEA at p. 5-74).

The 160-mile-long Cascadia Marine Trail is a National Recreation Trail. This inland sea trail extends from Olympia, Washington through Puget Sound, Hood Canal, Rosario Strait, and the Strait of Georgia to the border of Canada. Communities along the trail include Olympia, Tacoma, Seattle, Everett, Port Townsend, and Bellingham. The trail provides boaters with a unique opportunity to experience the environmental and aesthetic resources of the area. Public access, campsites, and other amenities are located along the trail. An estimated 50 campsites are located on lands managed by Washington State Parks, Washington DNR, county and city parks, and private landowners. Operation and maintenance of the trail is a cooperative effort among Washington SPRC, Washington Water Trails Association, Washington DNR, and other state and local agencies. To enhance the Cascadia Marine Trail, the entities' goal is to develop between 225 and 460 new campsites (Washington Water Trails Association, 2007).

Surfing occurs at Hobuck Beach (Clallam Bay-Sekiu Chamber of Commerce, 2003) and Neah Bay. There are both fresh water and salt water kayaking opportunities in the project area. The Strait of Juan de Fuca from Pillar Point to Cape Flattery offers several places one can launch and kayak through kelp beds and off-shore seastacks to view the variety of marine life while paddling (Clallam Bay-Sekiu Chamber of Commerce, 2003). Makah Bay offers an exciting location for experienced kayakers who are interested in kayak surfing (Clallam Bay-Sekiu Chamber of Commerce, 2003).

NMFS (2001) reports that whale-watching occurs from March through May during the gray whale northward migration. Companies that offer whale-watching typically operate out of Westport, Washington. Whale watching has not developed significantly in Neah Bay and the project area because of the remote location and the unpredictable whale viewing associated with this area. Some trips occur out of Neah Bay and Sekiu, located further east in the Strait of Juan de Fuca. The whale watching trips are available only by reservation during the summer.

Scuba diving in the vicinity of the project area is rated as superior (Finavera, 2006). The location of the project in relation to the Strait of Juan de Fuca and the Sanctuary offers a unique diving experience. Rocky reefs and kelp beds offer a wide variety of colorful invertebrates, including fish-eating anemones, giant mussels and the world's largest octopus (Clallam Bay-Sekiu Chamber of Commerce, 2003). Fish species commonly observed while diving amongst these areas include wolf eels, lingcod, perch, and various species of rock fish.

The Pacific Ocean off the Olympic Peninsula (Washington) is subject to commercial shipping, and tribal/commercial fishing represent primary uses. Regarding commercial shipping, Port Angeles, Washington handled 277 vessel calls in 2005. Both Port Angeles and Port of Grays Harbor, Washington are listed within the top 149 United States ports in 2004 for the amount of cargo handled, which is 1,430,678 and 1,487,658 metric tons, respectively (MMS, 2007). We discuss tribal/commercial and recreational fishing below.

Tribal/Commercial and Recreational Fishing

Intertidal invertebrate species important to the tribes and commercial fisheries include: California mussel, native (Olympia) oyster, Dungeness crab, ocean pink shrimp, and other crustacean species (FWS, 2005). The geoduck, a large edible clam, is of particular importance to tribal subsistence and commercial fisheries (MMS, 2007).

Neah Bay is one of only three north Washington Coast ports to host groundfish vessels. The Makah Tribe, along with three other Washington tribes, has treaty rights for ocean fishing and fish for a variety of species. They also have formal groundfish allocations for sablefish, black rockfish, and Pacific whiting. Twelve tribes, including the Makah Tribe, have and exercise treaty fishing rights to halibut. Access to historical fisheries is important for commercial, ceremonial, and subsistence purposes. The Makah Tribe comments that it directly regulates the seasons, locations, and gear of tribal fishermen participating in the tribe's commercial, ceremonial, and subsistence fisheries. Tribal fishermen use similar methods *(e.g.*, trawl, gillnet, and seine gear) as non-tribal fishermen. The Makah Tribe is the only tribe that harvests whiting, as well as widow rockfish, yellowtail rockfish, and other groundfish, using mid-water trawl gear (table 7).[45] The Makah Tribe's fishery is limited to their usual and accustomed fishing grounds.

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[45]Some of the trawl gear include: (1) otter trawl- -a net towed behind a vessel that is held open by two boards (or doors) attached to warps (cable or rope) between the net and the vessel; (2) bottom trawl--primarily an otter trawl whose doors are designed to drag along the seafloor - the footropes are fixed with rolling discs, metal or rubber bobbins that bounce over obstructions; and (3) mid-water or "pelagic" trawl--designed so that the doors do not contact the seabed - the footrope, made of metal chain, often drags over the seafloor (*In* Enticknap, 2002).

Table 7. Makah Tribe's at-sea catches by year (units are in pounds). (Source: NMFS, 2005d).

	Year			
Species Aggregation	**2000**	**2001**	**2002**	**2003**
Other Fish	483,822	1,529,540	2,987,067	3,145,036
Pacific Whiting	13,781,245	13,404,002	48,045,527	51,706,192
Total	14,265,068	14,933,542	51,032,594	54,851,228

The Makah Tribe has over 200 commercial and sport fishing vessels in Neah Bay. Sport fishing for salmon and bottom fish around the reservation is considered to be the best in the mainland U.S. (Makah Nation, 2007). The tribe's (commercial) fleet is composed of 43 boats, of which 29 boats fish for salmon, sablefish, and halibut. These boats primarily fish from March to October. Ten of the boats are small bottom trawlers. The trawl fishery is open from January to December, but primarily the fishing is from June to October. The mid-water whiting fleet is composed of four boats. Their season is from May to September.

The Makah Tribe does not conduct bottom trawling in the vicinity of the proposed project buoys or transmission cable because of the bottom rock outcrops and the relatively shallow depths of the area. The tribe typically fishes for crabs at depths from 150 to 300 feet. As the proposed project is planned to be located at a depths up to 150 feet, crabbing within the project area would likely be avoided. The pink shrimp fishery, which uses bottom trawling, does not occur in the project area. Currently the tribe does not have any other commercially harvested shellfish fisheries in the area (personal communication between Finavera and Brandon Bryant, Makah Tribe biologist, April 11, 2006, as cited in the PDEA at p. 5-76).

Washington DFW notes that non-tribal commercial fishing that uses certain types of gear (pots and fin fish trawling) is excluded within 3.0 miles of shore. Non-tribal commercial fisheries that are allowed in the proposed project area include coastal Dungeness crab, salmon, coastal baitfish, and pink shrimp trawl. NMFS and the NMSP also note that commercial fishing is not prohibited in the proposed project area, only bottom trawling by non-tribal vessels.

Washington DFW comments that the recreational fishery would be affected by the proposed project. Currently, recreational fisheries for halibut, bottomfish, and salmon occur in the project area. Of the seven rockfish species that have been identified as being over-fished, two species - - canary and yelloweye rockfish- -have had a detrimental effect on the State's recreational fisheries. To protect the yelloweye rockfish caught in offshore areas, and to increase the survivability of released rockfish (such as canary and yelloweye in the nearshore areas), Washington DFW has implemented depth restrictions for the recreational halibut and bottom fish fisheries. Recreational fishing seaward of the 20- or

30-fathom[46] depth contour depending on the fishery and time of year is prohibited. The depth restrictions keep the recreational fishery closer to shore; thus, healthier rockfish species (such as, black rockfish) are caught.

In addition, NMFS established closed areas to minimize the catch of over-fished Washington coast groundfish fisheries (*e.g.*, rockfish, flatfish (starry flounder), and lingcod) or to protect groundfish habitat. This information can be accessed through the NMFS website at www.nwr.noaa.gov.

Land-Based Recreation Opportunities and Uses

There are many opportunities to explore a variety of habitats while hiking in the vicinity of the project area. On the Makah Indian Reservation, Cape Flattery Trail is located in the most northwestern point in the lower U.S. According to the Makah Tribe (2007), the Cape Flattery Trail is one of the preferred destinations for eco-tourists and hikers and is one of the most beautiful places on the reservation. The trail is approximately 0.75 mile long and consists of a wooden boardwalk, stone, and gravel steps. The trail contains four observation decks which offer views of the Sanctuary and Tatoosh Island. The 18-acre Tatoosh Island is a former Makah Tribe fishing and whaling camp, and more recently a U.S. Coast Guard station. Another popular hiking trail on the reservation is the 3-mile-long Shi Shi Trail, and it is also located in the northwestern tip of the Olympic Peninsula. According to the Makah Tribe (2007), this trail is one of the most spectacular trails in Washington State. Interpretive signs are located at Cape Flattery and Shi Shi beach trailheads. The Bureau of Reclamation (2006) notes the Makah Indian Reservation, during the summer, is a popular destination for anglers and tourists with more than 2,000 visitors on some days.

Beachcombing occurs on Hobuck Beach and in the general vicinity of the project area. According to the Clallam Bay-Sekiu Chamber of Commerce (2003), Hobuck Beach is a favorite beach for local residents and families. Other popular beachcombing areas include the beaches within Olympic National Park and the Lake Ozette wilderness area located to the south of the project area.

The 922,651-acre Olympic National Park, administered by the National Park Service (NPS), contains over 60 miles of coastline, which represents the largest such stretch along the continental United States. Ninety-five percent (876,669 acres) of Olympic National Park is Congressionally-designated as wilderness. The park features three distinct ecosystems: old growth forest and temperate rainforest; glacier-capped mountains; and the coastline. Tidepools and sandy beaches provide habitat for a variety of species (*i.e.*, sea anemone, starfish). Recreational opportunities include hiking,

[46] A fathom is equal to 6 feet and is used to measure and specify marine depths.

backpacking, camping, fishing, wildlife observation, and interpretive programs. There are 611 miles of trails. A visitor center is located within the park. The NPS operates 16 campgrounds with a total of 910 sites. In 2005, approximately 31,000 people camped overnight in the park. Survey results (Van Ormer et al., 2001) indicate the following common activities: sightseeing/scenic drive (88 percent); walking on a nature trail (77 percent); enjoying the wilderness, solitude, and quiet (73 percent); and wildlife observation (72 percent). Fifty percent of the visitors spent 2 to 4 days at Olympic National Park.

Recent total annual recreation visits for Olympic National Park range from an estimated 3.3 million visitors in 2000, 3.6 million visitors in 2002, and 2.7 million visitors in 2006 (National Park Service, 2006a). In 2000, survey results (Van Ormer et al., 2001) indicate that international visitors to the park comprised 8 percent of the total visitation. The countries most represented were Canada (26 percent), Germany (21 percent), France (8 percent), and England (7 percent). Washington Department of Community, Trade and Economic Development (2006a) estimates 10 percent of visitor spending in Washington is generated by international travelers. For further discussion see section V.C.8.

A variety of local and migratory ducks and geese spend part of the fall and winter on the fields, inland waters, estuaries and bays of the Northern Puget Sound/Strait of Juan de Fuca area. Hunting for waterfowl species include old squaw, long tailed ducks, scoters (white-wing, surf, black), harlequin duck, bufflehead, Barrows and common goldeneye, greater and lesser scaup, hooded, common, and red-breasted mergansers.

The Makah Museum contains permanent exhibits including artifacts from the Ozette collection, uncovered from the Makah village partially buried by a mudslide nearly 500 years ago. The museum contains a full-size replica long house, and four handcrafted cedar dug-out canoes. Whaling, sealing and fishing gear, basketry, and other tools are also on display. The museum is open to the public and contains a gift shop (Makah Tribe, 2007). The Makah Marina, located across from the Makah Museum, provides 200 slips, a fuel dock, parking, restrooms, showers, and water. At Neah Bay, camping is permitted in designated areas. The Makah Cultural and Research Center contains the Makah language program, which works toward preserving and teaching the Makah language. There are over 60,000 artifacts and the center is available, upon request, to researchers who seek information about the Makah culture and Neah Bay community (Makah Tribe, 2007).

The Makah National Fish Hatchery, administered by the FWS, is located on the Sooes River about 8 miles south of Neah Bay, on the Makah Indian Reservation. In order to restore salmon for domestic and international fisheries, the hatchery rears fall Chinook salmon, along with coho and chum salmon and steelhead. The hatchery is designed for public viewing of salmon migrating over fish ladders to spawn in a hatchery environment.

Environmental Effects and Recommendations

During the development of the license application, stakeholders expressed interest in assessing the impacts of the project on recreation fishing and other uses both for Makah Bay and Hobuck Beach, including access to the project area, and marine safety (*e.g.*, buoy lighting, notice to mariners, coloration) (Finavera, 2006).

The land distribution station (or shore station) to be located adjacent to Hobuck Beach would be approximately 10 feet high with a floor plan measuring 15 feet by 15 feet and, other than the immediate building location, would not affect public access to Hobuck Beach (Finavera, 2006). We note the license application does not identify whether an access road would need to be constructed, or an existing road would be utilized.

In its filing of February 16, 2007, the Makah Tribe states that the proposed location for the shore station and staging area may be in an area with a recreational vehicle park and cabins with power, sewer, and water infrastructure, and therefore, they may request an alternative location for the site, presumably in the general area of the proposed location.

The offshore power plant would occupy an area of 60 feet by 240 feet on the water surface (Finavera, 2006). To reduce project-related impacts on the Pacific Ocean seabed, the applicant proposes to install the anchor system that would consist of a total of 10 VLA's and 10 surface floats and cover an approximate area of 625 feet by 450 feet. The 3.7-mile-long transmission cable would be anchored to the ocean seabed.

Finavera proposes the following measures: (1) develop and implement an Interpretive and Education Plan to provide information regarding the Makah Bay Project; (2) continue to consult and comply with the U.S. Coast Guard regarding navigational safety; and (3) develop a fishing and navigation exclusion zone for project protection and human safety.

Washington DNR states that the proposed project may adversely affect state-owned aquatic lands and the State's natural resources under its jurisdiction. We recognize the proposed project would be located on lands and in waters managed by federal and state agencies, and the Makah Tribe. Of the total 7 acres affected by the proposed water-based portion of the project, we are unclear on the acreage of Washington State-owned aquatic lands that would be affected by the proposed project.

Concerning the proposed Makah Bay Project, we identified the following four recreational resource issues: (1) project-related impacts on recreation; (2) Interpretive and Education Plan; (3) marine debris[47] and buoy retrieval; and (4) an exclusion zone. We discuss each issue below.

Project-Related Impacts on Recreation

Interior comments that Finavera has not proposed any measures to mitigate for project-related impacts on recreational activities and recreational fishing. Interior is concerned with potential project-related impacts on the aesthetic and recreation resources of the Makah Bay area, including the exclusion zone. Interior recommends: (1) if a license is issued, the licensee be directed to monitor recreation use over the term of the license to identify effects on recreational use; (2) the EA include an analysis of potential effects on cultural and natural resources within the Olympic National Park and address buoy retrieval from the park; and (3) the licensee consult with the NPS and the Washington State Interagency Committee for Outdoor Recreation throughout the term of the license.

Washington DFW comments that project-related impacts on the crab fishery would occur due to preclusion of the area that is currently used for fishing. Washington DFW states that Finavera did not include any measures to address mitigation for the loss of the fishing area due to the proposed project, and therefore, filed a recommendation for Finavera to provide mitigation for fishing area loss.

Staff Analysis

Once the proposed exclusion zone is marked, certain fishing activities (*e.g.*, anchoring, bottom trawling) would be prohibited near the four buoys and along the 3.7-mile-long transmission cable in order to avoid snagging on the cable and existing marine debris and derelict fishing gear. See our discussion herein on marine debris and derelict fishing gear.

Finavera (2006) notes that because bottom trawling does not occur in the proposed project area there would be no effect on this fishery. However, activity restrictions

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[47]NMFS defines marine debris as any man-made object discarded, disposed of, or abandoned that enters the coastal or marine environment. Marine debris may enter the environment directly, such as from a ship, or indirectly when washed out to sea via rivers, streams and storm drains. One of the most biologically harmful forms of marine debris is derelict fishing gear (DFG). DFG is nets, lines, pots, and other recreational or commercial fishing equipment that has been lost, abandoned, or discarded in the marine environment.

within the exclusion zone could result in a curtailment of recreational, crab, and long-line fishing (or surface troll lines) around the four proposed buoys. Washington DFW has implemented depth restrictions for recreational halibut and bottom fish fisheries. Due to these actions, curtailment and/or loss of fishing could concentrate fishing activities in other areas. We find that both direct (loss of fishing area) and indirect (concentration of fishing activities in other areas) project-related impacts would occur.

The buoy area would be located in approximately 150 feet of water over sand substrate. Because of the depth and lack of kelp beds/rocky habitat, it is unlikely that the proposed project would limit scuba diving opportunities. Because the proposed 3.7-mile-long transmission cable would be located offshore in approximately 150 feet of water, we expect an insignificant impact on kayaking.

As previously discussed, the proposed project would be located on the Makah Indian Reservation and within the Sanctuary, Flattery Rocks NWR, and Washington DNR-owned aquatic lands. Interior raised a concern with buoys that may dislodge and move ashore onto the Olympic National Park, which we address in section VII.

To identify effects on recreational use, Interior recommends that the licensee monitor recreation use over the term of the license. A goal of the NPS (2006c) is to provide a diverse range of visitor experience opportunities and manage visitor use. We expect the proposed location of the Makah Bay Project to provide the public with a potential new tourist destination, while other recreation resources within the proposed project area and throughout the region would continue to be important attractions. In this case, we recognize the need to protect environmental resources and to address a potential new recreational opportunity. A monitoring program would address recreational use patterns and associated effects on the environmental resources. The monitoring program would identify potential management options (*e.g.*, redistribute fishing use area due to the proposed exclusion zone by providing information on an alternative site).

We discuss the costs associated with developing and implementing a plan to monitor recreation in the project area in section VI and make our recommendation in section VII.

Interpretive and Education Plan

Finavera’s proposed Interpretive and Education Plan would include interpretive displays to be installed in the vicinity of Hobuck Beach. These interpretive displays would provide information about: (1) operation of the wave energy project; (2) the marine resources of the proposed project area; (3) the Makah Tribe; (4) the stakeholders and their efforts regarding the project; and (5) a project purpose of minimizing the tribe’s dependence on foreign fossil fuels.

Staff Analysis

The NPS (2006b) states that many communities look to the NPS to help provide tourism opportunities to sustain their economies and way of life. Olympic National Park is an important regional attraction that balances the protection of natural and cultural resources with improving the visitor experience (National Park Service, 2006c). Van Ormer et al. (2001) conclude that the most utilized interpretive services included the park brochure/map (91 percent), entrance station information/service (65 percent), and trailhead bulletin boards (52 percent).

Keeney (2005) states "education and outreach are critical to reducing marine debris." Other available information (*e.g.*, Washington State University and University of Washington, 2004; Northwest Straits Commission, 2007) draw the same conclusion.

The Sanctuary Advisory Council, in its comments on Finavera's license application, recommended a map depicting marine habitats of the project area be included as part of the PDEA. We find that such a map would enhance Finavera's proposed Interpretive and Education Plan.

An Interpretive and Education Plan for the proposed project could compliment existing interpretive programs at the Olympic National Park, Sanctuary, and Makah Indian Reservation, and could be developed in concert with the Northwest Straits Marine Conservation Initiative, as identified in Washington State University and University of Washington (2004). Information for the public about marine debris and derelict fishing gear monitoring and removal, which we discuss below, could be part of the plan. Also, developing and installing interpretive displays would help meet a projected demand for interpretive services identified by federal and state resource agencies. The interpretive displays could create an opportunity for the public to learn about the Makah Tribe.

We discuss the costs associated with developing and implementing an Interpretive and Education Plan in section VI and make our recommendation in section VII.

Marine Debris and Buoy Retrieval

The Northwest Straits Marine Conservation Initiative (Washington State University and University of Washington, 2004) addressed many issues, including derelict fishing gear removal, which led to partnership efforts and multi-agency projects. For example, Clallam County recovered 52 derelict pots containing 30 dead and 30 live Dungeness crab and 33 other crabs. It is estimated that the remaining derelict pots might be killing 17,000 crabs per year. While the location of Clallam County's efforts is realized within the Northwest Straits region and is outside the proposed project boundary, a nexus exists between its recovery efforts and our defined cumulative effects analysis.

MMS (2007) finds that fishing activities in the Pacific region with the highest potential for interactions (or conflicts) with Outer Continental Shelf activities are bottom trawling (potential for snagging on cables and debris) and surface long-lining (potential for space-use conflicts with seismic survey vessels). Washington DFW comments that during a storm, crab pots can move and become entangled in the project's anchor lines, causing an inability to retrieve the crab pots. Washington DFW asserts that the proposed transmission cable would preclude anglers from fishing in the area due to fishing gear becoming entangled. The Washington DFW recommends that to avoid this, the anchor system should be well-marked.

Washington DFW (2002) finds that derelict fishing gear can present safety, liability, and environmental impacts on marine species and associated habitat. Keeney (2005) reports commercial and recreational boaters regularly encounter derelict fishing gear. The NMSP and NMFS cite literature in its February 16, 2007, filing, that finds marine mammal entanglement with fishing gear, typically pots and nets, occurs regularly and can cause mortality. The gear can become entangled in and potentially damage boat propellers, which can become a safety issue when vessels are disabled. Wiig (no date) documented estimated costs in repairing boats damaged by derelict fishing gear, as wells as, various programs and associated costs to retrieve the gear. For example, the Japanese fishing industry spent $4.1 billion, in 1992, repairing boats damaged by the gear. Retrieval costs for derelict fishing gear range from $65 to $25,000 per ton. Some of the crab pots that were retrieved had a resale value of approximately $50.

NMFS and the NMSP find that the proposed location of the buoys and anchor lines would be in the path of gray whales, creating the potential for entanglement in the anchor lines. Pursuant to section 4(e) of the FPA, NMSP filed Condition 2 (site inspection) stipulating that Finavera develop and implement an installation inspection plan that would define plans and methods for removal of marine debris, including abandoned fishing gear that becomes entangled with project components; conduct periodic site inspections at a minimum of biannually, but more frequently as additional data becomes available; conduct visual inspections of the transmission cable annually and provide an annual report of the inspections to the NMSP by December 31 of each year; and provide for access and participation of NMSP staff in each inspection. In addition, NMSP's Condition 6 (marine mammal entanglement and collision) stipulates that Finavera develop and implement a mitigation and monitoring plan to prevent marine mammal entanglement.

Staff Analysis

Brown et al. (2005) assessed the costs and benefits of reducing marine debris and derelict fishing gear. The authors took into account the environmental, social, and economic factors and offered management measures.

As discussed in section V.C.3 and V.C.4, we find that retrieval of marine debris and derelict fishing gear would lead to improved marine habitat and reduced mortality of marine species. Because of the unique and significant environment in which the proposed project would be located (*e.g.*, Sanctuary, Flattery Rocks NWR), the importance of tribal/commercial fisheries, and the potential for marine species to become entangled in the proposed project-related facilities (*e.g.*, the cable system), it may be necessary to remove existing marine debris and derelict fishing gear (*e.g.*, crab and shrimp pots, gillnets, and ropes) from the proposed project area prior to project-related activities. NMFS and the NMSP, Washington DFW, Washington DNR, FWS, Makah Tribe, Northwest Straits Commission, and Clallam County could be consulted on identification and removal of marine debris and derelict fishing gear. In addition, buoy retrieval could be addressed.

We discuss the costs associated with marine debris retrieval in section VI and make our recommendation in section VII.

Exclusion Zone

Finavera recognized a need to develop a fishing and navigation exclusion zone for project protection and human safety (PDEA at 5-78). Such an exclusion zone could affect the Makah Tribe's ability to use their usual and accustomed fishing grounds. As noted by Washington State University and the University of Washington (2004), because tribes are legally restricted to the geographic boundaries of their usual and accustomed fishing grounds, the establishment of marine protected areas (especially no-take zones) limits their ability to exercise treaty-reserved fishing rights. The report further states that tribes cannot relocate to another usual and accustomed fishing ground if their available area is reduced by pollution, delineation of shipping lanes, or other limitations. Consequently, any further limits on the tribe's usual and accustomed fishing grounds would represent a cumulative effect.

Staff Analysis

We assume the area of Finavera's proposed exclusion zone would include the area occupied by the four buoys, 10 surface floats, and anchoring/mooring equipment. In addition, the proposed 3.7-mile-long transmission cable would be part of the exclusion zone.

With the installation of the proposed 3.7-mile-long transmission cable, we recognize the marine environment would be altered. Due to the proposed project locale (*i.e.*, Sanctuary) and fishing interests, we find that a larger area for an exclusion zone may be warranted for public and navigational safety, as well as to protect marine biota. Literature (Enticknap, 2002; National Oceanic and Atmospheric Administration and U.S. Army Corps of Engineers, 2005; MMS, 2007) discusses a trawling vessel snagged on a cable, making it vulnerable to capsizing or flooding in rough seas. Although we recognize an uncertainty exists with defining an exclusion zone and eventual associated impacts on tribal/commercial and recreational fishing, we find that the proposed marine environment area could be protected from commercial bottom trawling impacts, while allowing the use of other commercial fishing gear types. The Makah Tribe's usual and accustomed fishing grounds extend beyond the proposed project area; therefore, we expect that a proposed exclusion zone should not significantly harm the tribe's ability to continue fishing in their usual and accustomed fishing grounds.

We discuss the costs associated with establishing and maintaining an exclusion zone around project facilities in section VI and make our recommendation in section VII.

Navigation Issues

The nearest harbors to the project out of which shipping occurs are Port Angeles, which is 56 miles east of Cape Flattery, and Grays Harbor, which is 93 miles south of Cape Flattery. The West Coast Offshore Vessel Traffic Risk Management Project, co-sponsored by the Pacific State/British Columbia Oil Spill Task Force and the U.S. Coast Guard Pacific Area, recommends that, unless other traffic management areas exist (such as near ports), vessels of 300 gross tons or larger should maintain a minimum distance of 25 nautical miles offshore along the entire west coast (EPRI, 2004). The proposed project area is listed as an Area to Be Avoided (ATBA), which advises operators of vessels carrying petroleum and hazardous materials to maintain a 25-mile buffer from the coast. The distance narrows as shipping lanes converge at the entrance of the Strait of Juan de Fuca. This designation serves to direct larger vessels away from Makah Bay, but leave the area open to smaller vessels (Finavera, 2006).

To minimize hazards to navigation, the seabed and buoy components of the project (anchors, turbine-generator housing, and transmission cable) would be posted on a U.S. Coast Guard Notice to Mariners and the latter would be equipped with required U.S. Coast Guard navigation lights for identification by boaters. Finavera proposes to paint the four buoys using non-reflective colors that blend with the background landscape in order to minimize buoy visibility from shore. Finavera states that buoys would be made visible to boaters during the day and would likely aid navigation during periods of fog or low visibility; at night boaters may take their bearings to/from the buoys. Finavera proposes to continue to consult and comply with the U.S. Coast Guard regarding navigation safety.

The Sanctuary Advisory Council comments that surface buoys or floats should be installed to mark the extreme corners of the proposed project. For further discussion see section V.C.8 and VII.

Unavoidable Adverse Impacts

There would be a minor, long-term risk that increased visitation to the project area resulting from the installation and operation of the new generation technology would adversely affect other environmental resources in the project area.

8. Aesthetic Resources

Affected Environment

Climate, topography, and land uses can have an influence on the aesthetic characteristics of the region. Clallam County is located within the northern section of Washington's Olympic Peninsula. The county's western and northern boundaries are the Pacific Ocean and the Strait of Juan de Fuca shorelines. The county's southern boundary traverses Olympic National Park. Mountains, rugged coastlines, forest, rivers, and mild marine climate offer unique environmental amenities (Clallam County, 2007). At the northern entrance to Olympic National Park and Shi Shi Beach, the Port of Arches rock formations are a prominent visual feature. The Clallam County comprehensive plan and Clallam County shoreline master program guide the county in its local land use and decision-making process (*e.g.*, sustain natural resource based industries) that likely indirectly affects aesthetic resources.

Scenic views, wildlife observation, and a myriad of recreational opportunities draw residents and visitors to the Olympic Peninsula. The primary aesthetic resource use associated with the area is public viewing of the nearby islands, rocks, coastline, and seastacks from the mainland or from private or commercial watercraft and airplanes. Regarding the nearby islands, the Recreation Resources and Land Use Section herein discusses the Washington Islands NWR. The FWS (2005) states that since many of the islands are located within 2 miles of the Washington State coastline, the islands are a prominent visual feature for visitors that travel along the coastline or hike within Olympic National Park. The islands appear as rock pillars and tables that rise from the ocean in various sizes and forms. The FWS (2005) states that incidence of over-flight disturbances on Washington Islands NWR occur that disrupt seabird and marine mammal breeding and resting activities. Currently, there is a 2,000-foot (610 m) minimum flight altitude for aircraft over the islands. However, this regulation is difficult to enforce due to the remoteness of the area and is often violated.

In our geographic scope, we included the Strait of Juan de Fuca, of which the 61-mile-long Strait of Juan de Fuca Highway - SR112 is designated as a National Scenic Byway.[48] The SR112, which links Port Angeles to Neah Bay, provides scenic views of

[48] The National Scenic Byways Program is part of the U.S. Department of Transportation, Federal Highway Administration. The program was established to

rocky bluffs, forests, sandy beaches, and opportunities for wildlife observation (e.g., bald eagles, gray whales, Pacific white-sided dolphins). The highway also provides historical information of the area.

State Route 110, Highway 101, and State Route 109 provide vehicular access to or parallel the Washington coastline that afford residents and visitors an opportunity to view the area. These routes also provide access to various recreation facilities within Olympic National Park. Sea kayaking is an increasingly common activity for visitors to enjoy the aesthetic resources of the Washington coastline. In the off-season camping period (from October to April), the unique aesthetic character of the area still attracts residents and visitors.

Environmental Effects and Recommendations

To mitigate project-related impacts on aesthetic resources, Finavera proposes to: (1) plant native vegetative landscaping around the shore station so that the facilities fit into the natural landscape; (2) paint the buoys using non-reflective colors that blend with the background landscape; and (3) develop design guidelines for future project improvements.

Finavera (2006) cites a report (EPRI, 2004) that concludes most wave power plant proposals represent obstacles to marine navigation. However, the portion of the buoys above water is similar in size and shape to those used to demarcate shipping lanes and identify obstructions. Finavera (2006) concludes that the proposed buoys may not represent a navigational restriction, other than a small restriction zone around the buoy field.

Staff Analysis

The land-based proposed project facilities would be visible from Makah Passage Road. Because the proposed shore station would be located in proximity to a few residential dwellings and on the Makah Indian Tribe Reservation, we assume that the majority of travelers using Makah Passage Road would be tribal members or the public for recreation.

Project-related construction activities on the Makah Indian Reservation could result in a temporary disturbance to tribal members and the public due to dust and noise of equipment and vehicles. Construction activities and a staging area could temporarily change the viewshed until the area is revegetated. The current proposed shore station (15

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recognize, preserve, and enhance selected roads based on one or more archeological, cultural, historic, natural, recreational and scenic qualities.

feet by 15 feet) would create a contrast within the landscape; however, this impact would be expected to be minor due to the proposed small disturbed area and Finavera's proposal to revegetate. Because the disturbed area would be revegetated, the duration of aesthetic impacts and the likelihood of soil erosion would be reduced. The proposed vegetative screening would further reduce aesthetic impacts. To avoid and/or minimize the introduction of invasive plant species, Finavera could use native vegetation during revegetation.

Finavera proposes to paint the four buoys, spaced about 60 feet apart, using non-reflective colors that blend with the background landscape. Finavera (2006) finds that the proposed buoys may be visible from a high cliff or from Hobuck Beach as a small point on the horizon. The navigation lights on the buoys would likely be visible from other points on clear nights. The Department of Energy and Bonneville Power Administration (2007) cite studies in which artificial night-lighting can alter the fish species assemblages and change salmon behavior, thereby exposing them to the risk of predation.

We find Finavera's proposal to paint the buoys with colors in order to blend with the background landscape may conflict with navigational safety because the buoys could be difficult to distinguish, especially in inclement weather. In order to address the issues of protecting the aesthetic character of the Sanctuary area while at the same time providing for the safety of the public and project facilities, Finavera could consult with the U.S. Coast Guard and the Sanctuary on how to paint and mark the project buoys.

We cannot evaluate Finavera's proposal to develop design guidelines for future project improvements because Finavera did not provide any details on its measure.

We discuss the costs associated with protecting the aesthetic character of the proposed project area in section VI and make our recommendation in section VII.

Unavoidable Adverse Impacts

Dust and noise from shore-based construction activities on the Makah Indian Reservation would result in a temporary disturbance to the public. Land-disturbance and construction equipment would temporarily disturb the project area viewshed.

Deployment of the buoys and development of the shore station would represent a long-term, unavoidable adverse impact on aesthetic resources. However, because of the proposed small size (15 feet by 15 feet) of the shore station and distance of buoys from shore (3.7 statute miles or 3.2 nautical miles), these impacts are not expected to be significant.

9. Socioeconomic Resources

Affected Environment

Clallam County, located on the Olympic Peninsula (Washington), encompasses 1,739 square miles with 200 miles of coastline. The Makah Indian Reservation, located in the northwest portion of Clallam County, encompasses 47 square miles of land bounded by the Pacific Ocean, the Strait of Juan de Fuca, and Olympic National Park. State Route 112 connects the Makah Indian Reservation with the Olympic Peninsula. Electric power to the reservation is provided by the Clallam County Public Utility District. The annual usage on the reservation is approximately 16,700 megawatt-hours (Makah Tribe, 2005). Some of the communities within Clallam County include Port Angeles, Sequim, Neah Bay, Clallam Bay/Sekiu, and Forks.

Information on recent population trends, median household income, and housing units for Clallam County and the Makah Reservation is presented in table 8. For a comparison, there was a 6.7 percent increase in Washington State's population, from an estimated 5.8 million (2000) to 6.2 million (2005). The approximate number of housing units in 2005 was 2.6 million and the median household income was $48,185. Eleven percent of the population lives below the poverty level.

Table 8. Project area demographic information. (Sources: U.S. Census Bureau 2005; Washington OFM 2005; and Makah Tribe 2005).

Item	Area	
	Clallam County	Makah Indian Reservation
2000 Total Population	64,525	1,214
2005 Total Population	69,689	1,752 (2003)
Percent Change in Population 2000-2005	8.6 %	44 %
Housing Units 2005	32,773	unavailable
Area in Square Miles (Total)	1,739	47
Median Household Income – 2005	$42,367	$24,167 (1999)
Poverty Status – 2003 (% below poverty level)	11.9 %	27.2 % (1999)

Wholesale/retail trade (3,714 employees), health care and social assistance (3,459 employees), accommodations/food services (2,265 employees), and government (2,202 employees) are the largest employment sectors in Clallam County, Washington (State of Washington, Office of Financial Management, 2005). From 2000 to 2005, the number of new businesses or reorganization of existing firms increased from 378 to 869. In Clallam County, the unemployment rate decreased from 7.7 percent (2001) to 6.1 percent (2005) (Clallam County, Economic Development Council, 2005).

For the Makah Tribe, the following industries are the largest employment sectors: management, professional, and related occupations (203 employees); education, health and social services (128 employees); public administration (121 employees); and agriculture, forestry, fishing, and hunting (77 employees) (U.S. Census Bureau, 2000).

The area economy is also supported by commercial fishing. The biological productivity of the coastal and waters off the Olympic Peninsula (Washington) sustain plankton and fish populations, which attract a variety of foraging species, thereby contributing to the significant economic benefits of state and tribal economies (NMFS, 2001). As previously discussed, the Makah Tribe has a substantial commercial fishery which serves as a primary mainstay of its economy (Makah Tribe, 2007). Relative to the proposed project area, MMS (2007) notes that Neah Bay, Washington reported a fishery value of $4.9 million in 2004; Port Angeles reported $2.8 million.

Tourism and recreation contribute to the economy due to visitors' attraction to the Olympic Peninsula (Washington) and associated communities. In 2005, an estimated 3,170 jobs were related to or dependent on Clallam County tourism, resulting in $166.8 million generated in travel spending (*e.g.*, accommodations, restaurants). Tax receipts totaled $12.4 million (Washington Department of Community, Trade and Economic Development, 2006; 2006a). In 2005, there were 11,670 visitors to Neah Bay, Washington (Clallam County, Economic Development Council, 2005). Neah Bay, Washington is known for its halibut fishing (from May to June, ending when a seasonal quota is attained).

At Olympic National Park, visitors spent $90 million dollars in the local area (including Clallam County) generating $29 million in direct personal income (wages and salaries) for local residents and supporting 1,900 jobs in area tourism business. In addition, $27 million in sales is generated through secondary effects, such as visitor spending (Stynes, et al., 2001; Stynes and Sun, 2003).

Washington State and Clallam County populations of those 65 years old and over represent 11.5 percent and 22.0 percent, respectively. The Interagency Committee on Outdoor Recreation (2002) finds that older people (65 years and over) tend to be more safety conscious and aesthetically oriented. For this population group, we expect demand for passive recreation (*i.e.*, sight-seeing) would increase, which likely could shift the amount of travel spending generated for certain recreational opportunities.

Data for 2003 and 2005 indicate that Clallam County has 21,034 acres of farms, of which 12,116 are cropland. While the harvest of apples, cherries, grapes, and pears contribute to the value of irrigated crops, Clallam County's primary commodities are cattle, hay, and aquaculture ($18 million) (Washington State Department of Agriculture, 2003; 2005). In 2005, Washington State's $32 billion food and agriculture industry contributed 12 percent to the State's economy and employed 160,000 people (Washington State Department of Agriculture, 2005). Thus, the Clallam County agricultural industry contributed toward a beneficial effect on the economy, both locally and regionally.

Environmental Effects and Recommendations

The Makah Tribal Council envisions that the Makah Bay Project would provide sufficient energy to supply approximately 150 homes. To demonstrate the feasibility of the technology to the Makah, the Clallam County PUD, and the public, the size of the proposed project is limited to minimum size providing meaningful field data (Finavera, 2006).

The Makah Tribe states the proposed project's impact on recreational fisheries would affect the tribe. The tribe comments that tribal fishermen derive a significant income from chartering their boats or serving as fishing guides for recreational fishermen out of the port of Neah Bay. Additionally, the tribe derives significant revenues from fishing-related tourism. Project-related impacts on commercial and recreational fisheries should be addressed, including both the buoy and anchor footprint and the unburied portion of the transmission cable. These impacts should address the exclusion zone around the buoys and anchor system.

Staff Analysis

In concert with the various other entities' existing interpretive programs, we find a project-related Interpretive and Education Plan could contribute to the tourism industry by providing information to the public on the proposed project and the unique environment in which it would be located. Travel spending would likely be generated by the public to view the interpretive displays and surrounding area.

Although the Makah Tribe comments that significant income/revenues is derived from chartering their boats or serving as fishing guides for recreational fishermen and from fishing-related tourism, the tribe did not provide supporting documentation. However, Tiller and Chase (no date) find that salmon fishing by the 27 federally recognized Indian tribes in the State of Washington, including the Makah Tribe, has been valued at $6.8 million for 1997. The report states that many Puget Sound and coastal tribes have fisheries management programs, whereby in 1997, tribal hatcheries released more than 39 million salmon, benefiting Indian and non-Indian commercial and sport anglers in Washington State.

The National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers (2005), conclude that "given the complex manner in which fishery regulations, seafloor habitats, fish stocks, and navigational hazards (*e.g.*, submarine electric cables) all influence selection of the area fished, it is not possible to quantify the economic impacts to commercial fishers in their current condition. Nevertheless, the loss of area use directly limits their [fishers] ability to catch fish and could reduce the profitability of commercial fishing in the area." We agree with their conclusion and find it applicable to the Makah Tribe's comment regarding project-related impacts on commercial and recreational fisheries.

The Makah Tribe plans to derive economic benefit from the proposed project by leasing to Finavera property for the land station. Leasing the property could generate revenue for the tribe. In 2001, Finavera and the Makah Tribal Council entered into a MOA, "to develop and promote offshore wave power generation plants as one of the renewable energy technologies that contribute to non-polluting energy production, the efficient use of energy and which contribute to the preservation of wildlife habitat within the Pacific Northwest." The initial MOA has been replaced by a land lease agreement for the proposed project.

In its filing of February 16, 2007, the Makah Tribe states that the lease established with the tribe and Finavera would need to be renegotiated due to the change in the name of the applicant (from AquaEnergy to Finavera) and other changes regarding the proposed project. In its February 20, 2007 filing, Finavera states that it would secure land leases with the Makah Tribe and the State of Washington for the portions of the proposed project located on their lands.

Finavera (2006) states that local contractors would be used whenever possible for project-related construction and maintenance activities. We find, therefore, that short-term increase in, and long-term continuation of, existing employment, income, and tax revenues associated with the proposed project would occur.

Unavoidable Adverse Impacts

Although it is difficult to quantify, an unavoidable adverse impact on tribal/commercial fishing and associated income/revenues would likely occur due to the proposed exclusion zone to be located within the Makah Tribe's usual and accustomed fishing grounds.

10. Cultural Resources

Affected Environment

Cultural resources include prehistoric and historic-period archeological sites, objects, historic structures, and traditional cultural properties (TCP's). TCP's are places that may or may not have human alterations, but are important to maintaining the cultural identity of a community such as an Indian tribe. The Commission's regulations follow section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, in requiring that the Commission evaluate potential effects of a proposed project on cultural resources listed or eligible for listing in the National Register of Historic Places (National Register) and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the proposed undertaking. Cultural resources listed, or considered eligible for the National Register are called historic properties. Pursuant to section 106, if potential adverse effects are identified within the proposed project's area of potential effects (APE), the Commission needs to seek ways to avoid, reduce, or mitigate such adverse effects in consultation with the SHPO, and with any other interested parties, including Indian tribes. When the APE involves Indian reservation lands, the Commission seeks the concurrence of the THPO in lieu of the SHPO.

The Proposed Project's Area of Potential Effects

An APE, as defined in the implementing regulations for section 106, means the geographic area within which a proposed undertaking (such as constructing and operating the Makah Bay Project shore station) may cause changes in the character of, or use of historic properties. The APE for this proposed project consists of an approximate 60 by 240-foot area in the Pacific Ocean (use for tethering the AquaBuOYs 150 feet below the surface) 3.7 statute miles west from Hobuck Beach, a 3.7 mile-long corridor for a transmission cable (that will be anchored on the surface of the ocean floor) running from the AquaBuOY area to Hobuck Beach, a 25 by 25-foot area on the shore of Hobuck Beach for the distribution station, and an approximate 100 by 100-foot staging area south from the site of the distribution station on Hobuck Beach. The off-shore portions of the proposed project APE lies within the Makah Usual and Accustomed Grounds, Sanctuary, the Flattery Rocks NWR, and Washington State waters, while the land-based portions of the APE are located on the Makah Indian Reservation.

Culture History

The culture history in and around the project area centers on the Makah Indian Reservation that is situated in the northwestern tip of the Olympic Peninsula. Basically, Native Americans have inhabited the Olympic coastal area for at least 6,000 years and possibly much longer. Along the Pacific Northwest in general, fluted points, associated with the Paleoindian period of North America, evidences that Native Americans have inhabited the region from at least the close of the Pleistocene, dating back some 12,000 years ago. Despite some ethnographic information suggesting late arrivals of coastal peoples as recently as a thousand years ago, archeological investigations indicate continuous aboriginal occupation along much of the Olympic Peninsula for thousands of years (Wessen, 1990; Sanctuary, 2005). In the Olympic Peninsula, prominent archeological sites consist of shell midden village sites situated along the coast that date to the last 2000 to 1500 years (Wessen, 1990). In the northwestern tip of the Olympic Peninsula, there are nine coastal late prehistoric archeological midden sites in and near the Makah Indian Reservation. Of these sites, the Ozette and Hoko River are the best well-documented shell midden village sites and possess a wealth of archeological data. The Ozette site has an occupation of more than 2000 years and contains well-preserved plank houses made of cedar, along with other perishable items made of wood and woven plant materials.

Originally, the Makah inhabited the northwestern tip of the Olympic Peninsula, extending from the Strait of Juan de Fuca inland to the Hoko River, to as far south Cape Johnson (Renker and Gunter, 1990). Prior to European contact, there were five principal Makah villages: Neah Bay, Biheda, Wayatch, Tsoo-yess, and Ozette. The Makah people were sedentary, living year round in villages where they lived in cedar plank lodges like other Northwest coastal tribes. The Makah culture centered on the hunting and fishing of gray whales, fur seals, halibut, salmon, and other marine animals. While having a relative lack of interest in pursuing land animals, the acquisition of terrestrial plant resources was an important aspect of the Makah culture. The Makah Tribe placed a high value on the collection of a number of berries such as blue, cran, salmon, and huckle berries, and roots from grasses such as surf grass and buttercup. Camas, which grows outside the area, was traded by other inland-based tribes to the Makah. The Makah and other Olympic Coast Indian tribes have long fished the offshore waters using seaworthy canoes in conjunction with a variety of sophisticated harpoon, hook, net and line techniques. Traditionally, the Makah males were exclusively fishermen, while women principally collected and processed food resources. The Makah hunted gray whales more than the other coastal Washington tribes, and the Treaty of Neah Bay (1855) reserved their right to fish and hunt whales as well as seals (Sanctuary, 2005; Washington DFW, 1997). NOAA (2001) reports that “The Tribe believes that continuing its whaling tradition will provide important subsistence and ceremonial benefits to the Makah community and will help the Tribe to reaffirm its traditions and cultural identity. The large tribal ceremonies and celebrations involving most members of the Tribe after the successful hunt on May 17, 1999, are indicative of the benefits of whaling to the Makah Tribe.” In August, the Makah hold their annual celebration in Neah Bay to celebrate their ancestral heritage and traditions. The celebration typically includes traditional dancing and singing as well as canoe races and Slahal games.[49] In addition, the festivities also include a grand parade, street fair, dancing, singing, feasting, and a spectacular fireworks show (Makah Tribe, 2005).

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[49] According to the University of Waterloo (2005), a Slahal game consists of a visually impressive Pacific Northwest Coast Indian bone and stick gambling game. The play of the game is dependent upon two pieces of antler which are used like dice. The score keeping device consists of a colorful whale carved out of red cedar wood painted with typical Pacific Northwest Coast Indian tribal designs and sticks are inserted into the whale to aid in keeping score of the game. The game was made circa 1981 by Bill Kuhnely, Vancouver Island, British Columbia, Canada.

Europeans began exploring by sea the northern tip of the Olympic Peninsula at the end of the eighteenth century. After several years of contact, in 1792, the Spanish established a fort at the Makah village of Neah Bay called Nunez Gaona (Renker and Gunther, 1990). The fort proved to be unsuccessful, however, and the Spanish abandoned it four months later (Renker and Gunther, 1990). In the early 1800s, the Makah were able to capture and hold captive some shipwrecked Russians, and later, even a few Japanese sailors (Renker and Gunther, 1990). These and other contacts with Europeans encouraged the Makah to acquire non-native goods, such as iron and copper, blankets, guns, alcohol, and food in exchange for native resources such as fur-bearing mammals, especially fur seals. Trade increased between seafaring Europeans and the Makah, but by the 1850s, smallpox had devastated the native population, resulting in the abandonment of the village at Biheda (Renker and Gunther, 1990). In 1855, representatives of the four remaining tribal villages signed the Treaty of Neah Bay with Governor Stephens of the Washington Territory, establishing the Makah Indian Reservation. At Neah Bay, an Indian agency was established for the reservation, and a boarding school was constructed in the 1860s. From this time well into the twentieth century, the traditional life ways, customs, and traditions of the Makah were curtailed in place of European practices such as agriculture, and the speaking of their native language was severely discouraged. Native entrepreneurs of the Makah also abandoned their traditional whaling ventures for the hunting of seals in schooners when sealing became increasingly profitable towards the end of the nineteenth century. Some of the Makah even owned their own schooners (Renker and Gunther, 1990; Colson, 1953). The Makah Reservation was essentially isolated from the outside world until Washington State Road 112 was completed in the 1930s (Renker and Gunther, 1990). Prior to the highway, the only access to the reservation was by sea (Ibid). From the mid-twentieth century on, the Makah Indian Reservation became more integrated with the surrounding economy, where tourism, logging, and fishing became the main sources of income for the Makah. At the same time the Makah also began to revive their native culture. By the 1970s, with accumulating effects of pro-Native American civil rights legislation, and with archeological excavations at Ozette, the Makah experienced a cultural reawakening, culminating in their present-day success as an independent tribal people.

One of the best examples of the revitalization of the Makah Culture is the Makah Cultural and Research Center (MCRC) located in Neah Bay. Today the MCRC is recognized as one of finest tribal museum and research centers in the United States (Renker and Gunther, 1990; Makah Tribe 2005). The MCRC contains permanent exhibits including artifacts from the Ozette collection that were uncovered from the village that was partially buried by a mudslide around 1500 AD (Makah Tribe, 2005). The museum contains a full-size replica long house, and four handcrafted cedar dug-out canoes. Whaling, sealing and fishing gear, basketry, and other tools are also on display (Makah Tribe, 2005).

Environmental Effects and Recommendations

In their PDEA, Finavera stated that they initiated consultation with the Makah tribal cultural resource specialist and the state archeologist associated with the Washington SHPO. The applicant elaborated further that the Makah helped in the siting process for this proposed project, and the Makah were able to ensure that no sensitive cultural or historic sites would be affected by construction of this project. Thus, the applicant has concluded that no cultural resources would be affected by this proposed project. Nevertheless, the applicant proposes to develop and implement a cultural resources management plan in consultation with the Makah Tribe to protect cultural resources.

Commenting on the applicant's PDEA, in a letter filed February 16, 2007, the Makah point out that they established a THPO in 2000, and that the authority of the THPO should be recognized by federal agencies in their efforts to comply with section 106. The Makah also confirm that the proposed project on the Makah Indian Reservation should not affect any archeological site; however, they note that the land portion part of the project is situated between two previously recorded archeological sites.[50] As a cautionary measure, the Makah THPO recommends that a tribal cultural resources monitor be present during the excavation phase of the project involving any ground-disturbing activities to insure that no archeological sites would be affected. The Makah further recommend that their THPO be contacted by the applicant prior to the excavation phase of the project, where the tribe and applicant can plan on the number of days required and estimated cost for the tribal monitoring. In their April 7, 2007, response, the applicant acknowledges these comments from the Makah, and states that they have previously requested a cost estimate from the tribe for the monitoring work.

Staff Analysis

We conclude that this proposed project would not affect historic properties on the Makah Indian Reservation. However, to insure that no newly discovered archeological site would be affected by ground-disturbing activities involving the excavation phase of the project, we agree with the Makah Tribe that a tribal monitor be present during this aspect of the project.[51] However, we find that it is not necessary for Finavera to develop

[50]The Makah also note in their February 16, 2007, filing that the present location for the shore-based distribution station and staging area may need to be moved because the present location is close to a recreational area.

[51]We anticipate that there would be continuity with the use of a particular tribal monitor, or series of tribal monitors during the construction phase of the project. However, in an event where a tribal monitor could not be present, Finavera could, in

a cultural resources management plan, since it is unlikely that this project will have an adverse effect on historic properties, or other cultural resources. However, if an archeological site were to be discovered during monitoring, and that site was considered to be eligible to the National Register, a treatment plan for the resolution of adverse effects for this site would be developed by the applicant, in consultation with the Commission and THPO. We also intend to seek the concurrence of the THPO that this project would not have an effect on historic properties on the Makah Indian Reservation, with the condition that a tribal monitor be present to insure that no archeological site will be affected by this project. The monitoring would be done during the excavation phase of the project when ground-disturbing activities are taking place.

On the offshore aspect of the APE, we also conclude that this proposed project would not have an effect on any submerged cultural resource that would be eligible for the National Register. Although the applicant in the PDEA did not directly discuss their efforts in determining whether any submerged cultural resources may lie in the off-shore APE, in September 2002, the applicant did conduct a systematic geophysical survey of the ocean seafloor and sub-bottom using methods approved for archeological investigations (see PDEA at p. 4-6).[52] The purpose of the geophysical survey (Thales GeoSolutions, 2002) was to determine suitable sites for the tethering of the AquaBuOYs and routes for the 3.7-mile transmission cable. The geophysical survey covered a 1 by 5-km rectangular area which included the off-shore APE. The results of the geophysical survey produced a bathymetric map of the entire survey area at a 5-m resolution level of quality, and a backscatter mosaic of the same area at 1-m resolution level of quality (Thales GeoSolutions, 2002). The results of the geophysical survey showed that the ocean floor of the survey area consisted of modern sediments with scattered rock and surrounding rock outcrops (Thales GeoSolutions, 2002). Sub-bottom profile data of the sediments below the surface were also consistent with the bathymetric data. No unnatural anomalies or cultural resources were reported. On May 10, 2007, we received clarification from Finavera that the geophysical survey did not detect any submerged cultural resources (see phone memo filed on May 15, 2007). Thus, we will seek the concurrence of the SHPO that this proposed project would not have an effect on historic properties for the offshore portion of the APE.

We discuss the costs for protection of cultural resources in section VI, and make our recommendation in section VII.

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consultation with the THPO, acquire a qualified non-tribal monitor in place of the tribal monitor to complete the particular monitoring task at hand.

[52]Thales Geosolutions used Isis Sonar, which is used for a variety of applications, including detecting underwater archeological resources. (See Thales Geosolutions 2002, Appendix D, Equipment Specifications).

Unavoidable Adverse Impacts

None.

11. Project Decommissioning

NMSP Condition 8 provides for Finavera to purchase a surety bond to cover the costs of project removal and to prepare a decommissioning plan prior to commencing the decommissioning of the proposed project.

On December 14, 1994, the Commission issued a policy statement concerning relicensing and decommissioning of hydropower projects.[53] Specifically, the policy statement stated that the Commission would look at funding decommissioning costs on an individual basis, taking into account the condition and expected lifespan of the project in question as well as the applicant's financial ability to fund such an action at the end of the term of any license issued.

Finavera Renewables Ocean Energy Ltd., is a wholly-owned subsidiary of Finavera Revewables, Inc., of Vancouver Ontario. Finavera Renewables, Inc., is a publicly traded company on the Toronto stock exchange (TSX), and as of May 2, 2007, had a market capitalization (*i.e.*, stock value) of over $86,000,000 (Canadian dollars).

Should project retirement become necessary during the term of any license issued for this project, Finavera would likely be required by the NMSP and the Makah Tribe to remove all of the project facilities, including the project's buoys, mooring lines, anchors, transmission cable, and shore station. All of the equipment would have some salvage value that would at least partially offset the labor and equipment rental necessary to remove the facilities. We estimate this cost to be about $3.5 million, which is equivalent to the construction/installation costs less the cost of HDD.

The Commission will further address project decommissioning in the order for Finavera's license application. Specifically, the order will address the need for license requirements that would require Finavera to make financial provisions for the unexpected early retirement of the project.

[53] Dam Decommissioning at Relicensing, Policy Statement. 69 FERC ¶61,336. An errata was issued on January 11, 1995, to correct one project number and add another.

VI. DEVELOPMENTAL RESOURCES

Our developmental analysis provides a general estimate of the potential power benefits and costs of the proposed project as well as reasonable alternatives to project power. The Proposed Action includes a variety of environmental protection, mitigation, and enhancement (PM&E) measures proposed by Finavera. The Staff Alternative includes modified and additional measures recommended by staff that would ensure the best comprehensive development of the waterway. The Staff Alternative with Mandatory Conditions includes measures recommended by staff and all of NMSP's conditions submitted pursuant to section 4(e) of the FPA. This developmental analysis estimates the project's net annual economic benefits under the Proposed Action, the Staff Alternative, and the Staff Alternative with Mandatory Conditions.

A project's net economic benefits are the difference between the cost of producing power, including construction costs, licensing costs and the implementation of the proposed PM&E measures, and the value of the electric power it generates. The value of the power is based on the costs of obtaining the same amount of energy and firm generating capacity from a likely alternative source. In addition, we usually include a power value for the dependable capacity provided by the project.

For the Makah Bay Project, we relied on information provided by the applicant regarding their anticipated licensing, permitting, construction, and operations and maintenance costs (O&M) as well as their financing metrics in order to estimate the cost of producing project power. We then computed energy values based on the rate negotiated between the local utility authority (Clallum County PUD) that will be under contract for purchasing the power from the power generator (Finavera). Table 9 presents the significant economic assumptions used in our analysis.

It should be noted that due to the unpredictable nature of the wave energy resource and the unproven technology (point-absorbing buoy), we assumed that the project would not provide dependable capacity. Therefore, our analysis only includes a power value derived from project operation, and does not include any capacity value.

Table 9. Key economic assumptions for the economic analysis of the Makah Bay Project.

Parameter	Value	Source
Period of Analysis – years	30	Staff
Terms of Financing – years	20	Staff
Inflation	3.3%	Applicant
Weighted Cost of Money	10.00%	Applicant
Power Value		
Peak Energy Value - mills/kWh	40.00	Applicant
Off-Peak Energy Value - mills/kWh	40.00	Applicant
Capacity Value - $/kW-year of capacity	N/A	Staff
Production Costs		
Licensing Costs	$1,000,000	Applicant
Construction Cost	$7,020,040[54]	Applicant/Staff
Annual Cost[55]	$50,000	Applicant
Cost of PM&E Measures	See Table 10	Applicant/Staff

Project Power Benefits

The proposed project will feature an array of 4 heaving buoys that will each generate an average power of 46 kW and have a capacity of 250 kW (for a total capacity of 1 MW). An analysis of the wave and current resources in the vicinity of the proposed project prepared by the applicant yielded an estimated annual generation of 1,500 MWh for the project. It should be noted that the proposed project, if licensed, would be the first of its kind in U.S. waters, and as such, very little known operational data is available. In fact, one of the stated objectives of the proposed project is to obtain real-world operational data for use in future similar projects. In addition, due to the unpredictable nature of the wave resource, it is unknown specifically when project power would be produced over the license term (*i.e.*, during peak/non-peak hours). As such, several assumptions were required in order to estimate project power benefits.

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[54]The total estimated construction cost is derived from the construction cost provided by Finavera in section 1 of the license application plus about $1.5 million for Finavera's proposed buoy and installation design considerations for the protection of environmental resources in the project area (*e.g.*, HDD, closed-loop system, anti-fouling paint, etc.).

[55]The annual cost includes insurance and any other annual charges incurred by the operation of the project.

At the contract rate agreed upon between the utility and applicant (40 mills/kWh) and assuming the project produces the estimated output of 1,500 MWh, it would represent a total annual power value of $60,000. As previously stated, the project would generate no dependable capacity, and therefore, no capacity value is included in our analysis of project power benefits.

Cost of Environmental Measures

The Proposed Action includes a number of environmental PM&E measures. Table 10 presents the capital and O&M costs of the proposed measures that would benefit environmental resources in the project area.

Comparison of Alternatives

Table 11 summarizes the annualized costs, benefits, and net benefits of the Proposed Action, Staff Alternative, and the Staff Alternative with Mandatory Conditions.

As shown in table 11, the Proposed Action would incur a liability; the net annual benefits under the Proposed Action would be -$814,088 or -$542.73/MWh. The Project's net liability is due primarily to the relatively high capital and O&M costs of the project with respect to the minimal amount of power produced. This project's value relies on its successful testing and demonstration of the applicant's technology, its limited impact on affected resources in a particularly environmentally sensitive area, and its ability to raise the profile of the emergent ocean energy industry. In addition, our analysis does not include financial incentives that may exist in the future during the license term for this type of marine energy project, making it difficult to calculate the true project net benefit.

Regardless, the Commission does not determine whether it is economically reasonable or prudent for an applicant to construct or operate a project. It is the applicant's responsibility to determine whether operation of a project is a prudent decision from an economic standpoint. An economic analysis helps support an informed decision concerning what is in the public interest with respect to a proposed project, or proposed license condition. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

Table 10. Summary of environmental measures for the Makah Bay Project.

Environmental Measures	Entity	Capital and One-time Costs (2007$)	Annual Costs (2007$)	Annualized Cost[56] (2007$)	Adopted by Staff?
Aquatic/Terrestrial					
Detailed design and installation plan for the project facilities, including the final design of both the buoy to prevent marine mammal haul-out and seabird roosting and the submarine transmission line anchoring/mooring system.	Finavera; NMSP(Condition 1); WDFW; Staff	$0[57]	$0	$0	Yes
Retrieve marine debris and derelict fishing gear prior to construction and installation activities	Staff	$3,400	$0	$330	Yes
Shore station construction erosion control, revegetation, and noxious weed control plan	Staff	$4,000	$0	$390	Yes
Marine mammal observer present during construction/installation	Staff	$2,900	$0	$280	Yes
Install acoustic deterrent devices (“pingers”) on the buoys	Finavera; Staff	$1,000	$2,000	$1,420	Yes

[56] In many cases in this table, the 30-year annualized cost is lower than the annual cost (i.e., O&M cost) for the measure. The reason for this is that the annualized cost includes an estimate of the tax savings that Finavera would realize due to the combined high capital (including interest and depreciation) and O&M costs of the measure.

[57] The capital cost for this measure has already been included in the $7,020,040 construction cost shown in table 9; consequently, there is no additional cost for this measure.

Table 10. Summary of environmental measures for the Makah Bay Project.

Environmental Measures	Entity	Capital and One-time Costs (2007$)	Annual Costs (2007$)	Annualized Cost[56] (2007$)	Adopted by Staff?
Baseline and post-installation hard substrate benthic community survey	NMSP(Condition 1); Staff	$30,000	$0	$2,900	Yes
Macroalgae and eelgrass survey	Finavera; NMSP(Condition 1); Staff	$4,200	$0	$410	Yes
Water quality ("frac-out") monitoring (during drilling) plan	Sanctuary Advisory Council; Staff	$2,500	$0	$240	Yes
Project facilities inspection and maintenance plan that includes a provision for at least bi-annual visits and retrieving marine debris and derelict fishing gear	Finavera; Staff; NMSP (Conditions 1 & 2); WDFW; Sanctuary Advisory Council;	$2,500	$5,400	$3,810	Yes
Project facilities inspection and maintenance every 60 days	Sanctuary Advisory Council	$2,500	$16,200	$10,930	No
Improve and maintain aesthetic values of project area through the selection of non-reflective colors that blend with the natural landscape and develop design guidelines for future project improvements.	Finavera	$5,000	$500	$810	No
Fuel and oil spill control, prevention, and countermeasures plan	WDFW; Staff	$2,500	$0	$240	Yes
Anti-fouling paint effectiveness plan	Finavera; Staff; NMSP(Condition 3)	$4,500	$0	$440	Yes

Table 10. Summary of environmental measures for the Makah Bay Project.

Environmental Measures	Entity	Capital and One-time Costs (2007$)	Annual Costs (2007$)	Annualized Cost[56] (2007$)	Adopted by Staff?
Noise assessment plan (on-site assessment)	NMSP(Condition 4); Sanctuary Advisory Council; Staff	$17,500	$0	$1,690	Yes
Noise assessment plan (engineering/literature based)	Finavera	$2,500	$0	$240	No
Continuous acoustic cetacean monitoring for 10 years (including annual maintenance and monthly data retrieval)	WDFW; Sanctuary Advisory Council; Staff	$13,100	$19,500	$14,140	Yes
EMF assessment plan (onsite monitoring)	NMSP(Condition 5); WDFW; Sanctuary Advisory Council; Staff	$9,500	$0	$920	Yes
EMF assessment plan (engineering/literature based)	Finavera	$2,500	$0	$240	No
Monitor effectiveness of sea lion excluder device	Finavera; WDFW; Staff	$0	$0	$0[58]	Yes
Marine mammal entanglement and collision monitoring plan (includes notifying NOAA of entangled marine mammals and keeping a vessel on standby to assist in NOAA's retrieval of the entangled mammal)	Finavera; NMSP(Condition 6); Staff	$2,500	$0	$240	Yes

[58] The annualize cost for this measure is included as part of the cost for bi-annual project facilities maintenance and inspection.

Table 10. Summary of environmental measures for the Makah Bay Project.

Environmental Measures	Entity	Capital and One-time Costs (2007$)	Annual Costs (2007$)	Annualized Cost[56] (2007$)	Adopted by Staff?
Notify Sanctuary of emergencies	NMSP(Condition 9); Staff	$0	$0	$0	Yes
Reservation of NMSP section 4(e) authority	NMSP(Condition 10)	$0	$0	$0	No
Project exclusion zone plan	Finavera; Sanctuary Advisory Council; Staff	$3,900	$390	$640	Yes
Mark the four (4) proposed buoys with lights	Sanctuary Advisory Council; Staff	$10,000	$0	$970	Yes
Seabird monitoring plan (assume one-year survey/assessment of seabird use of the area)	Finavera; FWS; Staff	$8,700	$0	$840	Yes
Written approval from NMSP for project alterations	NMSP (Condition 7)	$0	$0	$0	No
Surety bond and decommissioning plan (cost is 2% of total estimated removal cost of $3.5 million dollars)	NMSP (Condition 8)	$70,000	$0	$6,780	No
Recreation					
Interpretive/Education Plan - includes developing a map depicting marine habitats and associated species	Finavera; NMSP(Condition 1); WDFW; Staff	$2,500	$6,000	$4,200	Yes
Interpretive Displays	Staff	$26,000	$0	$2,520	Yes

Table 10. Summary of environmental measures for the Makah Bay Project.

Environmental Measures	Entity	Capital and One-time Costs (2007$)	Annual Costs (2007$)	Annualized Cost[56] (2007$)	Adopted by Staff?
Monitor Recreation Use	Interior; Staff	$0	$2,500	$1,650	Yes
Cultural					
Develop and implement a cultural resources monitoring program consisting of measures to detect archaeological sites that might be disturbed during project-related construction activities	Staff	$5,000	$0	$480	Yes
Develop and implement a Cultural Resources Management Plan (CRMP)	Finavera	$2,500	$6,000	$4,200	No

Table 11. Summary of Costs, Power Benefits, and Net Benefits of the Makah Bay Wave Energy Project Alternatives.[59]

	Proposed Project	Staff Alternative	Staff Alternative with Mandatory Conditions
Installed Capacity	1 MW	1 MW	1 MW
Annual Generation	1,500 MWh	1,500 MWh	1,500 MWh
Annual Power Value	$60,000 [40.00 mills/kWh]	$60,000 [40.00 mills/kWh]	$60,000 [40.00 mills/kWh]
Annual Cost	$874,088 [$582.73/MWh]	$895,346 [$596.90 /MWh]	$913,058 [$608.71 /MWh]
Net Annual Benefit (Liability)	$(814,088) [($542.73)/MWh]	$(835,346) [($556.90)/MWh]	$(853,058) [($568.71)/MWh]

[59]The cost of the Staff Alternative and Staff Alternative with Mandatory Conditions reflects recommended additional PM&E measures not included in the Proposed Action.

VII. COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to all uses of the waterway on which a project is located. When we review a proposed project, we equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Accordingly, any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

Based on our independent review of agency and public comments filed on this project and our review of the environmental and economic effects of the proposed project and its alternatives, we selected the proposed project, with staff-recommended modified and additional measures, as the preferred option. We recommend this option because: (1) issuance of a hydropower license would allow Finavera to demonstrate the potential of an emergent renewable energy industry segment with the goal of bringing clean, competitively-priced electricity to commercial and residential consumers in Washington State and other coastal states; (2) the power produced by the proposed project would contribute to a diversified generation mix that would help meet a need for power in the region, the Clallam County PUD service territory, and the Makah Indian Reservation during the short and long term; (3) the 1-MW project would eliminate the need for an equivalent amount of fossil-fueled derived energy and capacity, which helps conserve these nonrenewable resources and limits atmospheric pollution; (4) the public benefits of this alternative would exceed those of the no-action alternative; and (5) the recommended measures would protect marine resources, wildlife, recreation, aesthetic resources, ocean uses, land uses, and cultural resources in the project area.

We recommend that the following measures be included in any license the Commission issues for the Makah Bay Project:

Measures Proposed by Finavera

- develop and implement a detailed project design and installation plan, including provisions for: (1) determining the final design and installation methods for the buoy and submarine transmission line anchoring systems; (2) using HDD to deploy the transmission cable from the shore station out to a depth of 10 to 30 feet below mean low tide; and (3) designing the buoys to be a closed-system and to prevent marine mammal haul-out and seabird roosting;

- conduct an eelgrass survey for purposes of determining the depth to which to deploy the submarine transmission line using HDD in order to avoid disturbing macroalgae/eelgrass beds;

- develop and implement a project facilities inspection and maintenance plan that includes provisions for: (1) at least bi-annual visits to the AquaBuOYs for purposes of retrieving entangled derelict fish gear from the buoys mooring and anchoring system and (2) notifying the Sanctuary within 24 hours of becoming aware of the need for any emergency response or repair to project facilities, providing 24-hour updates to the Sanctuary of the progress of any response, and providing a written report summarizing the emergency response within 30 days;

- install acoustic deterrent devices ("pingers") on the buoys to warn marine mammals of anchoring and mooring lines to avoid collision and entanglement;

- develop and implement an anti-fouling paint effectiveness plan to determine the type of anti-fouling paint to use on the buoys to avoid marine growth while at the same time protecting nearby, non-target marine resources from the toxic effects of the paint;

- develop and implement plans for: (1) monitoring for marine mammal entanglement and collision; (2) continuous cetacean acoustic monitoring; (3) assessing the effectiveness of the buoy seal and sea lion excluder device; and (4) monitoring seabird use and behavior around the buoys;

- develop and implement a plan for a project exclusion zone to protect the project facilities from fishing, trawling, and other in-water disturbances that could snag project cables or the submarine transmission line; and

- develop and implement an interpretive and education plan to provide information regarding the proposed project and use of the area by the Makah Tribe.

Modified and Additional Measures Recommended by Staff

- develop and implement a water quality monitoring plan for in-water project construction activities, including provisions to monitor the HDD process for any seepage of drilling fluid and take corrective actions to avoid continued seepage of the drilling fluid into the surround bed stratum and water column;

- develop a fuel and oil spill control, prevention, and countermeasures plan to be implemented during proposed project construction, operation, and maintenance activities and including provisions for: (1) inspecting vessels and equipment used during construction and maintenance for fuel and hydraulic leaks on a daily basis while at the project; and (2) containing and removing petroleum or other oil products in the event of a spill or leak;

- develop and implement a plan to conduct an on-site noise assessment of the proposed project buoys and associated anchoring and mooring equipment to be conducted within one year of the start of project operations and including a provision for determining potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals or fish;

- develop and implement a plan to conduct a baseline and post-installation hard substrate benthic community survey along the proposed submarine transmission line route;

- develop and implement a plan to conduct continuous acoustic cetacean monitoring for 10 years commencing with the start of project operations;

- develop and implement a plan to conduct an on-site EMF assessment within one year of the start of project operations;

- notify the Sanctuary of project emergencies consistent with Condition 9 of the NMSP's conditions submitted under section 4(e) of the FPA;

- develop and implement a seabird monitoring plan with a provision to conduct a survey/assessment of seabird use of the project area;

- include in the proposed detailed design engineering and installation plan, a provision for a marine mammal observer to be present during in-water construction and installation activities;

- develop and implement a shore station erosion control, revegetation, and noxious weed control plan for land-based project construction activities;

- develop and implement a recreation use monitoring plan for the project;

- remove existing marine debris and derelict fishing gear from the immediate project area prior to project construction and installation;

- include in the proposed Interpretive and Education Plan, a provision for placing a interpretive display within the proposed project boundary at the shore station with the following information: (1) a map depicting marine habitats and associated species within the proposed project area; (2) the type of marine debris potentially present in the project area, the effects such debris has on the marine environment and commercial/recreational fishing vessels, and solutions that Finavera is implementing to limit the amount of debris at the project; and (3) information informing the public of the exclusion zone and its purpose;

● include in the proposed plan for a project exclusion zone, provisions to: (1) mark the four proposed buoys with low-intensity navigation or hazard lights visible to 1.0-nautical mile, and (2) consult with the U.S. Coast Guard and the Sanctuary on the painting of the project buoys in a way that considers the aesthetic character of the Sanctuary as well as the safety of the public and project facilities; and

● develop and implement a plan for a cultural resource monitoring program with a provision to have a Makah tribal monitor present during all ground-disturbing activities to detect archaeological sites that might be disturbed.

The following is a discussion of the basis for the staff-recommended modified and additional measures.

Water Quality Monitoring

Developing and implementing a water quality monitoring plan for in-water project construction activities would be beneficial to marine resources in the project area in that such an action would help to limit any adverse effects caused by the potential leakage of drilling fluids into the surrounding marine environment. The annualized cost for this measure would be $240. We find that the benefits of this measure would justify the relatively small cost, and therefore, would be in the public interest.

Fuel and Oil Spill Control, Prevention, and Countermeasures Plan

Developing and implementing a fuel and oil spill control, prevention, and countermeasures plan would be beneficial to marine and terrestrial resources in that such an action would help to reduce, mitigate, or eliminate the potential for fuel and oil spills or leaks from vessels used in the installation and maintenance of the proposed project or from the shore station during routine project operations. The annualized cost for this measure would be $240. We find that the benefits of this measure would justify the relatively small cost, and therefore, would be in the public interest.

Project Facility Noise Assessment

Developing and implementing a plan to conduct an on-site noise assessment of the proposed project buoys and associated anchoring and mooring equipment would have the benefit of documenting noise levels produced specifically by the proposed wave energy technology. Such site and technology-specific information is not presently available and would provide a greater benefit than Finavera's proposal to estimate noise levels using an engineering and literature-based calculation. The plan would include a provision for determining potential noise attenuation measures (*e.g.*, sound insulating material) to implement in the event that noise levels would exceed thresholds for adverse effects on marine mammals or fish. The annualized cost for an on-site noise monitoring plan would be $1,690. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Benthic Marine Life Surveys

Developing and implementing a plan to conduct a baseline and post-installation hard substrate benthic community survey along the proposed submarine transmission line route would provide a means of limiting adverse effects on important marine resources. Surveys of biological communities along the transmission route have not been conducted, and would help to inform a final design for the project along with any mitigation measures that could be implemented to protect marine benthic life from any anticipated adverse effects of installing the line. The annualized cost for the surveys would be $2,900. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Acoustic Cetacean Monitoring

The ability of marine mammals to detect and react to this new generation technology and its associated anchoring and mooring system is not well understood. Developing and implementing a plan to conduct continuous acoustic cetacean monitoring for a period of 10 years commencing with the start of project operations would be beneficial in that such monitoring would provide the necessary information to determine whether cetaceans feeding and migrating within the buoy array could detect the mooring cables and chains and avoid them, and if not, what could be done to help them better detect the cables and chains. The annualized cost for acoustic cetacean monitoring would be $14,140. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

EMF Assessment

Developing and implementing a plan to conduct an on-site EMF assessment within one year of the start of project operations would have the benefit of documenting EMF produced specifically by the proposed wave energy technology under actual site conditions and could be used to verify our literature-based finding that project-generated EMF would likely have minimal adverse effect on marine life.[60] Such site and technology-specific information regarding EMF production from electrical lines anchored on top of the seabed is not presently available to our knowledge. Further, we're not

[60] In the event that the assessment would indicate high levels of EMF being emitted from the project's electric cables along with a documented effect on marine organisms, a potential mitigation measure could include burial of the transmission cable.

convinced that a simple engineering calculation or other desk-top approach would add any additional benefit to our similar literature-based analysis that we've already provided in this EA. The annualized cost for the on-site EMF assessment would be $920. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Notification of Project Emergencies

Notifying the Sanctuary of project emergencies consistent with Condition 9 of the NMSP's conditions submitted under section 4(e) of the FPA would allow Sanctuary personnel to assist Finavera with a response to prevent or quickly limit adverse effects on Sanctuary resources, including marine fisheries, mammals, and seabirds. Such a benefit to Sanctuary resources could be provided at no significance cost, and therefore, would be in the public interest.

Marine Mammal Observer

Marine mammals utilizing the project area could collide with vessels and equipment used in the construction and installation process. Having a marine mammal observer present during all in-water construction and installation activities and a defined protocol to avoid collisions would help to avoid such adverse effects. The annualized cost for providing a marine mammal observer during in-water construction would be $280. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Erosion Control, Re-Vegetation, and Noxious Weed Control

Upon completion, Finavera would landscape the shore station grounds to blend with the local flora. To ensure that potential erosion and sedimentation impacts would be minimized, a standard license article requires the development of an erosion and sediment control plan for Commission approval prior to construction activities. Such a plan would include details for vegetating disturbed areas and describing methods that would be used to control noxious weeds. Control of noxious weeds would ensure that wildlife habitats continue to remain productive. The annualized cost for developing and implementing an erosion control, revegetation, and noxious weed control plan would be $390. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Recreational Use Monitoring

The Makah Bay Project would likely provide the public a new tourist destination causing increased visits to the project area and the potential for associated adverse effects on other environmental resources. In addition, establishment of an exclusion zone around the in-water project facilities could curtail fishing within the project area and cause fishing to concentrate in other nearby areas. Development and implementation of a recreation monitoring plan would provide information on changes in recreational use patterns within the project area and allow for documentation of any adverse effects on environmental resources caused by such changes. The information could further be used to help identify management options to limit any adverse effects on environmental resources in the project area caused by recreation use. Monitoring recreation use should be conducted in consultation with Washington State Interagency Committee for Outdoor Recreation, the Makah Tribe, and NPS. The annualized cost for developing and implementing a recreation monitoring plan would be $1,650. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Removal of Marine Debris and Derelict Fishing Gear

Because of the unique and significant environment in which the proposed project would be located coupled with the potential for marine species to become entangled in the proposed project-related facilities, we recommend that Finavera remove and properly dispose of existing marine debris and derelict fishing gear (*e.g.*, crab and shrimp pots, gillnets, and ropes) from the immediate project area prior to project-related construction and installation activities. The annualized cost for removing and disposing of any existing debris from the immediate project area would be $300. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Interpretive and Education Plan

Finavera proposes an Interpretive and Education Plan with provisions to include interpretive displays in the vicinity of Hobuck Beach with information about: (1) operation of the wave energy project; (2) the marine resources of the proposed project area; (3) the Makah Tribe; (4) the stakeholders and their efforts regarding the project; and (5) a project purpose of minimizing the tribe's dependence on foreign fossil fuels. We conclude that due to the anticipated public interest in the Makah Bay Project, an Interpretive and Education Plan would benefit residents and visitors by complimenting existing federal and state resource agency and the Makah Tribe's interpretive programs, as well as providing information on new energy technology.

To contribute toward the quality of the recreational experience, we recommend that Finavera's proposed Interpretive and Education Plan include a provision for locating an interpretive display at the shore station with the following information: (1) a map depicting marine habitats and associated species within the proposed project area; (2) the type of marine debris potentially present in the project area, the effects such debris has on the marine environment and commercial/recreational fishing vessels, and solutions that Finavera is implementing to limit the amount of debris at the project; and (3) information informing the public of the exclusion zone and its purpose. At a minimum, the plan should be developed in consultation with the Washington DFW, FWS, Makah Tribe, Sanctuary, Washington State Interagency Committee for Outdoor Recreation, and the National Park Service. The annualized cost for our recommended interpretive display provision would be $2,520. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Exclusion Zone

We recommend that Finavera develop and implement an Exclusion Zone Plan for the project. At a minimum, the plan should contain: (1) a map or maps that clearly identifies the proposed project facilities and shows an exclusion zone boundary a minimum of 100 feet from all in-water facilities; (2) a provision to clearly mark the extreme corners of the exclusion zone; (3) a description of the activities to be excluded within the zone, including fishing, crabbing, anchoring, and any other activity that could potentially result in damage to in-water facilities or injury to the public; (4) a process for coordinating the Exclusion Zone Plan with other staff-recommended plans in order to take into account periodic inspection and removal of marine debris and derelict fishing gear; (5) a provision to mark the four proposed project buoys with low-intensity navigation or hazard marking lights visible at a distance of at least 1.0-nautical mile; (6) a provision to paint the buoys in a way that considers the aesthetic character of the Sanctuary as well as the safety of the public and project facilities; and (7) documentation of consultation with the FWS, U.S. Coast Guard, Makah Tribe, Washington DFW, Washington DNR, and the Sanctuary. The annualized cost for developing and implementing an exclusion zone plan for purposes of protecting the public and project facilities and with our recommended provisions would be $1,610. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Cultural Resource Monitoring Program

To insure that no newly discovered archeological site would be affected by ground-disturbing activities involving construction of the shore station on Hobuck Beach, we recommend that Finavera develop and implement a plan for a cultural resources monitoring program with a provision for a Makah tribal monitor be present during all ground-disturbing activities.[61] We find that it is not necessary for Finavera to develop

[61] We anticipate that there would be continuity with the use of a particular tribal monitor, or series of tribal monitors during the construction phase of the project.

their proposed cultural resource management plan for the project, since it is unlikely that the project would have an adverse effect on already identified historic properties and other cultural resources. The annualized cost for developing and implementing a plan for a cultural resource monitoring program would be $480. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Inspection and Maintenance

We recommend that Finavera develop and implement a project facilities inspection and maintenance plan that includes provisions for: (1) at least bi-annual visits to the AquaBuOYs for purposes of retrieving entangled derelict fish gear from the buoys mooring and anchoring system and (2) notifying the Sanctuary within 24 hours of becoming aware of the need for any emergency response or repair to project facilities, providing 24-hour updates to the Sanctuary of the progress of any response, and providing a written report summarizing the emergency response within 30 days. Biannual anchor inspections would serve to determine if marine mammals have become entangled in project components. Biannual visual inspections would also be adequate to ensure that the integrity of the transmission cable and project mooring system is maintained and that no derelict and abandoned fishing gear is being captured, minimizing the risk of marine mammals and diving seabirds to entanglement. Such visual monitoring efforts would likely require the use of a SCUBA diver or ROV. The annualized cost for conducting biannual inspections and maintenance would be $3,810. We find that the benefits of this measure would justify the cost, and therefore, would be in the public interest.

Conducting inspections and maintenance every 60 days as recommended by the Sanctuary Advisory Council would provide greater assurance that any entangled marine mammals and birds would be documented and recovered. However, available information suggests that the risk of entanglement is low. The annualized cost for conducting inspections and maintenance every 60 days would be $10,930. We find that the minimal benefits of this measure would not justify the relatively high cost, and therefore, would not be in the public interest.

However, in an event where a tribal monitor could not be present, Finavera could, in consultation with the THPO, acquire a qualified non-tribal monitor in place of the tribal monitor to complete the particular monitoring task at hand.

Measures Not Included in the Staff Alternative

The following is a discussion of measures that we did not adopt as part of our recommended alternative.

Mitigation of Fishing Loss Due to an Exclusion Zone

To mitigate for fishing loss due to implementation of an exclusion zone around project facilities, Washington DFW recommends that Finavera: (1) provide research regarding the species composition and species abundance in the vicinity of the proposed project during the term of a license; (2) conduct the research at least once every 2 years to provide information on population changes; (3) provide regular aerial surveys of fishing effort in the vicinity of the proposed project during the term of a license; (4) conduct the surveys at least twice a week during the fishing seasons; and (5) provide a community outreach to inform the public of the proposed project and associated closures.

Regarding items (1) and (2), the total area that would be excluded from fishing, anchoring, trawling, and similar underwater activities where there could be contact with the transmission cables, mooring lines, and buoys would be about 95 surface acres. Given the mobility of fish and crabs and the realization that fishing could still occur adjacent to the mostly narrow strip of the exclusion zone, we do not anticipate any significant changes in fish abundances in the Makah Bay area. We, therefore, conclude that conducting general studies of fish species composition and population abundance in the vicinity of the proposed project during the term of a license would provide no project related benefits, and therefore, would not be in the public interest.

Regarding items (3) and (4), Washington DFW provided no evidence or information to indicate that regular aerial surveys of fishing effort in the proposed project area are needed, and they did not justify the reason for conducting such surveys at least twice a week during the fishing season during the term of a license. We, therefore, have no basis for adopting their recommendations.

Regarding item (5), we are recommending that Finavera develop and implement an Interpretive and Education Plan with a provision for informing the public of the exclusion zone and its purpose.

Administrative Measures under the Staff Alternative with Mandatory Conditions

NMSP included the following administrative measures as part of their conditions submitted pursuant to section 4(e) of the FPA: (1) obtain written approval from NMSP for project alterations (Condition 7); and (2) reserve NMSP's authority to require modifications or additional conditions under section 4(e) of the FPA (Condition 10). We view these recommendations as being entirely administrative in nature and not directly related to the licensing of the project. These two measures relate more to future actions that ultimately may require an amendment of any license issued for the project. We, therefore, do not adopt the Staff Alternative with Mandatory Conditions as the preferred alternative, but do recognize that if section 4(e) of the FPA gives NMSP the authority to impose conditions on any license issued by the Commission for a project in the Sanctuary, then all of NMSP's appropriately submitted conditions must be included in any license issued for the project.

Commensurate with its decommissioning policy, the Commission would further address project decommissioning in regard to NMSP's Condition 8 (*i.e.*, purchase a decommissioning surety bond and develop a decommissioning plan prior to retiring the project) in the order for Finavera's license application. Specifically, the order would address the need for license requirements that would require Finavera to make financial provisions for the unexpected early retirement of the project.

The Staff Alternative includes measures consistent with NMSP's Conditions 1 through 6 and 9. Incorporation of Conditions 7, 8, and 10 would not cause us to eliminate any environmental measures under the Staff Alternative.

VIII. FISH AND WILDLIFE RECOMMENDATIONS

Under the provisions of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

On February 16, 2007, Washington DFW filed eight recommendations that they referred to as "fish and/or wildlife protection measures." Of these eight, seven fall within the scope of section 10(j). Recommendations that we consider outside of the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource section of this document. We recommend adopting all seven recommendations that fall within the scope of section 10(j) (table 12). The bases for our recommendations are discussed in section VII.

Table 12. Analysis of fish and wildlife agency section 10(j) recommendations.

Recommendation	Agency	Within the Scope of 10(j)?	Levelized Annual Cost	Recommend Adopting?
1. Continuous acoustic cetacean monitoring for 10 years	WDFW	Yes	$14,140	Adopt
2. Macroalgae and eelgrass survey	WDFW	No, study that could have been done during prefiling	$410	Adopt
3. Detailed anchoring plan for the transmission cable to avoid disturbing fish habitat	WDFW	Yes	Included in the construction cost for the project	Adopt
4. EMF monitoring plan	WDFW	Yes	$920	Adopt
5. Spill control, prevention, and countermeasures plan	WDFW	Yes	$240	Adopt
6. Transmission cable monitoring plan to verify that cable is stationary	WDFW	Yes	Included in the maintenance cost for the project	Adopt
7. Anchoring system monitoring plan to ensure buoy integrity and remove derelict fishing gear	WDFW	Yes	Included in the maintenance cost for the project	Adopt
8. Monitor effectiveness of sea lion exclusion device	WDFW	Yes	Included in the cost for bi-annual inspections of the project.	Adopt

IX. CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA, 16 U.S.C. section 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving waterways affected by the project. Under section 10(a)(2)(A) of the FPA, we reviewed 22 relevant comprehensive plans to determine whether the Makah Bay Project would be consistent with their provisions (table 13). No inconsistencies were found.

Table 13. Relevant comprehensive plans considered for the Makah Bay Project.

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Washington State Department of Community Development. Office of Archaeology and Historic Preservation. 1987. Resource protection planning process – southern Puget Sound study unit. Olympia, Washington. 62 pp.
Washington Department of Fisheries. Point No Point Treaty Council. U.S. Fish and Wildlife Service. Settlement agreement pursuant to the July 2, 1986, Order of the U.S. District Court for the Western District of Washington in Case No. 9213. Hood Canal salmon management plan. Seattle, Washington. October 1985.
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Washington State Department of Game. 1986. 1987 strategies for Washington's wildlife. Olympia, Washington. December 1986.
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Washington State Department of Wildlife. Point No Point Treaty Council. 1987. 1987 - 1988 winter and summer Steelhead forecasts and management recommendations. Olympia, Washington. December 1987.
Washington State Department of Wildlife. Quinault Fisheries Division. 1988. Stock status and harvest management plans for Steelhead returning to the Queets, Quinault, and Grays Harbor Rivers in winter 1987 - 1988. Olympia, Washington. January 20, 1988.
Washington State Energy Office. 1992. Washington State hydropower development/resource protection plan. Olympia, Washington. December 1992.

X. FINDING OF NO SIGNIFICANT IMPACT

Constructing and operating the Makah Bay Project, with our recommended measures, would result in minor, localized effects to fish, marine mammals, and seabirds of the Sanctuary; minor reductions in the area available for commercial and recreational fishing; some alteration of the aesthetic quality of Makah Bay; and minor degradation of the experience of people recreating and visiting Makah Bay. Finavera proposes a number of project design features to reduce or eliminate adverse environmental effects, including measures to prevent sea lion haul-out on the buoys, utilization of HDD when installing the submarine transmission line to avoid sensitive sea grass beds, and utilization of a closed-looped system to prevent entrainment of aquatic organisms. Finavera also proposes to conduct various marine resource monitoring and assessment activities to better ensure that the final design, construction, and operation of the project would protect marine resources in the project area. Staff-recommended modified and additional measures, such as water quality monitoring during construction; fuel and oil spill control prevention, and countermeasures; onsite noise and EMF assessments; recreational use monitoring; and cultural resources monitoring would further protect important environmental measures in the proposed project area.

Based on our independent analysis, the issuance of a license for the Makah Bay Project, with our recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

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