ENVIRONMENTAL ASSESSMENT

FOR HYDROPOWER PILOT PROJECT LICENSE

Admiralty Inlet Pilot Tidal Project—FERC Project No. 12690-005 (DOE/EA-1949)

Washington

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ACRE	Alderney Commission for Renewable Energy
ADCP	Acoustic Doppler Current Profiler
aMW	average megawatt
APE	area of potential effects
APL	Applied Physics Laboratory
BA -	Biological Assessment
BGEPA	Bald and Golden Eagle Protection Act
BOD	Biochemical Oxygen Demand
cm	centimeter
cm^2	square centimeters
cm^3	cubic centimeters
Certification	Water Quality Certification
Coast Guard	U.S. Coast Guard
Commission	Federal Energy Regulatory Commission
Corps	U.S. Army Corps of Engineers
CPA	Coast Protection Act
CPDF	Cumulative Probability Density Function
CTD	Conductivity-Temperature-Depth
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibels
DAHP	Department of Archaeology and Historic Preservation
DIDSON	Dual-Frequency Identification Sonar
DO	dissolved oxygen
DOE	U.S. Department of Energy
DPM	Detection Positive Minutes
DPS	Distinct Population Segment
EA	environmental assessment
EFH	essential fish habitat
EMEC -	European Marine Energy Center
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
Fugro	Fugro Seafloor Surveys, Inc
FWS	U.S. Fish and Wildlife Service
GRP	Glass Reinforced Plastic
GWh	gigawatt-hour
HDD	horizontal directional drilling

HIRA	Hazard Identification and Risk Assessment
Hz	hertz
IHA	incidental harassment authorization
Interior	U.S. Department of the Interior
kHz	kilohertz
km	kilometer
km^2	square kilometers
km^3	cubic kilometers
kV	kilovolt
kW	kilowatt
kWh	kilowatt hours
LOU	letter of understanding
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MBTA	Migratory Bird Treaty Act
MLW	mean low water
MLLW	mean lower low water
M	meter
m^2 -	square meters
m^3	cubic meters
mL	milliliter
mg/L	milligrams per liter
MARC	Marine Aquatic Resource Committee
MLLW	mean lower low water
mm -	millimeter
m/s	meters per second
MMPA	Marine Mammal Protection Act
MW	megawatt
MWh	megawatt-hour
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NNMREC	Northwest National Marine Renewable Energy Center
NOAA	National Oceanic and Atmospheric Administration
OHWM	ordinary high water mark
O&M	operations and maintenance
PC-1	Pacific Crossing system—a trans-oceanic broadband fiber optic cable system
PC Landing	PC Landing Corporation
ppt	parts per thousand
PAH	polycyclic aromatic hydrocarbons

PBDE	polybrominated diphenyl ethers
PCB	polycholorinated biphenyl
PFMC	Pacific Fishery Management Council
PHS	**p**riority habitats and species
POST	Pacific Ocean Shelf Tracking Project
PNNL	Pacific Northwest National Laboratory
project	Admiralty Inlet Pilot Tidal Project No. 12690
PSAMP	Puget Sound Assessment and Monitoring Program
PSAT	Puget Sound Action Team
rpm	revolutions per minute
RTE	rare, threatened, and endangered
SCADA	supervisory control and data acquisition
SEL	sound exposure level
SMP	Shoreline Master Program
SPL	sound pressure level
SRKW	Southern Resident killer whale
TISEC	Tidal In-Stream Energy Conversion
TGU	turbine generator unit
TSS	total suspended solids
U&A	Usual and Accustomed
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
Washington DOT	Washington State Department of Transportation
Washington DFW	Washington Department of Fish and Wildlife
Washington DNR	Washington Department of Natural Resources
Washington Ecology	Washington Department of Ecology
Washington PRC	Washington State Parks and Recreation Commission

EXECUTIVE SUMMARY

Proposed Action

On March 1, 2012, the Public Utility District No. 1 of Snohomish County, Washington (Snohomish PUD) filed an application for a 10-year license to construct and operate its proposed Admiralty Inlet Pilot Tidal Project (Admiralty Inlet Project or project). The 680-kilowatt (kW) project would be located on the east side of Admiralty Inlet in Puget Sound, Washington, about 1 kilometer west of Whidbey Island, entirely within Island County, Washington. The project would not be located on federal lands.

Cooperating Agency Role

On September 16, 2010, Snohomish PUD was selected to receive financial assistance from the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy to support the design, construction, deployment and monitoring phases of their project. To satisfy DOE's requirements under the National Environmental Policy Act (NEPA) for this project, DOE is participating as a cooperating agency in the preparation of the EA.

Project Description

The proposed Admiralty Inlet Pilot Tidal Project would consist of: (1) one 370-kilowatt (kW) OpenHydro tidal turbine (Turbine 1) and one 310-kW OpenHydro tidal turbine (Turbine 2), each approximately 19.2 feet high (6 meters) and mounted on a triangular subsea base; (2) two approximately 7,000-foot-long (2,200 meters), 6-kilovolt (kV) trunk cables, each consisting of: a) three power transmission core cables to transmit power from the turbine to shore; b) single mode fiber optic elements to convey turbine control and monitoring signals and environmental monitoring data between the turbines and the on-shore facilities; and c) low-power elements to provide power to the turbine control and monitoring system at the turbines; (3) an approximately 3.9-foot-long, 5.8-foot-wide, 2.9-foot-high on-shore cable termination vault; (4) 40-foot-long conduits to convey the power transmission core cables, the fiber optic elements, and the low-power elements from the cable termination vault to a cable control building; (5) a 24-foot-wide, 30-foot-long on-shore cable control building housing power and monitoring equipment; (6) a 12.47-kV step-up transformer located adjacent to the control building; (7) a 10-foot-long, buried 12.47-kV transmission line from the transformer to the Point of Metering and the Point of Common Ownership with Puget Sound Energy grid; and (8) appurtenant facilities. The estimated average annual generation of the project would be 216,000 kWh kilowatt-hours.

Proposed Environmental Measures

Snohomish PUD proposes the following environmental measures:

- To avoid eelgrass beds and other sensitive near-shore habitats, implement a Horizontal Directional Drilling (HDD) Plan that would deploy trunk cables from on land to a minimum depth of 18 meters off-shore.

- To avoid adverse effects on sensitive marine fish species, conduct marine installation during a Washington Department of Fish and Wildlife-approved work window of July 16 to October 14.

- To avoid harming PC Landing's international fiber optic cable (PC-1 North), located near the site, conduct turbine installation and monitoring using "live-boat" techniques (i.e., without anchoring) and prepare and implement a Hazard Identification and Risk Assessment, developed in consultation with the U.S. Army Corps of Engineers (Corps), Coast Guard, and PC Landing, prior to marine operations that includes: (1) setting criteria for weather and wave conditions that must exist before marine operations occur; (2) using industry-approved equipment and redundancy in the use of equipment and vessels; (3) setting criteria for aborting operations; and (4) identifying an established "port of refuge," away from PC-1 North, in the event of unanticipated adverse weather or other events that would cause installation or operations to be aborted.

- To monitor environmental effects and identify corrective actions, implement the following monitoring plans: (1) an Acoustic Monitoring and Mitigation Plan; (2) a Benthic Habitat Monitoring and Mitigation Plan; (3) a Marine Mammal Monitoring and Mitigation Plan; (4) a Near-Turbine Monitoring and Mitigation Plan; (5) a Derelict Gear Monitoring Plan; and (6) a Water Quality Monitoring Plan.

- To provide coordination, data reviews, and implementation of the above monitoring plans, implement an Adaptive Management Framework that includes conferring with a Marine Aquatic Resource Committee (MARC), composed of Snohomish PUD, agency, and tribal members.

- To educate the public about the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area, develop and implement an Interpretation and Education Plan that includes the installation of an interpretive display at Snohomish PUD's headquarters or at another appropriate location agreed upon with stakeholders.

- To ensure safe operation of the project, implement: (1) a Project and Public Safety Plan; (2) a Navigational Safety Plan; and (3) an Emergency Shutdown Plan.

- To restore the project site to a pre-project condition at the end of the license term if a new license is not sought or obtained, implement a Project Removal and Site Restoration Plan.

Alternatives Considered

This environmental assessment (EA) considers the following alternatives: (1) Snohomish PUD's proposal, as outlined above; (2) Snohomish PUD's proposal with staff modifications (staff alternative); and (3) no action, meaning the pilot project would not be installed, DOE would not provide financial assistance to fund the project, and there would be no change to the existing environment (no-action alternative).

Under the staff alternative, the project would be constructed and operated as proposed by the applicant, but with the following additional measures:

- Include in the Project Removal and Site Restoration Plan provisions for filing for Commission approval: (1) a specific timeline for the removal and site restoration activities 6 months prior to license expiration; (2) documentation of consultation with the MARC regarding planned removal and site restoration activities 6 months prior to license expiration; and (3) documentation of completion of project removal and site restoration activities prior to license expiration.

- Include in the HDD Plan provisions to implement noise abatement measures in the event HDD processes extend into the nighttime hours.

- Install an interpretive display at Fort Casey State Park, subject to state approval, describing the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area.

- Halt work if previously unidentified archeological or historic properties are discovered and develop protective measures in consultation with the Washington State Historic Preservation Officer (Washington SHPO).

- Include a reservation of authority for the Corps of Engineers to request removal, relocation, or other alteration if the project becomes an unreasonable obstruction to free navigation of navigable waters.

The recommended staff modifications include or are based in part on recommendations made by the federal and state resource agencies and other stakeholders

that have an interest in the resources that may be affected by construction and operation of the project.

Public Involvement and Areas of Concern

The intent of the Commission's pre-filing process is to initiate public involvement early in the project planning process and encourage citizens, governmental entities, tribes, and other interested parties to identify and resolve issues prior to an application being formally filed with the Commission. To this end, Snohomish PUD conducted consultation, which included numerous meetings and conference calls with a range of stakeholders, including resource agencies, tribes, and non-governmental organizations. Commission staff held a technical conference on April 12, 2010, to scope issues and information needs. On July 7, 2011, we waived certain pre-filing requirements and approved the use of pilot licensing procedures.[1] On October 6, 2011, we requested conditions and recommendations in response to the notice of ready for environmental analysis. Commission staff conducted a second technical conference on August 6, 2012, to discuss issues regarding the project's proximity to PC-1 North and effects on access to tribal fishing grounds.

The primary issues associated with licensing this pilot project are potential effects on marine and anadromous fish; essential fish habitat; bull trout; marine mammals; marbled murrelets; navigation; an international fiber optic cable (PC-1 North); access to tribal fishing grounds; recreation; and aesthetics.

Staff Alternative

Snohomish PUD has designed the project in a manner that would minimize the potential for environmental effects during construction and operation. Key features include the small scale of the project; a remotely controlled braking system for the turbines that would allow for the project to be shut down quickly in the case of an emergency; and a turbine design that includes a shroud enclosing the blade tips, a 7.2-foot (2.2 meter) hole through the turbine allowing flow and objects to freely pass through the turbine, and relatively slow operating speeds (16 revolutions-per-minute [rpm]), minimizing the potential for turbine blade strikes on fish, diving birds, and marine mammals. In addition to these design features, the results of the studies Snohomish PUD conducted suggest that environmental effects from the project would be minor. In addition, Snohomish PUD's proposal includes monitoring measures that are designed to detect and address any unanticipated adverse effects.

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[1] *See* 18 CFR §§ 5.8 and 5.10, which specify the project scoping requirements of the Commission's Integrated Licensing Process, by letter issued July 7, 2011.

General

The proposed Project and Public Safety Plan includes measures for identifying and responding to emergencies at the project. The proposed Emergency Shutdown Plan includes procedures for the remote shutdown of the project turbines in response to emergencies at the project. These safeguard plans, in combination with the various environmental monitoring plans described below, would work interdependently to ensure that the project is operated and maintained in a safe manner that minimizes the potential for harm to the public and environmental resources in the project area.

The proposed Project Removal and Site Restoration Plan, which includes measures for removing the project and restoring the project site in the case that a new license is not obtained at the end of the pilot project license term, would ensure protection of the aesthetic and environmental resources in and around Admiralty Inlet. A staff recommended modification to the proposed plan that includes provisions for a specific timeline for the removal and site restoration activities, as well as documentation of consultation with the appropriate agencies, 6 months prior to license expiration, and documentation of completion of project removal and site restoration activities prior to license expiration, would ensure that the project is removed and the site is sufficiently restored to near pre-project condition prior to license expiration.

Geologic Resources

Construction and operation of the project would likely have only minor effects on geologic resources, such as modifying localized sediment transport. The proposed Benthic Habitat Monitoring and Mitigation Plan, which includes the use of remotely operated vehicles (ROV) to conduct visual surveys of the seafloor in the project area, would identify unanticipated adverse effects on scouring or sediment transport.

Marine Resources

Construction and operation of the project would likely have only minor effects on marine resources, such as slightly modifying hydrodynamics and behavior of fish and marine mammals in the immediate project vicinity. Project operations may produce noise levels that may cause minor behavioral changes for marine mammals and fish very near the project, but would not rise to levels that would result in physical harm to these organisms. The proposed Near-Turbine Monitoring and Mitigation Plan, which would use a combination of optical, stereo and acoustic cameras mounted on the turbine foundation to observe interactions of marine fish, birds, and mammals near (9.8-23 feet or 3-7 meters) the turbines, would identify unanticipated adverse effects of the project on fish and marine mammal behavior, determine if potential harm from blade strike is occurring, and identify the need for corrective action, including potentially shutting down the turbine. The proposed Acoustic Monitoring and Mitigation Plan, which includes the use of a combination of a drifting noise measurement system and hydrophones mounted

on the turbine foundation, would measure noise radiated by the project and determine if it is occurring at levels that would require corrective action to minimize adverse effects on marine mammals. Although far-field behavioral changes in marine mammals are not expected, the proposed Marine Mammal Monitoring and Mitigation Plan, which would use a combination of acoustic hydrophones and on-shore observers to document marine mammal use in the vicinity of the turbines, would determine if the project is causing changes in marine mammal behavior and use of Admiralty Inlet. The proposed Derelict Gear Monitoring Plan, which would use periodic ROV surveys to inspect project features, as well as the cameras mounted on the turbine foundation, would identify any derelict fishing gear accumulating on project features, minimizing entanglement hazards for marine fish, birds, and mammals.

Rare, Threatened, and Endangered Species

Operational noise near the project site may rise to levels that adversely affect the southern resident killer whale and Stellar sea lion. The Acoustic Monitoring and Mitigation Plan and Marine Mammal Monitoring and Mitigation Plan would permit Snohomish PUD to determine if adverse effects are occurring and to take corrective actions. Project construction and operation would not be likely to adversely affect Pacific salmon and steelhead and their critical habitat, green sturgeon, eulachon, several rockfish species, and bull trout because of the small footprint of the project, the design characteristics of the turbines, and the abilities of the fish to detect and avoid the turbines. Project construction and operation would not affect marbled murrelet because the turbines would create little noise and the turbines would be located below their known maximum diving range. Project construction and operation would not affect the golden paintbrush because they are not likely present in the existing disturbed habitats. The U.S. Fish and Wildlife Service agreed that project construction and operation would not be likely to adversely affect bull trout and marbled murrelet.

Terrestrial Resources

Construction and operation of the project would result in the disturbance of about 0.3 acres (0.1 hectares) of previously disturbed, residential habitats and the temporary displacement of wildlife from the immediate construction area. No specific measures are proposed or recommended to offset these effects.

Recreation

Project installation, maintenance, and removal may require boaters to maneuver around construction vessels; however, these effects would be minor and short-term given the majority of such activities would be located well off-shore and with plenty of room to avoid construction activities. Snohomish PUD proposes to consult with stakeholders to develop and implement an Interpretation and Education Plan that includes installation of an interpretive display at Snohomish PUD's headquarters, or at another appropriate

location. Because of its proximity to Admiralty Inlet, development of an interpretive display at Fort Casey State Park, as opposed to Snohomish PUDs headquarters, would provide a more effective means of enhancing the public's understanding of the project and the potential value of Puget Sound as an ocean energy resource.

Navigation

Because the project is located outside the shipping channels and at sufficient depth to allow clearance for even the largest transport vessels, installation, maintenance, and removal activities would create only minor, short-term obstructions to navigation in a small part of Admiralty Inlet. The proposed Navigational Safety Plan would ensure mariners are alerted to installation activities and the presence of the project turbines, minimizing the potential to create obstructions to free navigation. The U.S. Coast Guard has determined that no restrictions to navigation are warranted at this time.

Land and Ocean Use

The on-shore portions of the project are located on private property, and there would be no effects on existing public land uses. Implementing Snohomish PUD's proposed "live-boat" techniques and strict adherence to weather and tidal conditions and safety measures defined in the proposed Hazard Identification and Risk Assessment (HIRA) would minimize any potential harm to PC-1 North during project installation, monitoring, and removal. Because of the proposed project's small footprint and location, there would be sufficient room to repair the fiber optic cable in the unlikely event of a cable fault near the turbines. While installation, maintenance, and removal activities may create short-term minor obstructions to navigation, project operation would not prevent access to or use of tribal fishing areas because there would be no restrictions or obstructions to navigation at the project site, and the size of the project would be very small relative to the fishing area. There is no current use of the project site as a commercial salmon fishery.

Aesthetic Resources

Construction activities would result in minor, short-term effects on degradation to scenic vistas at Fort Casey State Park and the scenic byway near the site of the proposed control building and HDD operation. Strict adherence to the proposed construction schedules would minimize these effects. Noise from HDD processes are not expected to be loud, but may be noticeable at near-by residences if they extend into the evening hours. Implementing staff's recommendation to include noise abatement measures in the HDD plan to ensure that noise levels do not exceed 55 decibels at the site should evening drilling be required, would minimize these temporary effects on nearby residences. Because the project control building would be similar in appearance to existing residential buildings and associated structures, project construction and operation would not have a permanent or long-term effect on aesthetic resources.

Cultural Resources

The Washington SHPO has concluded that the project would have no adverse affect upon cultural resources in or eligible for conclusion in the National Register of Historic Places. However, if previously unidentified archeological or historic properties are discovered, staff's recommended provisions to notify the Commission and the Washington SHPO, and develop and implement needed measures to protect the properties, would ensure the protection of any newly discovered archeological or historic properties.

Conclusions

Based on our analysis, we recommend licensing the project as proposed by Snohomish PUD, with the staff-recommended modifications.

In section 4.0, *Developmental Analysis*, we compare the total project cost to the cost of obtaining power from a likely alternative source of power in the region, for each of the alternatives identified above. Our analysis shows that during the first year of operation, the project as proposed would produce power at a cost that is $1,840,850 (about $8,552.27/megawatt hour (MWh)) more than the cost of alternative power. Under the staff-recommended alternative, the project would have the same energy capacity and energy attributes and would produce power at the same cost.

Although the cost of power that would be produced at the project is high, building the project, in addition to generating electricity, would collect data to further the development of commercial-scale arrays. On the basis of our independent analysis, we conclude that issuing an original license for the project with the staff-recommended measures would not be a major federal action significantly affecting the quality of the human environment.

We chose the staff alternative as the preferred alternative because under it the project would: (1) provide a short-term dependable source of electrical energy from a renewable resource (216 megawatt hours annually) which would not contribute to atmospheric pollution; (2) include environmental measures to protect, mitigate, and enhance environmental resources affected by the project; and (4) provide, through proposed monitoring, an improved understanding of the environmental effects of tidal energy projects.

ENVIRONMENTAL ASSESSMENT

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Office of Energy Projects
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Washington, DC

Cooperating Agency
U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Golden, CO

Admiralty Inlet Pilot Tidal Project
FERC Project No. 12690-005—Washington
DOE/EA-1949

1.0 INTRODUCTION

1.1 APPLICATION

On March 1, 2012, the Public Utility District No. 1 of Snohomish County, Washington (Snohomish PUD) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) to construct and operate the proposed Admiralty Inlet Pilot Tidal Project (Admiralty Inlet Project or project). The 680-kilowatt (kW) project would be located on the east side of Admiralty Inlet in Puget Sound, Washington, about 1 kilometer west of Whidbey Island, entirely within Island County, Washington (figure 1). The project would not affect federal lands. The estimated average annual generation of the project is 216,000 kilowatt-hours (kWh).

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the proposed Admiralty Inlet Project is two-fold: (1) principally, to evaluate the technical, economic, and environmental viability of OpenHydo's design and the tidal energy generation at the proposed project site in Admiralty Inlet; and (2) secondarily, to provide a new source of hydroelectric power. Therefore, under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a license to Snohomish PUD for the project and what conditions should be placed on 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 a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, or

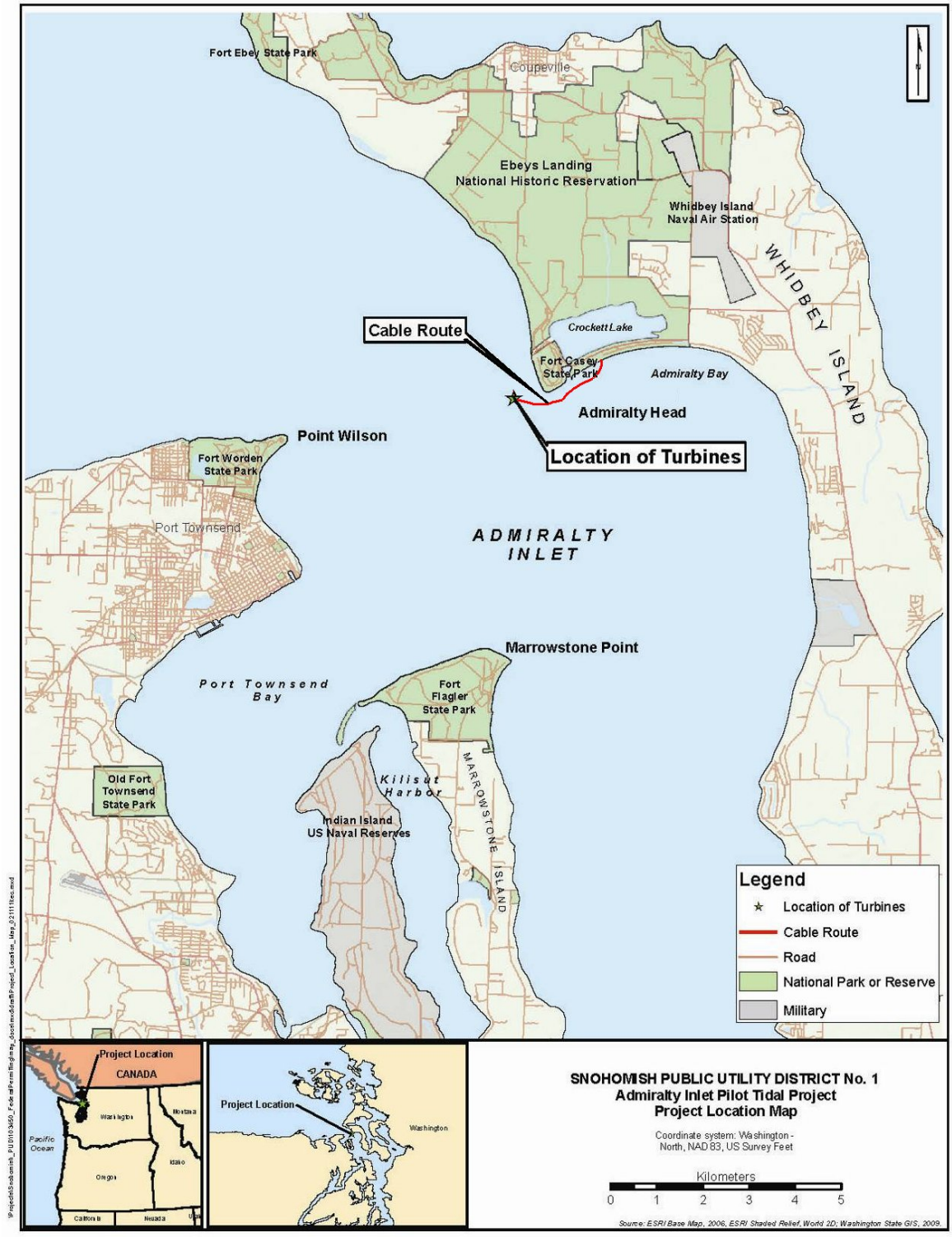

Figure 1. Location of Admiralty Inlet Pilot Tidal Project (Source: application).

water supply), the Commission must give equal consideration to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and enhancement of, fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing a license for the Admiralty Inlet Pilot Project would allow Snohomish PUD to generate electricity during its proposed 10-year license term, making electrical power from a renewable resource available to its customers. Snohomish PUD's proposed monitoring programs would also provide important information on any unanticipated environmental effects of tidal energy developments, which would assist with the evaluation of other similar projects.

The U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy's overall mission is to invest in clean energy technologies to strengthen the economy, protect the environment, and reduce dependence on foreign oil. The mission of the DOE Water Power Program is to research, test, and develop innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from U.S. water resources. These include marine and hydrokinetic (MHK) technologies that harness the energy from waves and ocean/tidal/river currents. DOE investments in these technologies aim to advance the technical readiness of MHK systems and support the development of a robust and competitive MHK industry in the U.S. The purpose for funding Snohomish PUD's project is to further this mission and help advance the technological and operational readiness of marine and hydrokinetic water power technologies.

This environmental assessment (EA) evaluates the environmental and economic effects of constructing and operating the proposed project: (1) as proposed by the applicant, and (2) with staff's recommended measures. Staff also considers the effects of the no-action alternative. Important issues that are addressed include potential effects on marine and anadromous fish; essential fish habitat; bull trout; marine mammals; marbled murrelets; navigation; an international fiber optic cable (PC-1); access to tribal fishing grounds; recreation; and aesthetics.

1.2.2 Need for Power

The successful development of the Admiralty Inlet Pilot Tidal Project 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 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.

1.3 COOPERATING AGENCY ROLES

DOE has provided financial assistance in support of the preliminary engineering and design phase of Snohomish PUD's project and is now considering authorizing the expenditure of additional federal funds in support of final project activities. Specifically, DOE funding would be used in support of the final design, construction, deployment, and monitoring phases of the project. Granting Snohomish PUD financial assistance for this project would constitute a major federal action as defined by the National Environmental Policy Act of 1969 (NEPA). DOE must consider the possible environmental impacts from the project before committing to provide funding. In accordance with the provisions of NEPA and DOE implementing regulations (10 C.F.R.1021), DOE has determined that an EA must be completed for the proposed project to evaluate the potential environmental impacts that could result from the award of the funding. To satisfy this requirement, on May 1, 2012, DOE filed a request to be a cooperating agency in the Commission's preparation of this EA. A letter of understanding (LOU), signed by both agencies, was issued on June 27, 2012, establishing DOE's cooperating agency status.

DOE's decision whether to provide financial assistance for the final design, construction, deployment and monitoring phases to Snohomish PUD for this project will be made after the completion of this EA and DOE's NEPA review process. Upon completion of this EA, DOE will assess all comments, FERC's conclusions, and all agency recommendations prior to issuing a final NEPA determination. This determination along with the final EA will be posted at DOE Golden, Colorado's Public Reading Room: http://www.eere.energy.gov/golden/NEPA_DEA.aspx.

1.4 STATUTORY AND REGULATORY REQUIREMENTS

A license for the project is subject to numerous requirements under the FPA and other applicable statutes. We summarize the major regulatory requirements in table 1 and describe them below.

Table 1. Major statutory and regulatory requirements for the Admiralty Inlet Pilot Tidal Project (source: staff).

Requirement	Agency	Status
Section 18 of the FPA (fishway prescriptions)	U.S. Department of the Interior (Interior) on behalf of the Fish and Wildlife Service (FWS)	Interior requested a reservation of authority to prescribe fishways under section 18 on May 23, 2012.
Section 10(j) of the FPA	National Marine Fisheries Service (NMFS), FWS, and Washington Department of Fish and Game (Washington DFG)	NMFS, Interior, and Washington DFG filed 10(j) recommendations on May 23, 2012.
Clean Water Act – Water Quality Certification (Certification)	Washington Department of Ecology (Washington Ecology)	Application for certification was received by Washington Ecology on February 9, 2012.
Endangered Species Act Consultation	NMFS, U.S. Fish and Wildlife Service (FWS)	Formal consultation with NMFS was requested on April 23, 2012; biological opinion was due on September 6, 2012. FWS concurred with staff's determination of not likely to adversely affect listed species on June 12, 2012.

Requirement	Agency	Status
Marine Mammals Protection Act	NMFS	Proposed construction and operation may adversely affect marine mammals. Snohomish PUD intends to request an Incidental Harassment Authorization pursuant to the Marine Mammal Protection Act after the license is issued but before any marine activities are conducted for the project.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	Project installation and operation is not expected to adversely affect Essential Fish Habitat (EFH). An EFH assessment was provided to NMFS on April 23, 2012.
Coastal Zone Management Act Consistency	Washington Ecology	Washington Ecology received a Coastal Zone Management Act consistency certification on March 26, 2012. Washington Ecology has not yet acted on the request, which was due September 24, 2012.
National Historic Preservation Act	Washington State Historic Preservation Office (Washington SHPO)	Washington SHPO concurred with a finding of no adverse effect on historic properties on February 28, 2012.

1.4.1 Federal Power Act

1.4.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of Commerce or the Interior. Interior, by letter dated November 7, 2011,

requests that a reservation of authority to prescribe fishways under section 18 be included in any license issued for the project.

1.4.1.2 Section 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 recommendations, expertise, and statutory responsibilities of such agency.

NMFS, FWS, and Washington DFG timely filed, on May 23, 2012, recommendations under section 10(j), as summarized in table 10, in section 5.4, *Fish and Wildlife Agency Recommendations.* In section 5.4, we also discuss how we address the agency recommendations and comply with section 10(j).

1.4.2 Clean Water Act

Under section 401 of the Clean Water Act (CWA), a license applicant must obtain certification from the appropriate state pollution control agency verifying compliance with the CWA. On February 7, 2012, Snohomish PUD applied to Washington Ecology for water quality certification (certification) for the Admiralty Inlet Project. Washington Ecology received this request on February 9, 2012.[2] Washington Ecology has not yet acted on the request.

1.4.3 Endangered Species Act

Section 7 of the Endangered Species Act (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. Federally listed species known to occur, or that may occur, in the vicinity of the project include: Puget Sound Chinook salmon and its designated critical habitat, Hood Canal summer-run chum salmon and its designated critical habitat, Puget Sound steelhead, Coastal-Puget Sound bull trout, green sturgeon, bocaccio, canary rockfish, yelloweye rockfish, eulachon, southern resident killer whale and its designated critical habitat, North Pacific humpback whale, Stellar sea lion, marbled murrelet, and

[2] Snohomish PUD requested the water quality certification through state's Joint Aquatic Resources Permit Application (JARPA).

golden paintbrush. Our analyses of project impacts on threatened and endangered species are presented in section 3.3.4, *Rare, Threatened, and Endangered Species*, and our recommendations in section 5.2, *Comprehensive Development and Recommended Alternative*.

Construction and operation of the project would not affect the golden paintbrush; is "not likely to adversely affect" the Puget Sound Chinook salmon and its designated critical habitat, Hood Canal summer-run chum salmon and its designated critical habitat, Puget Sound steelhead, Coastal-Puget Sound bull trout, green sturgeon, bocaccio, canary rockfish, yelloweye rockfish, eulachon, North Pacific humpback whale, designated critical habitat for the southern resident killer whale, and marbled murrelet; and "may adversely affect" southern resident killer whale and Stellar sea lion. We requested FWS's concurrence with our determination on bull trout, marbled murrelet, and golden paintbrush on April 24, 2012; FWS concurred with staff's findings on June 12, 2012. We requested formal consultation with NMFS on the project's potential effects on the southern resident killer whale and Stellar sea lion and their concurrence on not likely to adversely affect the remaining listed species on April 23, 2012. On May 23, 2012, NMFS stated that it could not begin formal consultation until the final monitoring and mitigation plans and the blade strike analysis for the southern killer whale were completed. The blade strike analysis was completed and filed with the license application on March 1, 2012. Final Benthic Habitat, Acoustic, Marine Mammal, and Near-Turbine Monitoring and Mitigation Plans, developed in consultation with NMFS and other agencies, were filed on November 19, 2012.

1.4.4 Marine Mammal Protection Act

The 1972 Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the "take" (defined under statute to include harassment)[3] of marine mammals in U.S. waters and the high seas. In 1986, Congress amended both the MMPA, under the incidental take program, and the ESA, to authorize incidental takings of depleted, endangered, or threatened marine mammals, provided the "taking" (defined under the statute as actions which are or may be lethal, injurious, or harassing) was small in number

[3] Under the 1994 Amendments to the MMPA, "harassment" is statutorily defined as "any act of pursuit, torment, or annoyance that has the potential to: (a) injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (b) disturb a marine mammal or marine mammal stock in the wild by causing a 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 mammal stock in the wild (Level B Harassment)." Marine Mammal Protection Act Amendments of 1994, Pub. L. No. 103-238, 108 Stat. 432 (1994); *see also* 50 CFR § 216.3 (2010) (regulation implementing the amendment).

and had a negligible impact on marine mammals. With this relationship between the MMPA and ESA, NMFS cannot complete section 7 consultation and issue an Incidental Take Permit for listed marine mammals until an Incidental Harassment Authorization (IHA)[4] has been issued.

The southern resident killer whale, humpback whale, and Stellar sea lion are ESA-listed species, and may occur in the vicinity of the proposed project. Additional non-listed marine mammals (e.g., harbor porpoise) may occur in the project vicinity. Noise from the operation of the turbines will exceed received sound pressure levels (SPL) of 120 decibels (dB), the level that is considered Level B harassment by NMFS for non-impulsive sounds. Therefore, we conclude that the proposed project may adversely affect marine mammals due to noise related to the operation of the turbines. Snohomish PUD will need an IHA for marine mammals in Admiralty Inlet.

1.4.5 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires federal agencies to consult with NMFS on all actions that may adversely affect EFH. The proposed project area contains EFH for Pacific groundfish, Pacific salmon, and several coastal pelagic species.

On April 23, 2012, an EFH assessment was filed with NMFS and requested that NMFS provide any EFH recommendations along with its biological opinion (BO). The effects of the project on EFH are summarized in section 3.3.2.2 *Environmental Effects*, *Marine Resources*. The only likely effects of the project are the immediate and temporary disturbance of the placement and presence of the devices and the trunk cables over a small fraction of the floor of the inlet. Therefore, we conclude that licensing the project would not likely adversely affect EFH for any of the species located in the project area.

1.4.6 Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or the agency's

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

concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

On March 26, 2012, Snohomish PUD submitted a request for CZMA consistency determination to Washington Ecology. Public notice of the application was issued on April 3, 2012. On September 26, 2012, Washington Ecology and Snohomish PUD jointly notified the Commission that the CZMA consistency determination cannot be granted until the State Environmental Policy Act (SEPA) determination, shoreline permit, and Section 401 water quality certification are issued and that there was insufficient time to obtain the SEPA determination, shoreline permit, and water quality certification before the September 24, 2012, deadline for issuing the CZMA consistency determination. Therefore, Washington Ecology and Snohomish PUD stated that they have agreed to extend the CZMA review period until Snohomish PUD can complete the enforceable policies under Washington's CZMA Program, and Ecology can issue CZMA consistency determination.

1.4.7 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires that every federal agency "take into account" how each of its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

On November 7, 2008, the Commission designated Snohomish PUD as a non-federal representative for the purposes of conducting section 106 consultation under the NHPA. Pursuant to section 106, and as the Commission's designated non-federal representative, Snohomish PUD consulted with the Washington State Historic Preservation Office (SHPO) to locate, determine National Register eligibility, and assess potential adverse effects to historic properties associated with the project. In a letter dated February 28, 2013, the Washington SHPO concurred with Snohomish PUD's defined area of potential effects (APE) for the project and Snohomish PUD's finding that the proposed project will have no adverse effect on National Register eligible or listed historic or cultural resources. Therefore, the drafting of a programmatic agreement to resolve adverse effects to historic properties will not be necessary and no further action pursuant to Section 106 is required at this time.

1.5 PUBLIC REVIEW AND COMMENT

The Commission's regulations (18 C.F.R., §§ 5.1-5.16) require that applicants consult with appropriate resource agencies, tribes, 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 ESA, the NHPA, and other federal statutes. Pre-filing

consultation must be complete and documented according to the Commission's regulations.[5]

1.5.1 Comments on the Draft License Application

On December 30, 2009, the Commission issued a notice that Snohomish PUD had filed a draft license application for the Admiralty Inlet Project. This notice set February 26, 2010, as the deadline for filing comments on the pre-filing materials. In response to the notice, the following entities commented:

Commenting Entities	Date Filed
Swinomish Indian Tribal Community	February 25, 2010
Sauk-Suiattle Indian Tribe	February 25, 2010
NMFS	February 26, 2010
U.S. National Park Service	February 26, 2010
FWS	February 26, 2010
Tulalip Tribes Of Washington (Tulalip Tribes)	March 1, 2010
Suquamish Tribe	March 3, 2010
American Waterways Operators	May 6, 2010, and June 1, 2010

Based on the received comments, Commission staff held a technical meeting on April 12, 2010, in Everett, Washington to further scope issues and to discuss information and monitoring needs for the license application. Discussions at the technical meeting focused on the information gaps that needed to be addressed to ensure that sufficient information existed for the Commission to make a determination on whether the proposed project meets the criteria for a pilot project and for processing a license application for a pilot project once it is filed with the Commission.

Subsequently, Snohomish PUD began facilitating discussions with NMFS, FWS, and the Washington Department of Natural Resources (Washington DNR) to address outstanding concerns of the parties regarding the use of the pilot licensing procedures

[5] The Commission waived sections 5.8 and 5.10 of its regulations, which specify the project scoping requirements for the Commission's Integrated Licensing Process, by letter issued July 7, 2011.

given potential project effects on southern resident killer whale, salmon and other fish.[6] Letters of support for using the pilot licensing procedures were filed by Washington DNR on July 2, 2010, NMFS on July 6, 2010, and FWS on July 8, 2010. On July 7, 2011, the Commission approved the use of the pilot project procedures.

1.5.2 Interventions

On April 23, 2012, the Commission issued a notice that Snohomish PUD had filed an application to license the project and set May 23, 2012, as the deadline for filing protests and motions to intervene. In response to the notice, the following entities filed notices or motions to intervene:

Intervenors	Date Filed
Washington Ecology	May 1, 2012
Washington DFW	May 4, 2012
Washington DNR	May 10, 2012
Tulalip Tribes	May 11, 2012
U.S. Department of Interior (Interior)	May 21, 2012
Whidbey Environmental Action Network	May 22, 2012
Sauk-Suiattle Indian Tribe of Washington	May 23, 2012
PC Landing Corporation	May 23, 2012*
NMFS	May 23, 2012
Swinomish Indians	May 23, 2012

* PC Landing Corporation (PC Landing) filed a motion to intervene in opposition to the project.

[6] While Washington Ecology and Washington DFW elected not to participate in the discussions, they were kept abreast of discussions through bi-monthly updates.

1.5.3 Comments on the License Application

The notice that the Commission issued on April 23, 2012, also requested comments, conditions and terms and recommendations. The following entities commented:

Commenting Agency and Other Entity	Date Filed
Interior	May 23, 2012
Washington DFW	May 23, 2012
NMFS	May 23, 2012
Public Safety and Homeland Security Bureau of the Federal Communications Commission (FCC)	May 24 and October 4, 2012
U.S. Army Corps of Engineers	June 11, 2012
GCI Communication Corporation	July 30, 2012
Point No Point Treaty Council	October 11, 2012
U.S Navy, Naval Facilities Engineering Command	June 22 and October 24, 2012

Snohomish PUD filed responses to comments, recommendations, and terms and conditions on June 22, 2012. Snohomish PUD filed a response to the Point No Point Treaty Council letter on October 22, 2012.

On August 6, 2012, Commission staff held a technical conference to discuss issues raised by PC Landing and the Federal Communications Commission (FCC) regarding the proximity of the proposed project to PC Landing's fiber optic communication cable, and the implications and information needs for possible alternative site locations for the hydrokinetic turbines. PC Landing filed comments following the conference on August 1 and 15, October 15, and November 6, 2012. Snohomish PUD filed responses to PC Landing's filings on August 27, September 10 and 26, October 25, and November 9, 2012. The FCC filed clarifying comments on October 4, 2012, indicating it did not oppose the Commission issuing a license for the project if certain conditions were included in the license to protect the fiber optical cable.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

The no-action alternative is license denial. Under the no-action alternative, the project would not be built, and the environmental resources in the project area would not

be affected. In addition, under the no-action alternative, DOE would not authorize the expenditure of federal funds for the final design, construction, deployment, and monitoring of Snohomish PUD's proposed project.

2.2 APPLICANT'S PROPOSAL

2.2.1 Project Facilities

The Admiralty Inlet Project would consist of: (1) one 370-kilowatt (kW) OpenHydro tidal turbine (Turbine 1) and one 310-kW OpenHydro tidal turbine (Turbine 2), each approximately 19.2 feet high (6 meters) and mounted on a triangular subsea base, fitted with an adaptable monitoring package for environmental monitoring equipment, a three-axis orthogonal accelerometer[7] for monitoring turbine vibration, and a tilt sensor for monitoring differential settlement; (2) two approximately 7,000-foot-long (2,200 meters), 6-kilovolt (kV) trunk cables, one extending from each turbine to the on-shore cable termination vault, each consisting of: a) three power transmission core cables to transmit power from the turbine to shore; b) single mode fiber optic elements to convey turbine control and monitoring signals and environmental monitoring data between the turbines and the on-shore facilities; and c) low-power elements to provide power to the turbine control and monitoring system at the turbines;[8] (3) an approximately 3.9-foot-long, 5.8-foot-wide, 2.9-foot-high on-shore cable termination vault; (4) 40-foot-long conduits to convey the power transmission core cables, the fiber optic elements, and the low-power elements from the cable termination vault to a cable control building; (5) a 24-foot-wide, 30-foot-long on-shore cable control building housing power and monitoring equipment; (6) a 12.47-kV step-up transformer located adjacent to the cable control building; (7) a 10-foot-long, buried 12.47-kV transmission line from the transformer to the Point of Metering and the Point of Common Ownership with Puget Sound Energy grid; and (8) and appurtenant facilities. The turbine configuration is shown as figure 2.

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[7] An accelerometer is an electromechanical device that measures acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. In this case, the accelerometer would measure real-time vibration in the x, y, and z axis of the turbine.

[8] The trunk cables would come on shore through a bore hole installed by horizontal directional drilling to the shore cable vault.

2.2.2 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 addressing potential environmental impact and project safety concerns, Snohomish PUD is proposing the following Safeguard Plans:

- Project and Public Safety Plan
- Navigational Safety Plan
- Emergency Shutdown Plan
- Project Removal and Site Restoration Plan

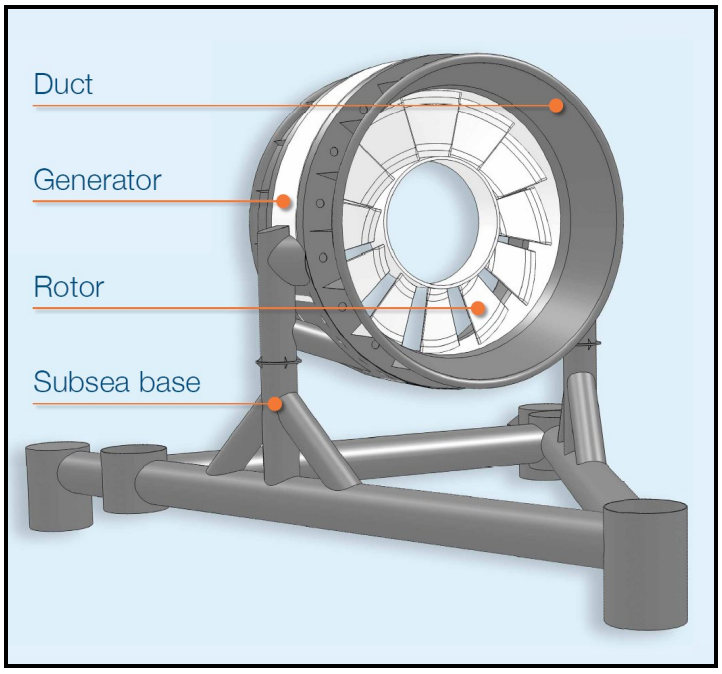

Figure 2. Illustration of the OpenHydro turbine (Source: application).

2.2.3 Project Installation and Removal

The installation process would begin with the construction of the on-shore cable control building, followed by horizontal directional drilling (HDD) operations to bring the trunk cables ashore. Snohomish PUD's proposed HDD Plan provides a detailed description of the procedures for conducting the process. In summary, after confirming the profile of the ocean floor in the installation area, the HDD would bore a path from the on-shore start point to the exit point on the ocean floor. After drilling, a cylindrical device used for cleaning or inspections (a drilling pig) with a steel cable attached would be run through the path from shore to the sea floor exit. After the trunk cables are laid from the turbine location site to the sea floor exit site of the HDD conduit, the steel cable would be attached to the trunk cables. The steel cable would then be retracted back to shore through the conduit, bringing the trunk cables through the conduit to the cable termination vault.

The turbines would be installed when conditions would be deemed optimal. Optimum conditions for installation would likely be a tidal speed of less than 1.5 knots and wind speed less than 20 miles per hour, and other criteria identified in a post-licensing Hazard Identification and Risk Assessment. The installation process would be the same for both turbines, but would occur about two weeks apart. The project's installation would require a turbine installation barge (see figure 3), a cable laying barge, three tugboats, a remotely operated vehicle (ROV), and small support vessels. The turbine would be suspended in the center of the turbine installation barge and the subsea trunk cable would be connected to the turbine. The turbine installation barge and the cable laying barge would be coupled together and transported to the installation site by the tugboats during the ebb tide. The three tugboats would be used to stabilize the barges over the installation site. Once the turbine installation barge is centered over the installation site, winches onboard would slowly lower the turbine to the sea floor. The cable laying barge would release cable at a rate that keeps up with the turbine as it descends through the water, but would still have some tension on it. The installation process is expected to take less than two hours. Once the turbine is positioned on the sea floor, the cable laying barge is decoupled from the turbine installation barge.

The cable laying process would begin during the flood tide. Two of the tugboats would be used to direct the cable laying barge over the cable route to the HDD sea floor exit point. The other tugboat would be used to operate the ROV, which would inspect the laying of the trunk cable along the sea floor. Once the trunk cable is laid on the sea floor to the HDD sea floor exit point, the cable laying barge would be anchored, and assist vessels would pay out the remaining cable, and floats would be attached to the end that would go through the HDD conduit to the on-shore connection. The submerged end of the steel cable (the pull cable) in the HDD conduit would be brought to the surface and attached to the floating end of the trunk cable. Once the trunk cable is attached to the pull cable, the pull cable would be retrieved through the HDD conduit to shore, threading the trunk cable through the HDD conduit as it is retrieved. Divers would monitor the trunk cable installation through the HDD conduit.

Snohomish PUD proposed a Project Removal and Site Restoration Plan that details how the turbines, subsea bases, and other equipment would be removed at the conclusion of the license. The turbines and subsea bases would be removed by reversing the installation process. Snohomish PUD proposed to leave in place or remove the trunk cables after consulting with the MARC, and remove all on shore equipment according to the terms of the agreement(s) between Snohomish PUD and the private land owners. Snohomish PUD would also remove the terrestrial transmission line and other transmission equipment in accordance with the terms of the agreement with Puget Sound Energy. It is expected that the control building would be converted to a garage for the adjoining residence.

Figure 3. OpenHydro Installation Barge (Source: application).

2.2.4 Project Operation

The proposed project would operate using the natural tidal currents of Admiralty Inlet. The OpenHydro System is designed to generate electrical output during a range of water currents present in a full tidal cycle, operating in a stationary orientation in both ebb and flood tides. The turbine converts the kinetic energy of water flowing in currents from 0.7 meters per second (m/s) to 3.3 m/s into rotational motion and delivers that

energy through the rotors into the generator. The turbines are expected to rotate approximately 70 percent of the time.

Manual controls located in the control building and remote web-based monitoring would be provided for turbine and grid connection functions. The system would be monitored continuously by Snohomish PUD personnel via an internet connection. The turbines would be monitored and controlled using a programmable logic controller and human machine interface. The monitoring of turbine operation would occur in real time and information on turbine operations would be transmitted to the control building through the fiber optic cables or copper wire bundles installed in the trunk cables. The electrical parameters of each turbine would be monitored, and automatic alarm thresholds would be set locally or remotely by project personnel. A three-axis orthogonal accelerometer would be mounted on the turbine to measure real-time vibration in the x, y, and z axis, and would signal that the turbine should be shut down if excessive vibration was measured. An integrated tilt sensor would be mounted on the turbine subsea base to monitor for any differential settling.

There would be two levels of alarm: one would generate a warning message for Snohomish PUD personnel, the other would cause a control algorithm to be engaged. The algorithm could result in the turbines ceasing operation. If the turbine needed to cease operation, an electronic brake would be applied. This brake would not totally cease turbine operation, but would slow the turbine rotation to less than 5 revolutions per minute (rpm), and cease electrical generation.

2.2.5 Project Maintenance

Although the OpenHydro turbines are designed to operate reliably with low maintenance demands, Snohomish PUD proposes to implement monitoring, inspection, and maintenance measures for the term of the license. Monitoring efforts would be conducted by the engineers to analyze data from the control and monitoring equipment on each turbine to highlight any anomalies in the equipment. This effort would be ongoing through the term of the installation.

Inspection would be done by the use of ROVs four times per year during the first year and two times per year each additional year of installation. Inspections would assess the overall structural integrity of each turbine and base, biological growth on the turbines and bases, condition of the turbine blades, condition of the connection anodes, position of the turbines on the sea floor, and the position and condition of the trunk cables. Inspections would be conducted on the following schedule: (1) immediately following installation of the tidal array; (2) following 1 month of operation; (3) following 3 months of operation; (4) following 6 months of operation; (5) following 9 months of operation; (6) following 12 months of operation; (7) following 18 months of operation; and (8) following 24 months of operation.

Maintenance of the turbines is anticipated to occur five years after deployment. The turbines would be removed, and all mechanical and electrical parts would be inspected and repaired or replaced as needed. The adaptable monitoring package (AMP) attached to each turbine would be recovered and redeployed every three to six months as part of the standard maintenance cycle.[9]

Inspection and maintenance documentation would be integral to the early years of the project as standard maintenance intervals are developed for the Admiralty Inlet Project. Maintenance records would be kept and maintenance events monitored for system degradation. A dedicated computer and data collection program would maintain records of maintenance and would include a real-time operational display and historical charts. The data would be available at remote locations over the internet. A schedule would be developed for periodic database archival.

As proposed by Snohomish PUD in the Project and Public Safety Plan, unscheduled maintenance operations may be triggered by a failure of the environmental monitoring equipment, or an operational problem with the turbine. Snohomish PUD would likely use an ROV to inspect the turbine or equipment before making a decision on how to proceed. Snohomish PUD anticipates an ROV could be mobilized in a matter of days. In the event that a component of the environmental monitoring equipment would need to be replaced, an unscheduled maintenance event to recover the AMP and replace it with a spare would take approximately 30 minutes, and the window for the repair to occur (dictated by appropriate tidal and weather conditions and the availability of a vessel) would likely be completed in one week.[10] In the event that the turbine fails, or that the environmental monitoring equipment fails at a point between where the AMP connects to the power source and the shore, the turbine may be recovered to the surface as described in the Emergency Shutdown Plan and the Project Removal and Site Restoration Plan.

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[9] The AMP includes optical-acoustical cameras for observing marine animals in the near-field (< 5 m) of the turbine rotor and passive acoustic hydrophone arrays to detect, classify, and localize marine mammal vocalizations.

[10] The initial specifications for the removal and installation of the adaptable monitoring package is for operations to be completed within 30 minutes, with the currents fully set in one direction throughout the water column, a mean velocity less than 0.7 m/s, and a Sea State less than 3 on the Beaufort Scale (8 to 12 mph winds, wave height 2 to 3.5 feet high). Based on analysis of current data collected within the project area, there is a 75% chance of at least one maintenance window occurring within 7 days of a system fault notification and a 90% chance of at least one maintenance window occurring within 14 days of a fault notification.

Snohomish PUD proposes in their Emergency Shutdown Plan to implement the following procedures when shutdown is required: (1) engage the emergency brake, which would cease turbine rotation and generation within one second; (2) electrically isolate the subsea systems from the grid; and (3) file a report with the Commission, agencies, and tribes detailing the measures undertaken during the shutdown. If the turbine must be removed, the process could take up to four weeks to complete. Turbine recovery would require the installer barge and associated equipment and crew to be mobilized and would have to be completed during acceptable tidal and weather conditions.[11] Any marine vessels that would be mobilized as part of a maintenance event would have to comply with the International Rules for Preventing Collisions at Sea and coordinated with the Coast Guard, as outlined in the Navigation Safety Plan.

2.2.6 Proposed Environmental Measures

Snohomish PUD proposes to construct and operate the project with the following environmental protection, mitigation, and enhancement measures:

- To monitor environmental effects and identify corrective actions, implement: (1) an Acoustic Monitoring and Mitigation Plan; (2) a Benthic Habitat Monitoring and Mitigation Plan; (3) a Marine Mammal Monitoring and Mitigation Plan; (4) a Near-Turbine Monitoring and Mitigation Plan; (5) a Derelict Gear Monitoring Plan; and (6) a Water Quality Monitoring Plan.

- To provide coordination, data reviews, and implementation of the above monitoring plans, implement an Adaptive Management Framework that includes conferring with a Marine Aquatic Resource Committee (MARC).[12]

- To avoid eelgrass beds and other sensitive near-shore habitats, implement a Horizontal Directional Drilling Plan that would deploy trunk cables from on land to a minimum depth of 18 meters off-shore.

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[11] Recovery of the turbine can occur when the Beaufort Sea State is 4 (13 to 17 mph winds and wave height 3.5 to 6 feet high) or lower, and tidal currents are set in one direction and have a velocity between 0.3 and 1.3 m/s for at least 90 minutes. Based on analysis of current data collected within the project site, there is a 70% chance of at least one suitable met-ocean window occurring within 14 days of the installer barge being mobilized.

[12] The Committee would be composed of the following entities: Snohomish PUD, NMFS, FWS, Washington DFW, Washington Ecology, Washington DNR, the Tulalip Tribes, Suquamish Tribe, Swinomish Indian Tribal Community, and Sauk-Suiattle Tribe. Additional members could be added by unanimous agreement by the MARC.

- To avoid adverse effects on sensitive marine fish species, conduct marine installation during a Washington Department of Fish and Wildlife-approved work window of July 16 to October 14.

- To educate the public about the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area, develop and implement an Interpretation and Education Plan that includes installation of an interpretive display at Snohomish PUD's headquarters or at another appropriate location agreed upon with stakeholders.

- To ensure safe operation of the project and protect the public, implement: 1) a Project and Public Safety Plan; 2) a Navigational Safety Plan; and 3) an Emergency Shutdown Plan.

- To avoid harming PC Landing's international fiber optic cable (PC-1 North), located near the site, conduct turbine installation and monitoring using "live-boat" techniques (i.e., without anchoring) and prepare and implement a Hazard Identification and Risk Assessment, developed in consultation with the Corps, Coast Guard, and PC Landing, prior to marine operations that includes: (a) setting criteria for weather and wave conditions that must exist before marine operations occur; (b) using industry-approved equipment and redundancy in the use of equipment and vessels (e.g., tugboat with back-up engine; back-up tugboat for emergencies; towing gear, barge, winches, winch wire, and hydraulic lifting tools new or certified based on industry standards); (c) setting criteria for aborting operations; and (d) identifying an established "port of refuge," located away from PC-1, in the event of unanticipated adverse weather or other events that would cause installation or operations to be aborted

- To restore the project site to a pre-project condition at the end of the license term if a new license is not sought or obtained, implement a Project Removal and Site Restoration Plan.

2.3 STAFF ALTERNATIVE

The staff alternative includes all of the measures included in Snohomish PUD's proposal, with the following modifications and additional measures developed by Commission staff.

- Include in the Project Removal and Site Restoration Plan provisions for filing for Commission approval: (1) a specific timeline for the removal and site restoration activities 6 months prior to license expiration; (2) documentation of consultation with the MARC regarding planned removal and site restoration

activities 6 months prior to license expiration; and (3) documentation of completion of project removal and site restoration activities prior to license expiration.

- Include in the HDD Plan provisions to implement noise abatement measures in the event HDD processes extend into the nighttime hours.

- Install an interpretive display at Fort Casey State Park, subject to state approval, describing the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area.

- Halt work if previously unidentified archeological or historic properties are discovered and develop protective measures in consultation with the Washington SHPO.

- Include a reservation of authority for the Corps of Engineers to require removal, relocation, or other alteration if the project becomes an unreasonable obstruction to free navigation of navigable waters.

3.0 ENVIRONMENTAL ANALYSIS

In this section, we present: (1) a general description of the project vicinity; (2) an explanation of the scope of our cumulative effects analysis; and (3) our analysis of the proposed action and other recommended environmental measures. Sections are organized by resource area. Under each resource area, historic and current conditions are first described. The existing condition is the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed mitigation, protection, and enhancement measures, and any potential cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section 5.2, *Comprehensive Development and Recommended Alternative*.

3.1 GENERAL DESCRIPTION OF THE PROJECT AREA

The proposed project is located in Admiralty Inlet in the northwestern portion of Puget Sound, between the Olympic Peninsula and Whidbey Island (Island County). Puget Sound is the second largest estuary in the United States, where salt water from the Pacific Ocean is mixed with fresh water draining from the surrounding watersheds.

The average water depth in Puget Sound is 140 meters, with a maximum depth, just north of Seattle, of 285 m (935 feet) (Fugro, 2009). Puget Sound supports a wide range of habitats that are home to thousands of plant and invertebrate species, as well as more than 200 species of fish, 100 species of marine birds, and nine species of marine mammals (Gustafson et al., 2000; Palsson et al., 1997). Puget Sound is bordered to the west and east by the Olympic and Cascade mountain ranges, respectively. This topography generally channels winds in a north/south direction, although wind conditions across Puget Sound can vary depending on local effects.

Admiralty Inlet is the gateway to much of Puget Sound, sitting between the Olympic Peninsula on the mainland of the State of Washington and Whidbey Island. Admiralty Inlet is 3,240 m (10,630 feet) wide with an average depth of 64 m (210 feet) and a maximum depth of 81 m (266 feet) (Snohomish PUD 2012). It connects the northwestern end of Puget Sound to the Strait of Juan de Fuca. Tidal currents in Admiralty Inlet exceed 3 meters per second. The turbines would be located approximately 1 kilometer west-southwest of Admiralty Head, at a water depth of approximately 58 meters.

Fort Casey State Park occupies the nearest land on Admiralty Head, which is east of the turbine sites and to the west of the proposed cable control building. This part of the coastline is dominated by high, sandy bluffs. The beaches along Admiralty Head tend to be sand and cobbles. The Port Townsend-Coupeville ferry terminal and light residential development occur near the cable control building. Major land and water uses in the Project area include recreation, commercial fishing (except salmon), transportation,

and commerce. The main urban areas in the Project area are the town of Coupeville, several miles to the north on Whidbey Island, and Port Townsend, which is located on the opposite side of Admiralty Inlet from the Project. Much of Admiralty Inlet's western shoreline is characterized by forest, light residential development, and the city of Port Townsend, while a majority of the eastern half of the channel, particularly along the Whidbey Island shore, is characterized by forest and agriculture (City of Port Townsend 2007).

Admiralty Inlet serves as a main route for all shipping traffic for the ports of Everett, Seattle, Tacoma, and Olympia (McCurdy 2007). Admiralty Inlet is also traversed by a ferry route: the Port Townsend-Coupeville ferry runs between Port Townsend and Admiralty Head on Whidbey Island. Admiralty Inlet also supports substantial naval traffic, including that associated with the Naval Station Everett, Puget Sound Naval Shipyard, and the Bangor Submarine Base.

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (40 C.F.R. § 1508.7), a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time, including hydropower and other land and water development activities.

Based on information in the license application, agency comments, other filings related to the project, and our independent analysis, we have identified marine fish and mammals (including threatened, and endangered species), as resources/uses having the potential to be cumulatively affected by the proposed project in combination with other activities in the proposed project area, such as commercial fishing, and vessel traffic. While the installation of additional hydrokinetic devices may be possible in the future (e.g., as proposed by the U.S. Navy in Admiralty Inlet), their development is not well enough defined to be reasonably foreseeable and to be appropriately analyzed.

3.2.1 Geographic Scope

The geographic scope of the analysis for cumulatively affected resources is defined by the physical limits or boundaries of: (1) the proposed action's effects on the resources, and (2) contributing effects from other projects or activities. Based on the nature, size, and location of the proposed project, the geographic scope for cumulatively affected resources is Admiralty Inlet. We choose this geographic scope because the effects of project operations are primarily limited to Admiralty Inlet, where these

resources may directly and indirectly be affected by construction and operation of the project.

3.2.2 Temporal Scope

The temporal scope of analysis includes a discussion of the past, present, and future actions and their effects on marine resources. Based on the potential term of a license, the temporal scope looks 10 years into the future, concentrating on the effect of reasonably foreseeable future actions. The historical discussion is limited, by necessity, to the amount of available information for the resource.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the effect 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 cumulative and site-specific environmental issues.

Admiralty Inlet is a constricted channel in Puget Sound, and therefore by its nature, experiences strong tidal currents and significant vertical mixing. Because the turbines that are being deployed and their potential to release pollutants or cause changes to the waters of Puget Sound are so small compared to the volume of water and tidal mixing forces of Puget Sound, anticipated water quality effects are expected to be localized and short-term. Therefore, the analysis of project effects on water quality focuses on the production of turbidity/sediment, changes in pH, spill of oil, and use of anti-bio-fouling paints. Nothing in the record suggests that project construction or operation would alter other water quality conditions in the larger Puget Sound (e.g., dissolved oxygen, temperature, etc.).

Similarly, Polagye et al. (2009) modeled the effects of energy removal of the project on Admiralty Inlet. Modeling results show that "The far-field effects of extraction from an array this size would have an immeasurably small effect on the tidal regime of Puget Sound… Any detectable effects should be confined to near-field flow variations in the immediate vicinity of the devices" (Polagye et al., 2009). Consequently, the analyses of project effects on hydrodynamics focus on the near-field environment.

We present our recommendations in section 5.2, *Comprehensive Development and Recommended Alternative.*

3.3.1 Geologic and Soil Resources

3.3.1.1 Affected Environment

The proposed tidal turbine project is located in Admiralty Inlet, a straight within Puget Sound that connects the Strait of Juan de Fuca to Puget Sound. Daily ebb and flood tides move water between the Pacific Ocean and Puget Sound via Admiralty Inlet. The project area is located in the Puget Sound Lowland physiographic province, a north-south trending structural basin located between the Olympic Mountains to the west and the Cascade Mountains to the east, with Puget Sound running through the center. This basin was formed by the subduction of the Juan de Fuca oceanic plate beneath the North American Plate.

At least six continental glaciations advanced into the Puget Sound Lowlands over the previous two million years. Each successive glaciation shaped the landscape by both partially eroding the existing ground surface, and depositing a fresh sequence of clay, silt, sand and gravel sediments. Advancing and retreating glaciers created deep and narrow channels in the region divided by islands and peninsulas, including Admiralty Inlet and Puget Sound. Sedimentary deposits that have been overridden by thick glacial ice are typically highly consolidated, and post glacial sediments are less consolidated, which influences the engineering behavior of the soils. The stratigraphy in the project area contains both glacially-consolidated and unconsolidated sediments.

In the proposed project turbine installation area, a series of generally east-west trending (active) seismic faults subdivide the Puget Sound basin. The region is characterized by moderate to high seismicity (U.S.G.S., 2012a). Johnson, et. al, (1996) speculated that shallow crustal seismic faults in the area may generate earthquakes of magnitude 7 or higher. The Southern Whidbey Island Fault, cuts through the proposed project area (Polenz et al., 2005).

Movement of water through the relatively narrow Admiralty Inlet during the tidal cycle results in strong tidal currents, which is an important mechanism for sediment transport in the project area. The major source of sediment contributed to the project area is likely from erosion of the shoreline and bluffs along the west side of Whidbey Island. In areas where benthic slopes are steep, occasional slumps and slides occur that deliver sediments to the deeper seafloor. Earthquake activity may also trigger slumps and slides on the steep submarine slopes. Strong tidal currents in the project area scour small particles (sands and silts) and leave behind larger gravels and boulders.

In the project area, tidal currents can reach 3.4 m/s. The sea floor surface in the area of the turbine installation site is a cobbled pavement interspersed with gravel and shell and small and large boulders (figure 4). The thickness of the layer of this cobbled

pavement is estimated to be between three and six feet thick. The sediment beneath the cobble pavement layer is predicted to be clay/sand and/or sand/gravel/cobble/boulders.[13]

Figure 4. ROV image of cobble pavement bottom in project area (Source: applicant).

Snohomish PUD used a sub bottom profiler (SBP) system and a low frequency acoustic subsurface reflection (seismic reflection) system to measure the thickness of unconsolidated sediments in the project area. Less-consolidated sediments have different reflection patterns than more highly consolidated sediments, providing an indication of the overall density of sediments in the project area. While these techniques do not identify individual soil types, they do provide a measure of the relative consolidation of the sediment layers to each other, allowing some extrapolation of the predicted engineering properties at the site. While individual soil types measured by these techniques can be compared against soil core samples to verify the identity of the individual soils present, Snohomish PUD was unable to gather soil borings for

[13] *See* Snohomish PUD 2012 (LA, Appendix L-11. Golder Associates, 2011. "Geophysical Investigation for Admiralty Inlet Turbine Project."

comparison in the proposed project installation site because the samplers were unable to penetrate the cobble pavement to sample the soils beneath.

The on-shore facilities would be located on private land south of Crockett Lake. Soils would include sand and cobbles, some larger particles, and a mix of sediment locally derived from shoreline bluffs. Specific soil types at the onshore facilities would include:[14]

- Beaches: 50 percent
- Endoaquents, tidal, and similar soils: 30 percent
- Xerorthents and similar soils: 20 percent

3.3.1.2 Environmental Effects

Project installation, maintenance, operation, and removal will require land-disturbing activities associated with HDD processes, construction of the cable control building, and installation of the underground section of the trunk cable and the associated conduits between the cable termination vault and the cable control building, which can result in soil erosion and sedimentation and adverse effects on aquatic habitat and organisms. At-sea operations associated with the HDD processes would also result in the temporary disturbance of the seabed. During operation, PC Landing asserts that the design and the weight of the turbines could result in differential settling of the turbines and scouring of sediments.

Soil Disturbance and HDD Processes

Snohomish PUD proposes to implement a Horizontal Directional Drilling Plan to minimize soil disturbance at the sea floor where the trunk cables would burrow under the kelp bed to be brought ashore. Starting from the proposed cable termination vault, Snohomish PUD would use a mixture of bentonite clay and water as the drilling fluid, which would function as a lubricant for the drill head and pipe. The bentonite clay-water slurry and the dredging spoils removed during the drilling would be pumped to a holding tank. As the HDD conduit path approaches the exit on the sea floor (approximately 100 feet from the exit), the drilling fluid would be replaced with fresh water to remove mud from the conduit path and to ensure a clean exit. Pressure and volume would be monitored to ensure that fractures that could cause wet soil to escape to the surface or within the water column could be repaired.

Snohomish PUD proposes the following measures for site restoration after the HDD and on-shore construction is complete: (1) restore the site to original grade; (2)

[14] U.S.G.S., 2012b.

replant and/or plant new grass, bushes and/or trees as needed; (3) repair any site structures such as roads, fences, curbs, retaining walls, etc. to equal or better condition if damaged during the installation; (4) remove any project generated garbage; and (5) remove any signs of the project such as ruts in the road, excessive dirt, etc.

Staff Analysis

Implementing Snohomish PUD's Horizontal Directional Drilling Plan would preserve geologic resources in the project area during construction by controlling the collection of any soils removed from the conduit without allowing wet soil to escape to the soil surface or within the water column. Proposed site restoration measures after the HDD and on-shore construction are complete would further minimize any potential for soil erosion or sedimentation from site construction activities. A detailed site-specific soil erosion control plan is typically required by the Commission as part of the final design and specifications. Such a plan would further minimize adverse effects of soil erosion and sedimentation on aquatic resources.

Differential Settling and Scour from the Turbines

The footprint of the turbine foundation would be three legs arranged in a triangular configuration with a cylindrical foot meeting the sea floor at each vertex. The pressure exerted down by the weight of the turbines would be distributed to the sea floor through the three cylindrical feet, each of which would be potentially designed to have a spiked extension on the bottom to allow penetration of the foot into the first 1.5 feet or so of the cobble pavement. The size of the footings can be enlarged to decrease the force experienced at each footing by the weight of the turbine and foundation. Each turbine foundation would cover a maximum area of approximately 10 square meters.

Snohomish PUD would monitor for differential settling of the turbines with an integrated tilt sensor, mounted on the turbine frame. Snohomish PUD also would monitor the installation area using ROVs to evaluate if excessive scour is occurring in the vicinity of the turbines. Inspections would be conducted on the following schedule: (1) immediately following installation of the tidal array; (2) following 1 month of operation; (3) following 3 months of operation; (4) following 6 months of operation; (5) following 9 months of operation; (6) following 12 months of operation; (7) following 18 months of operation; and (8) following 24 months of operation. Snohomish PUD also states that the turbine foundation would be designed to provide adequate support for the turbines, and that the turbine foundations would be designed to minimize scour.

Turbine 1 would be installed approximately 170 meters, or 558 feet (as measured from the centroid of the turbine base) from the buried PC-1 cable, and Turbine 2 is would be installed approximately 237 meters, or 780 feet (as measured from the centroid of the

turbine base) from the buried PC-1 cable.[15] PC Landing asserts that the turbine foundations may not be adequately designed because of the uncertainty in the composition of the sediment immediately beneath the cobble pavement at the project installation area. PC Landing is concerned that without an adequate foundation, differential settling of the turbine may cause the turbine to topple or list, requiring corrective action by Snohomish PUD and increasing the potential for damaging the PC-1 North cable. PC Landing is also concerned that the weight of the turbines could penetrate the cobble pavement to expose the softer sediments underneath, more readily mobilizing the softer sediments and resulting in scour several hundreds of meters away, exposing the buried PC-1 North cable and making it more vulnerable to damage. PC Landing councils that a greater separation (750 to 1,000 meters) between the turbines and the PC-1 North cable are necessary to reduce the risk to PC-1 North.

Staff Analysis

Scour is the suspension and subsequent movement of sediments and cobbles from the sea floor resulting from the movement of water. Little information is available on scour depth and width based on field monitoring of gravity structures in tidal currents. Experiments on monopile and tripod foundation structures show the propagation of scour radiating out from the device, but decreasing in depth as the distance from the device increases (Stahlmann and Schlurmann, 2010; den Boon, et. al., 2004). The distance of propagation is dependant on the current speed, the depth of water, the depth of the scour, and the diameter of the base (DNV, 2010). The sediment type also influences the extent of scour. For example, the overall extent of scour in a sand bed is typically 4 to 5 times the diameter of the diameter of the foundation cylinder; however, greater extents have been observed (Whitehouse, et al., 2011). The scour process is not immediate, but is also dependant on time (DNV, 2010).

The tidal currents in Admiralty Inlet are strong and have scoured the sea floor in the vicinity of the project, washing away clays and silts, shifting sands and gravels, and leaving surface areas of cobbles, rocks, and boulders that are too large to be mobilized on the sea bed. A generic example of this phenomena is shown below (figure 5): (1) the critical erosion velocity is the velocity required to mobilize a still particle from a stationary position (gray); (2) once mobilized, the velocity required to transport the particle is shown as the transportation velocity (peach); and (3) the velocity of the water below which the particle will drop out of suspension and settle to the sea floor is shown as the deposition velocity (pink). The exact curves for a waterway are dependant on the features of the river or inlet, the depth of water, and the density of the particles. An obstruction in the flow of water, such as would be expected to occur when a turbine is

[15] Snohomish PUD originally proposed a separation distance of 328 feet in the FLA. On August 27, 2012, Snohomish PUD proposed to move the installation sites to approximately 558 feet from the PC-1 cable.

installed on the sea floor, would force the water in the current to flow around the object more quickly, increasing the velocity at the site of the obstruction. The increased velocity could mobilize larger particles.

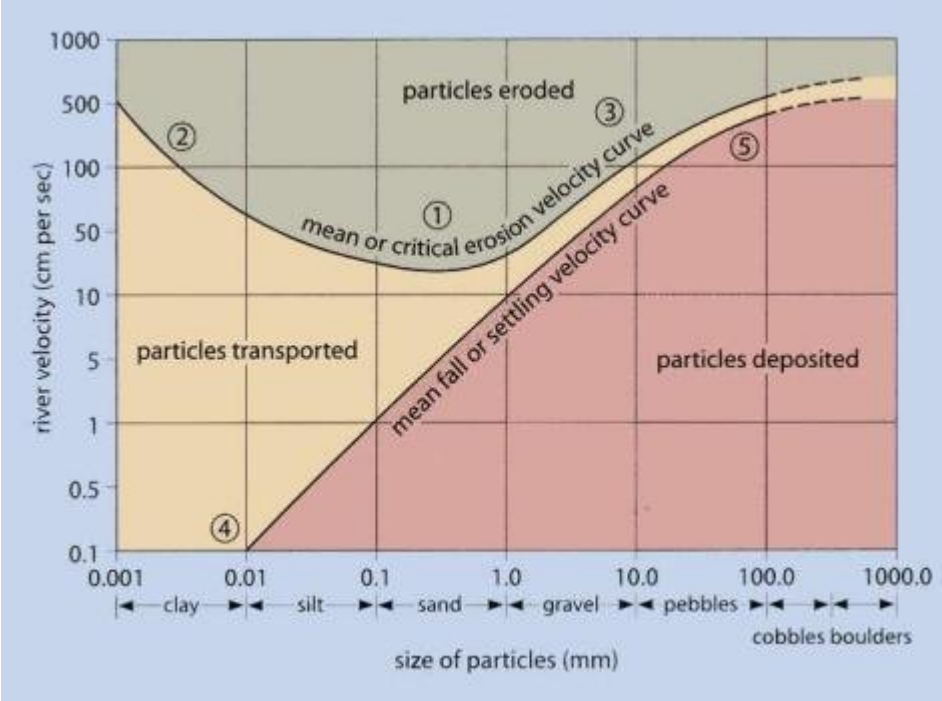

Figure 5. Hjulstrom's Diagram showing the transport, deposition, and erosion of particles based on particle size and water velocity (Source: www.geographylwc.org.uk).

Changes to the magnitude of tidal flows in the immediate vicinity of the proposed project could affect scour both at the project turbine and in the immediate vicinity. Snohomish PUD estimates that the velocity around the turbine foundation is expected to increase to around 2 m/s, which, according to the Hjulstrom Diagram shown above, would be high enough to locally mobilize and transport some cobbles but would not be anticipated to be high enough to mobilize and transport boulders. Under current conditions, the cobble pavement acts as scour protection for the softer sediments predicted to lie underneath. These smaller diameter particles may be exposed to the tidal currents and could experience scour if the turbine foundation structure penetrates the cobble pavement. While there is some uncertainty regarding if the turbine foundation would penetrate the cobble pavement, if the structure does, the lateral extent of the scour would likely be limited to the area where cobble-sized and smaller particles are exposed, and would not be anticipated to laterally extend beyond where the cobble pavement would be intact.

Any scour that may occur at the project installation site would not be expected to occur all at once, but would be expected to increase over time until it reaches equilibrium within the system. ROV monitoring, as proposed in the Project Safeguard Plans, would occur three times in the near turbine areas within the first three months of the project installation. Any scour that occurs around the turbine foundation and propagates out can be measured and monitored over time. If scour is found to be a problem at the foundation site, either in causing differential settling to occur or in propagating toward the PC-1 North cable, scour protection (such as scour skirts or scour-resistant materials) could be installed at the turbine bases to minimize or correct the problem. Additional monitoring as detailed in the Project Safeguard Plans over the installation life of the project would provide an increased understanding on the effects of the two turbines on hydrodynamics and sediment transport processes.

The sea floor surface in the area of the turbine installation site is a cobbled pavement interspersed with gravel and shell and has small and large boulders. The thickness of the layer of this cobbled pavement is estimated to be between three and six feet thick. The sediment beneath the cobble pavement layer is predicted to be clay/sand and/or sand/gravel/cobble/boulders (Golder Associates, 2011). Available data and conservative design criteria suggest that the foundation feet will not penetrate the seabed to a depth greater than approximately 1.5 to 2 feet. During the final design phase of the project, Snohomish PUD would work with Commission engineers in the Division of Dam Safety to ensure that the size of the footings and other design features would be adequate to support the turbine foundation given the anticipated geology at the installation site.

Given the shallow penetration of gravity base legs and the restricted spatial coverage of the devices, it is anticipated that there would be minimal effects on the rock faces where penetration occurs. Consequently, any scour would be localized around the foundation footings. Any differential settling would be detected, as noted above by Snohomish PUD's monitoring efforts, allowing Snohomish PUD time to take any corrective actions needed to stabilize the turbines.

While the proposed project has the potential to impact the sea floor in the immediate vicinity of the turbines, the effects on geologic resources in the vicinity of the PC-1 cable in the project vicinity are expected to be minimal because of the small number of turbines (two), the distance between the turbine and the PC-1 cable (558 feet to the closest turbine), and the continued monitoring of the site after the installation has occurred.

3.3.2 Marine Resources

3.3.2.1 Affected Environment

Water Use

Admiralty Inlet serves as a main route for all shipping traffic for the ports of Everett, Seattle, Tacoma, and Olympia (McCurdy, 2007). Commercial and recreational fishing are important uses of Puget Sound and Admiralty Inlet, particularly to the tribes in the area. Recreation in other forms, such as boating and diving is important as well. Fishing, recreation, and navigation are discussed in detail elsewhere in this document.

Water Quality

The U.S. Environmental Protection Agency (EPA) designated Puget Sound as an Estuary of National Significance in 1988. There are indications that the increase in human disturbance in the Puget Sound area threatens the health of Puget Sound. These indicators include the loss or impairment of habitat, historic and current toxic contamination of sediment and organisms, and diminished populations of certain species.

Washington DFW has assigned the use designation, "Extraordinary," to Admiralty Inlet for the following uses: shellfish harvest, primary contact recreation, wildlife habitat, harvesting, commercial/navigation, boating, and aesthetics. Associated water quality criteria have been established. Under the National Pollutant Discharge Elimination System (NPDES) Washington Ecology has issued about a dozen discharge permits in the northern half of Admiralty Inlet, which it regulates.

Water Quantity and Tides

The volume of water between mean high water and mean low water in Puget Sound is equal to 8.1 km^3 (6.5 million acre-feet), about 4.8 percent of the total volume of 168.7 km^3 (137 million acre-feet) (Mofjeld and Larsen, 1984).

Tides in Puget Sound generally follow a semi-diurnal cycle over a 25-hour period, with two high and two low tides that tend to be different in range and timing. The average daily tidal variation is 2.4 m (7.8 feet) in northern areas of Puget Sound and 4.3 m (14.1 feet) in southern areas of Puget Sound. Geographic variation in the shape and depth of Puget Sound influences local tidal patterns. In Admiralty Inlet, the tidal range is recorded by the NOAA observational station 9444900 located at Port Townsend (48°6.7'N 122°45.4'W) and reaches 3.4 (11.2 feet) meters.

Currents within Puget Sound are primarily driven by tides and the inputs from surface water sources, although the speed and direction of winds can also be influential. Generally, current velocities in Puget Sound range from 0.3 to 1.0 meters per second (1 to 3 ft/s), although 1.5 meters per second (4.9 ft/s) is normal in some regions (Gilmore et al., 1996).

Strong currents occur within Admiralty Inlet because the relatively narrow and shallow channel reduces the cross-sectional area and regulates flow. Currents in the main portion of the inlet are effectively bi-directional, and velocities of 2.6 meters per second

(Polagye et al., 2007) and 2.2 meters per second (NOAA, 2007*a*) have been recorded in the Project area. Outside of the deep channel current velocities decrease because of shallower water depths and eddies. Numerous turbulent eddies form on ebb and flood tides (McGary and Lincoln, 1977). On flood tide, an eddy forms in the entirety of Admiralty Bay southeast of Admiralty Head, and on ebb tide, eddies form to the northeast of Admiralty Head (McGary and Lincoln, 1977).

Acoustic Environment

Several factors contribute to ambient noise in Admiralty Inlet, including anthropogenic sound, bedload transport associated with strong tidal currents, rain, and biological vocalizations. Anthropogenic sources of ocean noise include commercial shipping, military activities, geophysical surveys, oil drilling and production, dredging and construction, sonar systems, and oceanographic research. Sound pressure spectral densities can range from about 35 to 80 dB (re 1 $\mu Pa^2/Hz$) for usual marine traffic (10 to 1,000 Hz), and 20 to 80 dB (re 1 $\mu Pa^2/Hz$) for breaking waves and associated spray and bubbles (100 to 25,000 Hz) (Richardson et al. 1995).

At frequencies below 1 kHz, ambient noise levels are dominated by anthropogenic sound associated with commercial vessel traffic (Bassett et al., *in press*). Consequently, the temporal patterns in ambient noise levels at those frequencies mirror those in commercial vessel traffic. Percentile ambient noise levels in the 25 Hz – 1000 Hz frequency range are shown in figure 6. These data are derived from measurements of ambient noise in Admiralty Inlet using autonomous recording hydrophones on seabed moorings (see Bassett 2010, Bassett et al. 2010, Bassett et al. 2012a, and Bassett et al. 2012*b*).

Figure 7 presents similar information for higher frequencies (1 kHz – 25 kHz), specifically, median one-third octave levels at different hub-height current velocities. The turbine source one-third octave levels derived from European Marine Energy Center (EMEC) measurements is shown in both figures as a red line. These measurements were conducted at a current velocity of 1.8 m/s. Bassett et al. (2012*a*) demonstrates that low frequency ambient noise is dominated by shipping traffic. For higher frequencies, as the current velocity increases, bedload transport noise elevates ambient noise levels proportionally to the square of velocity (Bassett et al., 2012*b*). While rainfall and biological noise also elevate noise at these frequencies (e.g., 20 kHz), these do not affect ambient noise levels as significantly as bedload transport.

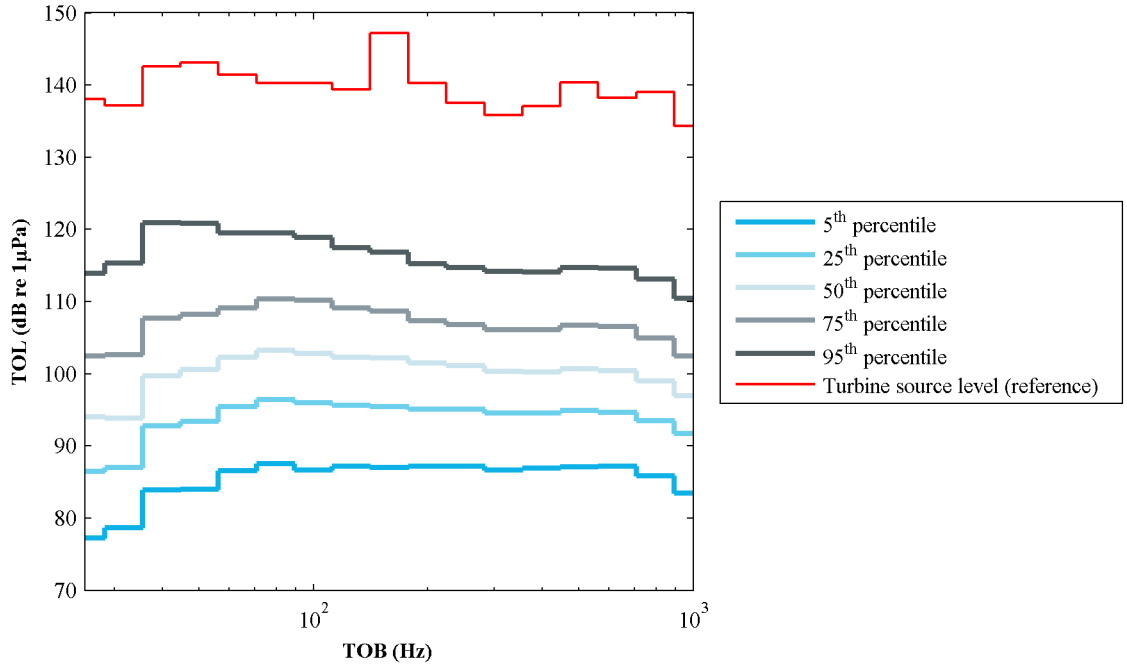

Figure 6. Percentile One-third octave levels (TOLs) for ambient noise (25 Hz – 1 kHz) (Source: application).

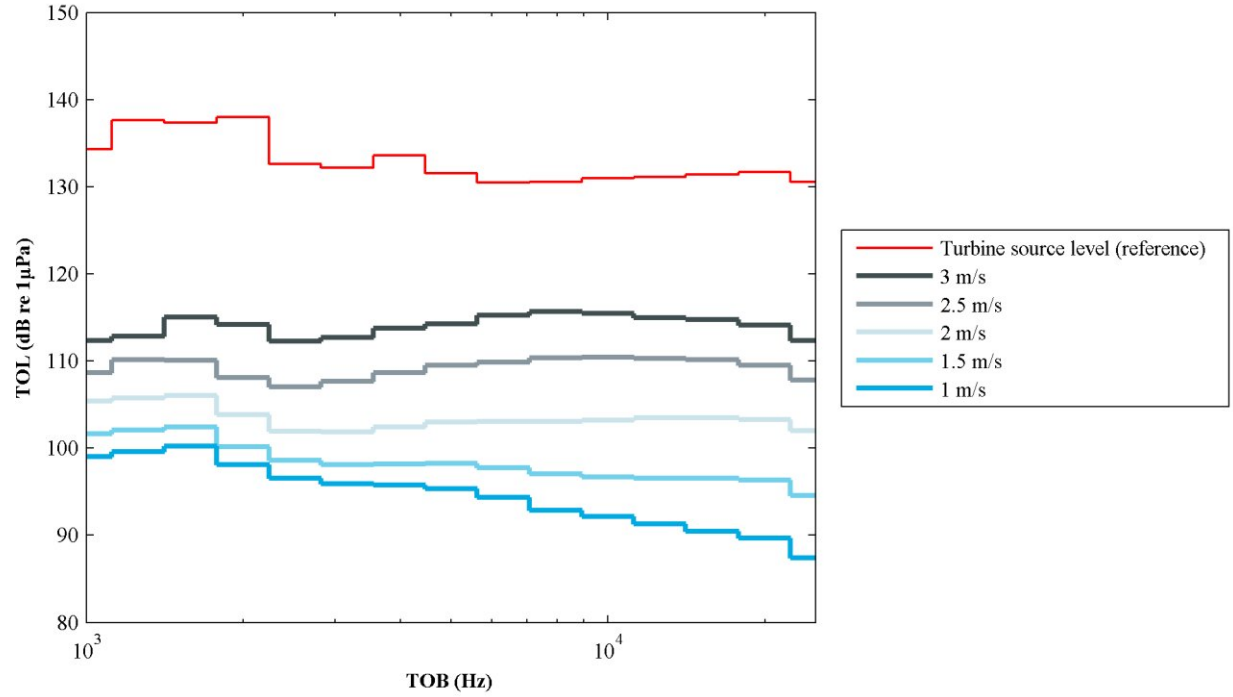

Figure 7. Median One-third octave levels (TOLs) for ambient noise (1 kHz – 25 khz) as a function of current velocity (Source: application).

Marine Invertebrates and Benthic Habitat

From 1987 to 2008 Washington DFW conducted 50 trawls in Admiralty Inlet in depth range of 31 to 60 m (102 to 198 feet), depths within which the turbines would be deployed. The primary crustaceans collected were dock shrimp, Alaskan pink shrimp, giant barnacle, Dungeness crab, and red rock crab (Snohomish PUD, 2012). The primary echinoderms collected were green sea urchin, sunflower star, red sea cucumber, and red sea urchin. The most abundant mollusks collected were pink scallop, California market squid, and northern horse mussel. Other invertebrates collected included gigantic anemone and warty sea squirt.

The primary invertebrate species harvested commercially in Admiralty Inlet are geoduck clams, Dungeness crabs, and green sea urchins. Total shellfish and fish harvest has decreased substantially in Admiralty Inlet over the last four decades, though the catch of commercially targeted crab and shrimp species has increased since the 1980s. Clam harvest has also increased in nearshore marine areas.

To characterize the site-specific benthic habitat and community, the District conducted ROV surveys in August, late September, and early October 2010 (Greene, 2011). The benthic community in the turbine site, especially the boulder and cobble substrate, was dominated with encrusting organisms such as sponges, bryozoans, and tubeworms. The finer grain substrate, pebbles, and gravel are relatively easily moved by the tidal currents, and are therefore not encrusted with organisms. In addition a variety of attached organisms (anemones) were observed. The anemones varied in size from 4 to 12 cm (1.6 to 4.7 in) in diameter when closed and three basic types were distinguished by color and pattern. A total of 1,375 anemones were counted. Sessile organisms observed included chitons, limpids, tunicates, clams, and stemmed and basket sponges. Epifauna observed included shrimp, hermit crab, crab, sea stars, urchins, and turban snails. The most dominant epifauna species observed were urchin and common five-legged orange starfish, which composed 90 percent of the species observed (Greene, 2010).

An ROV video survey of the revised trunk cable route was conducted in July 2012, with a particular focus on surveying for eelgrass beds, kelp forests, and geoduck clams. Conditions were found to be similar to those observed in the October 2010 survey (Greene, 2012). No geoduck clams, eelgrass beds, or kelp forests were observed (McCallister, 2012).

Marine Fish

There are a total of eight salmonid species that reside within Puget Sound: Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, steelhead, cutthroat trout, and bull trout. Bull trout, Puget Sound Chinook salmon, steelhead and chum salmon are ESA-listed species that are federally protected (DON, 2006). Species

listed under the ESA are addressed in the section 3.3.3, *Threatened and Endangered Species*. Effects on fish in general are addressed in section 3.3.2.2 below.

For all species of anadromous salmonids originating from the Skagit River, Stillaguamish River, Snohomish River, Lake Washington Basin, Duwamish/Green River, Puyallup River, Nisqually River Deschutes River, Skokomish River, Hamma Hamma River, Dosewallops River, Duckabush River, and Quilcene River, both out-migrating juveniles and returning adults pass through Admiralty Inlet. These rivers collectively produce in excess of a million adult fish, of hatchery and wild origin, each year (Snohomish PUD, 2012).

Ground fish are important species for both commercial and recreational harvest in the Pacific Northwest, and are managed by the Pacific Fisheries Management Council (PFMC). It is estimated that 75 of the 82 ground fish species managed by PFMC occupy the Puget Sound area at least once during their life cycle (DON, 2006; Palsson et al., 1998).

The diverse species incorporated within the general grouping of 'ground fish' exhibit a wide range of life histories and habitat use. Rockfish are the most diverse group in terms of habitat use and can be found in near shore areas as well as deeper shelf waters. Most adult rockfish are dependent of rocky substrate, but young rockfish use a range of habitats (Washington DFW, 2011c). Open-water forage fish are an important base component of marine food chains and serve as prey for numerous predatory species. Pelagic fish are found throughout the water column and feed on small invertebrate species. Most pelagic fish are found in the warmer waters of California, but several important species are found within Puget Sound including northern anchovy, Pacific sardine, and Pacific mackerel. The abundance of each species can fluctuate greatly, varying considerably from year to year.

Comprising sharks, skates, and rays, or elasmobranchs, fish with a cartilaginous rather than bony skeleton. Puget Sound provides habitat for a number of such species including ten sharks, one ray, and five skates.

In terms of density of fish (number fish/hectare) sampled during Washington DFW surveys at the two locations nearest the project site, the most numerous fish sampled were spotted ratfish, ribbed sculpin, buffalo sculpin, grunt sculpin, kelp greenling, and lingcod. No salmon were captured in trawls at either of these locations (Snohomish PUD, 2012).

In the 50 trawls conducted in Admiralty Inlet by Washington DFW from 1987 to 2008 in a depth range within which the turbines would be deployed, the most numerous species collected was spotted ratfish (65 percent of the catch). The next most abundant species were Pacific sanddab (5 percent), English sole (4 percent), southern rock sole (4 percent), great sculpin (3 percent), buffalo sculpin, Pacific tomcod, spiny dogfish, and

Puget Sound rockfish (all 2 percent). All species of rockfish caught (Puget Sound, copper, greenstripe, quillback, redstripe, and unidentified rockfish) composed 5 percent of the total catch (Snohomish PUD, 2012).

The State of Washington and the Corps have established work windows for 17 Tidal Reference Areas in the State of Washington's coastal waters to avoid or minimize impacts from marine construction.[16] The project is proposed in Tidal Area 10, Port Townsend, which includes waters of the San Juan Islands, Admiralty Inlet, the Strait of Juan de Fuca, and associated bays and inlets. The Tidal Reference Area 10 work windows are: salmon (start of work period begins July 16 and ends by March 1); bull trout (July 16 to February 15); Pacific hearing (May 1 to January 14); Pacific sand lance (March 2 to October 14). When all species are combined, the start of the construction period begins July 16 and ends October 14.

Essential Fish Habitat

The Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297, 110 Stat. 3559), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Pursuant to the Magnuson-Stevens Act:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH.

- NMFS must provide conservation recommendations for any federal or state action that would adversely affect EFH.

[16] See the Washington Administrative Code at Title 220, Chapters 110-230 through 110-330 (http://apps.leg.wa.gov/wac/default.aspx?cite=220-110-230) and Corps guidance (http://www.nws.usace.army.mil/Portals/27/docs/regulatory/ESA%20forms%20and%20templates/Marine%20Fish%20Work%20Windows%20(8-14-12).pdf).

- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' EFH conservation recommendations, the federal agency must explain its reasons for not following the recommendations.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting this definition of EFH, 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 (50 CFR § 600.10 (2010)). Adverse effect means any impact that reduces the quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. § 600.810(a)).

EFH consultation with NMFS is required for any federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities. The objectives of EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset any potential adverse effects to EFH.

Admiralty Inlet is EFH for Pacific groundfish, Pacific coast salmon, and coastal pelagics. There are 89 groundfish, 3 salmon and 5 coastal pelagic species specifically identified in the Fishery Management Plans (FMP) on the Pacific coast, though not all these species are found in the project area.

EFH Habitat Areas of Particular Concern (HAPCs) are discrete subsets of EFH. HAPCs, as provided in the EFH regulations, are types or areas of habitat within EFH that are identified based on one or more of the following considerations: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether, and to what extent, development activities are or will be stressing the habitat type; or the rarity of the habitat type. A HAPC designation does not confer additional protection or restriction upon an area, but helps prioritize conservation efforts, and should be considered in an analysis of an area's sensitivity.

HAPCs include both geographic areas and habitat types. In some cases, HAPCs identified by means of specific habitat type may overlap with the designation of a specific area. HAPCs based on habitat type may vary in location and extent over time and include estuaries, canopy kelp, seagrass, rocky reefs, and areas of interest. Areas of interest are discrete areas that are of special interest due to their unique geological and ecological characteristics.

The project area is within HAPC for federally managed Pacific groundfish. The following is an overview of EFH for the three EFH groupings.

Pacific Groundfish

The Pacific Coast Groundfish Fishery Management Plan provides for management of more than 80 species that typically live on or near the bottom of the ocean (PFMC, 2008). Information on the life histories and habitats of these species varies in completeness, so while some species are well-studied, there is relatively little information on certain other species. Therefore, the Fishery Management Plan does not include descriptions identifying EFH for each life stage of the managed species, but rather, includes a description of the overall area identified as groundfish EFH. PFMC (2008) defines EFH for Pacific groundfish as:

- Depths less than or equal to 3,500 meters to mean higher high water (MHHW)[17] or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 parts per trillion (ppt) during the period of average annual low flow;

- Seamounts in depths greater than 3,500 meters as mapped in the EFH assessment GIS (PFMC, 2008); and

- Areas designated as HAPCs not identified by the above criteria.

This EFH identification is a precautionary approach because uncertainty still exists about the relative value of different habitats to individual groundfish species/life stages, and thus the actual extent of groundfish EFH (PFMC, 2008).

As mentioned above, the project area is within HAPC for Pacific groundfish. Specifically, estuaries, kelp beds, seagrasses, rocky reefs, and areas of interest are the HAPCs designated under the Magnuson-Stevens Act within the project boundary; these are defined below (Snohomish PUD, 2012).

[17] The mean higher high water line (MHHW) is at the average level of the higher of the two daily tides.

- Estuaries - The inland extent of the estuary HAPC is defined as MHHW line, or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow. The seaward extent is an imaginary line closing the mouth of a river, bay, or sound and extending to the seaward limit of wetland emergents, shrubs, or trees occurring beyond the lines closing rivers, bays, or sounds. This HAPC also includes those estuary-influenced offshore areas of continuously diluted seawater (Cowardin et al., 1979).

- Canopy Kelp - The canopy kelp HAPC includes waters, substrate, and other biogenic habitat associated with canopy-forming kelp species (e.g., Macrocystis spp. and Nereocystis spp.).

- Seagrass - The seagrass HAPC includes those waters, substrate, and other biogenic features associated with eelgrass species (Zostera spp.), widgeon grass (Ruppia maritima), or surfgrass (Phyllospadix spp.).

- Rocky Reefs - The rocky reefs HAPC includes those waters, substrates and other biogenic features associated with hard substrate (bedrock, boulders, cobble, gravel, etc.) to MHHW. ROV sampling of the turbine installation site show extensive rocky reef habitat.

- Areas of Interest - All waters and sea bottom in Washington state waters from the three nautical mile boundary of the territorial sea shoreward to MHHW.

Of these five HAPCs, the placement and operation of the project would only affect Rocky Reefs and Areas of Interest.

Pacific Coast Salmon

The Pacific Coast Salmon FMP guides management of commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California. The Pacific salmon fishery includes Puget Sound Chinook, coho, and Puget Sound pink salmon.

The PFMC has designated both freshwater and marine EFH for these salmon species. In marine areas, designated EFH for Pacific salmon extends from nearshore and tidal submerged environments within state territorial waters out to the full extent of the economic exclusion zone (EEZ),[18] (370.4 km) (230.2 mi) offshore of Washington,

[18] The economic exclusion zone, or EEZ, is a zone of the ocean in which, under international law, thea coastal nation has, "sovereign rights for the purpose of exploring,

Oregon, and California north of Point Conception (PFMC, 2000). The Pacific salmon EFH also includes marine areas off Alaska designated as EFH by the North Pacific Fishery Management Council. Puget Sound is designated EFH for Chinook, coho, and pink salmon.

Marine EFH supports three life stages of Pacific salmon including (1) estuarine rearing, (2) ocean rearing, and (3) juvenile and adult migration. Features of estuarine and marine habitats that are essential to these life stages include the following: (1) adequate water quality, (2) adequate temperature, (3) adequate prey species and forage base (food), and (4) adequate depth, cover, marine vegetation, and algae in estuarine and near-shore habitats (PFMC, 2000).

Coastal Pelagic Species

Coastal pelagic species are schooling fish that are associated with the open ocean and coastal areas and migrate in coastal waters. The Coastal Pelagics Species Fishery Management Plan consists of five species of which the following three had EFH identified in the Project area by NMFS (Snohomish PUD, 2012): Pacific sardine, northern anchovy, and Pacific mackerel (PFMC, 1998).

PFMC (1998) defines the east-west boundary of EFH for coastal pelagics as all marine waters out to the EEZ with water temperatures between 10ºC (50ºF) to 26ºC (79ºF). The southern boundary is the United States-Mexico maritime boundary. The northern boundary is defined as the position of the 10ºC (50ºF) isotherm, which varies seasonally and annually. Admiralty Inlet includes the five coastal pelagic species and is considered EFH when temperatures are between 10ºC and 26ºC (50 to 79ºF) (PFMC, 1998).

Marine Mammals

Marine mammals listed under the Endangered Species Act (ESA) are addressed in section 3.3.3, *Threatened and Endangered Species*. Non-ESA listed marine mammal species that are observed in central Puget Sound include harbor porpoise, Dall's porpoise, Minke whale, gray whale, California sea lion, harbor seal, and northern elephant seal.[19]

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exploiting, conserving, and managing living and nonliving resources," (U.S. Commission on Ocean Policy, 2004). The EEZ usually extends to 200 m (322km) from the coast.

[19] Northern fur seals typically occur offshore in Washington, though they occasionally visit the Juan de Fuca Strait, Puget Sound, and the Strait of Georgia, with one or two records per year (Calambokidis and Baird 1994).

Based on 12 years of surveys (1992 -2004) conducted by Washington DFW, harbor seals are the most commonly sighted (687 sightings) marine mammal within 0.4 km (0.25 miles) of Admiralty Inlet, followed by harbor porpoise (67 sightings), Dall's porpoise (16 sightings), river otter (12 sightings), killer whale (10 sightings), and California sea lion (8 sightings) (Washington DFW, 2006).

Harbor seal - Harbor seal is the most common, widely distributed pinniped found in Washington waters and represented 86 percent of the marine mammals observed by Washington DFW between 1992 and 2004. Harbor seals use hundreds of sites along the coast to rest or haulout including intertidal sand bars and mudflats in estuaries; intertidal rocks and reefs; sandy, cobble, and rocky beaches; islands; logbooms; docks; and floats in all marine areas of the state. Jeffries et al. (2000) identified 13 harbor seal haulout locations in the project area, the closest being located on Marrowstone Island, about 6 kilometers southwest of the project. In the Marrowstone Island vicinity, harbor seals have been sighted on haulouts on scattered intertidal rocks along the northeast and southeast side of the island. In the same vicinity, harbor seals have been noted along the beach and spit at the entrance into Kilisut Harbor. Northwest of the project area, harbor seals utilize haulouts on Protection Island. These include on the beach and spit areas around Kanem Point and Violet Point. Both of these areas are also considered nursery areas for harbor seals and have peak counts during the pupping season (mid-June through August) and annual molt (late July through September).

Between October 2009 and April 2010, marine mammal pre-installation field studies were conducted to collect information to characterize the existing marine mammal use within the project vicinity. The field studies included land-based and boat-based observations of marine mammals in the study area (a five nautical mile radius around the proposed project deployment site). Overall, 2,145 sighting locations were recorded of seven species. Harbor seals were observed most often, occurring on 95 percent of days and 49 percent of all sightings, with a total of 1,041 sightings recorded on 110 separate days. Median group size of harbor seal observations was one and the maximum group size was four. Sightings of harbor seals sometimes included observations of surface feeding behavior events (Tollit et al., 2010).

Harbor seals are generally non-migratory, and often move based on factors such as tides, weather, season, food availability, and reproduction. According to aerial surveys conducted during 1999 and radio-tagging studies from 1991-1992, the Washington inland water stock of harbor seals is estimated to be at a population of 14,612 (Jeffries et al., 2003). The population of the Washington inland water stock of harbor seals was estimated to be growing at an annual rate of 10 percent with a maximum net productivity rate of 12 percent; the harbor seal population is within its optimum sustainable population level (Carretta et al., 2006).

California sea lion - The California sea lion is found in Washington waters and utilizes haulout sites along the outer coast, Strait of Juan de Fuca, and in Puget Sound. In Admiralty Inlet, only eight California sea lions were observed during Washington DFW marine mammal surveys conducted between 1992 and 2004 (Washington DFW, 2006). During the marine mammal pre-installation field studies conducted between October 2009 and April 2010, 19 California sea lions were observed on 15 separate days. Medium group size observed was one and maximum group size was four (Tollit et al., 2010).

Similar to harbor seals, haulout sites are located on jetties, offshore rocks and islands, logbooms, marina docks, and navigation buoys. Four California sea lion haulout locations have been identified in Admiralty Inlet—all navigation buoys in the southern half of Admiralty Inlet (Jeffries et al., 2000). California sea lions are frequently sighted resting in the water in groups within Puget Sound (Carretta et al., 2007). The California sea lion is a social species and can form groups of several hundred individuals onshore at haulout locations. They typically use shallow coastal and estuarine waters (NOAA, 2009*b*). The California sea lion population has been estimated at 238,000, which includes the range from southern Mexico to southwestern Canada (Carretta et al., 2007). Recent peak numbers of 3,000 to 5,000 California sea lions have been noted within northwest waters (Washington and British Columbia) during the fall until late spring when most return to breeding rookeries in California and Mexico. Peak counts of over 1,000 California sea lions have been recorded in Puget Sound in recent years (Jeffries et al., 2000).

Northern elephant seals - Northern elephant seals are the largest pinniped found in Washington waters. Breeding occurs at rookeries in California and Mexico. After the winter breeding season and annual molt cycles, they disperse to waters off Oregon and Washington and beyond. Males travel to the Gulf of Alaska to feed and females feed in deep offshore waters from southern California to northern Oregon (between 35° and 45° N) (Jeffries et al., 2000). Northern elephant seals spend much of the year in the ocean diving to depths of about 1,000 to 2,500 feet. However, while on land, northern elephant seals prefer haulouts on sandy beaches (NOAA, 2009*c*). Two northern elephant seal haulouts, Protection Island and Minor Islands, have been identified in the project area, where individuals have been seen hauled out at beaches. Pups have also been occasionally observed at these sites. Recent northern elephant seal counts have been recorded in excess of 100,000 animals in northwest waters (Jeffries et al., 2000).

Harbor porpoise - Harbor porpoise are found in coastal and inland waters extending from the Alaskan coast down to Point Conception, California. The species occurs year-round in the inland trans-boundary waters of Washington and British Columbia and along the Oregon and Washington coast. Harbor porpoises are relatively common and can be observed in the region year-round (Calambokidis and Baird, 1994). Densities of 1-1.5 animals/km^2 are reported in the region, with selection of habitat with

high current speeds noted and abundances higher in the summer months (Hall, 2004). While seasonal changes in abundance along the west coast have been noted, movement patterns are not fully understood. From aerial surveys of inland waters of Washington conducted during August 2002 and 2003, the harbor porpoise population was estimated to be 10,682. In Admiralty Inlet, 67 harbor porpoise were observed during Washington DFW marine mammals surveys conducted between 1992 and 2004 (Washington DFW, 2006).

As part of Snohomish PUD's pre-installation studies, a multi-year study was conducted in the northeastern area of Admiralty Inlet to investigate the acoustic activity of porpoises logged by T-PODs - passive acoustic monitoring hydrophones used to collect high frequency cetacean echolocations. The study information was evaluated to characterize site use and investigate typical patterns of porpoises.

Between May 2009 and May 2010, four POD deployments were conducted using a T-POD. During the study, the PODs were attached laterally to a Sea Spider, which was then lowered to the sea floor. Data were logged over a period of 321 full days from a single T-POD moored at four locations in 51-62 meters water depth. The T-POD only detected porpoises; there were no detections on the 50 kHz scan channel set to detect dolphin echolocations (Tollit et al., 2010).

Porpoises were detected by the T-POD every day of the 321 day study period, with detections logging 16 individual hours of each day and averaging 130 detection positive minutes (DPM) per day, which represents on average nine percent of a day. More than one third of all hours had no detectable porpoise click trains (e.g., DPM per hour = 0) and in 11.2 percent of hours recorded, DPM per hour exceeded 15. The median value was two minutes per hour; DPM per hour between night and day periods were found to be highly significant, with DPM median values during the night period five-fold than that of during the day period. Highs in DPM occurred around midnight, while lows occurred around midday. Further evaluation of the study indicates that echolocation use by porpoises in Admiralty Inlet is highest at night, especially during neap tides. Neap tides in Admiralty Inlet may also provide improved foraging conditions due to increased availability of prey aggregations or water clarity and/or potentially reduced energetic demands during foraging trips. The study also indicated monthly variation in click detections with clear lows (DPM) in April and August and a clear peak in June (Tollit et al., 2010).

Land-based studies that took place between October 2009 and April 2010, found that porpoises were present on average 63 percent of the 116 days, and 56 percent of every hour, monitored (n=231 hours) (Tollit et al., 2010). This appears to be consistent with data collected from the POD that had DPM in 51 percent of all daylight hours recorded.

Porpoise 'encounters' per day ranged between 30 and 48. Encounters (and DPM rates) may represent either multiple individuals or the same individual repeatedly. Typical group sizes in daylight periods were between two and six in land-based observer studies in the area (Tollit et al., 2010). This study also clearly documented that between October 2009 and April 2010, all porpoise sightings in the vicinity of the project site that were confidently confirmed to species were harbor porpoises (Tollit et al., 2010).

Since November, 2009, Sea Spider deployments have also included C-PODs. These are the successor to the T-POD and, whereas a T-POD uses analog electronics, the C-POD records click trains digitally for post-processing to classify click trains (sonar, sediment motion, echolocation). Because of their relatively recent development, C-PODs are not discussed to a great extent in the literature, but have provided further information about harbor porpoise trends at this site and the potential to use these tools for post-installation monitoring. Generalized Linear Model (GLM) analysis of long-term C-POD data identifies, among other factors, time of day, ambient noise level, tidal current velocity, and season as significant in explaining echolocation activity. However, the residual deviance in the model (detections unexplained by the model) is still quite high suggesting that activity is somewhat stochastic or driven by other factors not measured by Sea Spider instrumentation (e.g., prey density) (Cavagnaro et al., 2012).

Notably, both C-POD and T-POD data indicate harbor porpoise activity at this location is significantly higher than at other locations where tidal energy devices have been deployed, suggesting that harbor porpoise may serve as an effective marker species for understanding the effects that turbine operation may have on marine mammals. This conclusion is tempered by a study by Polagye et al. (2012*b*) that monitored harbor porpoise responsiveness to passenger ferries using C-PODs and concluded that no significant changes in harbor porpoise echolocation activity could be correlated with elevated noise levels from ferry passage, despite an expected pronounced avoidance response when broadband sound pressure levels exceed 140 dB re 1µPa (e.g., Southall et al., 2007). Turbine noise will only rarely reach the same intensity as ferry noise (further discussion later in this section). Results suggest that harbor porpoise in Admiralty Inlet may be habituated to relatively high levels of anthropogenic noise due to omnipresent shipping traffic (Bassett et al., 2012*a*).

Dall's porpoise - Dall's porpoise are common in shelf, slope, and offshore waters along California, Oregon, and Washington. The species prefers temperate waters that are more than 600 feet deep with temperatures between 36˚F and 63˚F (NOAA, 2009*d*). North-south movement along the coast is based on changes in oceanographic conditions and seasonality. Dall's porpoise often travel in groups averaging between 2 and 20 individuals, but have also been seen in larger groups. The distribution of Dall's porpoise throughout the California, Oregon, and Washington region varies yearly due to oceanographic conditions. The most recent population estimate of Dall's porpoise for the west coast region is 48,376. An estimate of population for the inland waters of

Washington State is not available (Carretta et al., 2008*a*). In Admiralty Inlet, 16 Dall's porpoise were observed during Washington DFW marine mammals surveys conducted between 1992 and 2004 (Washington DFW, 2006). During the marine mammal pre-installation studies conducted between October 2009 and April 2010, a probable Dall's porpoise was detected only once during the T-POD study (Tollit et al., 2010). C-POD auto-detection algorithms are, as yet, unable to discriminate between echolocation by Dall's porpoise and harbor porpoise.

Minke whale - The minke whale stock within the inland waters of Washington establishes home ranges and does not migrate like other stocks (Carretta et al., 2008*b*). Minke whales prefer temperate waters within coastal/inshore and oceanic/offshore areas and often feed in cooler waters (NOAA, 2009*e*). There is no estimated population size for minke whales and there are no data or trends related to minke whale abundance in inland Washington waters (Carretta et al., 2008*b*). No minke whales were observed in Admiralty Inlet during Washington DFW marine mammals surveys conducted between 1992 and 2004 (Washington DFW, 2006). However, two minke whale observations were documented in Admiralty Inlet from recreational land-based surveys conducted by the public during 2005 and 2006: one in March 2005 and one in September 2006 (OrcaNetwork, 2007). During the marine mammal pre-installation studies conducted between October 2009 and April 2010, four minke whales were sighted on two separate days. During each observation of minke whale, only one (lone whale) was observed (Tollit et al., 2010).

Gray whale - Gray whales make one of the longest migrations of any mammal between their winter breeding grounds off Baja California, Mexico and their feeding grounds in the Bering and Chukchi Seas and are found mainly in shallow coastal waters. Migration of gray whales along the Pacific Northwest coast occurs in December and January (southbound) and in the spring (northbound). Gray whales have also been identified outside of the migratory time periods along California, Oregon, Washington, and British Columbia and are referred to as "seasonal residents" or the Pacific Coast Feeding Aggregation whales by NMFS. Gray whales are frequently observed traveling alone or in small groups; however, in feeding and breeding grounds are often found in larger groups. Gray whales are occasionally observed in Puget Sound. In 1998, Calambokidis et al. (2002) sighted 35 individual gray whales in an area east of Cape Flattery, and extending to Admiralty Inlet; 15 of which were unique sightings. The research shows that gray whales using Puget Sound are the same few individuals returning to the same locations and usually in the springtime. Gray whales were also observed in Admiralty Inlet 11 times during the public recreational land-based surveys conducted during 2005 and 2006 (OrcaNetwork 2007):

Marine Birds

Shorebird and seabird observational data from Washington DFW vessel surveys are available from 1992 through 2004. Snohomish PUD processed these data in GIS to evaluate birds sighted within 0.4 kilometers (0.25 miles) of Admiralty Inlet (table 2). Sightings in Admiralty Inlet included 55,590 sightings, representing 57 species. Washington DFW also maintains records for seabird colonies in the vicinity of Admiralty Inlet and has identified 11 colonies of the either alcids, cormorants, and "other" species near the project.

Table 2. Shore bird, seabird, and other avian sightings within 0.4 km (0.25 miles) of Admiralty Inlet from Washington DFW vessel surveys (1992 to 2004).

Species	Number	Species	Number
American wigeon	2,698	Heermann's gull	3,853
Ancient murrelet	152	Herring gull	386
Bald eagle	83	Hooded merganser	183
Barrows goldeneye	67	Horned grebe	408
Belted kingfisher	38	Killdeer	2
Black brant	1,635	Mallard	889
Black oystercatcher	8	Marbled murrelet	250
Black scoter	258	Mew gull	432
Black turnstone	8	Northern pintail	444
Black-bellied plover	20	Northwestern crow	930
Bonapartes gull	1,879	Oldsquaw	398
Brandts cormorant	10	Osprey	3
Bufflehead	9,455	Pacific loon	502
California gull	99	Pelagic cormorant	98
Canada goose	35	Pigeon guillemot	1,897
Canvasback	25	Red-breasted merganser	815
Caspian tern	74	Red-necked grebe	318
Common goldeneye	662	Red-tailed hawk	4
Common loon	240	Red-throated loon	143
Common merganser	124	Rhinoceros auklet	5,177
Common murre	6,062	Rock dove	1
Double-crested cormorant	789	Ruddy duck	166
Dunlin	200	Sanderling	5
Gadwall	77	Surf scoter	2,748
Glaucous-winged gull	4,713	Tufted puffin	1
Great blue heron	419	Western grebe	3,129
Greater scaup	121	Whimbrel	1
Green-winged teal	141	White-winged scoter	1,198
Harlequin duck	1,117		
Species Total			57

Species	Number	Species	Number
Observational Total			55,590

Of note, rhinoceros auklets (*Cerorhinca monocerata*) nest at only two sites in the inland marine waters of Washington: about 34,000 birds nest on Protection Island (Wilson, 1977; Thompson et al., 1985), and about 2,600 birds nest on Smith Island (Speich and Wahl, 1989), located approximately 18 km and 22 km north of the Project area, respectively. The colony of rhinoceros auklets on Protection Island is considered the third largest colony in North America (Pers. comm., C. Collar, District, with Sue Thomas, USFWS, August 27, 2009). From studies performed in the late 1970s it was found that Admiralty Inlet was a major foraging area for the auklets, with foraging occurring mostly in the western part of the Inlet near Port Townsend (Wahl and Speich, 1994).

3.3.2.2 Environmental Effects

Construction and operation of the project has the potential to affect water quality locally; alter localized marine benthic habitats due to changes in hydrodynamics; result in the injury or direct mortality of marine and anadromous fish, marine birds, and marine mammals due to contact with the turbines or marine debris entanglement; disrupt or impair essential behavior patterns or migrations in fish or marine mammals due to electromagnetic fields (EMF) and increased noise; and alter marine community composition (use patterns, attraction, aversion) due to the presence of project components and creation of "new" habitat features. As discussed below, such potential adverse effects of a pilot project are expected to be minor and short-term. Snohomish PUD proposes to implement a suite of mitigation and monitoring plans, developed in consultation with various stakeholders, to address the uncertainty associated with the installation and operation of this new technology and to mitigate for these effects. We discuss each of these effects below.

Water Quality Effects

Potential effects on water quality result from: turbidity/sediment generation during HDD operations and land-disturbing activities associated with project installation and removal; discharges of drilling mud (frac-out) during HDD operations; spills of oil during construction, operation, and maintenance; fluid leakage from project components; and leachate from antifouling paint.

To minimize and control these sources of water quality effects, Snohomish PUD proposes to implement a HDD plan and a Water Quality Monitoring Plan. The HDD Plan describes the procedures and methods for conducting HDD to minimize turbidity and occurrences of a frac-out. The Water Quality Monitoring Plan describes the measures Snohomish PUD would follow to control oil spills, minimize leachate from

antifouling paint, and monitor turbidity/sediment, pH, and oil and sheen production during construction, maintenance, and project removal activities.

Specifically, during HDD operation, Snohomish PUD would cease HDD work if a frac-out or other release of grout material occurs and would not resume HDD work unless and until turbidity levels are less than or equal to 5 NTU over background turbidity when such levels are 50 NTU or less, or when there is more than a 10 percent increase over background turbidity when background turbidity is more than 50 NTU. If these benchmarks are exceeded, the Water Quality Monitoring Plan defines the steps that Snohomish PUD would take to further control turbidity including ensuring that all best management practices are in place and functioning properly, determining if additional measures are needed (such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours if turbidity levels exceed 250 NTU), and conducting daily turbidity monitoring. Snohomish PUD would also monitor pH levels following a frac-out. Snohomish PUD would also visually monitor for oil and sheen during vessel operations. No water quality monitoring is proposed during maintenance operations, except for visual monitoring for oil and sheen from marine vessels because sediment disturbance would not be great and localized. A monitoring report would be submitted to Washington Ecology.

To minimize fuel spills during the construction and maintenance of the project, Snohomish PUD would include a secondary containment unit with a 1033-liter capacity on the OpenHydro deployment barge[20] and ensure that all marine construction and maintenance contractors maintain a spill response plan.

To minimize adverse effects of using anti-fouling paint, two coats of anti-fouling paint would be applied to the blades and outer ring of the rotor; painting would occur onshore and well before deployment. No anti-fouling paint would be applied to turbine foundations.

Washington DFW and FWS recommend that Snohomish PUD implement its proposed HDD and Water Quality Monitoring Plan.

Staff Analysis

Installation of the trunk cables would disturb the seabed, resulting in localized increases in turbidity due to the suspension of sediments and formation of sediment

[20] The OpenHydro deployment barge contains a 300-liter diesel tank and a 350-liter hydraulic oil tank.

plumes.[21] However, such effects would be minor because the seabed at the deployment site of the two turbines consists primarily of granular sediments, cobbles, and boulders. Moreover, the adverse effect would be unavoidable, but short-term, as underwater currents and wave turbulence would quickly dissipate the sediment plumes.

While there is some potential for the release of soil or bentonite to the marine environment from horizontal directional drilling, the resulting turbidity would be minor and the materials raise little concern.[22] The District has a detailed plan for drilling in a manner that avoids substantial releases to the water. Monitoring of the drilling process, as proposed by Snohomish PUD, would aid in the detection of any seepage of the fluid and identification and implementation of any corrective measures (*e.g.*, rerouting the drill route or stopping drilling to allow the fracture to seal). Snohomish PUD's HDD plan and Water Quality Monitoring Plan include steps drill operators would take to avoid leaking drilling fluid into the surrounding bed stratum and water column. The small amount of material that would escape would be quickly diluted in the tidal flows of Puget Sound.

Because the project turbines do not contain oil or other synthetic coolants and lubricants eliminates any concern with that the devices might leak toxic chemicals. The potential would still exist for the construction and drilling equipment and associated vessels to leak or spill petroleum or other chemicals into the surrounding waters. Snohomish PUD's plans to require secondary containment, to visually monitor for oil sheen, and ensure contractor implementation of spill response plans would provide adequate spill protection. Such measures would be adequate to minimize adverse effects of an oil spill.

Antifouling paints can be applied to vessels, buoys, and piers or other in-water structures in the marine environment to prevent or reduce 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). Snohomish PUD would only paint those operational surfaces required to ensure efficient operation. A minimal amount of antifouling paint, approved for use in marine waters, would be used. No anti-fouling paint would be applied to turbine foundations. The paint will cover 95 m^2 of each turbine. Given the small amount of paint, any leacheate would quickly dissipate in the surrounding waters and represents a minor adverse affect.

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[21]The seabed within the project area consists primarily of cobble. See section V.C.1 for more information on geological resources within the proposed project area.

[22] 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.

Electromagnetic Field (EMF) Effects

Concern about the potential effects of anthropogenic electromagnetic fields (EMF) on marine organism is widespread but knowledge of such effects is very limited (Polagye , 2010; DOE, 2009). A variety of fish and other organisms have been found to be sensitive to EMF fields, and it is known that some fish use them for navigation or feeding. In some circumstances this sensitivity to EMF could effect fish movement and feeding.

Snohomish PUD does not propose to monitor EMF. In discussing its section 10(j) recommendations, NMFS states that EMF is not a concern in the context of this pilot-scale project proposal.

Staff Analysis

Electrical devices and cables generate EMF in the form of an electrical field (E field) and magnetic field (B field). The E field can, and usually is, shielded (U.S. DOE, 2009). The B field, in combination with moving water, can generate a third field called an induced field (iE field). The District reports that the OpenHydro turbine and generators have been designed to shield the E field and neutralize the B field, so that there is no magnetic field release from the turbine itself. With no B field, there would be no iE field. While OpenHydro, the turbine manufacture, has been able to neutralize the B field by using certain parts of the turbine generator to balance other parts, it is impossible to eliminate a B field from a transmission cable.

The proposed 10 cm-diameter, trunk cables would carry 12 kV of 3 phase, 14 amp alternating current (AC), which would produce the three types of fields. The transmission line would be shielded so that there would be no E field. However, the Snohomish PUD modeled the B field and estimated that while the intensity of the field at the surface of the cable would be 187 Amps per meter (A/m), it would drop to 40 A/m, equal to the intensity of the Earth's magnetic field at the latitude of the project, at a distance of 8 cm (3.1 inches) from the cable surface. Snohomish PUD describes the B field as very small in space and intensity. A small B field would result in a small iE field as well.

Sensitivity to EMF Effects

According to a literature review by the U.S. Department of Energy (2009) and the District's application, several species that could be present in the project area, or are related or similar to fish that could be present in Puget Sound, are known to be sensitive

to electric fields at low levels of intensity.[23] Several species are sensitive to low intensity B fields.[24] Sensitivity to EMF does not necessarily translate into vulnerability to harm from EMF. Some experiments have shown no effect of EMF at all.[25]

To experience a B field greater than the earth's magnetic field, a fish would have to be swimming within 8 cm of the cable which would be 10 cm in diameter and lying on the bottom of the inlet. Even in that case, it is not clear that there would be any effects.

Most of the migratory species, including salmon, typically swim higher in the water column than 8 to 18 cm (3.1 to 7.0 in) from the bottom. Even green sturgeon, which generally feed on the bottom, often travel higher in the water column. With the fish generally traveling much farther than 8 cm (3.1 in) above the transmission line it would not function to interfere with migration. For organisms using the area for food and general habitat, the trunk cable and associate B and iE fields would occupy a very small portion of the inlet, potentially excluding fish from an inconsequential amount of habitat. The land portion of the trunk cable would be deeply buried, keeping the zone of EMF out of easy contact with marine or terrestrial organisms.

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[23] Among the fish that might be affected by low intensity iE fields, sharks, skates, and rays have tissues used to sense electric fields to assist in finding prey. Two species of Asian sturgeon have been shown to react to electric fields. Atlantic salmon, eels, and cod have been shown to respond to iE fields. Skates showed physiological responses to electric fields, dogfish attacked electrodes, and sharks attacked iE fields. Dogfish avoided constant electric fields associated with 150 kV cables with 600 A current, but were attracted to an electric field of about $1/100^{th}$ of that intensity, which is similar to much of their prey. Sturgeon, including green sturgeon, are known to use electrical fields to find their prey and are known to respond to changes in electric fields. (Summarized from DOE, 2009.)

[24] Many marine species demonstrate sensitivity to B fields, including using magnetic fields for navigation. Some do so via sensitivity to iE fields and some via their own magnetic deposits. Four of the five species of Pacific salmon have magnetite crystals within them that are believed to serve this purpose. (Sea turtles and cetaceans use magnetic deposits as well.) Sharks and rays may use the iE field they induce while moving through the Earth's magnetic field to navigate. (Summarized from DOE, 2009.)

[25] Flounder and invertebrates exposed to potentially harmful magnetic fields for several weeks did not differ in survival from controls. Another set of invertebrates showed almost no difference in distribution between stronger and weaker areas of a magnetic field. Oxygen consumption of prawn subjected to different levels and types of magnetic fields did not vary. (Summarized from DOE, 2009.)

The scale of the project proposal is small and the timeframe relatively short at 10 years. The likelihood of negative effects on fish and invertebrates is small. The likelihood of negative effect is even smaller for marine mammals given relative the scale of the physical effect (centimeters) relative to the scale of the marine mammals (meters) and the scale of their routine movements (kilometers). Though there is not a specific EMF monitoring plan, other plans indirectly could detect some unexpected effects and any significant threat could be quickly addressed. No party had expressed significant and specific concerns regarding EMF and this proposal. Overall, EMF is not likely to have negative effects on fish or other organisms at the pilot-scale of this project proposal.

Benthic Habitat Effects

The turbine and foundation structure (turbine structure) would provide a hard surface, which would be colonized by benthic invertebrates as were several of the Snohomish PUD's baseline sampling devices.[26] The colonization of hard surfaces is the norm in marine environments. Each turbine structure could generate a reef effect, which could have broader effects on the community ecology near the turbines (Polagye et al., 2010).

Colonization also could affect machine performance and acoustic characteristics of the turbines. To preserve the operational functions of the device, the turbine blades, hub, and interior shroud would be painted with antifouling paint. The rest of the device would have no coating on the surfaces of steel and concrete. The unpainted portions would be colonized. Antifouling paint is discussed in the section on water quality effects.

Snohomish PUD has proposed a Benthic Habitat Monitoring and Mitigation Plan to describe the benthic habitat created by the installation and presence of the project. Snohomish PUD would monitor and characterize the colonization of the turbine structures, the area immediately around the contact points with the seabed, the trunk cable, and the drill exit point from horizontal directional drilling for the shore landing.

Using ROVs, Snohomish PUD would take video images of four specific portions of the turbine structures. The ROV filming would be carried out four times in year one and two times in each following year. A benthic ecologist would review the video, estimate the percentage represented by each taxa group and make qualitative estimates of

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[26] See images at Benthic Habitat Monitoring and Mitigation Plan, page 9, figure 6, filed with the Commission on November 16, 2012, which show significant fouling by barnacles and red algae on a "sea spider" instrumentation package after deployment in the project area from May to August 2011. Tubeworms and chitin were also observed on similar devices upon deployment recovery (Benthic Habitat Monitoring and Mitigation Plan, page 8).

rates of expansion or retreat of the colonized area, and records of any fish or marine mammals captured on video. The drilling exit point and two or three points along the trunk cable would be filmed. That video would be interpreted in a manner similar to the turbine structure footage and in comparison to adjacent areas. For three areas around the contact points of the turbine structure and the sea floor, video would be interpreted to attempt to quantify any scouring trends. Comparisons would also be made against ROV video of the turbine deployment area taken in August, September, and October of 2010 and along the cable route, including the drilling exit point, and the turbine deployment area, taken in July of 2012.

NMFS, FWS, and Washington DFW recommend that the District implement its proposed Benthic Habitat and Water Quality Monitoring Plan. Washington DFW noted the importance of eelgrass and kelp habitat to juvenile salmon and other organisms. Washington DFW also highlighted the economic importance of the geoduck clam harvest.

The Suquamish Tribe raises concern about effects of the project on the commercially and culturally important Dungeness crabs and shrimp. The Swinomish Tribe raises concerns that the project would reduce the productivity of shellfish rearing habitat or lead to direct mortality of shellfish. Both tribes reportedly harvest shellfish in the proposed project area.

Staff Analysis

Colonization

The turbine structures would be colonized quickly by benthic invertebrates, at least where they are not coated in antifouling paint. It was apparent in the growth on Snohomish PUD's water monitoring devices and has been observed and studied at several artificial reefs (Snohomish PUD, 2012; Bohnsack and Sutherland, 1985). At the outset, the cover and flow refuge provided by the turbine structure would probably attract fish, with or without the presence of benthic colonizers (Buckley and Hueckel, 1985). While the benthic colonizers would both influence and be influenced by the development of a larger community on the turbine structure, an abundance of benthic organisms as food sources would not necessarily be a prerequisite for a reef effect. A number of studies have demonstrated that fish who occupy reefs depend on the surrounding area for their food base (Bohnsack and Sutherland, 1985).

This colonization process should be detectable by comparison of ROV video imagery of the target areas over time. Baseline images of benthic habitat in the project area already exist. Similarly changes in the benthic community along the trunk cable and at the drilling exit should be detectable if present. Comparison with focal areas nearby, but at least 20 m (66 feet) from the target sites would help to account for seasonal and

inter-annual variation. ROV video of the area surrounding three connection points between the turbine structures and the seabed, would allow detection of scour.

If scouring is significant, the issue would be referred to consultation to determine if the focal points required adjustment (Adaptive Management trigger 2). If the drilling point exit is colonized by different fauna than was originally present, the issue would be referred to consultation as to whether to modify or increase monitoring or seek mitigation (Trigger 3). If erosion is observed around the turbine structure contact points, stability analysis of the entire structure would be carried out and the issue would be referred to consultation regarding the need for project modifications (Trigger 4

The issue of reef effects would be informed by the Near-Turbine Monitoring and Mitigation Plan and Marine Mammal Monitoring and Mitigation Plan as well as the Benthic Habitat Monitoring and Mitigation Plan.

Special or Commercial Benthic Resources

The seven invertebrates that were harvested from Admiralty Inlet in annual weights greater than 1,000 pounds were geoduck clams, manila clams, pacific pink scallops, Dungeness crab, sea cucumbers, and green and red sea urchins. In Washington DFW trawls at the depth of the turbines, Geoduck and manila clams were not found near the proposed turbine site. (Geoduck clams along the transmission corridor are discussed above.) Dungeness crabs, green sea urchins, and pink scallops were collected near the proposed turbine site and sea cucumbers and red sea urchins were collected at the depth of the turbine, but farther from the proposed turbine site.

Benthic invertebrates that support commercially and culturally valuable shellfish fisheries are present near and at the depth of the proposed turbine site. At the same time, these species appear to be widespread in Admiralty Inlet at low to moderate densities. As with fish, the project has the potential to affect small numbers of the benthic organisms, particularly the mobile ones. However, given the small footprint of the turbine structures and transmission corridor relative to Admiralty Inlet and the densities of these organisms, such effects would not convey to the fishery scale. There is no apparent mechanism through which productivity would be reduced. Using the measures in the Benthic Habitat Monitoring and Mitigation Plan and the Near Turbine Monitoring and Mitigation Plan, the District would likely detect a surprising concentration of commercially valuable invertebrates near the turbine structures and the issue of monitoring adjustments of mitigation measures in response could be addressed through consultation and adaptive management.

Summary

Effects on the benthic community could have an indirect effect on other aspects of the project, such as reef effects and project operations and maintenance, but the benthic

community is unlikely to be harmed. The Benthic Habitat Monitoring and Mitigation Plan would both help to detect and, if necessary, manage any negative effects on the benthic community. The plan, combined with other plans, would help in interpreting and managing for indirect effects of the project acting through the benthic factors.

Behavioral Changes and Injury from Interaction with the Turbines

Two potential categories of effects of tidal turbines on mobile marine organisms, including fish, marine mammals, and diving birds, are indirect effects occurring through behavior change and direct injury from the spinning blades. Behavior change could result from attraction to or avoidance of the turbines and lead to issues such as disruption of foraging, disruption of migration, or changes in predation (Polagye et al, 2011). Ultimately, behavior change could lead to stress effects including effects to reproduction, growth, or internal chemistry (Polagye et al, 2011). Direct impacts like blade strike could lead to injury or death. Such effects could be limited to individual organisms or could convey up to the population scale. Other potential effects, including acoustic energy effects and electromagnetic fields, have been discussed previously. Finally, potential direct or indirect effects could arise from performing installation activities at the project site or along the transmission corridor during biologically important times

Snohomish PUD proposes a Near-Turbine Monitoring and Mitigation Plan (near-turbine plan) to observe and minimize the effects of interactions of mobile marine organisms with the turbines. Near-turbine is defined as about 3 to 7 meters and is based on the characteristics of the available technology as well as the study goals. Snohomish PUD proposes to achieve three study objectives in the first year of project operations. The first year seasonal study sequence would consist of the following.

1) A presence or absence study to evaluate conditions, including current velocity and direction time of day, and season for which species presence or absence is likely. Another objective of this study would be to determine the effectiveness of the camera system to identify species under different environmental conditions.

2) An artificial lighting study to develop guidelines for strobe frequency, duration, and interval that would allow for observation of interactions with the turbine rotor (aggregation, strike, passage) without altering marine animal behavior. This study would use an acoustic camera with a field of view similar to the optical camera.

3) A turbine interaction study to evaluate the frequency and type of near-turbine interactions between marine animals and the turbine rotor.

After the first year, Snohomish PUD would pursue two additional study objectives including the following.

4) An artificial reef effect study to characterize marine mammal use of the turbine structure.

5) A fish avoidance study to determine if fish are avoiding the turbines at a relatively close range.

Snohomish PUD proposes to use a pair of optical, stereo cameras, which would capture still images out to a distance from about 3 to 7 m. The optical cameras would be assisted by a strobe light and would support 3-dimensional imagery. They would be complemented by an acoustic camera, which would take footage before and after the optical camera still shots. For maintenance purposes, and to allow reconfiguration of the camera systems, much of the monitoring system would be recoverable. Active sonar probably would be added for a later study phase as determined through the proposed adaptive management and consultation process. Snohomish PUD bases this design on an evaluation of previous efforts to monitor environmental effects of tidal energy elsewhere in the United State and the world.[27]

Snohomish PUD proposes to conduct each of the three first-year, near-turbine plan studies four times over the year, once in each season. In each season, Snohomish PUD would carry out each of the three studies in consecutive order as listed in their proposal. Snohomish PUD would establish design and timing of remaining two studies of the near-turbine plan based on the findings of the first three studies and consultation with the agencies, tribes, and the Commission.

Snohomish PUD includes elements of adaptive management in the near-turbine plan proposal. Adaptive management triggers in the proposal include: (1) shutting the project down if harm to an ESA-listed species is suggested by monitoring; (2) consultation with the agencies, tribes, and Commission if monitoring shows aquatic species passing through the turbine rotor; (3) consultation with the agencies, tribes, and Commission if monitoring shows diving marine mammals in the field of view; (4) consultation with the agencies, tribes, and Commission if monitoring shows diving sea birds in the field of view; (5) a contextually appropriate response to a monitoring system outage, including temporary shut-down if needed.

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[27] Examples reviewed include Verdant Power's Roosevelt Island Tidal Energy Project No. 12611 in the East River, New York; Ocean Renewable Energy Company's Cobscook Bay Tidal Energy Project No. 12711 in Eastport, Maine; Marine Current Turbine's Deployment in Strangford Lough, Northern Ireland, United Kingdom; and OpenHydro's deployments at the European Marine Energy Centre (EMEC) at the Orkney Islands, Scotland, United Kingdom and at the Fundy Ocean Research Centre for Energy (FORCE) at Minas Pass, Nova Scotia, Canada.

To avoid potential effects of installing the turbines and cables during biologically important times, Snohomish PUD (2012) has proposed to construct the project within the work windows identified by the State of Washington and the U.S. Army Corps of Engineers.

NMFS, FWS, and Washington DFW recommend Snohomish PUD implement the Near-turbine Monitoring and Mitigation Plan pursuant to section 10(j) of the FPA. The plan and its adaptive management elements address the agencies concerns about the effect of this project at its pilot scale.

The Tulalip, Sauk-Suittle, and Swinomish Tribes each raise concerns about the effects of the proposed project on fish and fish stocks. The Tulalip Tribe also raises the concerns about the accuracy of the near-turbine plan and the lack of a reference site. The Sauk-Suittle and Swinomish Tribes note that Admiralty Inlet is a migratory pathway for all five species of Pacific salmon and that the project may affect migration negatively and cause mortality of juvenile and adult salmon. The Sauk-Suittle and Swinomish Tribes also describe Admiralty Inlet as a rearing ground and identified direct mortality of young as a concern.

Staff Analysis

Likelihood of Exposure to Turbines

Washington DFW collected over 51 species of fish, representing a large range of life history patterns, in trawl surveys in the depth zone of 31 m (102 feet) to 60 m (198 feet). That depth zone includes the depth of the proposed turbines, which would be about 55 m (180 feet). Densities of fish trawled at that depth ranged from lows of less than 1.0 fish per hectare (2.5 fish per acre) for 27 species up to an outlier of 406 fish per hectare (1,015 fish per acre) for the spotted ratfish. The remaining 24 species collected ranged in density from 1.0 to 30 fish per hectare (2.5 to 45 fish per acre) (Snohomish PUD 2012). Given that these numbers are additive, the total density of fish in this depth zone is about 625 fish per hectare (1,563 fish per acre). At such densities, some fish would be likely to be in the vicinity of the turbines simply by chance. Adding to the background densities the fact that many fish are attracted to structures, either artificial or natural, fish are likely to be in the vicinity of the turbines.

Diving birds could reach the depth of the turbines.[28] Though diving birds are capable swimmers, they are temporary visitors to the marine depths, particularly relative to the fish. There is a smaller likelihood of bird presence near the turbines than there is a likelihood of fish in the turbine area. If diving birds are attracted strongly to the devices, their presence should be detectable to surface observers as well as the near-turbine monitoring systems.

Likelihood of Direct Impact of Turbines on Fish

Though fish would be near the turbines, it is likely that most fish would avoid them once they detect them. Unlike the case in a conventional hydropower setting, any fish approaching the turbines would have the option of swimming around them. Fish living at the depth of the turbines, which is below the photic zone, are adapted to that environment. Even if they cannot see the turbines from a distance, they are likely to sense them. Snohomish PUD (2012) found in its hydraulic modeling that there would be a pressure wave from the turbines that would be detectable by fish as much as 10 m (32.8 feet) upstream. Detecting the pressure wave, fish could then avoid the device.

Such avoidance behavior was demonstrated by Alden Research Laboratories, Inc. through tests using rainbow trout of about 15 cm and 25 cm (5.9 and 9.8 in). They released the fish 7.5 m (25 feet) upstream of the device (EPRI, 2011). In four trials, about 90 percent of the 400 fish tested entirely avoided Lucent Energy Technology's horizontal axis, spherical turbine. Similarly, in tests at the U.S. Geological Survey's Conte Anadromous Fish Research Laboratory, Atlantic salmon smolts appeared to avoid a straight-bladed, cross-flow turbine (EPRI, 2011).

An OpenHydro turbine, similar to the ones proposed for Admiralty Inlet, was tested at the European Marine Energy Center facility off of the coast of Scotland. In 31 days of day photographing the device in the Springs of 2009 and 2010, pollock fed just downstream of the turbine when the current velocity was low and the blades were not turning. When velocities increased and the device was turning, the fish were not present. In that case the fish vacated the area of the turbine when the tide generated higher velocity conditions and the turbine was spinning.

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[28] Washington DFW (2012) provided references to diving birds reaching depths that could expose them to the turbines, including the common loon diving to 60 to 70 m (197 to 230 ft), the common murre diving to 180 m (591 ft), the pigeon guillemont diving to 50 m (164 ft), the rhinoceros auklet diving to 57 m (187 ft), and the tufted puffin diving to 100 to 110 m (328 to 361 ft). The theoretical maximum depth for the marbled murrelets is 47 m (154 ft).

Finally, in addition to the having the option to swim around the turbine, in the case of the OpenHydro turbines, there is a 2.2 m (7.2 foot) hole through the center of the turbine through which fish might pass. Moderately low pressures in the hole, may actually encourage fish to go through the hole.

For those fish that do pass through the turbine's sweep, the hydrokinetic[29] characteristics of the OpenHydro turbine avoid much of the risk to fish associated with conventional hydropower turbines. These differences expose the fish to substantially milder pressure changes and shear forces, somewhat lower direct blade strike velocities under most conditions, and lower likelihood grinding when passing through the hydrokinetic OpenHydro turbine than when passing through a conventional hydropower turbine.

Rapid pressure changes in conventional hydropower operations can harm fish. The pressure change associated with the OpenHydro turbine is minimal compared to a conventional turbine. The maximum predicted pressure change associated with the OpenHydro turbine in a 2.5 m/s (8.2 ft/s) current is predicted to be 4.5 kiloPascals (kPa; 0.65 pounds per square inch, PSI) and would occur only in small areas on the blade margins (Snohomish PUD, 2012). A fish passing through a conventional hydropower plant and could experience an increase in pressure of 200 kPa (29 PSI) from the intake to the turbine followed by a reduction in pressure of about 300 kPa (44 PSI), all in two or three minutes (EPRI, 2011a). Minimum values for a threshold for pressure-induced harm to fish are on the order of 30 to 100 kPa (4.4 to 13.5 PSI) (Snohomish PUD, 2002; EPRI, 2011a). The estimated pressure around the proposed turbines is well below the threshold of concern for fish that pass through the turbine. [30]

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[29] Hydrokinetic turbines generate power from the kinetic energy in the velocity of flowing water without use of potential energy in the form of the head from a dam. The OpenHydro turbine is one of several examples of hydrokinetic turbines.

[30] For context, atmospheric pressure at sea level is about 101 kPa (13.5 PSI). Rockfish are quite sensitive to pressure compared to many other fish, including salmon and trout. (Rockfish are members of a group of fish whose swim bladders adjust pressure through gas diffusion rather than direct gas exchange.) Because of this vulnerability when anglers pull rockfish from depths of greater than 20 m (65 feet) to the surface (at atmospheric pressure) about 1/3 of the fish die from the rapid reduction in pressure (Washington DFW, 2011c). Pulling a rockfish from a 20 m (65 foot) depth exposes the fish to a pressure reduction of about 200 kPa (29 PSI). This pressure change is more equivalent to that of a fish passing through conventional hydropower plant than to a fish passing through the OpenHydro hydrokinetic turbine during which the fish would experience at most a pressure change of about 4.5 kPa (0.65 PSI).

Shear forces on a fish, resulting from rapid change in velocity between different areas of water affecting the surface of a fish at the same, can be put enough stress on a fish to be harmful. Shear force effects cam be a problem in conventional hydropower plants. Forces below 500/s are believed to be below the threshold of harm for fish (EPRI, 2011a). The maximum shear force around the proposed turbines has been estimated at less than 80/s at the very edge of the blade (Snohomish PUD, 2002). The estimated shear forces around the proposed turbines are well below the threshold of concern for fish that pass through the turbine.

Another risk factor in conventional hydropower is damage or death from being struck by a blade. The risk of strike is reduced, relative to a conventional hydropower turbine, by the fact that the OpenHydro blades are expected to spin at 6 to 20 revolutions per minute (rpm) routinely, and up to 29 rpm at its limits, as compared to 30-150 RPM for a turbine in a conventional hydropower project (Snohomish PUD, 2012). Blade velocities below 4.5 m/s (15 feet/s) are considered to result in minimal injury to most fish, including large, vulnerable species like sturgeon and eels (EPRI, 2011a). The proposed turbines would have a maximum blade velocity of 7.0 m/s (23 feet/s), but would more typically operate at up to 4.9 m/s (16 feet/s) (Snohomish PUD, 2012 as converted by staff). The project turbines would operate most of the time at a level of minimal risk to fish that pass through the blades. The most significant risk for fish passing through the blades would occur if large fish pass through the blades when they the blades are spinning at an unusually high speed. The monitoring system would be suited to capturing such events. Blade speed would be tracked through SCADA system and large, vulnerable fish, like sturgeon, would be among the most identifiable fish using the proposed camera system.

Closely related to strike is the risk of harm to fish from grinding of fish between parts of a turbine, which is another concern in many conventional hydropower turbines (EPRI, 2011a). The OpenHydro device has a shroud enclosing the blade tips to prevent fish from entering the device from the side at the fastest moving point (Snohomish PUD, 2012). The shroud should also minimize grinding by enclosing the space between the blade and the rim.

Indications of early testing are that hydrokinetic turbines have higher survival rates than those of conventional hydropower projects, even when fish are forced through the turbines. An *in situ* entrainment test of a small, ducted, hydrokinetic turbine in the Mississippi River at Hastings, Minnesota was carried out using balloon-tagged fish. Researchers found that 99 percent of the passed fish survived. In a laboratory setting, Alden Research Labs, Inc, in another element of the flume study mentioned previously, released rainbow trout and smallmouth bass at a point about 28 cm (11 in) in front one horizontal cross-flow (spherical) and one horizontal axis turbine (EPRI, 2011). Survival rates were between 98 and 100 percent and were not significantly different from those of the fish exposed to the control treatment (EPRI, 2011).

The near-turbine monitoring plan would be implemented from the beginning of the operation of the project and would observe interactions with the turbines. The combination of optical and acoustic imagery would capture strike events should they occur frequently. This information would allow the adjustment of operations through the mechanisms established in the adaptive management plan, or, if necessary, shutdown and removal.

Likelihood of Indirect Effects on Behavior

The turbines structures would displace a small amount of natural benthic habitat. However, relative to the area of natural habitat available, the turbine footprints are inconsequential. The transmission line and horizontal drilling exit point are expected to return to a natural condition.

The turbine structures, with their high relief, will attract fish. Fish and invertebrates are known to colonize artificial reefs quickly, though the community structure may take years to develop into a pattern similar to that of nearby, longstanding reefs (Bohnsack and Sutherland, 1985). In many reefs, larger fish will be the first colonizers and use the structure as cover, while obtaining most of their food in the surrounding environment (Buckley and Hueckel, 1985; Bohnsack and Sutherland, 1985; West et al., 1994; Washington DFW, 2011c). In spite of evidence that fish do most of their feeding around the reef, there has been positive correlation observed between the presence of predators and the abundance of prey on artificial reefs (Bohnsack and Sutherland, 1985).

It is difficult to predict the exact outcome of the aggregation of fish. At the scale of two turbines which would occupy a small portion of the Admiralty Inlet cross section, the probability of having a substantial harmful effect is minimal. There is no evidence that the turbine would prevent migration through the inlet, even if an organism were to avoid them locally. Rockfish are oriented to the bottom and to structure in general (Washington DFW, 2011a). Effects on rockfish are discussed below with the Rare, Threatened, and Endangered Species. Aggregation would bring fish closer to the turbine blades. Direct effects of the turbine blades are discussed immediately above.

Snohomish PUD's monitoring plan is designed to attempt to identify species of fish near the turbine. Under the Benthic Community Monitoring and Mitigation Plan, Snohomish PUD would be identifying benthic colonizers. With this information, a reef effect should be detectable and the species composition could be analyzed for potential negative interactions. Interactions of concern could be addressed in the adaptive management and consultation process.

Installation Effects

The time of year of installation of the devices and transmission cables would be one of the most active periods of the project and, as a result, one of the greatest opportunities to affect fish. By identifying the more important and active times for key species life histories, the State of Washington and the Corps have established a system for minimizing or eliminating effects associated with installation. In this case, by deploying within the work window of July 16 to October 14, Snohomish PUD would reduce or eliminated effects on juvenile salmonid migration, feeding, and rearing; bull use of the estuary, trout Pacific herring spawning beds, and Pacific sand lance.

Salmon and Fish Stocks

Regarding the tribes' concerns, the concern about harm to fish in general is addressed by the characteristics of the turbines; the experiences at other relevant projects; the small footprint and relatively short term nature of the project; and the monitoring, adaptive management, and mitigation schemes discussed above. Given these observations and protections, the likelihood of harm to fish is small, likely to be detected if it occurs, and certain to be addressed if it is detected. With these measures in place, an effect at the scale of a fish stock is extremely unlikely.

The Tribes specifically identify concerns about the project killing juvenile and adult salmon or interfering with their migration. Concerns about salmon in general are covered in more detail in section 3.3.3.2, *Threatened and Endangered Species*. The general discussion about the low risk of effects on fish from this pilot project, included in this section, applies to salmon. Scheduling project installation in the State of Washington's work window will help to protect salmon and other fish stocks as well.

Adequacy of the Near-Turbine Monitoring Plan

Overall the monitoring plan builds on the latest studies around the world in the environmental effects of hydrokinetic turbines. The District's imaging design builds on previous efforts, proposing to combine optical and acoustic imaging and sonar in a way that should allow taxonomic distinction and behavioral observation beyond what has been done in the past. The Near-turbine Monitoring and Mitigation Plan was developed in extensive consultation with the experts at the Washington DFW, FWS, NMFS, Pacific Northwest National Laboratory, European Marine Energy Center and elsewhere. The plan, as well as the monitoring results, is subject to adaptive management. Monitoring plan design issues, such as the influence of the strobe lighting on the monitoring results, are to be evaluated explicitly and adjusted as part of the plan.

The Tulalip Tribe raises concern about the accuracy of the results of the monitoring plans in general. The only specific concern they raise, however, is a lack of reference sites. There are no paired reference sites for the near-turbine study. For the issue of blade strike, the concept of a reference site is not applicable in an observational study. For the issues of behavior and reef effects, development of a reference site would

be difficult, if not impossible, because the effect of the monitoring equipment itself on the fish behavior would be impossible to eliminate. The baseline information that has been collected by Snohomish PUD would serve to reference the monitoring results for the near-turbine study. For effects of the operating turbine, the turbine when locked or when water velocities are too slow to turn the turbine blades would serve for comparison.

The two turbines are unlikely to cause either direct injury to the fish, such as blade strike, or to cause harm indirectly through behavior change. If one of these factors appears to cause acute harm to fish, the monitoring program would be likely to detect it, triggering consultation on adaptive management measures to mitigate the harm or remove the threat. Major purposes of the near-turbine plan would be to estimate the frequency of fish (or marine mammal) interaction with the turbine structures, conditions associated with the occurrence of interactions, and the outcome of interactions.

Noise Effects (Acoustic Monitoring and Mitigation Plan and Marine Mammal Monitoring and Mitigation Plan

Noise effects can be divided into short-term, temporary effects associated with installation, maintenance and removal of the turbines, and long-term (up to 10 years for the requested license), intermittent, but persistent effects from noise generated by the operation of the turbines.

Project installation, maintenance, and removal would result in the temporary production of underwater noise associated primarily from the HDD drilling process, installation activities, and service vessel engines running during these operations. To minimize environmental effects during project construction, Snohomish PUD would conduct marine installation work during Washington DFW-approved work windows.[31] In addition, Snohomish PUD would, during installation and removal, follow NMFS guidelines for vessel operations around marine mammals. Specifically, if a listed cetacean occurs within 500 meters, or listed pinniped occurs within 100 meters of an installation or removal vessel, installation or removal operations would be halted until the cetacean or pinniped leaves the vicinity of project operations.[32]

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[31] The project is located in the Tidal Reference Area 10 (Port Townsend). The species work windows for this reference area include: salmon, bull trout, Pacific herring, and Pacific sand lance. The work windows are from July 16 to March 1 for salmon, July 16 to February 15 for bull trout, May 1 to January 14 for Pacific herring, and March 2 to October 14 for Pacific sand lance.

[32] This proposal is included in the Marine Mammal Monitoring and Mitigation Plan.

During operation, broadband noise would be generated by the rotation of the turbine. Noise generated during turbine operation is a function of tidal velocity and corresponding energy production. Noise generated by the flow of water around the support structure or in the turbine wake is not expected to significantly contribute to ambient noise levels because the source is weak (Polagye et al., 2011).

Marine life are sensitive to sound pressure levels (SPL) (expressed in dB re 1 μPa), particle velocity (expressed in m/s), and the frequency of sound (expressed in Hz). The potential effects of variable noise frequencies and pressure levels on marine life include changes in hearing sensitivity and behavioral patterns (NAS, 2003). Of particular concern, are effects of man-made noises on marine mammals because, at certain levels, they can cause stress, interfere with communication and predator/prey detection, and change behavior patterns. Interactions of marine mammals and tidal turbines are an area of high uncertainty (Polagye et al., 2011). As explained further below, sound from project operation is not expected to rise to a level that constitutes injury to marine mammals, but would periodically rise to a level that could cause behavioral changes over small scales.

To determine whether levels of underwater noise are occurring at levels that may harm marine resources and whether such noise or other factors are resulting in behavioral changes in area marine mammals, Snohomish PUD proposes to implement an Acoustic Monitoring and Mitigation Plan and a Marine Mammal Monitoring and Mitigation Plan.

To determine the levels of underwater noise generated by the turbines during operation, Snohomish PUD proposes to implement a post-deployment Acoustic Monitoring and Mitigation Plan that would involve conducting *in-situ* measurements of the acoustic emissions of the operating turbines to test two hypotheses: (1) that the sound from tidal turbines vary with power generation state, and (2) that the sound from the tidal turbines change over time due to biofouling or component wear. To test the first hypothesis, acoustic data would be collected using five surface drifters—specifically the SWIFT (Surface Wave Instrument Float with Tracking), which is a buoyant spar buoy, equipped with a radio frequency transmitter, GPS logger, and hydrophone. The frequency response of the hydrophone and data acquisition system is linear (±3 dB) from 20 Hz to 80 kHz. The Automatic Identification System (AIS) receiver deployed on Admiralty Head in cooperation with Washington State Parks would be used to monitor vessel traffic and confirm that noise from commercial vessels is not masking turbine sound. Doppler profilers mounted to the turbine foundation would monitor tidal currents throughout the acoustic survey and the turbine Supervisory Control and Data Acquisition (SCADA) would monitor power output. Acoustic surveys would be conducted for nominal inflow velocity conditions of 1.5, 2.0 and 2.5 m/s. Data would be collected to sample noise from each turbine operating independently and together. The total data set would consist of five measurements, from five bouys, during six surveys (three velocity states measured on the rising and falling tide).

The data collected would be used to quantify the trend in source level with power generation state. Source levels would be estimated for root mean square (rms) sound pressure levels corresponding to four functional hearing groups for marine mammals to determine if noise generated by the project are occurring at levels that may harm marine mammals. The low frequency limit for each group would correspond to: low-frequency cetaceans (7 Hz), mid-frequency cetaceans (150 Hz), high-frequency cetaceans (200 Hz), and pinnipeds (75 Hz). The high-frequency limit would be determined, in consultation with the MARC, based the maximum frequency of sound produced by operating turbines, as determined from the monitoring study. Results of the study would be reported to the MARC, orally within 60 days of survey completion and in a final written report with 120 days.

To test whether noise generated by the project might change over time from wear or bio-fouling and approach levels that may be harmful to marine mammals, acoustic data would be collected by a hydrophone with a flow shield that is integrated into the adaptable monitoring package (AMP) on each turbine. Vessel traffic, tidal currents, and power generation would be monitored as described above. On a quarterly basis, a time series analysis would be completed to determine noise levels and calculate sound pressure levels for the four functional hearing groups. If the mean, broadband sound pressure level increases by more than 5 dB relative to the mean broadband sound pressure level during the first quarter of operation and there are no obvious contributions form local anthropogenic sources, the increase in noise would be attributed to a change in the acoustic properties of the turbines and the MARC would be consulted to determine next steps.

The Marine Mammal Monitoring and Mitigation Plan is designed to test whether marine mammals, partitioned by the above functional groups, respond to the sound from project operation or prey aggregations through attraction, avoidance, or change in behavioral state. Monitoring would be conducted during installation, operation, removal of the project. The proposed monitoring uses a combination of shore-based visual observations and acoustic-based observations, depending on the functional group, and compliments existing efforts and expertise already in place, as represented by the Orca Network, Bean Reach marine Science and Sustainability School, NMFS, and the Whale Museum. Detailed methods are provided in the plan. In summary, for pinnipeds, 2 to 3 experienced observers positioned on Admiralty Head would, using scanning techniques, document pinnipeds entering into the study area (500 to 1000 meter radius, centered on the turbine).[33] Observations would be during winter (October 1 to March 31) and during summer (April 1 to September 30). These data, coupled with the vessel traffic data obtained from the AIS system, generation state from the SCADA, project generated noise

[33] The final study area would be determined in consultation with the MARC and based on observation trials to determine practical limits of the shore-based observers.

from the Acoustic Monitoring and Mitigation Plan, and the presence of prey from the Near-turbine Monitoring and Mitigation Plan) would be analyzed to determine if pinniped presence/absence is correlated with turbine noise. Data would be collected for one calendar year of operation.

Harbor porpoise were selected to represent mid-frequency cetaceans because of their high level of use in the area and sensitive to acoustic disturbance (although in this area they may be habituated to sound from shipping traffic). Shore-based observers would use focal group techniques and high-definition video to follow harbor porpoise through the study area. Using these data point-of-closest-approach and directionality of movement would be tested to determine if turbine sound is altering movements. A pair of C-POD click detectors integrated into the AMP on each turbine would collect echolocation activity. These data would be compared to pre-installation studies to determine if there were any detectable changes. The study period would be for one calendar year as for pinnipeds.

Because of their iconic and listed status, killer whales (both the listed southern resident and non-listed transients) would be followed for the entire license period through the use of shore-based observers, localizing hydrophones, and near-turbine monitoring system. The localizing hydrophones would consist of a passive acoustic array of four hydrophones located on the foundation of one turbine that have a functional frequency range of 200 kH in order to detect killer whale vocalizations. Shore-based observers would be dispatched upon auto-detection of killer whale calls on the hydrophones on the turbine, the hydrophone at the Port Townsend Marine Science Center, or sightings reported through the Orca Network. Direction of transit, surfacing interval, behavior state, surface active behavior, click rate and call rate would be recorded and analyzed to determine changes in behavior.

The plan includes a schedule for reporting monitoring results to the MARC and the Commission. It also includes eight triggers for modifying the plan based on monitoring results or identified adverse effects on marine mammals.

NMFS, FWS, and Washington DFW recommend implementing the Acoustic Monitoring and Mitigation Plan. The Tulalip Tribes object to issuing a license, in part, because they believe the project would interfere with marine mammal migration and movement and the proposed monitoring plans are insufficient to protect marine mammals.

Staff Analysis

Underwater noise would be generated from at sea actions including installation, maintenance, and removal of the project. At sea installation activities are expected to require approximately 20 days.

Removal of the turbines would require raising the turbines and support frames. This may also be required for unscheduled large-scale maintenance. For turbine recovery, a non-propulsion turbine installation barge, ROV, supporting tugboats, and personnel transfer/safety boats would be required. Removal is expected to be completed within one tidal cycle for each turbine.

Boats and ROVs would be required periodically for environmental monitoring and maintenance inspections. It is expected that these environmental monitoring and maintenance activities could occur during parts of several days each month during the early stages of operation and are expected to decrease in frequency over the five year deployment period.

The primary noise produced during project installation, maintenance, and removal operations would be from boat engines (Minerals Management Service [MMS] 2007) and construction equipment on the non-propulsion barges, but would also include divers and ROVs. All sound sources would be continuous and would range between 125 and 175 dB (re 1 µPa @ 1 m).[34] Noise from tugboats and the construction barge dominates over other noise sources during these operations; maximum source levels during HDD, cable laying, turbine installation and removal, routine maintenance, and environmental monitoring ranges from 165 dB to 178 dB, with the frequency content expected to range from 20 Hz to 10 kHz (Richardson et al., 1995).

During project operations, broadband noise would be generated by the rotation of the turbine. The two turbines will be deployed for up to 10 years. During that time, the turbines are expected to create operational noise only when they are rotating, which, on the basis of pre-installation velocity surveys, is expected to occur 70 percent of the time (water velocity must exceed 0.7 m/s before the turbines will rotate). This noise would be a continuous, broadband source.

The spatial extent of this noise depends on the propagation of underwater noise and intensity of the noise source (which will vary with turbine rotation rate), and the temporal extent is dependent on the water velocity. There are limited data on noise generated by operating turbines. OpenHydro conducted an underwater noise assessment, using drifting hydrophone recordings, for a six-meter turbine at EMEC. OpenHydro obtained broadband source levels for the turbine by integrating over all frequencies of interest (i.e., from 10 Hz to 5 kHz). This resulted in an estimated broadband source level of 154 dB (re 1µPa at 1 m).

Polagye et al. (2012*a*) reanalyzed these data to estimate received levels associated with operation of the turbines in Admiralty Inlet for a range of inflow velocities in the

[34] Sound intensities reported in this EA are rms (root mean square) values.

context of ambient noise. Figure 8 shows the expected distribution of broadband source levels (dB re 1µPa at 1m) for a 6 m diameter turbine and the frequency distribution of the source for different operating percentiles. The "reference" measurements from EMEC fall around the 75th percentile level for Admiralty Inlet (i.e., turbine noise would be no louder than this 75% of the time and louder 25% of the time). The maximum broadband source level is estimated to be 172 dB re 1µPa at 1 m, corresponding to an inflow velocity of 3.6 m/s. This source level is predicted to occur infrequently during turbine operation (i.e., < 0.01% of the time based on Doppler velocity measurements). Source levels are not predicted to exceed 180 dB re 1µPa under any operating condition.

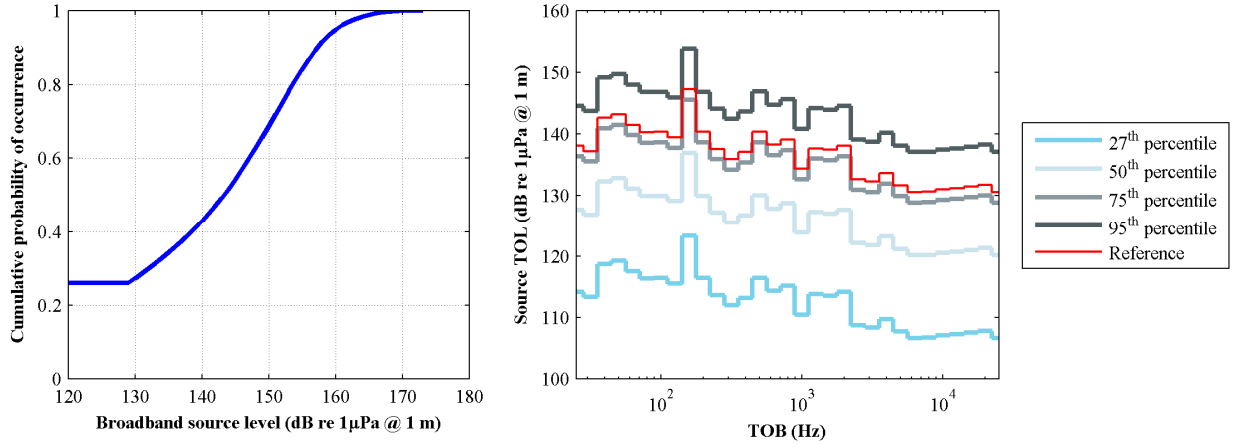

Figure 8. Probability distribution of turbine source levels (left). Broadband (25 Hz – 25 kHz) one-third octave source levels (right) for select operating percentiles (Source: application).

Many marine fish and mammal species use sound in communication, navigation, predator/prey interactions, and hazard avoidance. Because these organisms have different biological receptors and sensitivities to sound, each would likely respond differently and at different sound intensity and frequency as explained further below for each group.

Marine Fish

Most species of fish can detect sounds between 75 and 150 dB (re 1µPa) and frequencies from below 50 Hz up to 500-1,500 Hz (Hastings, 2005; Popper and Hastings, 2009). Atlantic salmon, which share similar auditory systems with Pacific salmon, typically can detect sounds between 95 and 130 dB (re 1µPa), at frequencies between 30 and 400 Hz (Hastings and Popper, 2005). Consequently, noise from installation,

maintenance, and removal activities, as well as operation of the turbines, are likely to be detectable by fish in the project area under some ambient noise conditions.

However, the studies reviewed by Hastings and Popper (2009) 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 (TTS) and permanent (PTS) hearing loss, auditory and non-auditory tissue damage, egg damage, reduced growth rates, or mortality. An unpublished study (Jørgensen et al., 2005) reported that larval and juvenile (≤ 6 cm standard length) pollock, Atlantic cod, Atlantic herring, and spotted wolfish were exposed to between 4 and 100 pulses of 1 second duration of pure tones at 1.5, 4 and 6.5 kHz. Sound pressure levels at the location of the fish ranged from 150 to 189 dB (re 1 µPa), and "there were no effects on fish behavior during or after exposure to sound (other than some startle or panic movements for sounds at 1.5 kHz) and there were no effects on behavior, growth (length and weight), or survival of fish kept as long as 34 days post-exposure."[35] Internal organs showed no damage resulting from the sound exposure (Jørgensen et al., 2005). Pacific Northwest National Laboratory conducted laboratory exposure studies of juvenile Chinook salmon in which the subjects were exposed to simulated turbine noise at 159 dB re 1µPa (broadband), continuously for 24 h (Halvorsen et al., 2011). Post-exposure necroscopies indicated that non-lethal, low levels of tissue damage may have occurred, but that noise exposure did not lead to PTS or TTS.

Based on estimated maximum sound levels of 178 dB (re 1 µPa @ 1 m) during installation, maintenance, and removal, fish may temporally avoid the immediate vicinity of at sea activities. Because the activities would be short-term (days or hours depending on the specific activity) and comparable to existing noise levels associated with the high vessel traffic of the shipping lanes, adverse effects are not expected to be significant. Adhering to Washington DFW work windows during installation would minimize potential disturbance of sensitive fish species when they are most vulnerable to disturbance.

As explained above, the maximum broadband source level for turbine operation is 172 dB (re: 1 µPa @ 1 m); thus fish are likely to detect turbine noise, and at such levels could, based on lab results, be subject to temporary hearing loss. However, these levels correspond to maximum generation, which occurs infrequently and for short periods (on the order of minutes, not hours); furthermore, noise generated from turbine operation will attenuate with distance (both horizontally and vertically). Modeling conducted by Polagye et al. (2012a) suggests that fish would detect the turbines and avoid the turbines before injury occurs.

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[35] Exception was one test conducted on two groups of Atlantic herring at an SPL of 189 dB re 1 µPa, experienced post-exposure mortality of 20-30%.

Based on detection probabilities generated for Atlantic cod, a hearing generalist, Polagye et al. (2012) predicted that for one-third octave bands with center frequencies exceeding 500 Hz, detection is unlikely under any combination of turbine noise and ambient noise due to increasing hearing thresholds. At lower frequencies, detection of turbine noise is only likely (i.e., probability exceeding 50%) within a few hundred meters of the project. This establishes an upper bound for the extent of potential behavioral disturbance (i.e., zone of responsiveness is equal to or, more likely, smaller than the zone of detection). The reasons for the relatively low detection probability is that, under most operating conditions, the turbine is relatively quiet and ambient noise at low frequencies (i.e., < 1 kHz) is dominated by shipping at this location (Bassett et al., 2012*a*).

For the above reasons, project operations are not expected to create noise at levels that will negatively affect fish, except perhaps in the immediate project area during peak tidal velocities, when avoidance may occur. This is estimated to occur 0.01 percent of the time the turbines are operational. Such effects, however, would be inconsequential given the size of Puget Sound and available habitats surrounding the project. Additionally, exposure would be limited for those migratory species that may only be transiting through the project area (e.g., Pacific salmon).

Marine Mammals

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. Marine mammals as a taxonomic group have functional hearing ranges of 10 Hz to 200 kHz; this includes ultrasonic, frequencies greater than 20 kHz, and infrasonic, frequencies less than 20 Hz. Odontocetes and pinnipeds are typically more sensitive to higher frequencies and mysticetes are more sensitive to lower frequencies (Richardson et al., 1995).

Noise exposure criteria for injury to marine mammals are given for two types of sounds, impulsive (transient) and non-impulsive (continuous). Impulsive sounds are generally characterized by rapid rise of sound pressure followed by a sound pressure fall. Examples of impulsive sound include explosions, gunshots, and pile driving strikes. No such activities would occur during project installation, operation, maintenance, or removal; therefore, project construction and operation will only generate non-impulsive sounds.

NMFS has established two levels of acoustic thresholds to evaluate potential effects to marine mammals, Level A and Level B Harassment. Level A Harassment has the potential to injure a marine mammal or marine mammal stock in the wild, while 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. For non-impulsive sounds, received sound pressure levels of 120 dB (re 1 μPa) is considered Level B harassment and has the potential for behavioral disturbance to cetaceans and pinnipeds.

NMFS uses a "do not exceed" exposure criterion of 180 dB (re 1 μPa) for mysticetes and (recently) all odontocetes exposed to sequences of impulsive sounds, and a 190 dB (re 1 μPa) criterion for pinnipeds exposed to such sounds (Southall et al., 2007). As described above, noise levels associated with project installation, maintenance, operation, and removal would be continuous and are not expected to exceed the 180 dB (re 1 μPa) threshold that could result in harm to marine mammals.

However, vessel use during project installation, maintenance, and removal activities may exceed the 120 dB (re 1 μPa) threshold. Because these effects would be temporary, and short-term and similar to existing sources of noise in the Admiralty Inlet, they are not expected to adversely affect marine mammal use, particularly considering the cross section of the two tidal turbines in comparison to the cross section of Admiralty Inlet at the deployment site is extremely small.

Turbine operation is also expected to exceed the 120 dB (re 1 μPa) threshold. Figure 9 shows the distance to the 120 dB re 1μPa isobel as a function of operating percentile for the turbines. Only beyond the 75th operating percentile does broadband noise from the turbines exceed the threshold for Level B harassment beyond 100 m.

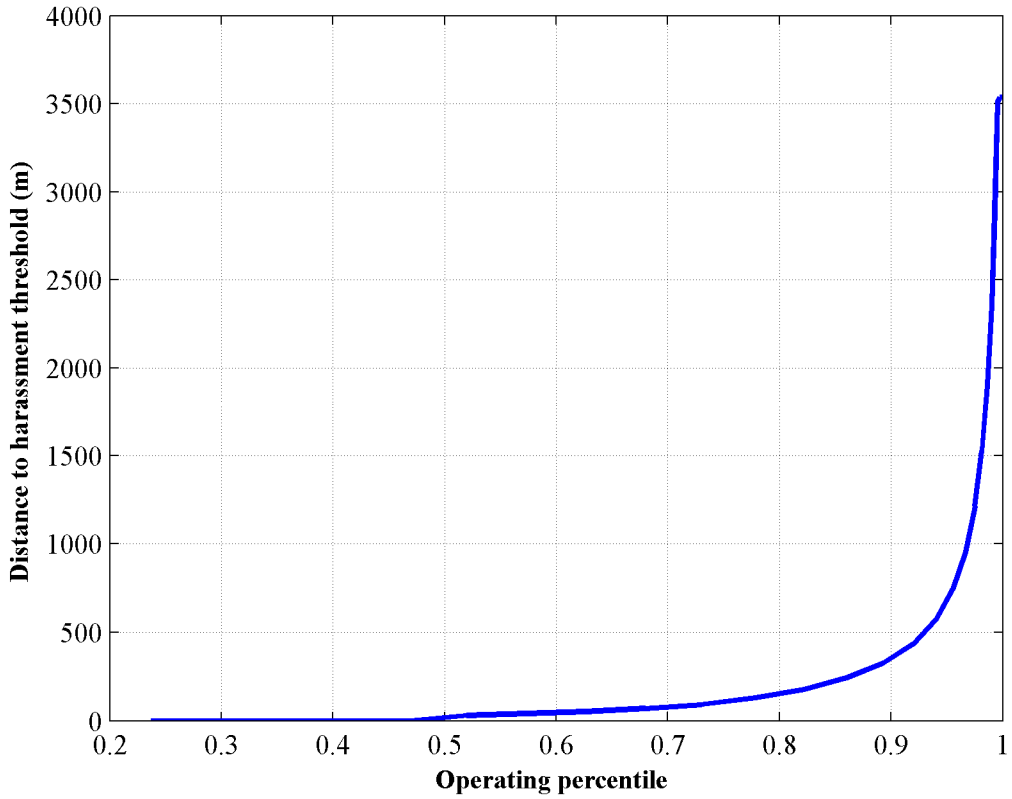

Figure 9. Distance from project center (mid-point between turbines) to Level B harassment threshold for broadband (25 Hz – 25 kHz) sound pressure levels (Source: application).

Polagye et al. (2012*a*) assessed the probability of detecting turbine noise relative to ambient noise (i.e., signal excess) for three classes of marine mammals: mid-frequency cetaceans (represented by killer whales), high-frequency cetaceans (represented by harbor porpoises), and pinnipeds (represented by harbor seals). The probability of these classes of marine mammal detecting turbine noise was investigated for six one-third octave bands: 50 Hz, 160 Hz, 500 Hz, 2 kHz, 8 kHz, and 25 kHz. The first four bands correspond to "tonal clusters" in which turbine noise is at a relative maximum and, therefore, more likely to be detected against ambient noise. The final two bands are important for marine mammal communication.

In general, the probability of these marine mammals detecting turbine noise is less than 50 percent at ranges beyond a few hundred meters. This conclusion is based on a combination of sound attenuation (spreading and absorption), hearing thresholds, and the ambient noise baseline (turbine noise and shipping noise have similar spectral profiles). Mid-frequency cetaceans, high-frequency cetaceans, and pinnipeds are most likely to detect turbine noise at frequencies of a few hundred Hz. While detection of turbine noise

at higher frequencies is possible, it is only likely very close to the project. Detection does not necessarily imply responsiveness, but does establish a likely upper bound for the possible zone of responsiveness. Snohomish PUD's Near-turbine Mitigation and Monitoring Plan (discussed earlier) and Marine Mammal Monitoring Plan (discussed later) would help determine marine mammal responses to the turbines.

Polagye et al. (2012*a*) did not evaluate noise detection by low-frequency cetaceans because no audiograms for this class of marine mammals exist (Southall et al., 2007). However, based on the results for fish hearing presented above, low-frequency cetaceans would be expected to detect turbine noise at greater range than other cetaceans or pinnipeds (e.g., high probability of detecting noise at distances out to 1 km from the project site).

Due to the device's passive mechanics and low rotational speeds, it is unlikely that radiated noise would induce physical harm, trauma, or dramatic behavioral response of marine fish and mammals. Nonetheless, direct and indirect interaction of hydrokinetic turbine technology and marine resources is not fully known. The Acoustic Monitoring and Mitigation Plan and Marine Mammal Monitoring and Mitigation Plan would effectively monitor noise levels emitted by project operation, provide a better understanding of any potential adverse effects to marine resources, and determine if noise levels that may harm marine resources have been exceeded. Furthermore, the Near-turbine Mitigation and Monitoring Plan and Marine Mammal Monitoring and Mitigation Plan would help determine marine mammal behavioral responses to the turbines. These plans contain adaptive management triggers and mitigation measures if adverse effects are detected. The methods and reporting proposed in the plan would allow for an adequate assessment of these potential effects and the need for any mitigation measures.

Marine Debris Entanglement

In dynamic tidal sites, any floating or benthic debris carried within the water column in the tidal flow could be become entangled on the turbine or gravity based foundation. Such debris may include derelict fishing gear, which could pose an entanglement risk to marine mammals, fish, and potentially marine birds in the vicinity of the project.

Snohomish PUD proposes to monitor for derelict fishing gear as part of its Derelict Gear Monitoring Plan. There will also be an ability to monitor much of the turbine face from the video cameras installed as part of the Near-Turbine Monitoring and Mitigation Plan.

During the first year following project installation, Snohomish PUD would deploy an ROV at a minimum of once every three months to inspect project features for accumulation of derelict gear. Following the first year, Snohomish PUD would review the monitoring results with the MARC to determine the degree to which derelict gear gets

caught on the project, if at all, and determine whether changing the frequency of subsequent underwater inspections is appropriate.

If the District observes derelict fishing gear snagged on the project works, Snohomish PUD would notify the MARC and would remove the gear as soon as possible in accordance with a removal plan developed in consultation with the Washington DFW and MARC. Because ROVs capable of detection and subsequent removal of derelict gear are available for deployment at the project site within 48 hours and, given the frequency of appropriate ocean conditions for ROV use, any derelict fishing gear snagged on project works would likely be removed shortly after it is detected (i.e., within one week). The derelict gear removal would generally involve a support vessel maintaining position using "live boat" techniques, ROV approach and assessment of the derelict gear and any aquatic species trapped, ROV securing of the derelict gear using a manipulator arm and/or cutting tool, and winching up of the ROV and derelict gear by the support vessel. Upon removal, the derelict gear will be examined by a marine biologist. Species, size, and number of trapped or entangled marine life observed by video and from observations of gear brought to surface will be recorded and reported to the MARC. Disposal would typically consist of removal of lead from nets for recycling, and landfill disposal for all remaining material.

FWS and Washington DFW recommend that Snohomish PUD implement the Derelict Gear Monitoring Plan filed with the license application.

Staff Analysis

Commercial and recreational fishing activities have contributed to numerous instances of derelict fishing gear in the Puget Sound region. The Northwest Straits Commission independently estimated that as many as 4,000 derelict fishing nets/gear are present on the seafloor in Puget Sound and the Northwest Straits south of the U.S.-Canada border (NWSF, 2007). Good et al. (2009) reported that for the 902 derelict fishing nets recovered since 2002 from the United States portions of the Juan de Fuca Strait and Puget Sound, 876 were gillnets, 23 were purse seines, two were trawl nets, and one was an aquaculture net. Most gillnets were recovered from depths less than 22 meters, with a maximum depth of 42.7 meters (Good et al., 2009).[36]

However, recovery efforts by the Northwest Straits Marine Conservation Initiative have significantly reduced derelict gear in Puget Sound, including Admiralty Inlet. Utilizing divers and side scan sonar, approximately 2,500 high priority derelict nets have been removed from Puget Sound, moving towards fulfillment of the goal to clear 90

[36] The report does not specify whether the derelict gear is more common in depths less than 22 meters or if gear in shallower water was targeted for recovery.

percent of the existing derelict fishing nets from high priority areas of Puget Sound by 2012 (Northwest Straits, 2012). High priority areas in Puget Sound include the San Juan Islands, Central Puget Sound, and Admiralty Inlet (Northwest Straits 2009). Because of these efforts, it is expected that the risk of derelict fishing gear snagging on project works has decreased substantially, and will decrease even more in the future.

The probability of derelict gear becoming snagged on the project turbines is further reduced by the lack of any mooring or anchoring lines that could snag floating debris, and by the hydrodynamic movement of water around the turbine and through the open center, and by the reversal of the tide direction every 6 hours, which would likely prevent debris from attaching or remaining attached to project works. Additionally, no gillnet fishing occurs in Admiralty Inlet (gillnets represented 97 percent of the derelict gear retrieved as reported by Good et al. [2009]). The closest commercial gillnet fishing occurs in Hood Canal to the south and the San Juan Islands area to the north (Washington DFW, 2010b).

In the unlikely event that marine debris becomes entangled on the project turbines, performance of turbines is expected to drop and would be detected by Snohomish PUD's operations control system. As an additional safeguard, Snohomish PUD's Derelict Gear Monitoring and Mitigation Plan would provide a means for detecting and removing derelict gear snagged on project works. Furthermore, the video cameras installed as part of the Near-Turbine Monitoring and Mitigation Plan would provide a means to monitor much of the turbine face. Consultation with the MARC would provide a mechanism to evaluate the effectiveness of monitoring methods and determine whether adjustments to monitoring methods are necessary.

Essential Fish Habitat

Snohomish PUD developed an EFH assessment that it included in Appendix G of the Admiralty Inlet Pilot Tidal Project license application (the Biological Assessment). As noted in the EFH assessment, Admiralty Inlet has been designated as EFH for Pacific Groundfish, Pacific Coast Salmon, and Coastal Pelagics. The assessment characterized potential effects of the project on EFH, including habitat alteration, biofouling and species attraction, blade strike and entrainment, noise, and the introduction of EMF. A summary of that assessment is provided in the analysis above.

Snohomish PUD does not expect any significant effects on EFH, given the following proposed environmental measures:

- Use HDD to deploy transmission cable from a minimum depth of 18 meters to shore to avoid adverse impacts to nearshore and shoreline habitats;
- Lay the transmission cables on the seabed to avoid the need for dredging or open trenching, thereby eliminating potential sediment suspension or transport;

- Conduct installation work only during Washington DFW-approved work windows;
- Conduct near-turbine monitoring and identification of aquatic species (Near-Turbine Monitoring and Mitigation Plan);
- Monitor for derelict gear and remove it as necessary (Derelict Gear Monitoring and Mitigation Plan);
- Conduct benthic habitat monitoring (Benthic Habitat Monitoring and Mitigation Plan);
- Conduct environmental monitoring during Project construction and removal (Water Quality Monitoring Plan);
- Finalize an Emergency Shutdown Plan (part of Project Safeguard Plans); and
- Implement adaptive management to modify Project and Project operations, as necessary, based on monitoring results and consultation (Adaptive Management Plan).

Staff Analysis

As with the discussion of risk to species or taxa groups, the risk to their habitats is small with this pilot project proposal. The first reason is that the proposed project is small relative to the habitat available in Admiralty Inlet. A second reason is that analysis shows that the risks from direct impact through blade strike, indirect effects through behavior change, including that caused by reef effects, avoidance, acoustic factors, or EMF are small). Finally, detailed monitoring plans, developed with area stakeholders and other experts, would be implemented to detect such effects. Included with the monitoring measures are measures to consult with stakeholders who helped develop the plans and adapt the plans or the project if concerns about harm to organisms or their habitats dictate. In a worst case scenario, the project would be shut down and removed. The only likely effects of the project are the immediate and temporary disturbance of the placement and presence of the devices and the transmission line over a small fraction of the floor of the inlet. In the context of the project surroundings, the proposed monitoring and mitigation plans, and the minor and localized nature of any potential effects, we conclude that the project would not adversely affect EFH.

Adaptive Management Framework

Snohomish PUD proposes to use an adaptive management framework within its environmental monitoring plans to allow for future modifications to the plans based on preliminary results. This adaptive management strategy would entail implementing and reviewing the various monitoring and mitigation plans with a Marine Aquatic Resource Committee (MARC) consisting of representatives from state and federal agencies and Tribes. The adaptive management framework includes specific triggers for addressing

indentified adverse effects on marine resources. The framework also defines meeting protocols and dispute resolution procedures.

Washington DFW recommends the Commission include as a license term, a steering committee called the MARC which would assist and review creation and implementation of monitoring and management plans, including the use of adaptive management.

Snohomish PUD notes that its adaptive management framework already provides for consultation with the MARC and that a specific article requiring its establishment is not necessary. Further, to the extent that Washington DFW is requesting that the MARC be obligated to implement certain license obligations, it suggests the FERC must reject the recommendation because it would obligate parties other than the licensee.

Staff Analysis

The purpose of the Commission's hydrokinetic pilot project license is to allow for the deployment of new technology marine and hydrokinetic projects in which the environmental effects are not yet well understood, while managing the uncertainty through required post-license monitoring and safeguard plans that ensure the protection of the public and environment. Due to the learning curve of monitoring these types of projects in their often volatile environments (*i.e.*, strong currents, extreme tidal fluctuations), the ability to utilize an adaptive management strategy to receive feedback from stakeholders and modify plans as necessary is imperative.

The consultation framework provided in the various monitoring plans provides for managing uncertainty with feedback from stakeholders, including Washington DFW. Further, as noted by Snohomish PUD, the Commission's jurisdiction is limited to its licensee's.

3.3.2.3 Cumulative Effects

Although it is unclear to what extent the proposed project would affect marine resources until the results of the proposed monitoring plans have been analyzed, marine resources have the potential to be cumulatively affected by the proposed project in conjunction with other past, present, and reasonably foreseeable actions in Admiralty Inlet. The environmental effects of new technology hydrokinetic projects would be evaluated through the effective monitoring of pilot projects such as is being proposed by Snohomish PUD.

Nonetheless, given the small scale of the project, short term of operation, a remotely controlled braking system for the turbines that would allow for the project to be shut down quickly in the case of an emergency; the design of the turbines, with the blade tips shrouded within the duct, that minimizes the potential strikes on fish, diving birds,

and marine mammals; and site restoration following operation, any cumulative adverse effects from project construction and operation are not expected or would be insignificant.

3.3.3 Rare, Threatened, and Endangered Species

3.3.3.1 Affected Environment

Fourteen ESA-listed species (nine fish, three mammals, one bird, and one plant) are considered to have the potential to occur in the project area (table 3).

Table 3. Federally listed threatened and endangered species with potential to occur in proposed project area (Source: application, as modified by staff).

Common Name (Stock)	Scientific Name	Federal Status	Relevant Recovery Plans and Status Reports
Fish			
Chinook Salmon (Puget Sound)	*Oncorhynchus tshawytscha*	CH T	Good et al. 2005; SSPS 2007
Chum Salmon (Hood Canal Summer-run)	*Oncorhynchus keta*	CH T	Good et al. 2005; Brewer et al. 2005; SSPS 2007
Steelhead (Puget Sound)	*Oncorhynchus mykiss*	T	Good et al. 2005; NOAA 2005*b*
Bull Trout (Coastal/Puget Sound)	*Salvelinus confluentus*	CH T	USFWS 2004; SSPS 2007
Green Sturgeon (Southern DPS)	*Acipenser medirostris*	CH T	NMFS 2005*c*
Bocaccio (Puget Sound/Georgia Basin)	*Sebastes paucispinis*	E	Drake et al. 2010*a*
Canary Rockfish (Puget Sound/Georgia Basin)	*Sebastes pinniger*	T	Drake et al. 2010*a*
Yelloweye Rockfish (Puget Sound/Georgia Basin)	*Sebastes ruberrimus*	T	Drake et al. 2010*a*
Eulachon (Southern Pacific)	*Thaleichthys pacificus*	T	Drake et al. 2010*a*

Common Name (Stock)	Scientific Name	Federal Status	Relevant Recovery Plans and Status Reports
Marine Mammals			
Southern Resident Killer Whale	*Orcinus orca*	CH E	NMFS 2008*c*; Krahn et al. 2004
Humpback Whale (North Pacific)	*Megaptera novaeangliae*	E	NMFS 2005*e*, 1991
Steller Sea Lion (Eastern)	*Eumetopias jubatus*	CH T	NMFS 2008*e*; Angliss and Outlaw 2006
Birds			
Marbled Murrelet	*Brachyramphus marmoratus*	CH T	USFWS 2003, 1997
Plants			
Golden Paintbrush	*Castilleja levisecta*	T	USFWS 2007, 2000

E = Endangered
T = Threatened
CH=Critical Habitat

Each species is discussed below relative to known or expected distributions, habitat requirements, recovery plans, and designated critical habitat. The discussion is a summary of the detailed information contained in the biological assessment filed with NMFS and FWS on April 23 and April 24, 2012, respectively.

Chinook Salmon (Puget Sound)

NMFS listed the Puget Sound evolutionarily significant unit (ESU) of Chinook salmon as a threatened species on March 24, 1999[37] and reaffirmed the listing on June 28, 2005.[38] Factors threatening naturally spawned Chinook salmon throughout its range are numerous and varied. The present depressed condition is the result of several long-standing, human-induced factors including habitat degradation, water diversions, harvest, and artificial propagation (64 FR 14316). Recovery efforts for the Puget Sound population of Chinook salmon are addressed in the Puget Sound Salmon Recovery Plan (Shared Strategy for Puget Sound [SSPS], 2007). NMFS designated critical habitat for Puget Sound Chinook salmon on September 26, 2005, with the designations effective January 2, 2006.[39] Within designated areas, EFH extends from the line of extreme high

[37] 64 FR 14308-14328.
[38] 70 FR 37160-37204.
[39] 70 FR 52630-52858.

tide out to a depth of 30 meters. Admiralty Inlet and the project action area are included in the critical habitat designation.

Chinook salmon exhibit two life histories: ocean-type and stream-type. Ocean-type Chinook salmon generally migrate from freshwater to the marine environment as sub-yearlings; however, if environmental conditions are not conducive to outmigration, they may remain in freshwater for their entire first year (Meyers et al., 1998). Populations of Puget Sound Chinook salmon exhibit a great deal of variation in the timing of outmigration by juveniles (SSPS, 2007). Stream-type Chinook salmon generally remain in freshwater for two years, sometimes three years before entering saltwater. Ocean-type Chinook utilize estuaries and coastal waters, whereas stream-type Chinook utilize freshwater systems and a variety of habitats within these systems (Meyers et al., 1998).

Upon entering saltwater, Chinook salmon remain at sea for one to six years, but more commonly two to four years, before returning to their natal streams to spawn. While at sea, Chinook salmon exhibit coastally oriented ocean migration patterns. Chinook salmon originating from Puget Sound tributaries predominantly mature as three or four-year olds (SSPS, 2007).

Admiralty Inlet is an important environment for both juvenile and adult Chinook salmon. Juvenile Chinook use the shoreline and nearshore habitats in Puget Sound, including Whidbey Island, for foraging and rearing, prior to moving off-shore to deeper waters.

Hood Canal Summer-run Chum Salmon

NMFS listed the Hood Canal Summer-run evolutionarily significant unit (ESU) of chum salmon as a threatened species on March 24, 1999[40] and reaffirmed the listing on June 28, 2005.[41] Factors threatening naturally spawned chum salmon throughout its range are numerous and varied. The present depressed condition is the result of several long-standing human-induced factors including habitat degradation, water diversions, harvest, and artificial propagation.

Residence in the estuary appears to be the most critical life phase for chum salmon. Chum salmon are considered second to Chinook salmon in their dependence upon estuarine waters (Groot and Margolis, 1991).

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[40] 64 FR 14308-14328.

[41] 70 FR 37160-37204.

Admiralty Inlet contains critical habitat that is an extension of that from Hood Canal. The Inlet constitutes an important marine habitat that is frequently used by both juveniles and adults (Good et al., 2005). Because spawning occurs within Hood Canal (Good et al. 2005), Admiralty Inlet provides a migratory pathway for species migrating into Puget Sound.

Steelhead (Puget Sound)

Puget Sound Distinct Population Segment (DPS) steelhead was listed as a threatened species on May 11, 2007.[42] The primary listing factors for steelhead are the present or threatened destruction, modification, or curtailment of its habitat or range; barriers to fish passage and adverse effects on water quality and quantity resulting from dams, the loss of wetland and riparian habitats, and agricultural and urban development.

Steelhead, the sea-run form of freshwater rainbow trout, displays a wide range of life history diversity that enables the species to persist in highly variable environments. The diversity of life history characteristics include the potential presence of resident and anadromous forms, varying periods of freshwater and ocean residency, summer and winter adult return timing to freshwater, and plasticity of life history between generations (Washington DFW, 2008).

There are two life-history types of anadromous steelhead: summer-run and winter-run. The difference in the steelhead runs is the timing of adult freshwater entry for spawning (Moyle, 1976). Unlike other Pacific salmon, steelhead are iteroparous, capable of repeating spawning. In contrast to semelparous Pacific salmon (spawn once in lifetime), steelhead females do not guard their redds (nests) but return to the ocean following spawning (Burgner et al., 1992). In some cases, anadromous steelhead yield offspring of the freshwater rainbow trout variation (72 FR 26722). Reproductive interactions may occur between steelhead and resident rainbow trout (Washington DFW, 2008).

Puget Sound steelhead feed in the ocean for one to three years before returning to their natal stream to spawn. Adult steelheads on the central coast of British Columbia spend considerable time at the surface, based on telemetry. The geometric mean depth was 1.6 meters, and on average the fish spent 72 percent of the time in the top one meter of the water column. The maximum depth observed was 30 meters (Ruggerone et al., 1990).

Bull Trout (Coastal/Puget Sound)

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[42] 72 FR 26732.

The FWS listed the Coastal-Puget Sound DPS of bull trout as a threatened species on November 1, 1999.[43] Primary listing factors include present or threatened destruction, modification, or curtailment of its habitat or range, specifically barriers, timber harvesting, agricultural practices, and urban development. On October 18, 2010 the FWS revised the critical habitat for bull trout, with the designations effective November 17, 2010.[44] The proposed critical habitat for nearshore marine areas is based on the photic zone. Critical habitat for nearshore marine areas extends from the mean higher high water line offshore to the depth of 10 meters (33 feet) relative to the mean lower low water line.[45] This distance equates to the average depth of the photic zone and is considered the habitat most consistently used by bull trout in marine waters. Critical habitat is not designated within Admiralty Inlet and therefore is not located within the Project area.

Bull trout are members of the char group within the family Salmonidae. Bull trout closely resemble Dolly Varden, a related species. Genetic analyses indicate, however, that bull trout are more closely related to an Asian char than to Dolly Varden (Pleyte et al., 1992).

Bull trout exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. The fluvial, adfluvial and resident forms exist throughout the range of the bull trout (Rieman and McIntyre, 1993). These forms spend their entire in freshwater. The anadromous life history form is currently known only to occur in the Coastal-Puget Sound region within the coterminous United States (Volk, 2000). Technically, the Coastal-Puget Sound population segment is amphidromous, meaning individuals often return seasonally to freshwater as subadults, sometimes for several years, before returning to their natal tributary to spawn. These subadult bull trout move into marine waters and return to freshwater to take advantage of seasonal forage opportunities to feed on salmonid eggs, smolts, or juveniles (SSPS, 2007). Multiple life history types may be expressed in the same population, and this diversity of life history types is considered important to the stability and viability of bull trout populations (Rieman and McIntyre, 1993). While juvenile bull trout are limited to freshwater, subadult and adult bull trout occur in Puget Sound. In a study to assess spatial and temporal distribution of bull trout in estuarine and nearshore marine waters of Puget Sound, tagged adult and subadult bull trout were found in depths ranging from 1 to 20 meters, over all substrate types (Goetz et al., 2003).

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[43] 64 FR 58910-58933.

[44] 75 FR 63973.

[45] The mean lower low water line (MHHW) is at the average level of the lower of the two daily tides.

The majority of growth and maturation for anadromous bull trout occurs in estuarine and marine waters. In marine waters of Washington, bull trout feed on Pacific herring, Pacific sand lance, and surf smelt (Goetz et al., 2004; Washington DFW et al., 1997). Bull trout normally reach sexual maturity in four to seven years and may live longer than 12 years (FWS, 2004). Unlike Chinook and chum salmon, bull trout have the ability to spawn more than once in a lifetime. Bull trout spawn annually or bi-annually in headwater areas, and return to larger rivers, lakes or estuaries to forage. Repeat spawners are extremely important to the long-term persistence of bull trout populations; they typically have greater fecundity, and these survivors have multiple opportunities to contribute to the gene pool (SSPS, 2007).

Admiralty Inlet provides important foraging, migrating, and overwintering habitat for bull trout. Marine important foraging, migrating, and overwintering habitat for Coastal-Puget Sound bull trout includes portions of Puget Sound and associated nearshore and estuarine areas. These habitats provide an abundance of preferred prey species, including juvenile trout, salmon, and forage fish species such as sandlance, surf smelt, and herring. Bull trout are dependent upon productive forage fish spawning beaches and intertidal habitats such as eelgrass beds and large woody debris present in nearshore areas. Both subadult and adult bull trout have been observed using tidally influenced areas (USFWS, 2004). Bull trout in the Coastal-Puget Sound population segment also move through marine areas to gain access to independent streams to forage or take refuge from high flows (SSPS, 2007).

Green Sturgeon (Southern DPS)

Based on a preliminary genetic analysis and suspected fidelity to natal rivers, the North American green sturgeon was split into a northern and southern DPS under the ESA on January 29, 2003.[46] The Northern DPS consists of green sturgeon populations originating from coastal watersheds northward of, and including, the Eel River in northern California. NMFS determined that the Northern DPS did not warrant listing as an endangered or threatened species.

The Southern DPS consists of green sturgeon populations originating from watersheds south of the Eel River in California. NMFS determined that green sturgeon from the Sacramento River and Delta system has declined substantially and that the Southern DPS would likely become endangered in the near future if ongoing threats were not addressed. On April 7, 2006[47] NMFS issued a final rule listing the green sturgeon Southern DPS as a threatened species based on the following listing factors: reduction of access to spawning areas, concentration of adults into one spawning area, destruction,

[46] 68 FR 4433.
[47] 71 FR 17757.

modification or curtailment of habitat, and inadequacy of existing regulatory mechanisms. Critical habitat for the green sturgeon Southern DPS was finalized on October 9, 2009.[48] Admiralty Inlet and Puget Sound are not included in the final critical habitat designation.

Green sturgeon are a long-lived anadromous fish species with a wide distribution. Green sturgeon are thought to have a maximum age of 60 to 70 years (NMFS, 2007b). This species reaches maturity at 15 to 19 years of age (Van Eenennaam et al. 2006) and spawns every two to five years (Adams et al., 2002; Erickson and Webb, 2007). Green sturgeon is a large species with mature fish ranging from 139 to 223 centimeters (54.7 to 87.8 in.) in length and can weigh up to 350 pounds (159 kilograms)(NMFS, 2007c and Skinner, 1982).

Based on information from some genetic analyses, limited tagging studies, and commercial fishing reports, green sturgeon are believed to make some extensive movements from natal rivers, generally in a northerly direction (NMFS, 2005b; Adams et al., 2002; Erickson and Hightower, 2007; Israel and May, 2007, Lindley et al., 2008). Data collected from seven out-migrating green sturgeon tagged with pop-off archival tags in the Rogue River indicates that green sturgeon were more active at night, generally inhabited depths of 40 to 70 m, and occasionally made rapid ascents to the surface.

The primary threat is attributed to the decrease in spawning habitat to a single population in the upper Sacramento River. Migration barriers and water diversion projects have reduced or eliminated what was thought to have been historical spawning habitat in the nearby Feather and San Joaquin River systems. Water quality degradation due to thermal and potential contaminants within the Sacramento River system are also considered factors in the population decline and continued threats to the Southern DPS. While there is no focused fishery for green sturgeon, incidental catches and mortality from commercial and recreational fishing industry, in part targeting white sturgeon, was also listed as a threat (Erickson and Webb, 2007). Invasive species, such as the striped bass, also pose a potential risk, as they are known to prey on juvenile green sturgeon.

Bocaccio (Puget Sound/Georgia Basin)

NMFS determined that the bocaccio populations in the Georgia Basin (Puget Sound and the Strait of Georgia) are a DPS and are "at high risk" of extinction throughout all its range. NMFS listed bocaccio as endangered on April 28, 2010,[49] but has not designated any critical habitat yet. The primary factors responsible for the decline of bocaccio are overutilization for commercial and recreational purposes;

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[48] 74 FR 52300.

[49] 75 FR 22276.

degradation of water quality, including low dissolved oxygen and elevated contaminant levels; and loss of rocky habitat, loss of eelgrass and kelp, and introduction of non-native species that modify habitat.

Bocaccio is a deepwater rockfish species often associated with steep slopes consisting of sand or rocky substrates and occurring in Central Puget Sound, Tacoma Narrows, and Ports Gardner and Susan, and along the Strait of Juan de Fuca (Miller and Borton, 1980). They range from Baja California to the Gulf of Alaska, but are most common from Baja California to Oregon (Love et al., 2002). They are most frequently located between 50 and 250 meters deep, but are found as deep as 475 meters (Orr et al., 2000). Deep-benthic habitats for rockfish primarily include boulder, bedrock, and hardpan outcroppings, in the South Sound; deep rocky habitats are not as common, but do occur, in Admiralty Inlet (NMFS letter dated July 23, 2009). Bocaccio are suspected to live as long as 54 years (Drake et al., 2008).

Approximately 50 percent of adults mature in four to six years (MBC, 1987). Bocaccio spawn in the fall, generally between August and November (74 FR 18516). Fecundity ranges from 20,000 to over 2 million eggs, which is significantly more than many other rockfish species (Love et al., 2002). Bocaccio larvae feed on larval krill, diatoms, and dinoflagellates (74 FR 18531). Pelagic juveniles feed on fish larvae, copepods, and krill. Larvae and juvenile pelagics tend to frequent surface waters and tend to remain there for three to six months until moving to deeper waters of 18 to 30 meters (Carr, 1983; Feder et al., 1974; Johnson, 2006; Love and Yoklavich, 2008). Adults are generally associated with hard substrate but will venture into mud flats. The main predators of bocaccio are marine mammals (Committee on the Status of Endangered Wildlife in Canada, 2002).

There is no single reliable historic or current population estimate for bocaccio within the Puget Sound/Georgia Basin DPS; however, a dramatic decline in abundance is apparent (Drake et al., 2010b).

Canary Rockfish (Puget Sound/Georgia Basin)

NMFS determined that the canary rockfish (Sebastes pinniger) populations in the Georgia Basin are discrete from coastal populations and are a DPS. NMFS concluded that the Georgia Basin DPS is at "moderate risk" of extinction throughout its range based on a steep decline in abundance in Puget Sound. NMFS listed canary rockfish as threatened on April 28, 2010,[50] but has not designated any critical habitat.

The primary factors responsible for the decline of canary rockfish are overutilization for commercial and recreational purposes; degradation of water quality,

[50] 75 FR 22276.

including low dissolved oxygen and elevated contaminant levels; and loss of rocky habitat, loss of eelgrass and kelp, and introduction of non-native species that modify habitat.

The canary rockfish is a large rockfish that reaches up to 2.5 feet in length and 10 pounds in weight. As with most rockfish, canary rockfish live long lives, and mature and reproduce slowly, making them vulnerable to overfishing. Canary rockfish can live up to 69 years off the west coast of the United States (Palsson et al., 2009).

The canary rockfish occupies rocky and coarse habitats that occur throughout Puget Sound (Miller and Borton, 1980), and their range extends from the western Gulf of Alaska to northern Baja California (Boehlert, 1980; Mecklenburg et al., 2002). Larval and pelagic juveniles are typically found in surface waters (Love et al. 2002), but canary rockfish tend to move into deeper water as they age. Adults inhabit waters 160 to 820 feet (50 to 250 meters) deep (Orr et al., 2000), but have been found up to 1,400 feet (425 meters) deep (Boehlert, 1980).

Canary rockfish reach sexual maturity around ages 7 to 9 for males and 7 to 12 for females (Echeverria, 1987; Lea et al., 1999). Canary rockfish spawn annually with females producing between 260,000 and 1,900,000 eggs per year. Off Oregon and Washington coasts, parturition peaks in December and January (Barss, 1989; Echeverria, 1987).

Canary rockfish larvae feed on primarily crustacean larvae, invertebrate eggs, and copepods (Moser and Boehlert, 1991; Love et al., 2002). Juveniles consume prey such as crustaceans, barnacle cyprids, and euphasiid eggs and larvae (Gaines and Roughgarden, 1987; Love et al., 1991). Predators of juveniles include other fishes (e.g., lingcod, cabezon, salmon, and other rockfish), birds, and porpoise (Ainley et al., 1981; Love et al. 1991; Miller and Geibel, 1973; Morejohn et al. 1978; Roberts 1979). Adults feed on crustaceans and small fishes (Cailliet et al., 2000; Love et al., 2002). Predators of adults include yelloweye rockfish, lingcod, salmon, sharks, dolphins, and seals (Antonelis, Jr. and Fiscus, 1980; Merkel, 1957; Morejohn et al., 1978; Rosenthal et al., 1982).

There is no single reliable historic or current population estimate for canary rockfish within the Puget Sound/Georgia Basin DPS; however, a dramatic decline in abundance is apparent (Drake et al., 2010b). Palsson et al. (2009) note a precipitous decline in several species of rockfish in Puget Sound, including bocaccio, yelloweye rockfish and canary rockfish, and concluded that fishery removals (including bycatch from other fisheries) are highly likely to limit recovery of depleted canary rockfish populations in Puget Sound. In addition, they establish habitat disruption, derelict fishing gear, low dissolved oxygen, chemical toxicants and predation as moderate threats to Puget Sound rockfish populations.

The total rockfish population in the Puget Sound region is estimated to have declined around 3 percent per year for the past several decades, which corresponds to an approximate 70 percent decline in the time period ranging from 1965 to 2007 (Drake et al., 2010b)

Canary rockfish were infrequently observed in Puget Sound from 1996-2001 recreation data; they were reported at a frequency of 0.73 percent (sample size 550) in south Puget Sound, and 0.56 percent (sample size 1,718) in northern Puget Sound (Drake et al., 2008). These percentages are lower than historical percentages of catch from 1969 to 1989. Since 2002, fishing for canary rockfish has been prohibited.

Yelloweye Rockfish (Puget Sound/Georgia Basin)

Based upon stock assessments in adjacent coastal waters, NMFS determined that the yelloweye rockfish (Sebastes ruberrimus) populations in the Georgia Basin are a DPS and have a depleted status, and are therefore likely to become endangered in the foreseeable future throughout all its range. As a result, NMFS listed yelloweye rockfish as threatened on April 28, 2010,[51] but has not designated critical habitat. The primary factors responsible for the decline of yelloweye rockfish are overutilization for commercial and recreational purposes; degradation of water quality, including low dissolved oxygen and elevated contaminant levels; and loss of rocky habitat, loss of eelgrass and kelp, and introduction of non-native species that modify habitat (FR 22276).

Yelloweye rockfish range from Mexico to the Aleutian Islands, Alaska, but are most common from central California to the Gulf of Alaska (Clemens and Wilby, 1961, Eschmeyer et al. 1983, Hart 1973, Love 1996). Yelloweye occur in waters 25 to 475 meters deep (Orr et al. 2000) but are most commonly located between 91 to 180 meters (Love et al. 2002), and inhabit rocky pinnacles (Washington 1977, Love et al. 2002) and boulder fields (Wang 2005). Yelloweye are one of the largest species of rockfish, weighing up to 25 pounds (Love at al. 2002). Yelloweye are also one of the longest-lived rockfish, reaching ages of at least 118 years (Love, 1996; Love et al., 2002; O'Connell, 1987).

Yelloweye rockfish are a slow maturing species, with an average age maturity ranging from 19 to 22 years (Palsson et al., 2009). Females internally fertilize and are capable of storing sperm for several months before fertilization occurs, generally between September and April (Echeverria, 1987). Fecundity ranges from 1.2 to 2.7 million eggs, significantly more than other rockfish species (Love et al., 2002). In Puget Sound juvenile yelloweye occupy primarily shallow waters with high relief zones (Love et al., 1991; Richards et al., 1985). Juveniles prey on fish larvae, copepods, and krill. Adults move into deeper waters and continue to associate with rocky, high relief areas (Carlson

[51] 75 FR 22276.

and Straty, 1981; Love et al., 1991; Richards et al., 1985), and generally have a small home range (Coombs, 1979; DeMott, 1983; Love et al., 2002). Adult yelloweye are opportunistic feeders and are able to eat much larger prey than other rockfish. Adults feed on smaller yelloweye, and typically feed on sand lance, gadids, flatfish, shrimp, crab, and gastropods (Love et al., 2002; Yamanaka et al., 2006). Predators of yelloweye include salmon and killer whales (Ford et al., 1998; Love et al. 2002).

Eulachon

NMFS determined that the population of eulachon found within the states of Washington, Oregon, and California and extending from the Skeena River in British Columbia south to the Mad River in Northern California is a DPS (NMFS, 2009a). In March, 2010 (effective May 17, 2010), NMFS listed eulachon as threatened,[52] but has not designated critical habitat. The primary factors responsible for the decline of the Southern DPS of eulachon are the destruction, modification, or curtailment of habitat; dams and water diversions in rivers inhabited by eulachon; sediment dredging in areas inhabited by eulachon; overutilization for commercial, recreational, scientific, or educational purposes; and the inadequacy of existing regulatory mechanisms.

Eulachon is an anadromous smelt, which spawns in the lower portions of certain rivers draining into the northeastern Pacific Ocean ranging from Northern California to the southeastern Bering Sea in Bristol Bay, Alaska (Hubbs, 1925; Schultz and DeLacy, 1935; McAllister, 1963; Scott and Crossman, 1973; Wilson et al., 2006). In the continental United States, most eulachon originate in the Columbia River Basin. Eulachon spend 95 to 98 percent of their lives at sea (Hay and McCarter, 2000). In the ocean, juvenile eulachon move from shallow nearshore areas to deeper waters on the continental shelf. Larvae and young juveniles distribute widely in coastal waters, where, along with adults, they inhabit the ocean bottom in waters 20-150 meters deep (Hay and McCarter, 2000) and sometimes as deep as 182 meters (Barraclough, 1964).

Historical information dating back to 1858 indicates that eulachon were present in Puget Sound (Drake et al., 2010a). A 2007 Washington DFW technical report entitled "Marine Forage Fishes in Puget Sound" (Pentilla, 2007) presents detailed data on the biology, status, and trends of surf smelt and longfin smelt in Puget Sound, but states that "there is virtually no life history information within the Puget Sound Basin" available for eulachon. Similarly, detailed notes provided by Washington DFW and Oregon DFW as part of the ESA status review provide no evidence of spawning stocks of eulachon in Puget Sound rivers (Washington DFW and Oregon DFW, 2008).

Eulachon typically spend three to five years in saltwater before returning to freshwater to spawn from late winter through mid spring. Eggs are fertilized in the water

[52] 75 FR 13012.

column, and after fertilization the eggs sink and adhere to the river bottom, typically in areas of gravel and coarse sand. They are an important link in the food chain between zooplankton and larger organisms, including small salmon, lingcod, and other fish (NWPCC, 2004).

Eulachon are a small fish, rich in calories and important to marine and freshwater food webs, with historical importance to commercial and recreational fishermen as well as indigenous people from northern California to Alaska.

Southern Resident Killer Whale

NMFS listed the southern resident killer whale DPS as endangered on November 18, 2005.[53] NMFS determined the southern resident killer whale stock as a depleted species under the Marine Mammal Protection Act in May, 2003.[54] NMFS (2008c) issued a recovery plan for the southern resident killer whale in January 2008. NMFS designated critical habitat for the southern resident killer whales on November 29, 2006[55] Critical habitat includes three distinct marine areas identified as the Summer Core Area, Puget Sound Area, and the Strait of Juan de Fuca Area, and includes "waters relative to a contiguous shoreline delimited by the line at a depth of 6.1 meters (20 feet) relative to extreme high water." These three areas constitute the majority of Washington's northwestern coastline, excluding a few small areas. Admiralty Inlet lies within the Puget Sound Area. The following primary constituent elements were identified in the critical habitat ruling: water quality to support growth and development; prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and passage conditions to allow for migration, resting, and foraging.

Listing factors that continue to pose a threat or risk to killer whales within Puget Sound include: depleted prey abundance (salmon), low genetic diversity due to inbreeding, underwater noise pollution (e.g., from commercial, recreational, and research vessels), disease, and environmental contaminants.

Killer whales follow one of three life history forms or ecotypes. These forms include resident (which is a colloquial term referring not necessarily to site fidelity but rather to centralized movement patterns), transient, and offshore. The specific diet of pods varies both by location and by resident or transient behavior. Resident pods

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[53] 70 FR 69903-69912.

[54] 68 FR 31980-31983.

[55] 71 FR 69054-69070.

generally eat fish with few attacks on marine mammals, while transient pods are more prone to aggressive attacks on larger prey.

The southern resident killer whale DPS consists of three pods (one or more matriline groups traveling together), designated J, K, and L, that reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall (Bigg, 1982; Ford et al., 2000; Krahn et al., 2002). Pods can be found in the Puget Sound year-round, but during fall, winter and spring, southern resident killer whales are more prone to excursions and can be seen as far south as California. The majority of sightings of southern resident killer whales occur at locations off San Juan Island, where there have been 750-1,550 sightings from 1993-2005.

Winter and early spring movements and distribution are largely unknown for the population (NMFS, 2008*c*); ranges are best known from late spring to early autumn, when survey and observational effort is greatest. During this period, all three southern resident killer whale pods are regularly present in the Georgia Basin (including Georgia Strait, San Juan Islands, and Strait of Juan de Fuca) (NMFS, 2008*c*; Whale Museum, 2009*a*). The K and L pods typically arrive in May or June and spend most of their time in Georgia Basin until departing in October or November. While in inland waters during warmer months, all of the pods concentrate their activity from the south side of San Juan Islands through Haro Strait northward to North and South Pender Islands and Boundary Passage. Less time is generally spent elsewhere, including Admiralty Inlet west of Whidbey Island and Puget Sound (Hauser, 2006; NMFS, 2008*c*).

Since the 1970s, the Whale Museum in Friday Harbor, Washington has maintained a database of whale sightings—the Orca Master. From January, 1990, through December, 2008, the Orca Master database recorded 2,532 sightings of southern resident killer whale in Puget Sound "proper" (south of Deception Pass and Admiralty Inlet), and of those, 196 occurred within five nautical miles of the proposed project (Whale Museum, 2009b). These data suggest that southern resident killer whale transit through Admiralty Inlet as opposed to Deception Pass. All three pods use Puget Sound, with J pod the most common, and followed by K pod. Given reported pod associations during forays into Puget Sound it was estimated that a total of 1,442 southern resident killer whale animals transit through Admiralty Inlet in a year. During these transits, southern resident killer whale are more likely to use the western side of Admiralty Inlet, although the eastern portion is used as well. During these transits southern resident killer whale are often traveling, but also exhibit social and foraging behavior (Whale Museum 2009b).

Southern resident killer whales spend 95 percent of their time underwater, nearly all of which is between the surface and a depth of 30 meters (Baird, 2000; Baird et al., 2003, 2005). Baird et al. (2003, 2005) reported southern resident killer whale in inshore water of southern British Columbia and Washington averaged about 0.7 to two dives per

hour made below 30 meters, with such dives occurring more often during the daytime. These represented 5 percent of all dives and occupied less than 2.5 percent of an animal's total dive time. During the day, dives greater than 150 meters deep were made on average about once every five hours (Baird et al., 2003, 2005). Because dives below 30 meters represented only 2.5 percent of an animal's dive time, it is assumed that dives to 150 meters represent an extremely small portion of a whale's dive time.

Ford et al. (2000) report four behavioral states in killer whales, including foraging, traveling, resting, and socializing. Resident killer whales spend approximately 50 to 67 percent of time foraging, either actively feeding or searching for food (Ford, 1989). While traveling, killer whales swim in a tight formation, consistently swimming in a specific direction, often surfacing and diving simultaneously (Ford et al., 2000). This behavior is commonly observed among killer whales moving between locations such as feeding areas (Wiles, 2004). Resting, often occurring after foraging, comprises approximately 10 to 21 percent of resident killer whale behavior (Ford, 1989; Heimlich-Boran, 1988). During resting behavior, killer whales swim slowly, usually abreast, and in a tight formation, and surface and dive in unison (Ford et al., 2000). Socializing includes physical interactions, displays (e.g. breaching, tail slapping, spyhopping), and vocalizations (Ford et al., 2000). During the summer residents spend approximately 12 to 15 percent of their time socializing (Ford, 1989; Heimlich-Boran, 1988).

Since 1974, when annual censuses were initiated by the Department of Fisheries and Oceans Canada and later assumed by the Center for Whale Research in 1976, the population of southern resident killer whales ranged between 67 and 96 individuals. The L pod is the largest of the three pods, while J and K pods have similar numbers. As of November 2009, the estimated population totals 87 individuals: 41 in L pod, 27 in J pod, and 19 in K pod (Center for Whale Research, 2009). Survival of killer whales is age-specific, with higher mortality rates among young calves and low mortality rates among reproductive females. Generally, males have a lower life expectancy and higher mortality rates compared to females (Northwest Fisheries Science Center, 2008). Over the past three decades, on average, 3.3 calves were born each year, with an approximate 81 percent survival rate. Since 1978, there has been an average of 3.25 deaths per year (Northwest Fisheries Science Center, 2008).

Snohomish PUD also monitored marine mammal use of the project area by boat and from a vantage point on Admiralty Head between October, 2009 and April, 2010. The visual observation data collected during this study were used to complement results from passive acoustic monitoring (PAM) efforts from two hydrophones already mounted on the seafloor in the project area, as well as a cabled hydrophone located near Port Townshend. southern resident killer whale were seen in the study area by land based observers on three observer days (October 10, 20, and 21, 2009 and one fast response day [December 6, 2009]). During the study period, an estimated 22 southern resident killer

whale transits[56] were observed. Of the 22 times that southern resident killer whale transited the study area, the southern resident killer whale were detected acoustically via the automated algorithm of the Port Townsend Marine Science Center (PTMSC) hydrophone (14 times, 64 percent) and/or by human listeners (10 times, 45 percent) (Tollit et al., 2010b).

This study used opportunistic sighting information and PAM to successfully collect new data on seven (of the estimated 22) southern resident killer whale transits observed through Admiralty Inlet. Opportunistic dive depth information was collected in the vicinity of the proposed installation site using a vertical hydrophone array. The vertical array was deployed and used to collect recordings during seven of the southern resident killer whale transits. Of the 189 total minutes recorded, localized calls or clicks were recorded during a total of 104 minutes (55 percent). A total of 655 calls and clicks were localized at depths from the surface down to 142 meters; however, 80 percent of the vocalizations were produced at depths of 30 meters or less, with little difference in average depth by behavior category. During the closest approach to the proposed project site (October 21, 2009), while the focal group was categorized as foraging, depths from 23 to 58 meters were recorded from eight calls and clicks. This study indicated that there is great variability in the amount southern resident killer whales vocalize when transiting through the study area (0 to 92 percent of recording time). Periods of little or no vocal activity were witnessed, most notably on October 10, 2009, when the pods were described as undertaking slow (thought to be restful) travel (Tollit et al. 2010b).

Seven boat-based follows were conducted as southern resident killer whale transited the study area beaten October, 2009 and April, 2010. Location data of the focal group of whales showed a wide use of the study area by the whales traveling through the shipping lanes and generally west and southwest of the project site; land-based observations provided similar data. All three southern resident killer whale pod matrilines were observed transiting the study area. J pod was observed on six occasions, K pod on four occasions, and L pod on three occasions (all in October, 2009). On October 21, 2009, all three pods spent more than four hours in the study area, moving through the inlet to the north and then circling back for a double transit pass in one day; also on this day, the whales were observed (by boat and land) foraging close (~275 meters) to the project site. The same southern resident killer whale approach was detected by the C-POD during the PAM study (Tollit et al., 2010b) and by the Port Townsend hydrophone. In summary, during transits, a total of 11.5 hours of focal sampling were conducted. During this time, southern resident killer whale spent most of their time in the study area traveling (74 percent), while the remainder of the time was spent foraging (21 percent) and socializing (5 percent) (Tollit et al., 2010b).

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[56] A transit of Admiralty Inlet is defined as any crossing (entry or exit) of the line connecting Admiralty Head and Point Wilson.

Humpback Whale (North Pacific)

The humpback whale was listed as endangered on December 2, 1970.[57] There has been a prohibition on taking humpback whales since 1966. A recovery plan was issued for the humpback whale in 1991 (NMFS, 1991). Critical habitat has not been designated for the humpback whale.

The humpback whale occurs in all oceans, with the possible exception of the Arctic (NMFS, 1991). Humpback whales in the North Pacific feed in coastal waters from California to Russia and in the Bering Sea. Following restrictions on the whaling industry and prohibition of taking of humpback whales since 1966, populations of humpback whale have been increasing. The North Pacific humpback population is estimated to be 6,000 whales (Calambokidis et al., 1997).

Movement along the western United States coastline primarily occurs during summer and fall; however, historical whale observations have been made in every month except February, March, and April (NMFS, 1991). Within the summer feeding areas, humpback whales' distribution is likely driven by locations of dense patches of prey which vary inter-annually, seasonally, diurnally, and daily (NMFS, 1991). Generally, humpback sightings in northwest coastal waters are relatively uncommon. Barlow and Forney (2007) estimated 1,096 humpbacks in California, Oregon, and Washington waters based on summer/fall ship line-transect surveys in 2001. Forney (2007) estimated 1,769 humpbacks in the same region based on a 2005 summer/fall ship line-transect survey, which included additional fine-scale coastal strata not included in the 2001 survey.

Humpback whales feed on small crustaceans (krill), and various species of small fish (anchovies, herring, pollock, mackerel, sandlance). Each whale may consume nearly a ton of food per day while feeding and filter huge volumes of seawater. Feeding behavior is diverse and can vary from use of columns, clouds or nets of expelled bubbles to concentrate prey; herding, and possibly disabling prey by maneuvering, flicking or pounding with flukes and flippers; using the water surface as a barrier to prevent the escape of prey; feeding in formation ("echelon feeding"); acoustic cues to synchronize feeding lunges; and short and long-term cooperation between individuals (NMFS, 1991; Weinrich et al. 1992).

Steller Sea Lion (Eastern)

NMFS listed the Steller sea lion as threatened on April 5, 1990.[58] In May 1997, NMFS reclassified the species as two DPS, the western and eastern stock (NOAA,

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[57] 35 FR 18319.
[58] 55 FR 12645.

2007b). The western stock occurs from the western Gulf of Alaska west to Japan, while the eastern stock is found from Alaska south along the West Coast states of California, Oregon and Washington (NOAA 2007b). The western stock was reclassified as an endangered species under the ESA, while the eastern stock remained classified as a threatened species[59] In March 2008, NMFS issued the final recovery plan for the species (NMFS, 2008e). On August 27, 1993, NMFS designated critical habitat for both the western and eastern DPS of Steller sea lions; however it does not include waters of Washington.[60]

Primary listing factors included decline in prey abundance and quality. While the eastern DPS is improving, threats still exist. In order of relative importance, these include environmental variability, competition with fisheries, predation from killer whales, toxins, inadvertent commercial take, Alaskan native harvest, disease, and adverse interactions associated with tourism and research (NMFS, 2008e).

Sea lion habitat includes both marine waters and terrestrial rookeries (i.e., breeding grounds and haulouts), with the primary factor influencing habitat selection being prey availability. Males are the primary occupants of haulout sites. Although Steller sea lions may be found on gravel or cobble beaches, their preferred terrestrial habitat typically consists of exposed rocky shorelines associated with shallow well mixed waters, average tidal speeds, and gradual bottom slopes. Rookeries are nearly exclusively located on offshore islands and reefs (NMFS, 2008e).

Breeding primarily occurs from late May to early July (NMFS 2008e). Females remain with pups for one week after birth and then leave for varying lengths of time to feed. During June and July, Steller sea lions show high fidelity to their natal rookeries. Outside of June and July, however, Steller sea lions can travel great distances to feed. Foraging Steller sea lions have been observed traveling up to 1,770 kilometers from their natal grounds at travel rates exceeding 160 kilometers/day (NMFS, 2008e).

There are no rookeries within Washington State; however, adolescent and adult Steller sea lions can be found along the coast throughout the year (NMFS, 2008e; Pitcher et al., 2007). There are four haulouts, including two major sites (sites with greater than 50 animals) in Washington, which are regularly used during the breeding season. Steller sea lions at these sites are assumed to be immature animals and non-breeding animals associated with rookeries from other areas.

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[59] 62 FR 24345-24355.

[60] 58 FR 45269-45285.

Steller sea lions are observed in Puget Sound in the fall, winter, and spring. From 1983 to 1986, Steiger and Calambokidis (1986) observed Steller sea lions overwintering in South Puget Sound, south of Tacoma Narrows. The first sightings occurred in late fall and early winter, with numbers peaking in April or May, with the last sightings in May (Steiger and Calambokidis, 1986).

Steller sea lion use of Puget Sound, and the project area, appears to be increasing in recent years. In 2000, Jeffries et al. (2000) surveyed the area in and around Marrowstone Island, located in Admiralty Inlet, about 8.4 kilometers south of the project, and did not find any signs of habitat usage or haulout. Since 2000, a steady use of a site on the northeast side of the island has occurred. Three to 15 sea lions have been observed at this site over the last five years (personal communication, T. Loughlin, NRC, Inc. and P. Browne, HDR with S. Jeffries, Washington DFW). Three other sites at which Steller sea lions have been observed are located 37 to 58 kilometers north of the project, and 5 to 50 Steller sea lions have been observed at these sites (personal communication, P. Browne, HDR with S. Jeffries, Washington DFW, July 2009; Jeffries et al., 2000).

Snohomish PUD's marine mammal field studies conducted between October 2009 and April 2010, recorded 362 sightings of Steller sea lions in the project study area over 77 separate days. Steller sea lions were sighted mainly within about 1 kilometer of the observation point (bluffs at Fort Casey, near Admiralty Head) and were more frequently observed in the inshore zone (71 percent of observations). Typically, lone Steller sea lions were observed; however, interquartile range was 1 to 2, with a maximum group size of 14 observed. Sightings of Steller sea lions sometimes included observations of surface feeding behavioral events (Tollit et al., 2010a).

Marbled Murrelet

The USFWS listed the marbled murrelet as threatened under the ESA on September 28, 1992.[61] In 1997, the USFWS finalized a recovery plan for this species (FWS, 1997).

Once thought to be abundant in the Pacific Northwest, marbled murrelets are now only considered common during certain times of the year (FWS, 1997). Listing factors for marbled murrelet include loss and modification of nesting habitat primarily due to commercial timber harvesting, threats from mortality associated with gill net fishing operations, and effects of oil spills.

The marbled murrelet is a long-lived small seabird of the Alcidae family that inhabits the eastern Pacific coastline from Alaska to southern California. Spending much of its life at sea, but using old-growth forests for nesting, the marbled murrelet is

[61] 57 FR 45328-45337.

generally found in association with calm, shallow coastal waters and bays typically less than 1-1.6 kilometers from shore (Seattle Audubon Society, 2007).

Marbled murrelets forage for prey by diving and swimming underwater, propelling themselves with their wings. They generally forage in nearshore waters shallower than 30 meters but are capable of diving to depths of up to 47 meters (Mathews and Burger 1998). During summer, fish form a significant part of their diet, with typical prey including Pacific sand lance, Pacific herring, northern anchovy, smelts, and sea perch (FWS 1997). During winter and spring, fish are less important and invertebrates such as euphausiids, mysids, and gammarid amphipods may represent a considerable fraction of their total diet (FWS, 1997). As such, marbled murrelets are considered opportunistic feeders, requiring primarily that their prey fall within certain size classes (FWS 1997).

Marbled murrelets nest from late March to late September, in coniferous old-growth forests or stands that may be as many as 70 to 80 kilometers inland (Seattle Audubon Society 2007; USFWS 1997, 2006). Due to its sheltered waters, mixed rock and sandy shorelines, and its proximity to old-growth forests, Puget Sound is used heavily during the breeding season (Strong 1995; USFWS 1997). Puget Sound is also believed to be a vital wintering area for populations of marbled murrelets moving south from British Columbia to take advantage of the basin's protected bays and channels (Speich and Wahl 1995; USFWS 1997). Areas of winter concentration include Sequim, Discovery and Chuckanut Bays; the waters around the San Juan and Whatcom County islands; and the inland waters east of and including Admiralty Inlet (Seattle Audubon Society 2007; Speich and Wahl 1995).

Snohomish PUD's field studies documented five marbled murrelets on one occasion (December 10, 2009) in the project area (Tollit et al. 2010a). Marbled murrelet population sizes and trends are regularly monitored in Puget Sound between May 15 and July 31 (Raphael et al. 2007). The proposed project is located within Conservation Zone 1 (Puget Sound) and includes marine habitat. Conservation Zone 1 is subdivided into three strata and each stratum is divided into "Primary Sampling Units" (PSUs) that are about 20 kilometers long.

Conservation Zone 1 contains one of the larger murrelet populations in the species' listed range, and supports an estimated 41 percent of the murrelets in the coterminous United States (Huff et al. 2003). Since 2000, the estimated population size for Conservation Zone 1 has ranged from a low of 5,500 murrelets in 2004 to a high of 9,700 in 2002. The most recent (2007) estimated population size for Conservation Zone 1 is 6,985 murrelets. Since 2000, the estimated murrelet density in Conservation Zone 1 has ranged from 1.56 to 2.78 murrelets per km^2. Admiralty Inlet occurs within stratum 2 in Conservation Zone 1. At-sea population surveys estimated marbled murrelet densities for stratum 2 varied from 1.12 to 2.43 murrelets per square kilometer between 2000 and 2007 (Huff et al. 2003; Falxa et al. 2008).

Population numbers in Conservation Zone 1 are likely declining; however, the precise rate of decline is unknown. The juvenile ratio derived from at-sea survey efforts is 0.09 in Conservation Zone 1. Although the juvenile ratio appears low, exact numbers are still unknown as juvenile ratios in Washington may be skewed by murrelets coming and going to British Columbia (FWS 2008).

Golden Paintbrush

The FWS listed the golden paintbrush as a threatened species on June 11, 1997.[62] Primary listing factors were loss of habitat and encroachment of native and nonnative woody species. A final recovery plan for the species was issued in August 2000 (USFWS 2000).

Golden paintbrush is a short-lived perennial herb. Plants emerge in early March. By mid-April, the plant is in bud, flowering generally begins the last week in April and continues until early June. Fruits mature from June to mid-July; by mid-July, the plants are in senescence. Capsules persist on the plants well into August.

Golden paintbrush is endemic to the Pacific Northwest. The historic range of the species extends from the Puget Trough physiographic province in Washington and British Columbia to as far south as the Willamette Valley of Oregon (WSDNR 1997, USFWS 2000). However, assessments of the species' status in its range found the plant extirpated from many of the recorded sites. In Washington, golden paintbrush occurs at elevations from sea level to approximately 91 meters (300 feet) above sea level. The species generally occurs on flat, open grasslands that are characterized by mounded topography, and on steep coastal bluffs that are grass dominated.

FWS (2000) identifies 11 extant populations of golden paintbrush, nine in Washington, and two in British Columbia. In Washington, the populations occur in Thurston County (1), San Juan County (3), and Island County (5 populations on Whidbey Island). The five populations on Whidbey Island occur on the following sites: Admiralty Inlet Natural Area Preserve (formerly Bocker Environmental Reserve), Fort Casey State Park, West Beach, Forbes Point, and Ebey's Landing. Three sites are less than one acre and two are approximately 1 acre in size (USFWS 2000). Fort Casey State Park is the closest site to the Project area.

FWS (2007) reports only two of the 11 extant populations (one in Thurston County, Washington and one in British Columbia) are stable (i.e., population of at least 1,000 individuals for at least five years), while the remaining nine populations are considered to be declining. Overall, the abundance of the species remains constant, with some populations increasing and others declining (FWS 2007). The population size and

[62] 62 FR 31740-31748.

trend for the five populations on Whidbey Island between 1999 and 2006 are shown in tables 4 and 5, respectively).

Table 4. Population Size For Golden Paintbrush Populations On Whidbey Island (Source: FWS 2007).

Site	1999	2000	2001	2002	2003	2004	2005	2006	Average
Admiralty Inlet (Naas)	277	97	97	98	122	59	120	94	121
Fort Casey State Park	175	151	166	185	307	235	260	760	280
West Beach	797	463	167	53	54	82	130	189	197
Forbes Point	1,572	1,882	1,834	711	765	532	123	260	960
Ebey's Landing	1,079	7,627	-	-	-	-	669	214	2,397

Table 5. Population Trends For Golden Paintbrush Populations On Whidbey Island (Source: FWS 2007).

Site	10-year recovery trend	5-year recovery trend
Admiralty Inlet (Naas)	Increasing in the short term	Increasing in the short term
Fort Casey State Park	Increasing in the short term	Increasing in the short term
West Beach	Stable	Stable
Forbes Point	Declining	---
Ebey's Landing	Stable	Declining

3.3.3.2 Environmental Effects

Effects of project installation, maintenance, operation, and removal on federally listed species are summarized below. Greater detail is provided in the biological assessment filed with NMFS and FWS on April 23 and April 24, 2012, respectively.

Because of the similarity of stressors on groups of species, potential environmental effects to these federally listed species are discussed below in the following groups: salmon and trout, green sturgeon, rockfish, eulachon, marine mammals, marbled murrelet, and golden paintbrush. The analysis considers and describes the stressor, the expected exposure to the stressor, the likelihood of exposure to the stressor, and the risk to individuals and populations of listed species. With regard to project effects on listed marine fish, many of the factors that potentially would affect the ESA-listed fish species would have similar potential to affect fish in general and have been discussed earlier. These sources include blade strike, behavior change, and acoustic effects. Blade strike and behavioral change are covered in the section on Behavioral and Direct Effects on Fish, Marine Mammals, and Birds Near the Turbines. Acoustic effects are covered in section on the Noise Effects. Our analysis of potential effects on fish in those sections applies unless modified, by more specific information described below.

Chinook Salmon, Chum Salmon, Steelhead, and Bull Trout

The Puget Sound chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout are related species and have broad similarities in their life histories and habitat use. Data from 158 sampling net tows in Puget sound revealed that all juvenile salmon, including chum and chinook salmon, were collected above a depth of 45 m (148 feet). The top of the turbines are at a depth of about 47.5m (156 feet). Adult salmon can be found at a range of depths, but are more commonly found in the top 30 m (98 feet), reducing their chances of interacting with the turbines. Steelhead trout juveniles are found in the top 6 m (20 feet) of water about 95 percent of the time. Adults at sea occur at any depth down to 200 m (656 feet), but have been found above 30 m (98 feet) of depth in Puget Sound. Bull trout adults are found at depths of 1 to 20 m (3.3 to 65.6 feet). Juveniles are not found in Admiralty Inlet.

Also, adult salmon are pelagic feeders. It is unlikely that their prey of schools of small fish and invertebrates would concentrate near the turbines. Steelhead trout feed on fish and invertebrates. Bull trout feed on fish (herring, sand lance, and surf smelt).

The probability of salmon or trout having direct interaction with the turbines would be largely by chance, which would be small given the relatively small portion of the Admiralty Inlet cross section occupied by the turbines and the small amount of time these fish spend at the depth of the turbines. The benthic organisms that are likely to collect on the turbine structures would not attract salmon and trout. Finally, probability would be further reduced by any avoidance behavior by these extremely strong swimmers.

Therefore, project construction, operation, maintenance, and removal are not likely to adversely affect these species.

Green Sturgeon

Green sturgeon feed on a benthic diet, and may be found near the turbines. Admiralty Inlet is one of many places the members of the southern DPS may feed in a lifetime. Admiralty Inlet is not an access corridor to their spawning grounds, which are in, or closer to, the Sacramento, River in California. While the turbines are more closely associated with green sturgeon habitat, the numbers of southern DPS green sturgeon near the turbines is likely to be small and again, given the small footprint of the turbines relative to the size of the benthic habitat in the inlet, the probability of frequent interaction is small.

There is some possibility that the turbine structures would attract organisms of interest to green sturgeon and thus attract sturgeon. Such a scenario, however, is the type of condition intended to be detected and addressed in the Benthic Habitat Monitoring and Mitigation Plan and the Near-Turbine Monitoring and Mitigation Plan. Green sturgeon, because of their distinctive shape, would be among the most likely fish to be identifiable by the optical and acoustic camera images. Thus, their attraction to the turbine structures

would be likely to be detected. Finally, with their adaptations for maneuvering and feeding on the bottom in dark places, the green sturgeon may be quite sensitive to the presence of the turbine and avoid it.

Therefore, the project is not likely to adversely affect this species.

Rockfish (Bocacci, Canary, and Yelloweye)

The three ESA-listed rockfish species are grouped as a deepwater rockfish species assemblage in Washington DFW's Final Puget Sound Rockfish Conservation Plan (2011b). They have been observed infrequently (canary and yelloweye rockfish) to never (bocaccio) in Washington DFW's tows described earlier. Though rare, the canary and yelloweye rockfish have been observed at multiple life stages near the project area. Rockfish are attracted to high-relief structures and are likely to be attracted to the 13 m (43 ft) tall turbine structures. In general, adult rockfish quickly colonize artificial reefs (Washington DFW, 2011c). The turbine structures are likely to gather rather than displace adult rockfish. Even with the possibility of attraction to the project, the rockfish densities should remain low, because of the small population size in Puget Sound and the modest amount of appropriately rocky habitat nearby.

A concern with high relief, fish attracting structures is negative reef effects. One such effect would be if the turbine structures became high mortality hot spot for endangered juvenile rockfish within the zone around the turbines. In a case where an artificial reef was create at a 30 m depth in Puget Sound by Washington DFW, rockfish segregated by size of hiding spaces, with juveniles occupying only places where they could enter a small hole when startled (West et al., 1994). If the juveniles of the deepwater rockfish assemblage, behave the same way as those at the shallower depth, they will only occupy the turbine structure to the extent that there is adequate hiding space for them. Such behavior would reduce the risk of the turbine habitat becoming a sink for juvenile rockfish.

The risk to the rockfish is limited by the very small scale of the project structures relative to the extensive habitat. The benthic, near-turbine, and marine mammal monitoring plans limit the risk further.

Vulnerability to turbine strike for rockfish is subject to the same factors as fish in general as discussed in the section on Behavioral and Direct Effects on Fish, Marine Mammals, and Birds Near the Turbines. The adult rockfish that approach the turbine structures, and particularly the large rockfish, should be detectable and observable with the cameras used in the Near-Turbine Monitoring and Mitigation Plan.

With the expected low level of interaction and the monitoring and adaptive management measures in place, risk to the threatened and endangered rockfish species

would be manageable for the small, short term, pilot project. Therefore, the project is not likely to adversely affect these species.

Eulachon

Though eulachon occur at the project depth, they only infrequently occur in Admiralty Inlet. They feed on zooplankton, which are drifting organisms that would not concentrate around the turbines. Therefore, eulachon would be unlikely to concentrate near the turbines.

As with the other ESA-listed species of fish, the same factors that reduce risk to other fish apply to the euchalon. These include the small footprint of the project, the characteristics of the turbines, the lack of concern about EMF, and the possibility of local avoidance of the turbines. Finally, the same monitoring and adaptive management safeguard plans apply.

Therefore, the project is not likely to adversely affect this species.

Marine Mammals (southern resident killer whale, humpback whale, and Steller sea lion)

Southern resident killer whale, humpback whale, and Steller sea lion are known to pass through the project area. Based on consultation with stakeholders, potential direct effects of project deployment and operation include: blade strike, underwater noise, and marine debris entanglement. No indirect effects have been identified.

The potential for injury or mortality to any of these species from blade strike is small. Humpback whales are infrequent and sightings in northwest coastal waters are uncommon, occurring one to two times per year in Admiralty Inlet (Osborne et al. 1988). In Admiralty Inlet, southern resident killer whale and humpback whales are both migratory and are therefore expected to be transiting through the Admiralty Inlet area and would be exposed to the turbines infrequently. While southern resident killer whale do dive to depths at which the turbines would be located (Tollit et al. 2010a), most southern resident killer whale dives occur to depths less than 30 meters (Baird 2000, Baird et al. 2003, 2005). In contrast, Steller sea lions are known to dive depths of the turbines and spend longer periods of time in Puget Sound and therefore could be exposed to the stressor more frequently. Nonetheless, the small project footprint relative to Admiralty Inlet,[63] design of the turbine (close shroud and open center), low rotational speeds (typical rotational speeds will range from 6 to 16 RPM, with a maximum rotational speed

[63] The turbine rotor diameter is 4.7 meters (the venturi duct diameter is 6 meters) with a 2.2 meter diameter open center, and therefore turbine sweep area would be 13.5 square meters for both turbines.

of 24 RPM), and frequency of operation (because the turbine does not start rotating until tidal velocity is 0.7 m/sec, the turbines will rotate only 60 to 70 percent of the time) minimizes potential risk of marine mammals coming in contact with a moving blade. In the unlikely event of that a southern resident killer whale does interact with the turbines, the consequences would be, at worst, minor bruising (Carlson et al., 2012).

As explained earlier in section 3.3.2.2, each of the species would be exposed to low-level noise during installation, maintenance, operation and removal of the turbines. During installation, maintenance, and removal activities, noise levels would be temporary and short-term and are primarily from vessel engines, which are similar to existing noises. Consequently, these species may be habituated to construction noises. In addition, Snohomish PUD would cease installation activities if a listed ceatacen occurs within 500 meters, or listed pinniped occurs within 100 meters of an installation or removal vessel until the cetacean or pinniped leaves the vicinity of project operations.

Turbine operation is expected to exceed NMFS's level B harassment threshold of 120 dB close to the project. During the highest tidal velocities, the three species would be exposed to NMFS Level B Harassment threshold as follows: humpback whale - within 650 meters; southern resident killer whale - within 260 meters; Steller sea lion - within 390 meters.[64] Ambient noise is expected to further limit the area of which received levels are both detectable and exceed 120 dB. The predominance of vessel traffic noise associated with passenger ferries and cargo vessels (Bassett et al., submitted) and, at high currents, bedload transport (Bassett et al., in prep), would generally limit marine mammal detection of turbine noise to within a few hundred meters of the project.

Although all three species could be exposed to derelict gear entangled on the turbine, the likelihood of such exposure is very small because: there is no gillnet fishing occurring in Admiralty Inlet; much of the derelict gear has been removed (NWSF 2011); limited potential for these species to encounter the project turbines relative to the Admiralty Inlet (these species can pass through 99.95 percent of cross-section of Admiralty Inlet at the Project location without encountering the proposed turbines); and the risk of derelict gear entangling with the turbine is reduced due to the hydrodynamic movement of water around the turbine and through the open center, and because of the reversal of the tide direction every 6 hours.

For the stated reasons, project installation, maintenance, operation and removal is not likely to adversely affect humpback whale, but due to noise levels, may adversely affect southern resident killer whale and Stellar sea lion.

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[64] Because turbine noise is dependant on current velocity, turbine noise will only ensonify an area greter than 100 m to Level B harassment (120 dB re 1μPa) 25 percent of the time.

Primary constituent elements for southern resident killer whales critical habitat are: water quality to support growth and development; prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and passage conditions to allow for migration, resting, and foraging. As described in section 3.2.2.2, project installation, maintenance, operation, and removal would not affect water quality, southern resident killer whale prey, or passage conditions; therefore, the proposed project would not be likely to adversely affect southern resident killer whale critical habitat.

The following proposed measures would allow Snohomish PUD to monitor for adverse effects and take appropriate steps, including shutting down the turbines; if adverse effects are found: the Near-turbine Monitoring and Mitigation Plan would allow Snohomish PUD to monitor close encounters with turbines; the Acoustic Monitoring and Mitigation Plan would permit Snohomish PUD to determine if operational noise levels are exceeding anticipated thresholds; the Marine Mammal Monitoring and Mitigation Plan would allow Snohomish PUD to monitor for changes in behavioral patterns of marine mammals and to stop installation activities if a listed marine mammal comes near the project vessels; and the Derelict Gear Monitoring Plan would allow Snohomish PUD to detect and remove any gear entangled on the turbine.

Marbled Murrelet

Based on consultation with stakeholders, potential direct effects of project deployment and operation include: blade strike, underwater noise, and marine debris entanglement. No indirect effects have been identified.

Marbled murrelets generally forage in nearshore waters shallower than 30 meters but are capable of diving to depths of up to 47 meters. The top of the turbine structure would be at a depth of 47.5 meters. Therefore, the project would be located at or below the calculated theoretical maximum diving depth (47 meters) of the marbled murrelet (Mathews and Burger 1998). At that depth, it is extremely unlikely that a marbled murrelet would directly interact with the turbine rotors.

The maximum expected broadband source level for a turbine is estimated at 172 dB rms (re: 1 ~Pa) @ 1m. The presence of a second turbine is not expected to increase this estimate significantly. Turbine sound is also expected to attenuate through spreading and absorption, such that at maximum source levels, broadband received levels are expected decrease to 150 dB within 13 m of the turbine. FWS considers behavioral response of murrelets to occur, with reasonable likelihood, when they are exposed to sound levels of 150 dB or greater. Based on the limited distance from the turbine this sound pressure level is predicted to occur and the depth at which this sound pressure level originates, it is extremely unlikely murrelets will be exposed to, and therefore adversely affected by, turbine noise.

The Acoustic Monitoring and Mitigation Plan is designed to measure actual sound generated by the tidal turbines under the full tidal range and rotational speeds. This information would be used to determine if estimated noise levels or FWS guidelines have been exceeded, and corrective actions identified. The plan provides triggers and mitigation measures for when the project is adversely affecting species, including potentially shutting the turbines down.

For the above reasons, project installation, maintenance, operation, and removal are not likely to adversely affect marbled murrelets. FWS concurred with this determination on June 12, 2012.

Golden Paintbrush

Although populations of golden paintbrush are known to occur on Whidbey Island, existing populations are not located near where land-disturbing activities associated with project installation would occur. Further, the project site consists of disturbed habitats associated with local residences, such that habitat conditions are not likely to support golden paintbrush. Therefore, project installation, maintenance, operation, and removal would not affect the golden paintbrush.

3.3.3.3 Cumulative Effects

Though commercial fishing has declined significantly in the last 20 years, commercial fishing and crabbing will continue in Admiralty Inlet, as will recreational fishing. Maritime travel on Puget Sound is heavy and will continue, with all maritime traffic bound for, or departing from, the ports of Seattle, Everett, Tacoma, and Olympia transiting through Admiralty Inlet via a major shipping lane in the middle of the inlet. The Port Townsend-Coupeville ferry will continue to run about 1.5 kilometers from the turbine deployment site, with about 10 round trips occurring across Admiralty Inlet during summer. Use of the area by small commercial and recreational craft will also continue. No other reasonably foreseeable actions have been identified in project area.

When considered cumulatively, the effects described above may have a small negative effect on federally listed fish and marine mammals and designated critical habitat. Snohomish PUD's proposed monitoring, adaptive management and consultation with resource agencies would ensure these effects are timely addressed.

3.3.4 Terrestrial Resources

3.3.4.1 Affected Environment

The proposed project would be located on private land east of Admiralty Head. Admiralty Head and the surrounding areas of Whidbey Island contain two vegetative zones: Puget Sound Douglas-fir and Woodland/Prairie Mosaic (Washington Gap

Analysis Project 1996). Both of these zones have been heavily converted to both agriculture and development.

The project site is located in a light residential development. Onsite vegetation is disturbed and dominated by grasses and herbs. The grasslands abut a rocky intertidal beach front. No wetland habitats are found onsite. However, the marshy grasslands associated with Crockett Lake immediately north of the project site attract over 90 species of migratory waterfowl and shorebirds (NPS 2003). Given the developed character of the project site, wildlife that may use the project site include species that are likely habituated to human disturbance, such as chipmunks, deer, foxes, squirrels, and ravens. Although Whidbey Island contains a variety of habitats that support state-listed species of concern, the disturbed character of onsite habitats would not support or attract these species.

3.3.4.2 Environmental Effects

Potential effects on terrestrial resources are limited primarily to vegetation and wildlife disturbance associated with construction activities, and to a lesser degree, project removal activities. Resource agencies and stakeholders have not raised specific concerns related to project effects on terrestrial resources, and no one has recommended specific measures to minimize effects on terrestrial resources.

Snohomish PUD has sited the terrestrial components of the project such that the power cables come onshore to connect to the grid at a location that is close to shore, that has been previously developed, and that requires no new roads. To minimize effects to the littoral and nearshore environment, Snohomish PUD proposes to use HDD to bring the subsea trunk cables ashore from a minimum depth of 18 meters to a vault located about 55 meters shoreward from the ordinary high water mark. An approximately 9-meter back haul cable would run underground from the vault to a constructed control building, and an approximately 70-meter back haul cable would run from the control building to the grid intertie.

The bentonite slurry/dredging spoils from the HDD would be recovered into an excavated temporary sump pit, expected to be less than 1.8 meters (6 feet) deep, no more than 6 meters (20 feet), and with a width of approximately 2.4 meters (8 feet). The final engineering design of the site will dictate the actual dimensions. The fluid that is picked up by the sump pump would be transferred to the solids control unit where the solids contained in the drilling fluid are mechanically separated allowing the mud to re-circulated down the HDD hole and used again. The solids are discarded into dumpsters (hoppers) and transported to a local prearranged dump site.

On land construction activities would require about five months to complete. Terrestrial vegetation would be left intact as much as possible during site preparation activities, and following construction, the HDD laydown area and any other disturbed

areas would be returned to its pre-installation condition. Fuel and lubricant leakages may inadvertently be discharged from vehicles during construction and facility maintenance activities. Snohomish PUD would implement best management practices to reduce the potential for a discharge and minimize impacts.

For project decommissioning and removal, Snohomish PUD states that it would remove all shore-based equipment according to the terms of the agreement(s) between itself and the owner of the private property on which the equipment would be constructed. Similarly, Snohomish PUD would remove the project transmission line and other equipment in accordance with agreement with Puget Sound Energy. Snohomish PUD further states that because several removal and restoration activities would be determined based on the condition of the site and equipment at the time of removal (e.g., subsea cables), a detailed scope of work can not be completed at this time. Snohomish PUD proposes to work with the MARC when developing the scope of work. For our analysis purposes, we assume that with the exception of the control building, which would likely be left to serve as a garage, all project equipment, including the power cables, would be removed from the site. This removal would require the cable vault and power cables to be removed and trenches back-filled with the excavated materials and the area returned to existing grade. The cables would be disposed of in an appropriate manner, including recycling where possible.

Staff Analysis

Land disturbing activities, including grading, trenching, backfilling and HDD processes, would disturb an area of about 0.3 acres (0.1 hectares). Because of the small footprint and disturbed character of the vegetation, adverse effects on vegetation and wildlife would be minor and temporary. Restoring the HDD laydown area and back haul trench surface areas to pre-installation conditions would further minimize adverse effects to wildlife. Mobile wildlife species are expected to avoid the project area during construction and would utilize similar habitats, which are abundant nearby, to conduct their life cycle activities following placement of the project components.

Soil-disturbing activities associated with project deployment could potentially cause erosion during project construction. Although Snohomish PUD proposes to use best management practices to minimize soil erosion and areas of disturbance, Snohomish PUD has not filed an erosion control plan. A detailed soil erosion control plan would ensure that best management practices are followed to limit the effects of erosion during project construction and deployment. The Commission typically requires the development of such plans.

Following construction, only the cable termination vault and control building would be above ground and maintenance activities would not likely adversely affect wildlife and vegetation. If the project components were to be removed following construction, some soil disturbing activities could again temporarily disrupt wildlife and

vegetation and could result in soil erosion. A detailed site removal plan, as proposed by Snohomish PUD, describing best management practices that would be followed during these activities would minimize adverse effects on terrestrial resources.

3.3.5 Recreation

3.3.5.1 Affected Environment

Admiralty Inlet and surrounding coastal areas host a wide array of recreation resources and activities, including fishing, boating, windsurfing, kite-boarding, diving, beach combing, hiking, sightseeing, picnicking, and camping. Admiralty Inlet is a popular location for whale watching and birding. The beach nearest the proposed turbines, known as Admiralty Head, is a popular shore-fishing site for salmon and steelhead.

Several state parks, two marine protected areas, and miles of public beaches are located along the shoreline to the north and east of the project area. The closest state park is Fort Casey, located on Admiralty Head. Fort Casey State Park is a 467-acre park located on Admiralty Head, with more than two miles of shoreline along Puget Sound, including Keystone Spit, the strip of land separating Crocket Lake from Admiralty Inlet, on which the land-based portions of the project would be located. The state park is an historical military fort that offers hiking, beachcombing, bird watching, boating, fishing, picnicking, and camping. The beach and bluff, a lighthouse, and the old gun batteries offer sweeping views across Admiralty Inlet and are popular attractions. The park is fully developed with parking, restrooms, campsites, trails, boat launch, and picnic areas. The proposed project turbines would be sited approximately a half kilometer offshore of the park.

Fort Casey State Park is also located within the nation's first national historical reserve, which is administered as a unit of the national park system. Ebey's Landing National Historical Reserve (Reserve) includes over 400 historical structures and nearly 17,600 acres of farms, prairies, dense forests, lakes, lagoons, and coastal and marine areas. The Reserve was created in 1978 to protect the rural working landscape, native and pioneer land use traditions, and ecological resources on central Whidbey Island.[65] The Reserve offers opportunities to beachcomb, hike, boat, camp, and watch wildlife. The proposed project's land-based components, including underground cables and the

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[65] National Park Service (NPS), 2006. Ebey's Landing National Historical Reserve General Management Plan. The reserve includes about 13,600 acres of land and nearly 4,000 acres of water (mostly at Penn Cove). General information about the reserve is available at: www.nps.gov/ebla/.

control building, would be sited on private land within the Reserve close to its southern boundary.

Two marine reserves designated by the Washington DFW to preserve species and/or habitat are located near the project: Admiralty Head Marine Preserve and the Keystone Conservation Area. The Admiralty Head Marine Preserve (figure 10) is located along the western shore of Admiralty Head and is managed as a partially-protected marine reserve for non-tribal citizens. Recreational and commercial fishing and harvesting activities, except for dive fishing for sea urchins and sea cucumbers, are prohibited.[66] The project turbines would be sited approximately a half kilometer south of the Admiralty Head Marine Preserve. The Keystone Conservation Area is a fully protected marine reserve for non-tribal citizens. The Keystone Conservation Area includes the eastern side of the jetty enclosing the Keystone Ferry harbor and extends eastward to a row of pilings. The project control building and land-based construction activities would be located about 350 meters to the southwest of the Keystone Conservation Area. Recreational and commercial fishing and harvesting are prohibited, although the Keystone Conservation Area is a popular location for recreational divers and student researchers. The project's subsea trunk cables would pass near the east corner of the Keystone Conservation Area.

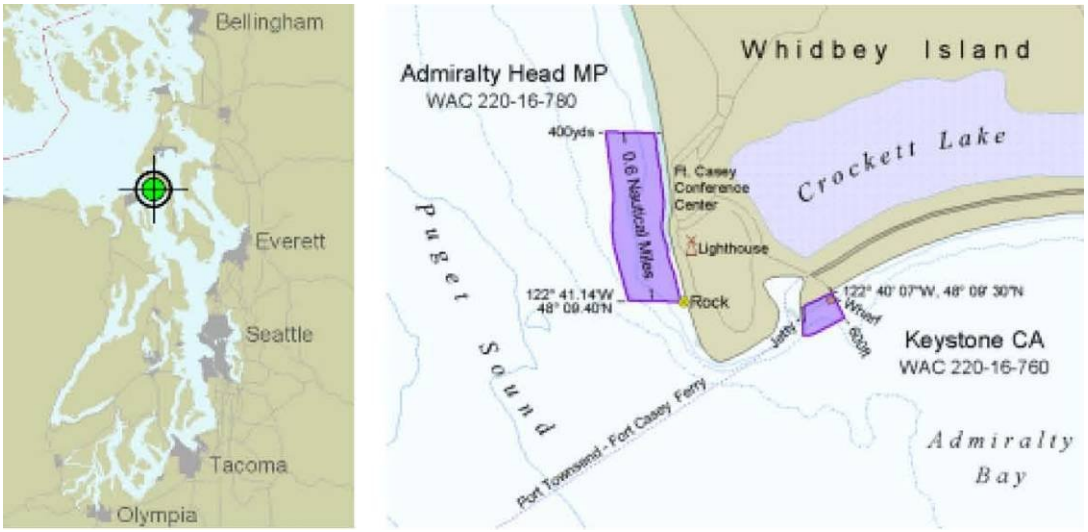

Figure 10. Admiralty Head Marine Preserve and Keystone Conservation Area (Source: application).

[66] WDFW. Marine Protected Areas within Puget Sound: Admiralty Head Marine Preserve. See http://wdfw.wa.gov/fishing/mpa/admiralty_head.html (accessed December 3, 2012).

Also in the vicinity of the project are campsites and put-in/take-out points for the Cascadia Marine Trail, a regional water trail for paddlers. The Cascadia Marine Trail (CMT) extends nearly 140 miles north from Olympia, Washington, through Admiralty Inlet, to the Canadian border. It is a designated National Recreation Trail and one of 16 National Millennium Trails. The non-motorized water trail does not follow a particular alignment and instead utilizes a broad area of marine waters to provide unique opportunities for experiencing the natural and aesthetic resources of the region. The CMT connects with more than 50 campsites.[67] Campsites that are nearest the proposed project include those at Fort Flagler State Park and Fort Worden State Park on the opposite shore of Admiralty Inlet. Both of these parks are located over three kilometers from the proposed turbines. To the north, a campsite at Fort Ebey State Park, also within the Ebey's Landing National Historical Reserve, is linked to the CMT, but it is located over nine kilometers from the proposed turbines.

In addition to paddling on the water trail, a variety of motorized and non-motorized recreational boating occurs in Admiralty Inlet. Commercial charters and cruise ships utilize Admiralty Inlet on a regular basis, while other boaters travel to and from a large number of public and private docks, ramps, harbors, and beaches throughout the region.[68] Due to strong currents and substantial shipping traffic, recreational boating in and around the project area consists of mostly thru-traffic, with some limited trolling and stationary sport fishing. Admiralty Inlet forms the principal entrance to all of Puget Sound and is utilized primarily as a traffic waterway rather than as a destination.

Many recreational boaters fish the marine waters of Admiralty Inlet for salmon, steelhead, many types of groundfish, and other species. Small parties in light, open boats, runabouts, and cabin-cruisers are not uncommon during more favorable weather. Some salmon charters operate virtually year round. Recreational anglers also use hook and line from beaches, piers, and docks. Others utilize pots, ring nets, and bare hands to capture Dungeness and red rock crab. Some clam-digging occurs on area beaches, and divers will forage for fish and shellfish as well.

Sportfishing, including trolling for salmon, is popular throughout Puget Sound. In Admiralty Inlet, the average sport catch of salmon from 2000 to 2006 was approximately

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[67] Washington Water Trails Association, www.wwta.org/trails/cmt/index.asp (accessed December 3, 2012).

[68] The applicant reported that there were 244 marinas and 331 launch sites for small boats in the Puget Sound region, based on data contained in a 2003 report from the Puget Sound Action Team.

26,500 fish, with the vast majority being coho and pink.[69] Sportfishing with downriggers for Chinook salmon and bottom fishing for halibut and other species is known to occur at depths comparable to the proposed turbines. However, favored fishing areas are dispersed over a wide area of Admiralty Inlet, and the immediate site of the proposed turbines is not known to be a specific fishing destination.

Recreational diving in Admiralty Inlet typically takes place in waters close to shore and away from stronger currents. Popular diving locations near the proposed project include Admiralty Head Marine Preserve, adjacent to Fort Casey State Park, and the Keystone Conservation Area, a well known and regionally significant diving destination. The Keystone dive area is managed as an underwater park and is located on the opposite side of the ferry harbor from Fort Casey State Park. A rock jetty comprised of large boulders forms an extensive underwater habitat supporting anemones, urchins, sea stars, rockfish, wolf eels, giant Pacific octopus, and many other watchable wildlife species. The upland area includes parking, restrooms, changing area, and showers.

Whale-watching outfitters offer spring, summer, and fall tours and have reported seeing whales throughout Admiralty Inlet, although most tours are focused on other locations (e.g., San Juan Islands). Species of interest include killer whales, minke whales, gray whales, harbor seals, harbor porpoises, Dall's porpoises, and California sea lions.

3.3.5.2 Environmental Effects

Project effects on recreation are primarily associated with minor, short-term disruptions and degradation of marine recreational uses during project installation, maintenance, and removal activities. These activities may prevent some boats from transiting the project area; however, these disruptions would generally last only a few hours or days. The degradation of recreational experience is mostly associated with changes in the aesthetic character of the inlet, which is addressed further below in section 3.3.7.

Effects on recreational activities during operation are also considered minor and are associated with potential interactions with fishing and diving near the turbines. Because the land-based components would not be located on land that is currently utilized or available to the public for recreation, project operation would not be expected

[69] The applicant-prepared EA reported the average catch over this period to be 35,500, based on personal communications with WDFW staff. The average catch of 26,500 stated above is based on data contained in the Washington State Sport Catch Report 2007, published by WDFW in September 2011.

to adversely affect recreational opportunities. Consequently, Snohomish PUD does not propose any recreational monitoring plans.

Snohomish PUD proposes to implement a Navigation Safety Plan to minimize potential hazards to fishing vessels in the vicinity of the project. These measures, discussed in greater detail in section 3.3.7, *Navigation*, below, include coordinating with the Coast Guard and NOAA to mark the installed turbines and the cable route on electronic and other navigational charts. Safety procedures would be reviewed annually with the Coast Guard and new precautions proposed for Commission review, if necessary. Snohomish PUD would also distribute informational materials on the project to commercial fishermen in coordination with Washington Sea Grant and to local recreational users in coordination with the Port Townsend and Central Whidbey Chambers of Commerce and the Washington State Parks and Recreation Commission.

In their May 22, 2012, motion to intervene, the Whidbey Environmental Action Network expressed concern that the proposed project would degrade the natural environment, including fisheries and flora, which would negatively affect the area's recreational opportunities. Potential impacts to these resources are addressed in other sections of this EA; however, no adverse effects on these resources have been identified that would impact recreation in the area.

In its May 23, 2012, comment letter, Interior recommends that Snohomish PUD work with National Park Service, Ebey's Landing Historical Reserve Trust Board, Island County Marine Resources Committee, and other stakeholders to develop and implement an interpretation and education plan in conjunction with the proposed project. In their June 22, 2012 response to this recommendation, Snohomish PUD proposes to collaborate with National Park Service and other stakeholders to develop and implement a plan for establishing an interpretive and educational display at Snohomish PUD headquarters or at another appropriate location as agreed by the stakeholder group consulted, as long as the display does not require a significant commitment of resources and does not result in the expansion of the project boundary.

No other agencies or interested parties voiced any additional concerns related to effects on recreational boating, fishing, or other recreational use (fishing concerns raised by the tribes are discussed in section 3.3.6.2).

Staff Analysis

All marine-based project components would be located underwater. Temporary effects to coastal recreation, such as visual impact, may occur when equipment, such as tugboats, barges, cranes, and support vessels, install or perform maintenance of the submerged components of the project. In addition, during construction, coastal recreation may be affected by large infrastructure such as construction vehicles, transport vessels, and cranes that would be necessary to perform work activities. Though the presence of

workboats and other vessels during project construction and operation may briefly impede the ability of recreational boaters to transit the project area or for fishermen to fish where facilities are being deployed, these effects would be temporary and involve only a very small area of Admiralty Inlet. Boaters should be able to easily navigate around these activities. These impacts would be temporary and minimized by a timely project construction schedule.

During operation, effects on recreational boating, fishing, and diving would be minor. Few recreational boaters would likely attempt to anchor in the vicinity of the turbines, due to strong currents, nearby shipping and ferry traffic, and deeper water. Implementation of Snohomish PUD's proposed Navigation Safety Plan would further minimize potential adverse interactions by alerting these users to the turbine hazards.

The risk to divers is also remote. The proposed turbine locations are not known to be in a recreational diving destination.[70] Only more technically experienced divers would be expected to possess the skills necessary to safely descend to the depth of the turbines (37 meters minimum). To access the turbines, a diver would need to approach the area under difficult conditions resulting from strong currents, poor visibility, exposed weather, and other boating traffic in the area. Snohomish PUD's Near-turbine monitoring program would alert Snohomish PUD in the unlikely event that divers are diving near the project and allow for the development of appropriate mitigation actions to ensure public safety.

Construction and operation may indirectly affect whale watching if these activities cause marine mammals to alter their behavior. While such effects are not expected, Snohomish PUD's marine mammal monitoring program would provide a means to monitor changes in marine mammal behavior and to take appropriate actions to minimize adverse effects, which would also benefit whale-watchers.

The interpretive display that would be developed would provide an added benefit to visitors to the area by educating them about this new energy resource. However, the display would be much more effective if it could be located within view of the turbine locations in Admiralty Inlet. While the turbines would not be visible, the display could speak to the power of the tidal currents, which often are visible immediately offshore of Admiralty Head and Fort Casey State Park. This is consistent with a primary purpose of the project, which is to demonstrate the potential for tidal energy in Washington State and other coastal states, and would enhance visitor experiences and provide a new educational opportunity.

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[70] Advanced divers have visited the wreck of the *SS Governor* located several miles to the northwest at a depth of 240 feet.

3.3.6 Land and Ocean Use

3.3.6.1 Affected Environment

Land Use

The proposed project would be located in and adjacent to Admiralty Inlet, a major marine waterway between Whidbey Island and the Olympic Peninsula that forms the entrance to Puget Sound. The most urbanized areas of Puget Sound are south of Whidbey Island. Coastal areas around Admiralty Inlet, with the exception of Port Townsend, are generally more rural or undeveloped. The portion of Whidbey Island that is nearest the project is developed with a state park, the Port Townsend-Coupeville ferry terminal, an historic lighthouse, and a conference retreat center utilizing numerous historic buildings (Camp Casey). Farther north along the shoreline are large areas of public and private open space and park land.

Areas east of the ferry terminal include a public boat launch and beach access area, undeveloped state park lands, several residences, and additional open space, Recreation is the predominant land use in the immediate project area.

Ocean Use

A diversity of commercial and non-commercial uses occur in Admiralty Inlet, including marine shipping (e.g., container ships, tankers, barges); tugboat services; car and passenger ferry service; military vessel activities; subsea cables and communication services; maintenance and operation of docks, harbors, terminals, and navigation channels; commercial, tribal, and recreational fishing; cruise ships and charter services; general boating (recreational and otherwise); commercial and recreational diving; marine research; conservation; and beach and tideland activities. Ocean energy development does not yet exist in Admiralty Inlet, but has been considered at several locations, including the site of the current proposal.

Larger commercial vessels generally travel within or near established shipping lanes located roughly through the center of the waterway. Scheduled ferry service crosses the shipping lanes from east to west several times daily. Although marine traffic is substantial,[71] the proposed turbines would be located well outside these corridors. Other boating is more widespread, as are commercial, tribal, and sport fishing activities. Although boating among smaller vessels is not routinely tracked or recorded, it is likely

[71] The applicant reports that container traffic through ports in Seattle and Tacoma totaled more than $70 billion in 2005 (citing the Trade Development Alliance of Greater Seattle, 2005). Much of the volume would have passed through these shipping lanes.

these vessels regularly occur in the general area of proposed turbine locations. The nearest developed harbor facilities are at the ferry terminal in Keystone Harbor. The harbor is dredged every few years to keep a channel clear for the ferry.

In addition, there are a number of subsea cables that transverse Admiralty Inlet in the proposed project area. Subsea cable GIS layers available from NOAA show at least 5 separate cables that run north to south through Admiralty Inlet.[72] The cable closest to the proposed project, the PC-1 Landing cable, is a trans-oceanic communications cable that runs in a loop between the U.S. to Japan, with two landing stations in Japan, and two landing stations in the U.S. Within Washington State, the PC-1 system includes two cables, a north cable (PC-1 North) that links with Japan and an east cable (PC-1 East) that links with a landing site in Grover Beach, California. Both cables traverse Admiralty Inlet and land at Harbour Pointe, in the town of Mukilteo, approximately 20 miles southeast of the proposed turbine installation site. The entire PC-1 cable system contains approximately 12,900 miles of subsea cable. PC-1 North is closest to the proposed project site.

Admiralty Inlet was closed to commercial salmon fishing in the early 1990s. Although sport fishing for salmon and limited tribal and non-tribal commercial fishing for other species occurs outside the shipping lanes, commercial fishing in the Inlet has declined by two-thirds since the 1970s. Commercially harvested species include herring (97 percent of the commercial catch), as well as spiny dogfish, sole rock, and starry flounder. Sport fishing and tribal fishing also target halibut and other groundfish. Scuba divers harvest geoduck clams, sea urchins, and sea cucumbers, while others use pots to capture Dungeness crab. The proposed site of the turbines is not known to be a specific fishing destination.

3.3.6.2 Environmental Effects

No conflicts with existing land uses have been identified or raised by stakeholders. Land uses would be unaffected by the construction and operation of proposed marine-based facilities, including the turbines and subsea power cable. Snohomish PUD indicates that adequate harbor facilities are available in the region to support the transit of equipment, materials, and personnel necessary to develop and operate the project. Construction of the control building would introduce a new use to the area; however, all equipment would be contained inside a modest building having the appearance of a typical residential garage, with no apparent effect.

However, with regard to ocean uses, the Tulalip Tribes, the Suquamish Tribe, and the Swinomish Indian Tribal Community are concerned that installation of the project

[72] See http://ocsgis.ncd.noaa.gov/ENC_Direct/encdirect_download.html.

would prevent the tribes from accessing their fishing grounds and adversely affect salmon and shellfish resources. Additionally, PC Landing is concerned that project construction and operation would increase the risk of harm to the operation of PC-1 North. No other conflicts or concerns have been raised in the record. Therefore, the analysis below focuses on tribal fishing access and interactions with PC-1.

Access to Tribal Fishing Grounds and Resources

The Tulalip and Suquamish Tribes assert that the project would impact fishing in areas used by the tribes and would interfere with the tribes' access to usual and accustomed fishing areas.[73] The Tulalip Tribes view the installation of the pilot project in Admiralty Inlet, within the Tulalip Tribes Usual and Accustomed fishing grounds and stations, as impairing, limiting, or eliminating tribal fishing access. The Tulalip Tribes state that the project threatens to impair passage of fish and degrade fish habitat necessary for the production of anadromous and resident fish stocks, to interfere with marine mammal migration and movement, and to interfere with the movement of currents, sediments, nutrients and forage fish; therefore, the project is likely to cause unknown adverse impacts to treaty-protected fisheries resources. The Tulalip Tribes also state that the project and its associated on- and off-shore infrastructure may also interfere with tribal fleet movements and operations. The Tulalip Tribes request that the pilot license be denied.

The Suquamish Tribe states that the project will negatively affect tribal fishing activity. Within Admiralty Inlet, the Suquamish Tribe conducts commercial, ceremonial, and subsistence fisheries that target multiple species including, but not limited to, demersal fish species, Dungeness crab, shrimp, and numerous bivalve clams. The Suquamish Tribe assert that some harvest gear and methods "would be excluded by the presence of the turbines and cables."

The Swinomish Indian Tribal Community also expressed concern that the project may alter migration or cause direct mortality on migrating salmon and steelhead vital to the Tribe and may reduce the productivity of rearing habitat or cause direct mortality of forage fish and shellfish rearing within the project area.

Snohomish PUD asserts that the project would not impair the tribes' ability to exercise their treaty fishing rights because the project is sited in a specific location where

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[73] The Tulalip Tribes describe the usual and accustomed fishing areas relevant to the Admiralty Inlet project to include "Admiralty Inlet", including its Whidbey Island Bays, Sartatoga Passage, Penn Cove, and Holmes Harbor; and Possession Sound and Puget Sound south of Whidbey Island to the present West Pint Lighthouse, including Tulalip Bay and Port Gardner. See letters filed with the Commission by the Suquamish Tribe, dated 2/26/2010 and 10/9/2012, and by the Tulalip Tribe, dated 8/17/2012.

there are currently no treaty fisheries occurring; there would be no navigational restrictions around the project through the Coast Guard; there would be no permanent effects due to the short-duration of project (10 years) and site restoration measures following project removal. Regardless, Snohomish PUD would collaborate with the tribes in the event that the tribes decided to pursue a specific fishery within the geographic location of the project during the term of the license.

Staff Analysis

Potential effects on fish, shellfish, marine mammals and their habitats are discussed in section 3.3.3.2, *Marine Resources*. Available data suggest that effects on these resources are likely to be minor to inconsequential, but the various monitoring plans proposed by Snohomish PUD would help determine if adverse effects are occurring and to identify and take appropriate mitigation. Therefore, there should be no effect on availability of resources important to the culture and use of the various Tribes.

Although the Tribes and commercial fishermen fish in Admiralty Inlet, the record suggests that commercial fishing (tribal and non-tribal) is not known to occur on a regular basis near the turbine sites or over the route of the cables. Regardless, during installation of the turbines, tribal (and other commercial) fishing vessels attempting to fish near the project or to traverse through the project area to get to desired fishing grounds would have to steer around the various barges and vessels. However, such effects would be short-term (20 days) and minor considering the vast expanse of the Admiralty Inlet. The project, and installation of various components, would occupy less than 0.05 percent of the horizontal cross section of Admiralty Inlet. Snohomish PUD's proposed Navigation Safety Plan would alert all mariners, including tribal fisherman, to the installation activities so they could plan their fishing accordingly.

Once the turbines are installed and operating, no travel restrictions over the turbines would be required; therefore project operation would not affect tribal fleet movement and operations. The Coast Guard has determined that a Regulated Navigation Area (RNA), which would have restricted towing anchoring, bottom fishing, dredging, or other deep-water activities in the RNA was not needed at this time. However, if issues arise during operation, these restrictions might be reconsidered and the tribes would be afforded the opportunity to express their concerns before its implementation.

Tribal and other fishermen would not likely want to anchor or use nets, dredging, or long-line fishing gear in the immediate area of the turbines and power cables to avoid losing the valuable gear. Nonetheless, they could do so at their own risk. Any such effects would be minor considering the limited use of the area due to the proximity of the shipping lanes, the presence of the strong tidal currents, the small size of the project relative to the vast area of the inlet, and the presence of known fishing areas in the inlet that are located several kilometers or more from the proposed turbine sites.

Interactions with PC-1 North

PC Landing asserts that by installing the two turbines within 170 and 249 meters of PC-1 North that Snohomish PUD is unduly increasing the risk of damaging the cable during installation and maintenance activities. Damage would likely come from either dropping the turbines or an anchor from the installation or monitoring vessels on the cable. PC Landing states that during a maritime emergency, a ship's captain may elect to drop an anchor, even in a no-anchor zone, to protect life or property; consequently working close to PC-1 North would subject the fiber optic cable to unnecessary risk of damage. PC Landing stated that unplanned maintenance and repair activities may occur in inclement weather or adverse tidal conditions, which could push vessels maintaining or installing the turbines off-course, increasing the risk that project vessels may anchor in the area of PC-1 North. PC Landing also states that locating the project so close to PC-1 North reduces its ability to maintain and repair the cable in case of a cable fault, whether damage to the cable is related or unrelated to the project. PC Landing recommends that Snohomish PUD relocate the turbines to a site that is 750 to 1,000 meters from PC-1 North in accordance with International Cable Protection Committee[74] (ICPC) recommendations, but suggested that an area between at least 500 to 950 meters may be suitable for development.[75] In the alternative, PC Landing requests that the Commission deny the license application.

In response to concerns raised by PC Landing and the FCC, Snohomish PUD reexamined site energy characteristics and determined it could increase the turbine separation from PC-1 North from 104 and 150 meters to 170 and 249 meters (as measured from the centroid of the turbines); however, any further modification was not possible because it would likely prevent achieving the project's objectives of gathering information to determine if the energy potential for a commercial scale project is feasible

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[74] ICPC is a non-profit organization that helps to protect submarine cables from man-made and natural hazards. ICPC publishes recommendations, responds to information requests, facilitates exchange of information, and provides other services to submarine cable owners, maintenance authorities, and manufacturers; cable ship operators; submarine cable route survey companies; governments; and other seabed users. ICPC is a non-governmental organization and has no regulatory authority.

[75] In response to Commission staff inquiries as to possible alternative locations, PC Landing identified an area for further study that is located west of the proposed turbines and about 500 to 950 meters from PC-1 North. The proposed study area would be limited by the navigational channel and geologic hazard zones, and exhibits a wide region of gradually varying slopes, mostly between 0 and 2 degrees. Snohomish PUD stated slopes less than 5 degrees, depths between 40 and 100 meters are needed for successful project installation.

and possible environmental effects of the turbine technology, both at the pilot and commercial scale. In support of the conclusion, Snohomish PUD explains that its chosen site includes high resource intensity; water depth reflective of commercial-scale conditions; seabed and slope stability adequate for gravity foundation deployment; a location outside of high vessel traffic and close enough to shore to enable marine mammal monitoring by shoreline observers; ease of grid connection; and lack of impact to infrastructure (i.e., crossing of PC-1 North). Snohomish PUD states that it considered but abandoned sites with potentially higher kinetic power densities in Admiralty Inlet as too shallow for installation of the turbines, too close to major shipping channels, too steep a seabed slope, and substantially longer power cable runs.

Snohomish PUD also asserts that installation, maintenance, monitoring and removal would not pose a risk to PC-1 North because such operations do not require the use of anchoring (i.e., "live-boat" techniques), except during the installation of the trunk cables at the HDD sea floor exit, which would be located over 1,666 meters (5,300 feet) from the PC-1 North cable. To provide greater stability and back-up in case of vessel problems during installation, Snohomish PUD would use at least two tugboats to stabilize the installation vessel and two tugboats to stabilize the cable lay vessel. In addition, Snohomish PUD proposes to develop a Hazard Identification and Risk Assessment (HIRA) in consultation with the Coast Guard, the Corps, and PC Landing prior to marine operations that includes: (a) criteria for what weather and wave conditions must exist before marine operations can occur (e.g., wind speed less than 20 miles per hour, waves less than 2 meters, with a tidal velocity window of less than 1.5 knots, and during a running tide, with certainty of conditions remaining prevalent for duration of deployment or recovery); (b) use of industry-approved equipment and redundancy in the use of equipment and vessels (e.g., tugboat with back-up engine; back-up tugboat for emergencies; towing gear, barge, winches, winch wire, and hydraulic lifting tools that are new or certified based on industry standards); (c) criteria for aborting operations; and (d) an established "port of refuge," located kilometers away from PC-1 North, in the event of unanticipated adverse weather or other event. The HIRA would be developed after the issuance of any license for the project. Snohomish PUD has also committed to coordinate with PC Landing on any repairs needed in the vicinity of the project to ensure no damage occurs to either party.

Because of PC-1 North's importance to the American public, business, and financial institutions, the Public Safety and Homeland Security Bureau of the Federal Communications Commission (FCC), which licensed PC Landing's fiber optic cable on November 19, 1998,[76] initially recommended on May 23, 2012, that the Commission consider requiring a 500-meter separation between the turbines and PC-1 North. The

[76] *See* In the Matter of PC Landing Corp., *Cable Landing License*, 13 FCC RED 23384.

FCC's recommendation was based on concerns that at a separation distance of about 100 meters, Snohomish PUD may need more room to safely affix the turbines to the seabed and that maintenance of the fiber optic cable could be impaired by the presence of the turbines. Using ICPC recommendations,[77] the FCC recommended a separation distance of 500 meters.[78] On August 28, 2012, Snohomish PUD responded to the FCC's concerns, moving the turbines to 170 to and 249 meters from PC-1 North and defining strict conditions under which installation and removal would occur (described above). On October 4, 2012, the FCC stated that Snohomish PUD's August 28, 2012, filing presented relevant information indicating that installation and removal would not impair the ability to repair PC-1 North. Therefore, the FCC does not oppose licensing the project at the new distances from PC-1 North as long as the Commission determines that the project does not present a material risk to PC-1, and the Commission is able to ensure through its own licensing process (via imposition of conditions if appropriate), that Snohomish PUD and its agents, contractors and successors adhere to the safety and separation distance representations it has made in its August 28, 2012 filings. The Naval Seafloor Cable Protection Office similarly concluded that the changes and conditions noted also alleviate the concerns of its office (pers. communication via email, Catherine Creese, Assistant Director, Naval Seafloor Cable Protection Office, with David Turner, FERC, October 24, 2012).

Staff Analysis

Potential effects upon PC-1 North would either be from direct damage caused by physical interaction with the cable, or indirect effects from reduced access to existing cables for maintenance or repair work. OpenHydro has successfully deployed turbines using the "live-boat" techniques and under the sea-state conditions described above on three occasions—two of which involved larger turbines and heavier subsea bases than those that would be installed at Admiralty Inlet, in areas of much stronger currents—with

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[77] *See* "ICPC Recommendation No. 13, Proximity of Wind Farm Developments and Submarine Cables." ICPC, 2007.

[78] The ICPC recommendations are based on the distances required for a cable ship to carry out a cable repair relative to wind farms. With respect to wind farms, the recommendation is that the position of turbine structures in relation to existing submarine cables should allow access for a ship to repair an existing submarine cable. The distance is dependant on the depth of water where the cable is buried, and takes into account the length of a typical cable repair ship, the distance required to retrieve a cable using a grapnel, and a buffer of safety around the wind farm installation. Using the same principles for wind energy farms, the FCC recommended a distance of 500 meters, allowing 450 meters for "run-on (the distance between the submarine cable and the point at which the grapnel hits the ocean floor).

an accuracy of between 2 and 3.4 meters.[79] Installing the turbines using the "live-boat" process and only under the most favorable weather and tidal conditions (wind speed less than 20 miles per hour, waves less than 2 meters, with a tidal velocity window of less than 1.5 knots, and during a running tide[80]) would further ensure historical accuracy in installing the turbines and minimizing any potential for inadvertently dropping the turbines on the cable. Given the short period required to install each turbine (less than two hours), favorable weather and tidal conditions are likely to be available and remain throughout deployment. Snohomish PUD's proposed use of industry-approved equipment and equipment redundancy, development of criteria for halting installation and establishment of "port of refuge" located away from PC-1 North would minimize the potential of unexpected emergencies and adequately define procedures that would be implemented if those emergency conditions arose. Involving Coast Guard, the Corps, and PC Landing in the development of the HIRA would further ensure that their experience and operational needs are considered.

Physical interactions between the turbines once installed and the buried cable do not appear to be likely. The supporting design report predicts that the turbines will resist overturning with a factor of safety greater than three (i.e., the structure can withstand more than three times the expected load on the structure from the tidal currents without overturning) at all three vertices of the subsea turbine base. An encounter with tow cables or chains from tugboats is not anticipated to overturn the approximately 250-ton turbines. Therefore, physical interactions after installation are anticipated to be insignificant.

Given the small number and footprint of the turbines, the presence of the turbines would not prevent PC Landing's ability to repair PC-1 North in the very unlikely event of

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[79] In 2008, OpenHydro deployed a 6-meter, 220-ton turbine and gravity foundation off the coast of Orkney Scotland in under 1 hour's time and within 2 meters of the target deployment coordinates. In 2009, OpenHydro deployed a 10-meter, 280-ton turbine a gravity foundation in the Bay of Fundy, Nova Scotia in under 1 hour and within 2.8 meters of the target location. In 2011, OpenHydro installed a 16-meter, 1,000-ton turbine and gravity foundation off northern Brittany's coast in France in under 1 hour and within 3.4 meters of the target location.

[80] This ensures that ensures the tugboat and barge and turbine have the correct orientation to tidal direction. This tidal orientation is parallel to, or away from, PC-1 North, further decreasing the risk to the cable.

a cable fault at the turbine location not related to project installation or maintenance,[81] which for the reasons explained above are expected to be minimal. Even then, a repair could be successfully implemented, but would require procedures and additional cable that are not unlike procedures that would be applied if other obstructions were to be encountered during such a repair.

Subsea cable breaks or other malfunctions are typically repaired by a cable repair ship working as close as feasible to the break. Typically, an ROV or grapnel[82] is used to find the cable fault or break in a fiber optic cable, cut the cable near the cable fault, and retrieve the two ends for splicing with a new cable on the repair ship. Once aboard, the two cut ends are repaired and spliced back together, and the repaired cable is installed on the seabed or reburied.

If a cable fault occurred at the turbine location, the ship would have to make a cut in the cable north of the turbine and a second cut in the cable south of the turbine. This would leave a north end, a center section, and a south end. The cable north end would be hauled to the surface and spliced to a new cable section on board the ship sufficient to span the distance between the north cut and the south cut. The cable south end would then be brought to the surface and spliced to the other end of the new cable section. The repaired cable, with the new section installed, would then be relaid on the sea floor or buried, as required. The center section may be removed from the sea bed for disposal or left in place, depending on the circumstances of the project. The time required for a repair ship to make the additional cuts, the additional time to repair two spliced ends instead of one, the additional time to relay the longer length of cable on the sea floor (which may include burying the cable), and the cost of the new cable required to span the length of sea floor between the north and south cuts with enough slack to be lowered from the repair ship, would all contribute to an increased cost to repair the cable. The

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[81] The primary cause of cable disturbance is external damage from human activities, as opposed to damage occurring from natural events, such as earthquakes. The number of length-normalized faults in submarine cables installed in shallow (less than 3,280 feet deep) water is less than 0.35 faults per year per 3.28 million feet of cable installed (Kordahi et al. 2007). Using the failure rate of 0.35 faults per 3.28 million feet of installed submarine cable per year, the expected fault rate of the cable in the vicinity of the turbines is 0.1%, or 0.001 faults per year. The probability that a fault would occur from an event not associated with the installation, operation, maintenance, or removal of the turbines that would require repair during the proposed term of any license is considered insignificant.

[82] A long cable with a specialized hook on the end that is dragged either along the seabed or through the subsea floor (if the cable is buried) at a right angle to the cable until the hook "grabs" one of the cut cable ends.

additional cuts and repairs would also lengthen the time of cable outage, resulting in lost data transmission for PC Landing's customers. Customers of PC Landing may purchase protection to have their data rerouted via other networks in the event of a cable disruption. Per PC Landing's August 1, 2012 filing, customers representing 16 percent of the sold capacity on the system have purchased protection that would automatically reroute their data to other PC-1 segments. Other customer traffic would be rerouted if available capacity existed within the system, but additional time delays may be incurred if the rerouting was done manually.

Snohomish PUD estimated an additional 4-8 hours; however, PC Landing says it would be "significantly greater", but did not say how much greater, only stating this non-standard operation would add significant cost, delay, and complexity to the repair operation.

Moving the turbines further away from PC-1 North could eliminate them as obstacles to such a repair, but would expose the turbines to higher vessel traffic and a greater potential for adverse interaction with tugboats towing large barges. Moreover, as noted by Snohomish PUD, the further away from the shore the turbines are located the more difficult it becomes to implement the Marine Mammal Mitigation and Monitoring Plan, increases the cost of power cable installation, and would require crossing PC-1 North with the power cable.

3.3.7 Navigation

3.3.7.1 Affected Environment

Admiralty Inlet is located between the Olympic Peninsula and Whidbey Island where the northwestern end of Puget Sound meets the Strait of Juan de Fuca. Essentially all maritime traffic transiting to and from the ports of Seattle, Tacoma, Olympia, and Everett must pass through Admiralty Inlet. In 2011, the Port of Seattle was the sixth largest U.S. port based on shipping volume.[83] Admiralty Inlet also supports naval traffic associated with Naval Station Everett, Puget Sound Naval Shipyard, and Bangor Submarine Base. Additional maritime traffic is generated by the Port Townsend-Keystone ferry, which runs between Port Townsend and the Keystone community near Coupeville on Whidbey Island. Recreational uses of Admiralty Inlet, including boating, diving, recreational fishing, and camping also contribute to the volume of maritime traffic.

Activities in and adjacent to Admiralty Inlet are regulated by federal, state, and local authorities, including the Corps and the Coast Guard. The proposed location of the

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[83] http://www.portseattle.org/About/Publications/Statistics/Seaport/Pages/default.asp.

tidal energy project is in a Regulated Navigation Area subject to Coast Guard Vessel Traffic Service (VTS) control. VTS monitors, tracks, and communicates with all commercial vessel traffic in Puget Sound to facilitate the flow of maritime commerce and prevent accidents between multiple vessels using the inlet. The project is located approximately 3,000 feet east of the northbound lane of a regulated and International Maritime Organization-established Traffic Separation Scheme (TSS) (figure 11).

Maritime traffic transits the Inlet via northbound lanes when exiting Puget Sound into the Strait of Juan de Fuca, or southbound lanes when entering Puget Sound from the Strait of Juan de Fuca. A separation zone acts as a buffer between the northbound and southbound traffic to prevent vessel collisions.

The turbines would also be located 2,800 feet to 3,000 feet from the Coupeville – Port Townsend ferry route. The ferry operates year round, but provides more crossings of Admiralty Inlet during peak summer season. The number of crossings at any given time varies depending on the number of ferries available and maintenance issues.

3.3.7.2 Environmental Effects

Turbine and cable installation, maintenance, and removal will require barge, tugboat, and personnel vessels to operate in the project area for periods of up to six days. Unplanned maintenance activities could result in additional boat traffic in the area of the turbine installation. Such activities could represent obstacles to navigation. Following installation, the project turbines could represent a navigational hazard for tugboats and the vessels in tow if their tow lines were to be slack enough to encounter the turbines.

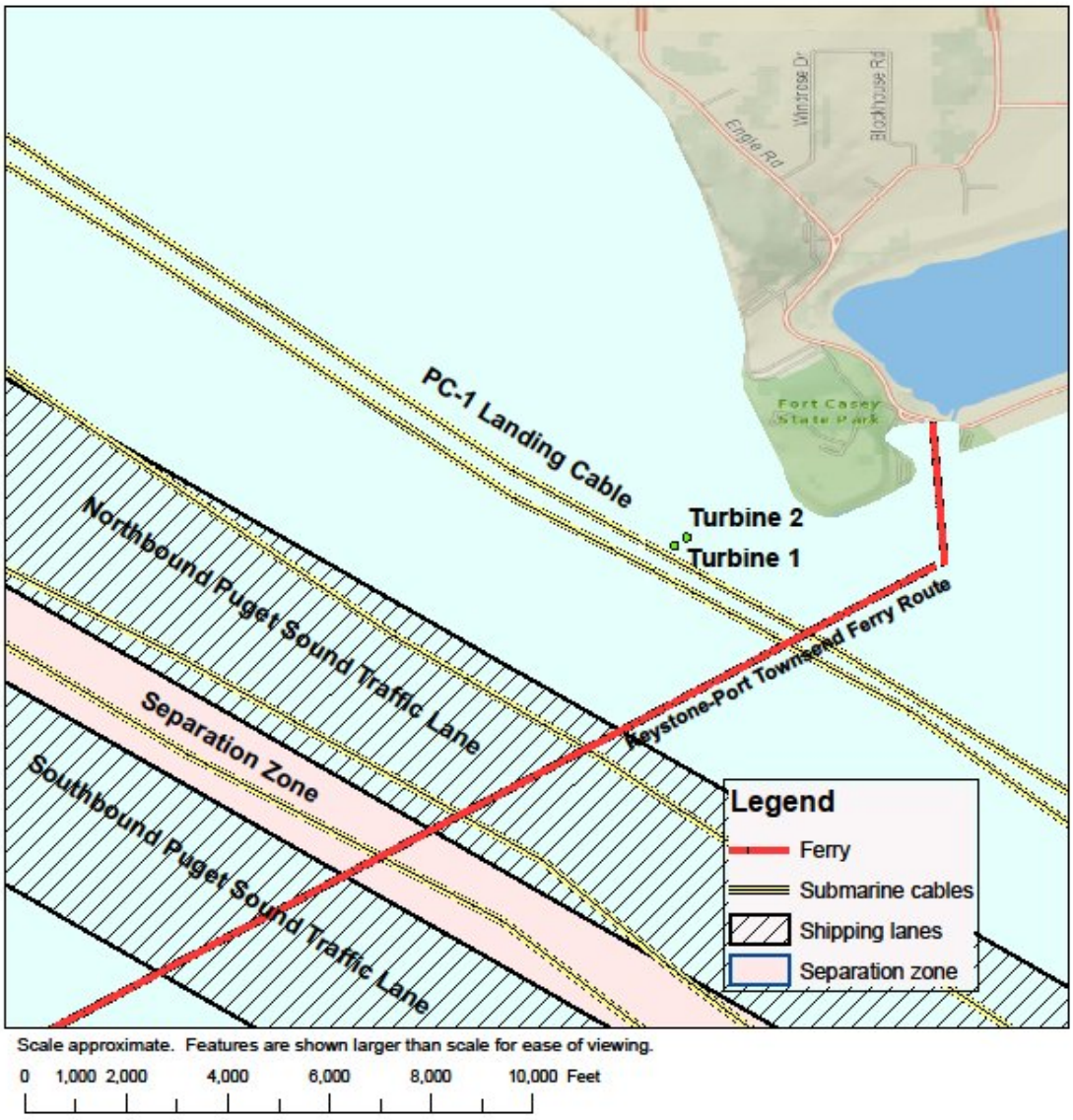

Figure 11. Location of proposed turbine installations, shipping channels, and submerged cables in Admiralty Inlet (Source: NOAA,[84] and applicant, as modified by staff).

Strong and turbulent currents complicate navigation and reduce tugboat maneuverability in the vicinity of the project. When tugboats are in motion, their

[84] NOAA EIC Direct to GIS, accessed May 11, 2012 at http://ocs-spatial.ncd.noaa.gov/encdirect/viewer.htm.

towlines do not have a great deal of slack hanging in the water. However, if the tugboat and its tow both significantly slow to avoid other maritime traffic (such as two ships meeting head-on) or for other reasons, the tugboat and its tow may move closer together and the towline between the ships will start to develop slack that hangs in the water between them in a catenary fashion. Depending on the length of the towline, this slack can be significant. The American Waterways Operators (AWO) asserts that tugboats and their vessels transiting the area can have towlines or chains that are up to 1,500 feet long and can dip 80 to 120 feet below the surface of the water. AWO also asserts that occasionally larger, faster-moving ships in the shipping lane can crowd the smaller, slower-moving tugboats out of the shipping lanes. If both a southbound and a northbound tugboat with a tow are diverted east of the shipping lanes, one or both ships may reduce speed and/or maneuver further east to avoid meeting head-on. The increased length of the towline resulting from the slowing of the tugboat and the movement of the tugboats east of the shipping lane could increase the likelihood that the slack towline could catch on the submerged turbines. If towlines were to catch on the turbines, it could cause damage to the vessels, their cargo, and potentially present a safety hazard to the crew. AWO and the Coast Guard recommend that Snohomish PUD not include buoys as they could create an additional navigational risk for vessels that would have to move around them.

To minimize potential navigation hazards posed by the project, Snohomish PUD developed a Navigation and Safety Plan[85] that includes provisions for (1) ensuring that all project vessels will comply with the International Rules for Preventing Collisions at Sea (COLREGS) in markings and operation, (2) ensuring that all such project vessel operations would be coordinated with the Puget Sound VTS, (3) conducting, at minimum, annual discussions with the Coast Guard to review project safety; and (4) reviewing the Navigational Safety Plan with the Coast Guard following any navigation safety issue that may arise during installation, operation, or decommissioning of the project.[86] Snohomish PUD would also distribute informational materials on the project to local commercial fishermen in coordination with Washington Sea Grant, and to local recreational users in coordination with the Port Townsend and Central Whidbey Chambers of Commerce and the Washington State Parks and Recreation Commission.

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[85] One of the plans within the Project Safeguard Plan filed as Appendix E of the license application. A revised Navigational Safety Plan was filed with the Commission on November 16, 2012.

[86] Snohomish PUD originally proposed a Regulated Navigation Area (RNA) around the project to further reduce potential accidental encounters with other vessels; however, after consultation with the Coast Guard, Snohomish PUD removed a RNA from their proposal. The Coast Guard reserves the right to require a RNA or other project safety provisions, if needed, in the future.

In addition to the measures proposed by Snohomish PUD in the Navigation and Safety Plan, the location of any submerged hydrokinetic device installed in Admiralty Inlet would be forwarded by the Coast Guard to NOAA for inclusion in the U.S. Coast Pilot[87] and on electronic and printed navigation maps.[88] The location would also be publicized to local mariners by the Coast Guard.

Staff Analysis

A number of factors reduce the project's potential effect on navigation. The turbines will be deployed outside the regulated TSS and ferry routes by approximately 2,800 feet to 3,000 feet, limiting the potential conflicts with the majority of vessels transiting through Admiralty Inlet. The short period for installation, maintenance, and removal activities and small footprint required for such activities would not represent a major navigational risk. Snohomish PUD's proposal to have all marine vessels associated with the project comply with the COLREGS, and to coordinate all vessel operations with the Coast Guard would reduce the likelihood of adverse interactions between the surface vessels and other marine traffic in the area. ROV monitoring equipment and maintenance personnel would have a reduced likelihood of adverse interactions with other marine traffic by the Coast Guard alerting or diverting other vessels in the area through the VTS.

Following turbine deployment, the turbines would represent a minor risk to navigation due to existing safeguards provided by the Coast Guard's VTS tracking and warning system and the depth of water. For those vessels that do leave the vessel traffic lanes and traverse over the proposed installation site, the depth of turbines (the top of the turbine will be approximately 140 feet below the water surface) would limit potential interactions to only those very few vessels with a tow line, chains, or other equipment that would fall at least that far below the surface of the water. The project would not be expected to affect any communications, radar, or positioning systems that would prevent a vessel from identifying or being notified of the turbines by the VTS system in case of an emergency. Existing restrictions on commercial salmon fishing in the vicinity of the project reduces the potential risk of fishing gear becoming entangled in the turbines.

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[87] The U.S. Coast Pilot is a series of nautical books that contain supplemental information that is difficult to portray on a nautical chart. Topics covered in the Coast Pilot include channel descriptions, anchorages, bridge and cable clearances, currents, tide and water levels, prominent features, pilotage, towage, weather, ice conditions, wharf descriptions, dangers, routes, traffic separation schemes, small-craft facilities, and Federal regulations applicable to navigation.

[88] *See* "Telephone Memo" filed November 28, 2012, between Coast Guard and Commission staff.

The potential for a tugboat's towline to snag a turbine is small. The installation site is over 2,800 feet from the navigation channel, which limits the number of marine vessels that traverse over the site. For calendar year 2010, 113 vessels passed within 650 feet of the proposed installation site based on information provided by the Automatic Identification System.[89] Snohomish PUD's risk assessment determined that the likelihood of two vessels meeting head-on in a 2-mile-long by 0.75-mile wide area over the proposed installation site would be less than one occurrence per month.[90] Therefore, approximately once per month there is a potential for one or more vessels transiting near the turbines at the same time to be required to change course to avoid a close passage. The Coast Guard's VTS tracking system would warn approaching vessels in the vicinity of the turbines, providing the tugboats sufficient notice to either avoid the turbines or winch in their tow cables to reduce the length of slack line that might encounter the turbines. The turbine installation site represents less than 0.05 percent of the horizontal cross-section of Admiralty Inlet. The sparse traffic outside of the navigation lanes should provide adequate room for vessels to alter their course to avoid transiting over the small area occupied by the turbines when cable tow lines are likely to be slack. The location of the turbines would also be publicized on navigational charts and through other sources so that mariners could avoid inadvertent interaction with the turbines.

The state ferry route does not approach the turbine locations, although it does cross over the proposed alignment of the power cables. It is highly unlikely the ferry would deploy an anchor or otherwise interact with the cables. If the installation of the trunk cables is coordinated to avoid conflicts with scheduled ferry service, then no impacts on ferry traffic would be expected.

The small footprint of the project reduces the probability of encountering the turbines and allows for continued navigation around the proposed project, as necessary. Operation of all vessels associated with the project using COLREGS standards and in coordination with the Coast Guard would help minimize adverse interactions with other vessels in the project area during construction and installation, maintenance, and removal of the project. Continued consultation with the Coast Guard throughout the term of any

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[89] The Automatic Identification System (AIS) is an automated tracking system used on ships and by VTS for identifying and locating vessels. AIS is fitted aboard international voyaging ships with gross tonnage (GT) of 300 or more tons, and all passenger ships regardless of size. AIS is designed to assist traffic monitoring personnel at VTS or other maritime authorities and watchstanders aboard ship by facilitating the tracking and monitoring of vessel movements.

[90] "Head-on" for the purposes of this assessment was defined as two vessels both being present in the 0.75-mile-wide, 2-mile-long area over the proposed installation within 15 minutes of each other.

license issued for the Admiralty Inlet Project would ensure that appropriate safety measures remain in place and any scheduled or unscheduled events that could affect navigation are appropriately addressed and necessary steps are taken to maintain public safety. Commission notification within 10 days of any adverse navigation event would allow Commission staff to coordinate the implementation of any unanticipated safety measures with Snohomish PUD and the Coast Guard.

While the proposed project has the potential to effect navigation in Admiralty Inlet, most of these impacts would be minimal because the project is located outside of the normal marine vessel transit routes, the Coast Guard directs traffic in the area of the turbines through the existing VTS, and the turbines would be installed below navigational traffic depth. The small footprint of the project and Snohomish PUD's proposal to implement the Navigational Safety Plan would mitigate any of the minor effects of the project on navigation in Admiralty Inlet.

3.3.8 Aesthetic Resources

3.3.8.1 Affected Environment

Admiralty Inlet offers many scenic vistas and outdoor recreation opportunities that appeal to residents and visitors year round. Several state and local parks and a national historical reserve exist in the vicinity of the proposed project and provide viewpoints from which to observe the waters of Admiralty Inlet and surrounding landscapes. The shoreline nearest the proposed turbine locations, Admiralty Head, is predominantly a mixed sand and gravel, bluff-backed beach with a large upland area occupied by Fort Casey State Park. The park affords sweeping views of the Inlet, the Olympic Peninsula, and Port Townsend. A popular viewing area is the broad, grassy bluff and historic gun batteries that overlook the Inlet and the proposed site of the underwater turbines. An undeveloped area of the park exists along the shoreline of Keystone Spit near the site of the proposed control building.

Ebey's Landing National Historical Reserve surrounds and includes the state park and other lands and offers extensive views of picturesque farmland, wild bluffs and beaches, Admiralty Inlet, and the Cascade and Olympic Mountains. The proposed control building and portions of the power cables and transmission line would be located on a private parcel within the reserve. This parcel and several neighboring properties are developed with homes and accessory buildings. These homes include historic properties, including the Schulke/Steadman House immediately west of the control building site.

The Whidbey Scenic Isle Way is a 54-mile state-designated scenic byway that runs the length of Whidbey Island and passes through the project area. This unique island byway provides convenient access to area towns, beaches, parks, wildlife areas, and historic sites, and includes a branch (State Route 20) connecting to the Port Townsend-Coupeville ferry terminal adjacent to Fort Casey State Park. The ferry

crossing passes within 1.5 kilometers of the proposed turbine sites. The proposed control building would be located adjacent to the byway in a relatively quiet and lightly developed area a half kilometer east of the ferry terminal.

3.3.8.2 Environmental Effects

The project includes marine and land-based components that could potentially affect aesthetic resources. Because the marine components (two 6-meter turbines and subsea cables) would be located on the sea floor approximately a half kilometer west of Admiralty Head, they would be not visible or audible from land or water, and therefore, would have no lasting effects on aesthetic resources. However, short-term effects are likely during project construction, monitoring, maintenance, and removal activities, when marine vessels, equipment, and the turbines would be visible in Admiralty Inlet and Admiralty Bay. Upon arrival, the 6-meter diameter turbines would likely be conspicuous from Fort Casey State Park and other nearby viewing areas, but would remain above water only briefly. Snohomish PUD indicates they could be deployed in a single 6-hour tidal cycle, which would substantially diminish any potential visual impact. Deploying the turbines, laying the subsea cables, and other associated marine activity would be of a short duration, with all marine installation activities expected to be completed within 20 days. Most activity would be located a half kilometer or more from likely viewing areas at Fort Casey State Park and the ferry terminal, resulting in only minor, temporary effects. Some marine activities may be audible onshore, but are not expected to generate any significant noise concerns. No mitigating measures are proposed or recommended for this activity.

Snohomish PUD projects that the primary visual disturbance would occur during the land-based HDD bore drilling process. Up to six large trucks would deliver equipment and materials to the site. A drill rig would be set up on the property to drill an HDD bore beneath the beach and near shore area, exiting underwater at a point at least 18 meters below the surface. Sections of the 10-inch diameter conduit liner would be partly assembled on the beach then towed seaward a short distance before being hauled through the bore. The power cables transmitting power from the turbines to the control building would be hauled by cable through the lined bore to a connection point at a subsurface vault adjacent to the control building. This drilling, assembling, and hauling activity would extend over a 45-day period and would likely be visible and audible to area residents, travelers on the ferry and scenic byway, nearby boaters, and those recreating along the beach. The activity would be substantial, resulting in temporary noise and visual effects on neighboring properties and those who may be traveling or recreating in the area. No lasting effects would be expected because Snohomish PUD would revegetate all disturbed areas following installation.

The control building would be the only substantial aboveground component that would be visible over the life of the project. Measuring 24 by 30 feet, and approximately 16 feet in height, the size of the control building would be comparable to other structures

in the area. Due to the sensitivity of the site's location along the scenic byway and within the Ebey's Landing National Historical Reserve, the appearance of the structure could potentially conflict with the historic character and visual quality of the reserve and byway.[91] To minimize these effects, Snohomish PUD proposes to design the control building to be generally compatible with existing buildings in the surrounding area.

As with project construction and installation, project removal could also affect views from nearby areas. Removal of the marine-based components would require the presence of several marine vessels, a barge, one or more tugboats, and a personnel transfer/safety boat. Visual effects would likely be minor and of short duration. Snohomish PUD would remove the land-based components according to the terms of the agreements with the private property owner and Puget Sound Energy. It is expected that if the project is terminated, equipment would be quickly removed and the control building would be utilized by the homeowner as a garage. Any newly disturbed areas would be revegetated, as needed.

In their May 22, 2012, motion to intervene, the Whidbey Environmental Action Network expressed concern that the proposed project may degrade the aesthetic character of the natural environment may be degraded by the proposed project.

The HDD bore drilling process, as described in Snohomish PUD's HDD Plan, would be likely to generate substantial noise that may affect residents, travelers, and recreationists in the vicinity of the project, including visitors to Fort Casey State Park, those utilizing the ferry and scenic byway, and boaters who may pass through the area while drilling is underway. The drill rig, associated pumps, vehicles, and other equipment could be moderately or highly disturbing to the quiet ambience that people in the area may be more accustomed to. The impacts would be temporary and are expected to last approximately 45 days. Snohomish PUD intends to conduct the HDD drilling up to 12 hours per day over a seven day period, but does not propose other measures to reduce noise, such as temporary sound barriers.

Equipment housed in the control building, including transformers, power inverters, and conditioners, cabling, and heating, ventilating, and air conditioning systems, may also create low-level noise that would be audible outside the control building over the life

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[91] A previous configuration of the project proposed locating the control building at Camp Casey to the north of Fort Casey State Park, which raised a concern about aesthetic impacts in a comment letter from the National Park Service. Snohomish PUD agreed to design the structure consistent with Camp Casey historical guidelines, which alleviated the concern. No comments were received regarding the relocation of the control building to Keystone Spit, which is also within the national historical reserve.

of the project. The impact would likely be minor and may only affect the nearest residences. No measures are proposed to minimize this potential noise impact.

Staff Analysis

Although the presence of marine vessels during project installation or removal (e.g., turbine deployment barge, cable-laying barge, tugboats, and small support vessels) could potentially affect the viewshed from Fort Casey State Park and other nearby areas, these vessels are expected to be no more conspicuous than vessels associated with frequent shipping traffic through Admiralty Inlet. Moreover, such effects would be temporary and short-term (lasting up to 45 days).

It is expected that noise from HDD drilling activity could be considerable and may be disruptive to neighboring residences. However, the impact would likely be comparable to other general construction activity involving heavy equipment, such as utility or road construction. Although the work is expected to be completed in seven days operating 12 hours per day, it is not uncommon with HDD drilling for unexpected problems to arise where it may become necessary to continue operating equipment for more than 12 hours at a time. If this were to occur here without a contingency plan in place, noise impacts to nearby residents could become more significant. Typically, when a noise sensitive area (NSA) is located within a half-mile of the noise source, additional measures may be necessary to maintain day-night sound levels below 55 dBA within the NSA.[92] The NSA in this instance would be the adjacent residences near the drill rig. Having a contingency in place that includes the placement of temporary sound barriers (e.g., plywood sound barrier surrounding the drilling operation) or other measures to reduce noise impacts on the NSA would provide an important safeguard in the event that HDD drilling does not proceed as smoothly as expected.

The control building would not significantly obstruct views from the scenic byway, nor be conspicuous to boaters in Admiralty Inlet. Designing the building to be compatible with existing structures would adequately minimize visual effects on the

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[92] The EPA reports that an outdoor day-night sound level of 55 decibels (dB) provides satisfactory outdoor sentence intelligibility for normal voices at a distance of approximately 11 feet (3.5 meters) and that the average expected community reaction to a noise level below 55 dB is minimal. This level would protect the vast majority of the population under most conditions against annoyance. Further, the noise level inside a typical home would be reduced by about 15 dB, resulting in additional protection from noise impacts. Therefore, 55 dB is a reasonable maximum level for construction noise at the property boundary outside of normal construction hours (e.g., 7:00 p.m. to 7:00 a.m.). See *Protective Noise Levels: Condensed Version of EPA Levels Document*. EPA, November 1978.

reserve and prevent any long-term degradation of the aesthetic environment of the reserve.

3.3.9 Cultural Resources

3.3.9.1 Affected Environment

Section 106 of the NHPA, as amended (section 106), requires the Commission to evaluate potential effects on properties listed or eligible for listing in the National Register prior to an undertaking. An undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including, among other things, processes requiring a federal permit, license, or approval. In this case, the undertaking is the proposed issuance of an original license for the project. Potential effects associated with this undertaking include project-related effects associated construction or with the day-to-day operation and maintenance of the project.

Historic properties are cultural resources listed or eligible for listing on the National Register. Historic properties represent things, structures, places, or archeological sites that can be either Native American or Euro-American in origin. In most cases, cultural resources less than 50 years old are not considered eligible for the National Register. Cultural resources also have to have enough internal contextual integrity to be considered historic properties. For example, dilapidated structures, heavily disturbed archeological sites, and isolated artifacts, may not have enough contextual integrity to be considered eligible.

Section 106 also requires that the Commission seek concurrence with the Washington State SHPO on any finding involving effects or no effects on historic properties, and allow the Advisory Council on Historic Preservation an opportunity to comment on any finding of adverse effects on historic properties.

The area of potential effects (APE) for the project is determined to include all submerged lands and terrestrial lands within the project boundary. The Washington SHPO concurred with the APE on August 3, 2011.

Culture Context

Pre-Contact and Ethnography of Native Americans

Native American groups have inhabited the region around Admiralty Inlet and Puget Sound since the end of the Pleistocene. The early inhabitants of the area were adapted to a coastal environment exploiting both marine and terrestrial resources, living in base camps and smaller seasonal habitation sites. The preservable material culture associated with these groups consists of chipped stone tools, including lanceolate-shaped

projectile points, bifaces, flakes and scrapers, used for fishing, hunting, gathering of plants, and shelter construction.

Native Americans living in the region were probably ancestral to Southern Coast Salish culture group who where indigenous to this part of the Northwest Pacific coastal region when Europeans arrived at the turn of the 18th century. The groups living in the area around Admiralty Inlet were Northern Lushootseed speakers, which were further divided into Lower and Upper Skagit communities, including the present-day Sauk-Suiattle Tribe, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes.

At the time of European contact, the groups had evolved into highly developed fishing societies adept in woodworking skills, manufacturing large ocean-going canoes, plank houses, and other endeavors involving beautiful totemic and anthromorphic religious artwork. These people were also skilled craftsmen in various textiles and basketry used for clothing and storage.

Following the arrival of European fur traders, Native American populations declined dramatically with the depletion of fur-bearing animals and introduction of European diseases. When the Americans established permanence in the Pacific Northwest, Governor Isaac Stevens of the newly established Washington Territory made various treaties with the Southern Coast Salish between 1854 and 1855. Many Native Americans became quickly dissatisfied with the treaties, resulting in the Indian Wars of 1855-1856. Hostilities between encroaching Anglo-American settlers and various Indian tribes continued in the region for the rest of decade.

Euro-American Occupation

Puget Sound was explored in 1792 by a British expedition under the leadership of George Vancouver. During the first decades of the 19th century, explorers and trappers of the Hudson Bay Company continued to make incursions in and around Puget Sound, adjacent waterways and rivers in pursuit of fur-bearing animals for international trade.

The lands north of Admiralty Inlet were surveyed as early as 1841 by the United States Exploring Expedition under the direction of Charles Wilkes. In 1851, a settlement at Elliot Bay was established by American settlers in an area that is now the center of Seattle at Pioneer Square. A peninsula of land on the north side of Admiralty Inlet, known as Admiralty Head, was settled a short time afterwards in 1853. From the 1860s through the 1890s, the area in and around Admiralty Head was fortified with a lighthouse and several forts to guard the entrance of Puget Sound and the burgeoning city of Seattle to the south. By the end of the 19th century, one of the forts at Admiralty Head became Fort Casey which was garrisoned up until the beginning of the First World War, when it was converted into a training post for the National Guard. From the beginning of the

American settlements at Admiralty Head, the civilian population centering around the town of Ebey's Landing have continued to develop.

Known Cultural Resources

AMEC Environment & Infrastructure, Inc. (AMEC) surveyed the terrestrial portions of the APE in January 2012. AMEC found two sites eligible for listing on the National Register. The first is a built resource consisting of a gabled roof house and associated garage, known as the Schulke/Steadman House[93] which continues to be occupied.[94] The house and garage were documented in 1983 by National Park Service personnel and is considered a contributing element to the Central Whidbey Island Historic District, established by the National Park Service in 1972, and is part of the larger Ebey's Landing National Historical Reserve established in 1978.[95] During field work investigations, AMEC personnel documented a light surface scatter of historic materials (archeological site 45IS303) associated with the Schulke/Steadman House occupation. Both the house and associated archeological site are considered eligible for inclusion in the National Register.

The second eligible site (archeological site 45IS304) was located along the shoreline within the APE. This archeological site represents a Native American occupation consisting of a light concentration of chipped stone material dating prior to European contract. The extent of the site is approximately 10 by 5 meters.

Snohomish PUD contracted Golder Associates, Inc. to conduct geophysical investigations for the submerged portions of the APE (Sylwester and Findley 2011). The contractor used a sub-bottom profiler with a seismic reflection system to map the benthic topography of the sea floor and its underlying structure. No shipwrecks or other cultural resource-related anomalies were detected. No historic properties were located within the submerged portion of the APE.

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[93] The Schulke/Steadman House was built in 1910 and was initially occupied by an enlisted man (Amos Schulke) and his family who was stationed at Fort Casey between 1915 and 1920.

[94] Another house, the Reynolds House (built in 1928) was located just outside of the APE, not far from the Schulke/Steadman House. This house is not eligible for the National Register, nor would it be affected by the proposed project.

[95] Both the reserve and historic district represent an unbroken historic sequence of the Puget Sound area from the exploration and Anglo-American settlement periods. It is represented by a town, 17 farms, and more than 400 historical structures and homes, many of which are occupied to the present day

No traditional cultural properties were located within or near the APE.

3.3.9.2 Environmental Effects

Land-disturbing activities associated with the construction of the cable control building, installation of the transmission cable, and project removal could potentially affect cultural resources. However, based on site investigations, Snohomish PUD determined that the proposed project would not have any adverse effects on historic properties, including Schulke/Steadman House and its associated historic artifact scatter, and the pre-contact Native American site. The Washington SHPO concurred with Snohomish PUD's finding of no adverse affect on February 28, 2012. Snohomish PUD did pose any additional measures to protect cultural resources.

In a letter filed with the Commission on May 23, 2012, the Tulalip Tribes stated that in the area immediately south of the proposed powerhouse[96] there is a known tribal archeological site, the northern extent of the site has not been established, and there is a high likelihood of finding additional artifacts and or burial remains during project construction.

Staff Analysis

Field investigations consisting of a 10 meter interval pedestrian survey accompanied by shovel test probes were conducted throughout surficial lands within and adjacent to the APE. Shovel tests were confined to 60 centimeters due to sloughing side walls caused by the lose structure of the marine gravels. AMEC concluded that each shovel test was dug to a sufficient depth to detect any pre-contact archaeological material. A metal detector was also used to identify cultural material. Thus all terrestrial portions of the proposed project that would be subject to disturbance were surveyed using accepted protocols.

The only Native American archeological site found during the survey was site 45IS304, located along the shore. HDD to install the transmission would go under this particular archeological site and would not adversely affect it.

Commission staff agrees with the findings and determinations made by AMEC and Snohomish PUD and concurs that the proposed project would not have any adverse effects on historic properties.

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[96] The Tulalip Tribe states that the archeological site is south of the proposed powerhouse; however, the turbine deployment site, which generates electric power, is offshore. We conclude that the Tulalip Tribes is referring to the proposed control building, which would lie just to the north of archeological site 45IS304.

As with any project, however, there is a chance that construction activities could lead to unanticipated discoveries of historic resources. To ensure protection of these resources in the event they are uncovered, it would be beneficial for any license order issued by the Commission to include a license article describing the procedures to be followed regarding cultural resources. Among other things, the article could state that: (1) following construction of the project, but prior to any new land-clearing or ground-disturbing activity that may be necessary over the license term, the licensee would consult with the Washington SHPO in compliance with section 106; and (2) in the event that cultural materials or human remains are inadvertently discovered during the course of constructing or developing project works or other facilities at the project, or over the license term, the licensee would stop all land-clearing and land-disturbing activities in the vicinity of the discoveries and consult with the Washington SHPO. If historic properties are identified, a Historic Properties Management Plan could be crafted by the licensee in consultation with the Washington SHPO, depending on the nature of the historic properties identified.

3.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, the Admiralty Inlet Project would not be installed and DOE would not provide financial assistance to fund the project. There would be no changes to the physical, biological, or cultural resources of the area and electrical generation from the project would not occur. There would be no potential for harming PC Landings fiber optic cable and there would be no changes in the navigation risks of Puget Sound. The power that would have been developed from this pilot project would not be available to the grid. The energetic, biological and environmental information that would be developed from installing and monitoring the operation of the tidal turbines would not be gathered.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the Admiralty Inlet Project's use of the natural tidal currents of Admiralty Inlet for hydropower purposes to see what effect various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp*.,[97] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the EA for the protection, mitigation and enhancement of environmental resources affected by the project; (2) the cost of alternative power; (3) the total project cost (i.e., for construction, operation, maintenance, and environmental measures); and (4) the difference between the cost of alternative power and total project cost. If the difference between the cost of alternative power and total project cost is positive, the project produces power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project produces power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. 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.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 6 summarizes the assumptions and economic information we use in our analysis. This information, unless otherwise identified, was provided by the applicant in its license application and subsequent filings. We find that the values provided by the applicant are reasonable for the purposes of our analysis. Cost items common to all alternatives include taxes and insurance costs; estimated future capital investment required to construct, maintain, and extend the life of equipment and facilities; licensing costs; and normal operation and maintenance cost.

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[97] See *Mead Corporation, Publishing Paper Division*, 72 FERC ¶ 61,027 (July 13, 1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

Table 6. Parameters for the economic analysis of the Admiralty Inlet Project (Source: Snohomish PUD and staff).

Parameter	Value
Period of analysis (years)[a]	30
Federal income tax rate (%)[b]	35
Insurance cost $/year	$20,000
Initial construction cost ($)[c]	$16,000,000
Future operation and maintenance ($/year)[d]	$198,000
Licensing cost ($)[d]	$2,500,000
Energy value ($/MWh) [e]	$30
Interest rate (%)[b]	6

[a] Regardless of the potential license term (e.g., 5-year pilot, 30, 40 or 50 years), we perform a 30-year economic analysis.

[b] Estimated by staff.

[c] Initial construction cost was provided by the applicant in the license application.

[d] The total cost of project operation and maintenance over the five-year period of operations is $4,430,000. The cost shown in the table is levelized over the 30-year period used for the FERC Mead analysis.

[e] In the FERC Mead analysis the value of energy is estimated from the *Energy Information Administration, Supplement to the Annual Energy Outlook 2012*.

4.2 COMPARISON OF ALTERNATIVES

Table 7 compares the installed capacity, annual generation, cost of alternative power, estimated total project cost, and difference between the cost of alternative power and total project cost for each of the alternatives considered in this EA: no action, Snohomish PUD's proposal, and the staff alternative.

The Admiralty Inlet Project is a proposed pilot project. Pilot projects are small, short-term, removable, and carefully-monitored projects intended to test technologies, sites, or both. From our comparison, both Snohomish PUD's proposal and the staff alternative would have an initial annual cost that far exceeds the current power value. The costs associated with the project are not indicative of future and larger-scale projects.

Table 7. Summary of the annual cost of alternative power and annual project cost for the alternatives for the Admiralty Inlet Pilot Tidal Project (Source: staff).

	Applicant's Proposal	**Staff Alternative**
Installed capacity (kW)	680	680
Annual generation (MWh)	216	216
Annual cost of alternative power	$6,480	$6,480
(2012 $/MWh)[a]	30.00	30.00
Annual project cost	1,847,290	$1,847.670
($/MWh)	8,552.27	8,544.01
Difference between the cost of alternative power and project cost [b]	(1,840,850)	($1,841,190)
($/MWh)	(8,522.47)	(8,524.01)

[a] Alternative fuel cost prices are from the Energy Information Administration's *Annual Energy Outlook 2012*, available at http://www.eia.gov/forecasts/aeo/index.cfm.

[b] A number in parentheses denotes that the difference between the cost of alternative power and project cost is negative, thus the total project cost is more than the cost of alternative power by that amount.

4.2.1 No-action Alternative

Under the no-action alternative, the project would not be constructed as proposed, and would not produce any electricity, and DOE would not provide financial assistance to fund the project.

4.2.2 Snohomish PUD's Proposal

Snohomish PUD proposes to install two OpenHydro turbines and associated facilities in Admiralty Inlet. Upon completion of the installation of the turbines, the trunk cables, the cable control building, and the interconnection to an existing transmission line, the project's installed capacity would be 680 kW, and would generate an average of 216 MWh of electricity annually. The average annual cost of alternative power would be $6,480, or $30.00/MWh. The average annual project cost would be $1,847,290, or about $8,552.27/MWh. Overall, the project would produce power at a cost that is $1,840,850 or $8,522.27/MWh, more than the cost of alternative power.

4.2.3 Staff Alternative

The staff alternative includes the same project facilities and operations as proposed by Snohomish PUD and, therefore, would have the same capacity and energy attributes. In addition to Snohomish PUD's proposed environmental protection and enhancement measures, staff recommends implementing noise abatement measures if HDD processes are required outside of expected construction schedules. Such costs would only be incurred in such circumstances. Consequently, project generation and costs would be the same as proposed by Snohomish PUD

4.3 COST OF ENVIRONMENTAL MEASURES

Table 8 gives the cost of each of the environmental enhancement measures considered in our analysis. All costs are converted to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost

Table 8. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of constructing and operating the Admiralty Inlet Project (Source: staff).

Enhancement/Mitigation Measures	Entities	Capital Cost (2012$)	Annual Cost (2012$)	Levelized Annual Cost (2012$)[a]
Safeguard Plans				
1. Project Removal and Site Restoration Plan	Applicant, Staff, Interior, WDFW	$0[b]	$0	$0
2. Project and Public Safety Plan	Applicant, Staff, Interior, WDFW	$0[c]	$0	$0
3. Navigational Safety Plan	Applicant, Staff, Interior, WDFW	$0[d]	$0	$0
4. Hazard Identification and Risk Assessment and use of "live boat" techniques	Applicant, Staff, Interior, WDFW	$30,000	$0	$2,000
5. Emergency Shutdown and Removal Plan	Applicant, Staff, Interior, WDFW	$0[c]	$0	$0

Enhancement/Mitigation Measures	Entities	Capital Cost (2012$)	Annual Cost (2012$)	Levelized Annual Cost (2012$)[a]
Aquatic Resources				
6. Water Quality Monitoring Plan	Applicant, Staff, Interior, WDFW	$50,000	$0	$3,340
7. Implement HDD Plan	Applicant, Staff, Interior, WDFW	$0[b]	$0	$0
8. Environmental Monitoring Infrastructure	Applicant, Staff, Interior, WDFW	$1,100,000	$0	$73,370
9. Derelict Gear Monitoring Plan	Applicant, Staff, Interior, WDFW	$0	$58,360[e]	$58,360
10. Acoustic Monitoring and Mitigation Plan	Applicant, Staff, Interior, NMFS, WDFW	$16,000	$35,350[f]	$36,420
11. Near-Turbine Monitoring and Mitigation Plan	Applicant, Staff, Interior, NMFS, WDFW	$425,000	$103,390[g]	$131,740
12. Marine Mammal Monitoring and Mitigation Plan	Applicant, Staff, Interior, NMFS, WDFW	$106,000	$111,730[h]	$118,800

Enhancement/Mitigation Measures	Entities	Capital Cost (2012$)	Annual Cost (2012$)	Levelized Annual Cost (2012$)[a]
13. Benthic Habitat Monitoring and Mitigation Plan	Applicant, Staff, Interior, NMFS, WDFW	$0	$58,030[i]	$58,030
14. Implement Adaptive Management Framework, including conferring wth a Marine Aquatic Resource Committee	Applicant, Washington DFW	$0	$0[j]	$0
Aesthetics				
14. Interpretation and Education Plan and interpretive display	Applicant, Staff, Interior	$5,000	$0	$330
15. Implement noise abatement contingency measures if drilling occurs during the evening hours.	Staff	$0	$0	$0[l]
16. Relocate project turbines 500 to 950 meters or more away from PC-1 North	P.C. Landing	$335,000 to $600,000		$22,350 to $40,020[m]

Enhancement/Mitigation Measures	Entities	Capital Cost (2012$)	Annual Cost (2012$)	Levelized Annual Cost (2012$)[a]
17. Modify the Project Removal and Site Restoration Plan to include specific timelines for removal	Staff	$0	$0	$0
18. Stop work if archaeological or historical resources are discovered and develop protection measures.	Staff	$0	$0	$0[n]

[a] The applicant provided estimated O&M costs, including monitoring costs, over the five-year timeframe of the pilot license procedures. As it is Commission policy to annualize all costs over a 30-year time frame, we have, where appropriate, converted the provided five-year annual costs to a present value, and then annualized that value over a 30-year term.

[b] No cost estimated – included in the total operation and maintenance costs ($4.43 million).

[c] The implementation of the Project and Public Safety Plan and the Emergency Shutdown and Removal Plans are anticipated to be $0, unless there is an emergency. In the event of an emergency removal, costs could range from $500,000 to $1,000,000.

[d] The implementation of the Navigational Safety Plan would be coordinated in consultation with the Coast Guard. The Coast Guard would notify NOAA, local mariners, and the VTS to the location of the turbines; therefore, no cost is anticipated for Snohomish PUD for this measure.

[e] Snohomish PUD would conduct five years of derelict gear monitoring at a cost of $175,000 per year. The cost is levelized over the 30-year period of the Mead analysis.

[f] Snohomish PUD would conduct five years of acoustical monitoring at a cost of $106,000 per year. The cost is levelized over the 30-year period of the Mead analysis.

[g] Snohomish PUD would conduct five years of near-turbine monitoring at a cost of $310,000 per year. The cost is levelized over the 30-year period of the Mead analysis.

[h] Snohomish PUD would conduct five years of marine mammal monitoring at a cost of $335,000 per year. The cost is levelized over the 30-year period of the Mead analysis.

[i] Snohomish PUD would conduct five years of benthic habitat monitoring at a cost of $335,000 per year. The cost is levelized over the 30-year period of the Mead analysis.

[j] Adaptive management provisions, including conferring with the Marine Aquatic Resource Committee, are already included in many of the proposed plans; therefore, creating a formal group to coordinate the consultation that is otherwise required to fulfill the license conditions of any license granted is not anticipated to generate an incremental cost to Snohomish PUD.

[k] The incremental cost of this measure is anticipated to be minimal.

[l] Implementation of staff's recommended noise abatement measures are anticipated to $0, unless HDD drilling processes extend into the nighttime hours. In that event, costs would likely be less than $5,000.

[m] Using an estimated cost of $250,000/km for additional cable, costs ranged from a low of $167,500 per cable (for 670 meters of additional cable) to a high of $300,000 per cable (for 1,170 meters of additional cable).

[n] Cost would only be incurred if archaeological or historical resources are discovered during land-disturbing activities.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPARISON OF ALTERNATIVES

In this section, we compare the developmental and non-developmental effects of Snohomish PUD's proposal, the staff alternative, and the no-action alternative.

We estimate the annual generation of the project under the two action alternatives identified above. Our analysis shows that the annual generation would be 216 MWh for the proposed action and the staff alternative.

We summarize the environmental effects of the project under the applicant's proposal and the staff alternative below (table 9). Under the no-action alternative, the pilot project would not be constructed, DOE would not provide financial assistance to fund the project, and environmental conditions would not be altered by the project.

Table 9. Comparison of alternatives for the Admiralty Inlet Project. (Source: Staff).

Snohomish PUD's Proposal	Staff Alternative
General	
• Implementing the Project and Public Safety Plan and Emergency Shutdown Plan would help to ensure environmental and public safety. • Implementing the Project Removal and Site Restoration Plan would help to ensure protection of the aesthetic and environmental resources in and around Admiralty Inlet.	• Same as applicant's proposal, plus: • Provisions in the Project Removal and Site Restoration Plan for providing a specific timeline for the removal and site restoration activities, as well as documentation of consultation with the appropriate agencies, 6 months prior to license expiration, and documentation of completion of project removal and site restoration activities prior to license expiration, would ensure that the project is removed and the site is sufficiently restored to near pre-project condition by the end of the license term.
Geologic and Soils	
• Implementing the HDD Plan would avoid sensitive shoreline habitats, but	• Same as applicant's proposal.

Snohomish PUD's Proposal	Staff Alternative
would result in minor, short-term, localized soil-disturbance on-shore and at-sea. • Implementing the Near-Turbine Monitoring and Mitigation Plan and Benthic Habitat Monitoring and Mitigation Plan would identify any unanticipated adverse effects of the project on scouring or sediment transport processes. • Implementing the Water Quality Monitoring Plan would identify the release of high turbidity levels and oil during installation, and implement any needed corrective actions, preventing adverse effects on aquatic resources.	
Marine Resources	
• Conducting in-water installation only during a Washington DFW work-window of July 16 to October 14 would avoid adverse effects on sensitive fish resources. • Implementing the Acoustic Monitoring Plan would characterize noise radiated by the project, monitor changes in noise radiated by the project over time from wear, and determine if corrective actions are needed if exceeding noise thresholds for marine mammals. • Implementation of the Benthic Habitat Monitoring and Mitigation Plan would help to ensure effective project operation and health of the benthic community in the project area. • Implementing the Near-turbine Monitoring and Mitigation Plan would help identify adverse behavioral changes	• Same as applicant's proposal.

Snohomish PUD's Proposal	Staff Alternative
and potential injury of marine fish, mammals, and birds interacting with the turbines and define any needed corrective actions. • Implementing the Marine Mammal Monitoring and Mitigation Plan would avoid adverse interactions between work vessels and marine mammals during installation, identify behavioral changes from turbine noise or prey aggregations during operation, and define any needed corrective actions. • Implementing the Derelict Gear Monitoring Plan would help ensure that any derelict gear caught on the turbines would be detected and promptly removed.	
Rare, Threatened, and Endangered Species	
• The project is not likely to adversely affect the Puget Sound Chinook Salmon and its designated critical habitat, Hood Canal summer-run chum salmon and its designated critical habitat, Puget Sound steelhead, Coastal-Puget Sound bull trout, green sturgeon, bocaccio, canary rockfish, yelloweye rockfish, eulachon, southern resident killer whale designated critical habitat, North Pacific humpback whale, and marbled murrelet; and would not effect golden paintbrush. Noise from turbine operations may exceed harassment thresholds for the southern resident killer whale and Stellar sea lion; therefore, they may be adversely affected. Implementing the Acoustic Monitoring Plan and Marine Mammal Monitoring Plan would ensure such effects are minimal and appropriate	• Same as applicant's proposal.

Snohomish PUD's Proposal	Staff Alternative
corrective actions are implemented.	
Terrestrial Resources	
• Implementing the HDD Plan would minimize habitat disturbance and revegetate disturbed areas (about 0.3 acres of grass habitat).	• Same as applicant's proposal.
Recreation	
• Developing and implementing an Interpretation and Education Plan and interpretive display at Snohomish PUD's headquarters or at another appropriate location would educate the public about the project and the potential ocean energy resource of Puget Sound	• Same as applicant's proposal, except for developing a plan to install the interpretative display within view of the turbine installation site, in a location in Fort Casey State Park, subject to state approval, would be more informative for the public.
Navigation	
• Implementing the Navigation and Safety Plan would ensure that project installation and operation are coordinated with vessel traffic, avoiding potential navigation hazards.	• Same as applicant's proposal, plus: • Adding a reservation of authority of the U.S. Army Corps of Engineers to require removal, relocation, or other alteration of the project if it becomes an unreasonable obstruction to navigation would ensure that navigation hazards are minimized.
Land and Ocean Use	
• Conducting turbine installation and monitoring using "live-boat" techniques and developing and implementing a Hazard Identification and Risk Assessment would ensure that project installation, operation, maintenance, and removal actions are conducted in a manner that would minimize any risk of damaging PC Landing's fiber optic	• Same as applicant's proposal.

Snohomish PUD's Proposal	Staff Alternative
cable.	
Aesthetic Resources	
• Implementing the HDD process would result in noise levels that could disturb nearby residences.	• Same as applicant's proposal, plus: • Implementing noise abatement measures if HDD processes extend into the night would minimize adverse effects on near-by residences.
Cultural Resources	
• None	• Same as applicant's proposal, plus: • Implementing further protection for inadvertent discoveries of archaeological or historical resources would ensure protection of cultural resources in the project area.

5.2 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a)(1) of the FPA require the Commission to give equal consideration to the power development purposes and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for licensing the Admiralty Inlet Pilot Tidal Project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

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 pilot project and its alternatives, we selected the staff alternative as the preferred option. We recommend this option because: (1) issuing a license to Snohomish PUD would allow them to test the generating equipment's dependability as a source of electrical energy for the region and evaluate the tidal energy potential of Admiralty Inlet; (2) the 216-MWh of electric energy generated annually during the 10-year pilot project license would come from a renewable resource, which would not contribute to atmospheric

pollution; (3) the recommended environmental measures would adequately protect, mitigate, and enhance fish and wildlife, recreation, aesthetic resources affected by the project; (4) the recommended safeguard and maritime operational measures would ensure navigation and international communications are not interrupted; and (5) the monitoring proposed for the project would provide an improved understanding of the environmental effects of tidal energy projects, which would be instrumental in assessing the potential effects of future projects of this type and identifying measures to minimize adverse environmental effects.

In the following section, we make recommendations as to which environmental measures proposed by Snohomish PUD or recommended by agencies and other entities should be included in any pilot project license issued for the project. In addition to Snohomish PUD's proposed environmental measures, we recommend the inclusion of some additional measures in any license issued for the pilot project.

Measures Proposed by Snohomish PUD

Based on our environmental analysis of Snohomish PUD's proposal as discussed in section 3.0 and the costs discussed in section 4.0, we recommend including the following environmental measures proposed by Snohomish PUD in any license issued for the pilot project.

- Implement the Project and Public Safety Plan.
- Implement the Emergency Shutdown Plan.
- Implement the Project Removal and Site Restoration Plan.
- Conduct in-water installation activities within the Washington DFW-approved work window of July 16 to October 14.
- Implement the HDD Plan
- Implement the Water Quality Monitoring Plan.
- Implement the Acoustic Monitoring and Mitigation Plan.
- Implement the Benthic Habitat Monitoring and Mitigation Plan.
- Implement the Marine Mammal Monitoring and Mitigation Plan.
- Implement the Near-Turbine Monitoring and Mitigation Plan.
- Implement the Derelict Gear Monitoring Plan

- Develop and implement the Interpretation and Education Plan.

- Implement the Navigational Safety Plan.

- Develop a Hazard Identification and Risk Assessment and conduct turbine installation, monitoring, and removal activities using "live boat" techniques.

Additional Measures Recommended by Staff

In addition to Snohomish PUD's proposed measures, we recommend including the following measures in any pilot project license issued:

- Include in the Project Removal and Site Restoration Plan provisions for filing for Commission approval: (1) a specific timeline for the removal and site restoration activities 6 months prior to license expiration; (2) documentation of consultation with the MARC regarding planned removal and site restoration activities 6 months prior to license expiration; and (3) documentation of completion of project removal and site restoration activities prior to license expiration.

- Include in the HDD Plan provisions to implement noise abatement measures in the event HDD processes extend into the nighttime hours.

- Install an interpretive display at Fort Casey State Park, subject to state approval, describing the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area.

- Halt work if previously unidentified archeological or historic properties are discovered during land-disturbing activities and develop protective measures in consultation with the Washington SHPO.

- Include a reservation of authority for the Corps of Engineers to request removal, relocation, or other alteration if the project becomes an unreasonable obstruction to free navigation of navigable waters.

The following discussion provides the basis for our additional recommendations for licensing the Admiralty Inlet Pilot Tidal Project.

Project Removal and Site Restoration Plan

Integral to the Commission's hydrokinetic pilot project license is the requirement that pilot projects be removed, and their sites restored at the end of the license term unless a new license is obtained. Snohomish PUD proposes a Project Removal and Site Restoration Plan that provides general information on the facilities that would be

removed, the monitoring that would take place during removal, and the length of time that removal would take. Provisions in the Project Removal and Site Restoration Plan for providing a specific timeline for the removal and site restoration activities, as well as documentation of consultation with the appropriate agencies, 6 months prior to license expiration, and documentation of completion of project removal and site restoration activities prior to license expiration, would ensure that the project is removed and the site is sufficiently restored to near pre-project condition by the end of the license term. We estimate that the costs of these provisions would be minimal and therefore conclude that the benefits outweigh any costs.

Noise Abatement Measures

HDD processes would occur in a lightly developed residential section of Whidbey Island. Noise from HDD drilling activity may become disruptive to neighboring residences if they continue into the evening hours. Although Snohomish PUD proposes to conduct HDD processes over 7 days on a 12-hour daytime schedule (e.g., 7 am to 7 pm), it is not uncommon with HDD drilling for unexpected problems to arise that may cause drilling to have to continue for more than 12 hours. To minimize potential noise effects during the evening hours, we recommend that Snohomish PUD's HDD Plan be modified to require installation of temporary sound barrier(s) (e.g., a plywood sound barrier surrounding the drilling operation) to maintain day-night sound levels below 55 dB at the project boundary, if HDD processes extend into the evening hours. There would be no cost to implement these measures, unless such circumstances arise. Should the sound barrier(s) be needed, we estimate the cost to construct a temporary sound barrier to be $5,000 (annualized to $330 over 30 years) and find this cost to be worth the benefit.

Interpretation and Education Plan

Snohomish PUD proposes to develop and implement an Interpretation and Education Plan, in consultation with the National Park Service and other stakeholders, which provides for installing an interpretive display at Snohomish PUD's headquarters in Everett Washington or at another appropriate location so long as the display does not require a significant commitment of resources or expand the project boundary. Fort Casey State Park is a tourist destination spot and provides views of the portion of Admiralty Inlet where the turbines would be installed. Installing the display at Fort Casey State Park would provide an added benefit to area visitors by educating them about this new energy resource and its relation to the environment and could further increase the interest in the area. Therefore, we recommend that Snohomish PUD consult with the Washington State Parks and Recreation Commission (Washington PRC), National Park Service, Ebey's Landing Historical Reserve Trust Board, and Island County Marine Resources Committee for installing the display at the park, subject to Washington PRC approval. If a suitable site can not be found at Fort Casey

State Park, an alternative site could be proposed. There should be no added cost for implementing staff's recommendation.

Cultural Resources

There are no known historical or archaeological properties within the project area listed or eligible for listing in the National Register. However, archaeological or historic sites could be discovered during any project construction or modification that requires land-disturbing activities. Therefore, we recommend that Snohomish PUD halt work and notify the Commission and Washington SHPO if previously unidentified archeological or historic properties are discovered during the course of constructing, maintaining, or removing project works or other facilities at the project. Additionally, Snohomish PUD should implement any measures developed in consultation with the Washington SHPO to protect the archeological or other cultural resources from further potential adverse effects. There would be a nominal cost for this measure and we recommend including this requirement in any new license issued for the project.

Navigation

The project turbines would be located outside the shipping lanes in Admiralty Inlet, but occasionally tugboats and their tows could venture over the turbines. As part of the Navigation Safety Plan, Snohomish PUD would work with the Coast Guard, Corps, and NOAA to update navigation charts and disseminate information to local mariners. These measures should be sufficient to ensure that the project does not represent a navigation obstruction. Nonetheless, the Corps, through its jurisdictional authorities under the Rivers and Harbors Act and its implementation through section 4(e) of the FPA, requests that the Commission reserve the Corps' ability to require removal, relocation, or other alterations if the project becomes an obstruction to navigation. Removal, relocation, or alteration if the project proves to be an obstruction is consistent with the intent of the pilot project. Therefore, we recommend including any such reservation of authority in any license issued.

Measures Not Recommended

The following discusses the basis for staff's conclusion not to recommend some of the measures recommended by agencies and other interested parties.

Relocating the Project Turbines

Snohomish PUD proposes to install two turbines within 170 and 249 meters of PC Landing's international telecommunications fiber optic cable, PC-1 North. PC Landing asserts that installing the turbines so close to the fiber optic cable would unduly risk damaging the cable during installation, maintenance, and removal activities. Damage could come from either dropping the turbines or an anchor from the installation

or monitoring vessels on the cable or from seabed scour created by the turbines uncovering the buried cable. PC Landing also states that locating the project so close to PC-1 North reduces its ability to maintain and repair the cable if needed, whether damage to the cable is related or un-related to the project. Consequently, PC Landing recommends that Snohomish PUD locate the turbines at a site 750 to 1,000 meters from PC-1 North in accordance with International Cable Protection Committee recommendations, but suggested that an area between at least 500 to 950 meters west of the PC-1 North may be suitable. In the alternative, PC Landing requests that the Commission deny the license application.

Snohomish PUD asserts that installation, maintenance, monitoring and removal would not pose a risk to PC-1 North because such operations do not require the use of anchoring, except during the installation of the trunk cables at the HDD sea floor exit, which would be located over 1,666 meters (5,300 feet) from the PC-1 North cable; and OpenHydro, the manufacture of the turbines, has the experience and equipment to install the turbines within five meters (16.4 feet) of the targeted location. In addition, Snohomish PUD proposes to develop a Hazard Identification and Risk Assessment (HIRA) in consultation with the Coast Guard, the Corps, and PC Landing prior to marine operations that includes: (a) criteria for weather and wave conditions that must exist before marine operations can occur (e.g., wind speed less than 20 miles per hour, waves less than 2 meters (6.56 feet), with a tidal velocity window of less than 1.5 knots, and during a running tide, with certainty of conditions remaining prevalent for duration of deployment or recovery); (b) use of industry-approved equipment and redundancy in the use of equipment and vessels (e.g., tugboat with back-up engine; back-up tugboat for emergencies; towing gear, barge, winches, winch wire, and hydraulic lifting tools that are new or certified based on industry standards); (c) criteria for aborting operations; and (d) an established "port of refuge," located at least two kilometers (6,562 feet)[98] away from PC-1 North, in the event of unanticipated adverse weather or other event.

Because of PC-1 North's importance to the American public, business, and financial institutions, the FCC initially recommended that the Commission consider requiring a 500-meter separation between the turbines and PC-1 North. It later stated that it does not oppose licensing the project at the currently proposed distances from PC-1 North if the Commission determines that the project does not present a material risk to PC-1 North, and the Commission is able to ensure through its own licensing

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[98] Snohomish PUD, in their filing of August 28, 2012, stated that they would create "an established "port of refuge," located kilometers away from PC-1, in the event of unanticipated adverse weather or other event." As their proposal is not specific as to how many kilometers from the PC-1 North the port would be established, Commission staff is using two kilometers for analysis.

process (via imposition of conditions if appropriate), that Snohomish PUD and its agents, contractors and successors adhere to the safety and separation distance representations Snohomish PUD made in its August 28, 2012, filings. The Naval Seafloor Cable Protection Office similarly concluded that the changes noted by the FCC also alleviate its concerns.

As explained in section 3.3.6.2, *Land and Ocean Use*, locating the turbines 500 meters or greater from PC-1 North would provide an increased margin of safety during installation, maintenance, and removal activities, and would provide PC Landing more room to repair the cable in the unlikely event that the section of the PC-1 North cable near the turbines needs to be repaired. With regard to making repairs to PC-1 North, the depth of the turbines would be well below the anticipated draft depth of cable repair boats. Further, while there could be some interference with grappling and subsequent reinstallation of the PC-1 North cable if a repair was needed, such repairs could be made with the turbines in place.

Moving the turbines west of PC-1 North would increase the estimated cost for the additional length of the two power cables extending from shore to a site 500 meters (1,640 feet) from PC-1 North by at least $335,000 ($22,350 annualized over 30 years); would put the turbines closer to heavy shipping lanes, with an increased chance of the turbines becoming an obstruction to navigation; and would adversely affect monitoring.[99]

Regardless, relocating the turbines to avoid risking damaging PC-1 North is not necessary because installing the turbines using the "live-boat" process (i.e., without the use of anchors) and under strict weather and tidal criteria (likely to include a wind speed less than 20 miles per hour, waves less than 2 meters, with a tidal velocity window of less than 1.5 knots, and during a running tide) would ensure OpenHydro's ability to install the turbines within its historical accuracy and adequately minimize potential for inadvertently dropping the turbines on the cable. Implementing the additional safety measures as defined in the HIRA above would further minimize any risk to the cable.

Once operational, existing tidal currents are not likely to result in scour except immediately around the turbine foundation. The Benthic Monitoring and Mitigation Plan and Near-Turbine Monitoring Plan would alert Snohomish PUD to any scour problems before they reached PC-1 North. Therefore, we anticipate that Snohomish PUD would identify and mitigate any excessive erosion or scour before the extent of the scour would affect PC Landing's PC-1 North cable.

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[99] Because Snohomish PUD would use land-based observations for some monitoring efforts, increasing the distance of the turbines from shore would make implementation of the Marine Mammal Monitoring and Mitigation Plan more difficult.

For the above reasons, we do not recommend changing the installation location of the turbines and find that the benefits of doing so are not worth the cost, including the cost of jeopardizing achievement of the project's objectives of determining if the energy potential for a commercial scale project is feasible and possible environmental effects of the turbine technology, both at the pilot and commercial scale. We recommend that any license issued for the project require the development of the HIRA in consultation with the Coast Guard, the Corps, and PC Landing to further ensure risks to PC-1 North are minimized.

Marine Aquatic Resource Committee (MARC) and Seeking Consensus from Agencies during Consultation

Washington DFW recommends that the Commission include as a license condition the establishment of a steering committee called the MARC, which would assist in the creation and review of monitoring and management plans, including adaptive management provisions. In its justification for the measure, Washington DFW states that Snohomish PUD should consult with the appropriate agencies and tribes when writing or implementing the monitoring and management plans and that the MARC creates a venue for such consultation to occur. Washington DFW goes on to state that "The MARC should be required to coordinate, as appropriate, the design and implementation of research and monitoring programs, the sharing of data and information, and the conduct of other activities under license terms…." Washington DFW also recommends that in all cases involving consultation, that the Commission require Snohomish PUD to obtain the views of, and attempt to reach consensus with, parties with authority under section 10(j) of the FPA.

Each of Snohomish PUD's monitoring and mitigation plans already provides for consultation with a MARC, which include agencies with 10(j) authority. The plans also include adaptive management provisions, which would be implemented in consultation with the MARC. We recommend implementing the plans, including the consultation and adaptive management requirements. A separate license condition requiring the establishment of the MARC would be redundant. Further, to the extent that Washington DFW is requesting that the Commission include a license requirement that would obligate the MARC to implement certain conditions of the license, we do not recommend such a requirement because it would not be enforceable by the Commission, as it would purport to place responsibility of the license on a non-licensee.

5.3 UNAVOIDABLE ADVERSE IMPACTS

There would be localized, short-term disturbances to the seabed during the HDD process and installation of the turbines. On-shore construction activities would disturb about 0.3 acres of previously disturbed residential habitats and may temporarily displace some wildlife during these activities. On-shore construction activities would create noise and visual effects, and require the use of heavy construction equipment, which

could disturb residences, but these effects would be minor and short-term. Fisherman and recreational boaters may need to work around project barges and vessels during project installation, on-site maintenance, and removal, but these activities will be short-term and minor considering the expanse of the Admiralty Inlet.

It is not yet clear if there are unavoidable adverse impacts that would occur as a result of the operation of the proposed pilot project. The purpose of the proposed environmental monitoring plans would be to better understand such potential impacts. Because there would be no restrictions to fishing at the site of the turbines or its cables, there would be no restriction restrictions to navigation or access to tribal fish grounds; however, fisherman may lose valuable gear if they get caught on the turbines or cables.

5.4 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) 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, and 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 purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency. In response to the ready for environmental analysis notice, the NMFS, FWS, and Washington DFW[100] submitted recommendations for the project on May 23, 2012. Table 10 lists the section 10(j) recommendations, and whether the measures are recommended by staff. Recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections of this document and the previous section.

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[100] On May 23, 2012, Washington DFW requested protection of eelgrass, kelp, and geoduck clams, a survey of the transmission corridor and horizontal drilling exit point to check for these resources, and inclusion of the transmission corridor and horizontal drilling exit point in the Benthic Monitoring Plan. In June of 2012 an ROV survey of the transmission corridor and horizontal drilling exit point was completed and also revealed no eelgrass, kelp, or geoducks (Greene, 2012; McCallister, 2012). On December 10, 2012, Washington DFW affirmed that the final Plan, filed on November 16, 2012, adequately addresses monitoring requirements for benthic monitoring and can be approved (see phone memo between Stephen Bowler, FERC, and Brock Applegate (Washington, DFW), December 13, 2012).

Table 10. Analysis of fish and wildlife agency recommendations for the Admiralty Inlet Project (Source: staff).

Recommendation	Agency	Within the scope of section 10(j)	Annualized Cost	Adopted? and Basis for Preliminary Determination of Inconsistency
1. Implement the Acoustic Monitoring and Mitigation Plan proposed by Snohomish PUD.	NMFS, FWS, Washington DFW	Yes	$36,420	Yes
2. Implement the Marine Mammal Monitoring and Mitigation Plan proposed by Snohomish PUD.	NMFS, FWS, Washington DFW	Yes	$118,800	Yes
3. Implement the Near-turbine Monitoring and Mitigation Plan proposed by Snohomish PUD.	NMFS, FWS,[a] Washington DFW	Yes	$131,740	Yes
4. Implement the Benthic Habitat Monitoring and Mitigation Plan proposed by Snohomish PUD.	NMFS, FWS	Yes	$58,030	Yes.
5. Implement the Derelict Gear Monitoring Plan proposed by Snohomish PUD.	FWS and Washington DFW	Yes	$58,360	Yes
6. Implement the Water Quality Monitoring Plan proposed by Snohomish PUD.	FWS and Washington DFW	Yes	$3,340	Yes
7. Implement the Project Safeguard Plans proposed by Snohomish PUD (the Safeguard Plans consist of: the Project and Public Safety Plan, Navigation Safety Plan, Emergency Shutdown Plan, and Project Removal and Site Restoration Plan).	FWS and Washington DFW	Yes, for the Emergency Shutdown and Project Removal Plan; No for the remaining plans because they are not	$0[b]	Yes.

Recommendation	Agency	Within the scope of section 10(j)	Annualized Cost	Adopted? and Basis for Preliminary Determination of Inconsistency
		specific measures to protect, mitigate, or enhance fish and wildlife resources.		
8. Implement the Horizontal Directional Drilling Plan.	FWS and Washington DFW	No, not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0[b]	Yes
9. Establish a Marine Aquatic Resource Committee (MARC) to review the development and implementation of the monitoring and management plans, including use of adaptive management, and during consultation, attempt to reach consensus with the specified parties, specifically including those parties with authority under section 10(j).	Washington DFW	No, not a specific measure to protect, mitigate, or enhance fish and wildlife resources.	$0[c]	No, because the measure is redundant with Snohomish PUD's adaptive management framework and consultation requirements specified in the separate monitoring plans.

[a] The FWS initially recommended that Snohomish PUD modify the Near-turbine Monitoring and Mitigation Plan to include provisions to monitor turbine interaction with marine birds. On November 27, 2012, FWS affirmed that the final Plan filed on November 16, 2012, adequately addresses monitoring requirements for marine

birds and the plan can be approved (see phone memo between David Turner, FERC, and Tim Romanski (FWS), November 28, 2012).

[b] This measure would only be implemented in the event of an unanticipated emergency; therefore, there is no cost for this measure.

[c] The cost of the establishment of this group and the specification of consultation activities are not anticipated to generate an incremental cost to Snohomish PUD.

5.5 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under section 10(a)(2)(A) of the FPA, federal and state agencies filed comprehensive plans that address various resources in Washington. We determined that six comprehensive plans (listed below) are relevant to the project. We found no inconsistencies.

Interagency Committee for Outdoor Recreation. 2002. Washington State Comprehensive Outdoor Recreation Planning Document (SCORP): 2002-2007. Olympia, Washington. October 2002.

National Marine Fisheries Service, Seattle, Washington. Pacific Fishery Management Council, Portland, Oregon. 1978. Fishery management plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California commencing in 1978. Department of Commerce. March 1978. 157 pp.

Northwest Power and Conservation Council. 2010. The Sixth Northwest conservation and electric power plan. Portland, Oregon. Council Document 2010-09. February 2010.

U.S. Fish and Wildlife Service. Undated. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.

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.

Washington Department of Fisheries. 1987. Hydroelectric project assessment guidelines. Olympia, Washington. 91 pp. Washington Department of Wildlife. Point No Point Treaty Council. 1987. 1987-88 winter and summer Steelhead forecasts and management recommendations. Olympia, Washington. December 1987. 19 pp.

6.0 FERC FINDING OF NO SIGNIFICANT IMPACT

On the basis of our independent analysis, FERC concludes that approval of the proposed action, with our recommended measures, would not constitute a major federal action significantly affecting the quality of the human environment.[101] Preparation of an environmental impact statement is not required.

[101] DOE's decision document will be posted separately after public review and comment of the EA.

7.0 LITERATURE CITED

Adams, P.B., C.B. Grimes, S.T. Lindley, and M.L. Moser. 2002. Status Review for North American Green Sturgeon, Acipenser medirostris. NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California. 49 p. Available online at URL: http://www.nmfs.noaa.gov/pr/species/statusreviews.htm.

Ainley, D.G., D.W. Anderson, and P.R. Kelly. 1981. Feeding ecology of marine cormorants in southwestern North America. Condor 83: 120-131. Cited in 74 FR 18516.

Antonelis, Jr., G.A. and C.H. Fiscus. 1980. The pinnipeds of the California Current. CalCOFI Rep. 21: 68-78. Cited in 74 FR 18516.

Baird, R.W. 2000. The killer whale: foraging specializations and group hunting. Pages 127-153 in J. Mann, R.C. Connor, P.L. Tyack, and H. Whitehead (editors). Cetacean societies: field studies of dolphins and whales. University of Chicago Press, Chicago, Illinois. Cited in NMFS 2008c.

Baird, R.W., M.B. Hanson, and L.M. Dill. 2005. Factors influencing the diving behaviour of fish-eating killer whales: sex differences and diel and inter-annual variation in diving rates. Canadian Journal of Zoology 83:257-267. Cited in NMFS 2008c.

Baird, R.W., M.B. Hanson, E.A. Ashe, M.R. Heithaus, and G.J. Marshall. 2003. Studies of foraging in "southern resident" killer whales during July 2002: dive depths, bursts in speed, and the use of a "Crittercam" system for examining subsurface behavior. National Marine Fisheries Service, National Marine Mammal Laboratory, Seattle, WA . Cited in NMFS 2008c.

Barraclough,W.E. 1964. Contribution to the marine life history of the eulachon Thaleichthys pacificus. Journal of the Fisheries Research Board of Canada. 21:1333-1337. Cited in NMFS 2010b.

Barss, W.H. 1989. Maturity and reproductive cycle for 35 species from the family Scorpaenidae found off Oregon. Report No. 89-7, Oregon Department of Fish and Game, Portland, Oregon. Cited in 74 FR 18516.

Bassett, C. 2010. Underwater Ambient Noise at a Proposed Tidal Energy Site in Puget Sound. University of Washington.

Bassett, C.S., J. Thomson, and B. Polagye. 2010. Characteristics of underwater ambient noise at a proposed tidal energy site in Puget Sound, MTS/IEEE Oceans 2010, Seattle, WA, September 20-23, 2010.

Bassett, C.S., J.M Thomson, and B. Polagye. 2012. Shifting gravel and cobbles as a source of ambient noise, In preparation for submission to J. Ocean. Eng.

Bassett, C.S., Polagye, B., Holt, M., and Thomson, J.M. 2012. A vessel noise budget for Admiralty Inlet, Puget Sound, WA (USA), To be submitted to the J. Acoust. Soc. Am.

Bassett, C.S., Polagye, B., Holt, M., and Thomson, J.M. 2012. A vessel noise budget for Admiralty Inlet, Puget Sound, WA (USA), To be submitted to the J. Acoust. Soc. Am.

Bigg, M. 1982. An assessment of killer whale (Orcinus orca) stocks off Vancouver Island, British Columbia. Report of the International Whaling Commission 32:655-666. Cited in NMFS 2008c.

Boehlert, G.W. 1980. Size composition, age composition, and growth of canary rockfish, Sebastes pinniger, and splitnose rockfish, S. diploproa, from the 1977 rockfish survey. Marine Fisheries Review 42: 57-63. Cited in 74 FR 18516.

Bohnsack, J.A. and D.L. Sutherland. 1985. Artificial reef research: a review with recommendations for future priorities. Bulletin of Marine Science, 37(11): 11-39.

Buckley R.M. and G.J. Hueckel. 1985. Biological processes and ecological development on an artificial reef in Puget Sound, Washington. Bulletin of Marine Science, 37(1): 50-69.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (Oncorhynchus mykiss) in offshore waters of the North Pacific. International North Pacific Fisheries Commission Bulletin Number 51, 92 p. Cited in NMFS 2005b.

Cailliet, G.M., E.J., Burton, J.M. Cope, and L.A. Kerr (editors). 2000. Biological characteristics of nearshore fishes of California: A review of existing knowledge. Vol. Final Report and Excel Data Matrix, Pacific States Marine Fisheries Commission. California Department of Fish and Game. Cited in 74 FR 18516.

Calambokidis, J. and R. Baird. 1994. Status of marine mammals in the Strait of Georgia, Puget Sound and the Juan de Fuca Strait and Potential human impacts. Symposium on the Marine Environment. January 13 and 14, 1994.

Calambokidis, J., G.H. Steiger, J.M. Straley, T.J. Quinn, II, L.M. Herman, S. Cerchio, D.R. Salden, M. Yamaguchi, F. Sato, J. Urbán, R.J. Jacobsen, O. von Ziegesar, K.C. Balcomb, C.M. Gabriele, M.E. Dahlheim, N. Higashi, S. Uchida, K.B. Ford, Y. Miyamura, P. Ladrón de Guevara, S.A. Mizroch, L. Schlender and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific Basin. Final Contract Report 50ABNF500113 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 72p. Cited in NMFS 2008d.

Calambokidis, J., J. Darling, V. Deecke, P. Gearin, M. Gosho, W. Megill, C.M. Tomback, D. Goley, C. Torpova, and B. Gisborne. 2002. Abundance, range and movements of a feeding aggregation of gray whales (Eschrichtius robustus) from California to southeastern Alaska in 1998. J. Cetacean Res. Manage. 4(3):267-276, 2002.

Carlson, H.R., and R.R. Straty. 1981. Habitat and nursery grounds of Pacific rockfish, Sebastes spp., in rocky coastal areas of southeastern Alaska. Marine Fisheries Review 43(7): 13-19. Cited in 74 FR 18516.

Carr, M.H. 1983. Spatial and temporal patterns of recruitment of young-of-the-year rockfishes (Genus Sebastes) into a central California kelp forest. Master of Arts, San Francisco State University/Moss Landing Marine Laboratories. Cited in 74 FR 18516.

Carretta, J.V., K.A. Forney, M.S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, M.M. Muto, D. Lynch, and L. Carswell. 2008b. NOAA Technical Memorandum NMFS, U.S. Pacific Marine Mammal Stock Assessments: 2008. Minke Whale (Balaenoptera acutorostrata): California/Oregon/Washington Stock. Revised: December 15, 2008.

Carretta, J.V., K.A. Forney, M.S.Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, M.M. Muto, D. Lynch, and L. Carswell. 2007. NOAA Technical Memorandum NMFS, U.S. Pacific Marine Mammal Stock Assessments: 2008. California Sea Lion (Zalophus californianus californianus): U.S. Stock. Revised October 30, 2007.

Carretta, J.V., K.A. Forney, M.S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, M.M. Muto, D. Lynch, and L. Carswell. 2006. NOAA Technical Memorandum NMFS, U.S. Pacific Marine Mammal Stock Assessments: 2008. Harbor Porpoise (Phocoena phocoena): Washington Inland Waters Stock. Revised: December 15, 2006.

Cavagnaro, R., B. Polagye, J. Wood, and D. Tollit (in preparation) Harbor porpoise echolocation activity in Admiralty Inlet, Puget Sound, WA.

Center for Whale Research. 2009. Southern Resident Killer Whale Research. [Online] URL: http://www.whaleresearch.com/research.html. Accessed December 21, 2009.

City of Port Townsend. 2007. Shoreline master program. City of Port Townsend, Port Townsend WA.

Clemens, W.A. and G.V. Wilby. 1961. Fishes of the Pacific coast of Canada. Bulletin of the Fisheries Research Board of Canada 68: 443. Cited in 74 FR 18516.

Committee on the Status of Endangered Wildlife in Canada. 2002. COSEWIC assessment and status report on the Bocaccio Sebastes paucispinis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 p. Cited in 74 FR 18516.

Coombs, C.I. 1979. Reef fishes near Depoe Bay, Oregon: movement and the recreational fishery. Master of Science, Fisheries and Wildlife, Oregon State University. Cited in 74 FR 18516.

Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service.

DeMott, G.E. 1983. Movement of tagged lingcod and rockfishes off Depoe Bay, Oregon. Master of Science, Oregon State University. Cited in 74 FR 18516.

Drake, J., E. Berntson, J. Cope, R. Gustafson, E. Holmes, P. Levin, N. Tolimieri, R. Waples, S. Sogard. 2008. Preliminary Scientific Conclusions of the Review of the Status of 5 Species of Rockfish: Bocaccio (Sebastes paucispinis), Canary Rockfish (Sebastes pinniger), Yelloweye Rockfish (Sebastes ruberrimus), Greenstriped Rockfish (Sebastes elongatus) and Redstripe Rockfish (Sebastes proriger) in Puget Sound, WA . National Marine Fisheries Service, Northwest Fisheries Science Center. Seattle, WA . 209p.

Drake, J., R. Emmett, K. Fresh, R. Gustafson, M. Rowse, D. Teel, M. Wilson, P. Adams, E. Spangler, R. Spangler. 2010a. Status Review Update for Eulachon in Washington, Oregon, and California. Prepared by the Eulachon Biological Review Team. National Marine Fisheries Service, Northwest Fisheries Science Center.

Echeverria, W.T. 1987. Thirty four species of California rockfishes: maturity and seasonality of reproduction. Fish. Bull. 85: 229-250. Cited in 74 FR 18516.

Electric Power Research Institute (EPRI). 2011. Evaluation of fish injury and mortality associated with hydrokinetic turbines. EPRI Technical Report 1024569, Palo Alto, CA.

Electric Power Research Institute (EPRI). 2011a. Fish passage through turbines: application of conventional hydropower data to hydrokinetic studies. EPRI Technical Report 1024638, Palo Alto, CA.

Erickson, D.L. and J.E. Hightower. 2007. Oceanic distribution and behavior of green sturgeon. American fisheries Society Symposium 56:197-211.

Erickson, D.L. and M. Webb. 2007. Spawning periodicity, spawning migration, and size at maturity of green sturgeon, Acipenser medirostris, in the Rogue River, Oregon. Environmental Biology of Fishes 79:255-268.

Eschmeyer, W.N., E.S. Herald, and H. Hammon. 1983. A field guide to Pacific Coast fishes of North America. Houghton Mifflin, Boston, Massachusetts, 336 p. Cited in 74 FR 18516.

Falxa, G., M. Huff, J. Baldwin, S. Miller, R. Young, C.J. Ralph, M.G. Raphael, T. Bloxton, C. Strong, Pearson, Scott; M. Lance, D. Lynch, B. Galleher, K. Nelson. 2008. Marbled Murrelet Effectiveness Monitoring Northwest Forest Plan - 2004-2007 Summary Report.

Feder, H.M., C.H. Turner, and C. Limbaugh. 1974. Observations on fishes associated with kelp beds in southern California. Fish Bulletin 160: 144. Cited in 74 FR 18516.

Ford, J.K.B. 1989. Acoustic behavior of resident killer whales (Orcinus orca) off Vancouver Island, British Columbia. Canadian Journal of Zoology 67:727-745. Cited in Wiles 2004.

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 2000. Killer whales: the natural history and genealogy of Orcinus orca in British Columbia and Washington State. Second edition UBC Press, Vancouver, British Columbia. Cited in Wiles 2004.

Ford, J.K.B., G.M. Ellis, L.G. Barrett-Lennard, A.B.Morton, R.S. Palm, and K.C. Balcomb. 1998. Dietary specialization in two sympatric populations of killer whales (Orcinus orca) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76(1456-1471). Cited in Drake et al. 2008.

Forney, K.A. 2007. Preliminary estimates of cetacean abundance along the U.S. West Coast and within four National Marine Sanctuaries during 2005. U.S.

Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-406. 27p.

Fugro. 2009. Bathymetric and geophysical survey site characterization Admiralty Inlet Pilot Tidal Project. Prepared for Snohomish County PUD No. 1 (SnoPUD). Survey period: June 25 to 30, 2009. Report Number: 0902J001. Vol. 1 of 1: draft final.

Gaines, S.D., and J. Roughgarden. 1987. Fish in offshore kelp forests affect recruitment to intertidal barnacle populations. Science 235: 479-481. Cited in 74 FR 18516.

Garish, T. and J. Cooper. 2012. Cultural Resources Assessment of the Pilot Tidal Energy Project (FERC #62110) Island County, WA . Prepared by AMEC for Snohomish County PUD. February 22, 2012.

Gilmore, R.R. Englebretson, R. Handlers, and S. Brand. 1996. Puget Sound area heavy weather port guide. Naval Research Laboratory, Monterey, CA.

Goetz, F., E. Jeanes, and E. Beamer. 2004. Bull trout in the nearshore. Preliminary draft. U.S. Army Corps of Engineers, Seattle, WA , June, 2004, 396 pp. Cited in USFWS 2008.

Goetz, F., E. Jeanes, G. Hart, C. bel, J. Starkes, and E. Conner. 2003. Behavior of anadromous bull trout in the Puget Sound and Pacific Coast of Washington. Estuarine Research Federation Conference. September 2003, Seattle, WA.

Golder Associates, Inc. 2011. Geophysical Investigation for Admiralty Inlet Turbine Project. Prepared for Public Utility District No. 1 of Snohomish County (Snohomish PUD). September 6, 2011. Survey Dates: May 25-26, 2011.

Good, T.P., J.A. June, M.A. Etnier, and G. Broadhurst. 2009. Ghosts of the Salish Sea: threats to marine birds in Puget Sound and the Northwest Straits from derelict fishing gear. Marine Ornithology 37: 67-76.

Good, T.P., R.S. Waples, and P. Adams (Eds.). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66. 598 p.

Greene, H.G. 2011. Habitat characterization of the SnoPUD turbine site – Admiralty Head, Washington State, Technical Report, June 1, 2011.

Greene, H.G. 2012. Review of ROV Video Collected Within the Tidal Turbine Box Offshore of Admiralty Head, WA, Memorandum, October, 2012.

Groot C. and L.Margolis. 1991. Pacific salmon life histories. UBC Press, Vancouver, BC, Canada.

Gustafson R.G., W.H.Lenarz, B.B. McCain, C.C. Schmitt, W.S. Grant, T.L. Builder, and R.D. Methot. 2000. Status review of Pacific hake, Pacific cod, and walleye pollock from Puget Sound, WA . U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC- 44. Available online at: www.nwfsc.noaa.gov/publications/techmemos/tm44 and www.nwfsc.noaa.gov/publications/techmemos/tm44/environment.htm. Accessed October 2007.

Hall, A. 2004. Seasonal abundance, distribution, and prey species of harbour porpoise (Phocoena phocoena) in southern Vancouver Island waters. MSc thesis, UBC. Cited in Tollit et al. 2010.

Halvorsen, MB, TJ Carlson, AE Copping. 2011. Effects of Tidal Turbine Noise on Fish Hearing and Tissues Draft Final Report Environmental Effects of Marine and Hydrokinetic Energy. Department of Energy under Contract DE-AC05-76RL01830, Pacific Northwest National Laboratory Sequim, WA .

Hart, J.L. 1973. Pacific Fishes of Canada. Fisheries Research Board of Canada Bulletin 180. Cited in 74 FR 18516.

Hastings, M.C. and A.N. Popper. 2005. Effects of Sound on Fish. (Subconsultants) Submitted by Jones & Stokes to California Dept. of Transportation Contract No. 43A0139. Task Order 1.

Hauser, D.D.W. 2006. Summer space use of southern resident killer whales (Orcinus orca) within Washington and British Columbia inshore waters. M.S. thesis, University of Washington, Seattle, WA . Cited in NMFS 2008c.

Hay, D.E., and McCarter, P.B. 2000. Status of the eulachon Thaleichthys pacificus in Canada. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, Research Document 2000-145. Ottawa, Ontario. Online at http://www.dfo-mpo.gc.ca/csas/csas/DocREC/2000/PDF/2000_145e.pdf. and cited in NMFS 2010b.

Heimlich-Boran, J.R. 1988. Behavioral ecology of killer whales (Orcinus orca) in the Pacific Northwest. Canadian Journal of Zoology 66:565-578. Cited in Wiles 2004 and NMFS 2008c.

Hubbs, C.L. 1925. A revision of the osmerid fishes of the North Pacific. Proceedings of the Biological Society of Washington 38: 49-56.

Huff, M., P. Jodice. J. Baldwin, S. Miller. R.Young, K. Ostom, C.J. Ralph,, M.G. Raphael, C. Strong, C. Thompson, G. Falxa, D. Evans Mack; K. Nelson. 2003. Marbled Murrelet Effectiveness Monitoring Northwest Forest Plan - 2002 Annual Summary Report (Version 2).

Interagency Committee for Outdoor Recreation. 2002. Washington State Comprehensive Outdoor Recreation Planning Document (SCORP): 2002-2007. Olympia, WA . October 2002.

Israel, J.A. and B. May. 2007. Mixed Stock Analysis of Green Sturgeon from Washington State Coastal Aggregations. Final Report. Genomic Variation Laboratory, University of California-Davis, Davis, CA.

Jeffries, S., H. Huber, J. Calambokidis, and J. Laake. 2003. Trends and status of harbor seals in Washington State: 1978-1999. J. Wildl. Manage. 67(1):208-219.

Jeffries, S.J., P. Gearin, H.R. Huber, D.L. Saul, and Darrell A. Pruett. 2000. Atlas of Seal and Sea Lion Haulout Sites in Washington. February 2000.

Johnson, D.W. 2006. Predation, habitat complexity, and variation in density-dependent mortality of temperate reef fishes. Ecology 87: 1179-1188. Cited in 74 FR 18516.

Johnson, S.Y., C. J. Potter, J.M. Armentrout, J.J. Miller, C. Finn, and C.S. Weaver. 1996. The southern Whidbey Island fault: An active structure in the Puget Lowland, Washington, Geol. Soc. Am. Bull., 108 (3), 334-354.

Jørgensen, R., Olsen, K.K., Falk-Petersen, I.B. & Kanapthippilai, P. 2005. Investigations of Potential Effects of Low Frequency Sonar Signals on Survival, Development and Behaviour of Fish Larvae and Juveniles. Norway: Norwegian College of Fishery Science, University of Tromsø. Cited in Popper and Hastings 2009.

Krahn, M.M., M.J. Ford, W.F. Perrin, P.R. Wade, R.P. Angliss, M.B. Hanson, B.L. Taylor, G.M. Ylitalo, M.E. Dahlheim, J.E. Stein, and R.S. Waples. 2004. 2004 status review of southern resident killer whales (Orcinus orca) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-62, U.S. Department of Commerce, Seattle, WA . Cited in NMFS 2008c.

Lea, R.N., McAllister, R.D., and D.A. VenTresca. 1999. Biological aspects of nearshore rockfishes of the genus Sebastes from central California. Fish Bull. 177: 1-109.

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E.L. Rechisky, J.T. Kelly, J. Heublein, and A.P. Klimley. 2008. Marine Migration of North American Green Sturgeon. Trans. Am. Fish. Soc. 137(1):182-194.

Love, M.S. 1996. Probably more than you want to know about the fishes of the Pacific Coast. Really Big Press, Santa Barbara, California, 215 p. Cited in 74 FR 18516.

Love, M.S., and M. Yoklavich. 2008. Habitat characteristics of juvenile cow cod, Sebastes levis (Scorpaenidae), in Southern California. Environmental Biology of Fishes 82: 195-202. Cited in 74 FR 18516.

Love, M.S., M. Carr, and L. Haldorson. 1991. The ecology of substrate-associated juveniles of the genus Sebastes. Env. Bio. Fish. 79: 533-545. Cited in 74 FR 18516.

Love, M.S., M.M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press, Berkeley, California. Cited in 74 FR 18516.

Mathews, N.J.C. and A.E. Burger. 1998. Diving depth of a marbled murrelet. Northwestern Naturalist 79(2):70-71. Cited in. USFWS letter to the District dated February 25, 2010.

MBC Applied Environmental Sciences. 1987. Ecology of Important Fisheries Species Offshore California. Minerals Management Service, Pacific Outer Continental Shelf Region. Washington, D.C. MMS 86-0093, 252 p. Cited in 74 FR 18516.

McAllister, D.E. 1963. A revision of the smelt family, Osmeridae. National Museum of Canada, Biological Series 71, Bulletin No. 191:1-53.

McCallister, M.A. 2012. Northwest Underwater Construction, LLC, ROV Survey, Memorandum, September 26, 2012.

McCurdy, R. 2007. President, Puget Sound Pilots. Personal communication with Snohomish Public Utility District.

McGary, N. and J. Lincoln. 1977. Tide Prints: surface tidal currents in Puget Sound. University of Washington Press. Cited in Polagye et al. 2007.

Mecklenburg, C., T. Mecklenburg, and L. Thorsteinson. 2002. Fishes of Alaska. Bethesda: American Fisheries Society. Cited in 74 FR 18516.

Merkel, T.J. 1957. Food habits of the king salmon Oncorhynchus tshawytscha. Calif. Fish Game 43: 249-270. Cited in 74 FR 18516.

Miller, B.S., and S.F. Borton. 1980. Geographical distribution of Puget Sound fishes: Maps and data source sheets. Univ. of Washington Fisheries Research Institute, 3 vols. Cited in Palsson 2009.

Miller, D.J. and J.J. Geibel. 1973. Summary of blue rockfish and lingcod life histories; a reef ecology study; and giant kelp, Macrocystis pyrifera, experiments in Monterey Bay, California. Fish Bulletin: 137. Cited in 74 FR 18516.

Minerals Management Service (MMS). 2007. Draft Programmatic EIS for alternative energy development and production and alternative use of facilities on the Outer Continental Shelf. U.S. Department of the Interior. March 2007. [Online] URL: http://ocsenergy.anl.gov/documents/dpeis/ index.cfm. Accessed June 2007.

Mofjeld, H.O., and Larsen, L.H. 1984. Tides and tidal currents in the inland waters of Western Washington. NOAA Tech. Memo. ERL PMEL-56 (PB84-237379), Seattle, 52 pp.

Morejohn, G.V. 1979. The natural history of Dall's porpoise in the North Pacific Ocean. In: Winn, H. E. and B. L. Olla (eds.), Behavior of Marine Mammals, p. 45-83. Plenum Press, New York - London.

Morejohn, G.V., J.T. Harvey, and L.T. Krasnow. 1978. The importance of Loligo opalescens in the food web of marine vertebrates in Monterey Bay, California. In C. W. Recksiek and H.W. Frey (eds.), Biological, oceanographic, and acoustic aspects of the market squid, Loligo opalescens Berry, p. 67-98. Cited in 74 FR 18516.

Moser, H.G., and G.W. Boehlert. 1991. Ecology of pelagic larvae and juveniles of the genus Sebastes. Environ. Biol. Fishes 30: 203-224. Cited in 74 FR 18516.

Moyle, PB. 1976. Inland fishes of California. University of California Press, Berkeley, CA.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

National Academy of Science (NAS). 2003. Ocean Noise and Marine Mammals. Prepared by the Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals, Ocean Studies Board, Division on Earth and Life Studies. The National Academies Press, WA , D.C. [Online] URL: http://www.nap.edu/catalog.php?record_ id=10564. Accessed 10/21/08.

National Marine Fisheries Service (NMFS). 1991. Recovery Plan for the Humpback Whale (Megaptera novaeanglia). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 105 pgs.

National Marine Fisheries Service (NMFS). 2005b. Status review update for Puget Sound steelhead. July 26, 2005.

National Marine Fisheries Service (NMFS). 2007b. Green Sturgeon (Acipenser medirostris). [Online] URL: http://www.nmfs.noaa.gov/pr/species/fish/greensturgeon.htm. Accessed October 11, 2007.

National Marine Fisheries Service (NMFS). 2007c. Species of Concern - Green Sturgeon (Acipenser medirostris) Northern DPS. [Online] URL: http://www.nmfs.noaa.gov/pr/pdfs/species/greensturgeon_detailed.pdf. Accessed October 17, 2007.

National Marine Fisheries Service (NMFS). 2008a. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, WA .

National Marine Fisheries Service (NMFS). 2008b. Recovery Plan for the Steller Sea Lion (Eumetopias jubatus). Revision. National Marine Fisheries Service, Silver Spring, MD. 325 pages.

National Marine Fisheries Service (NMFS). 2008c. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, WA .

National Marine Fisheries Service (NMFS). 2008e. Recovery Plan for the Steller Sea Lion (Eumetopias jubatus). Revision. National Marine Fisheries Service, Silver Spring, MD. 325 pages.

National Marine Fisheries Service (NMFS). 2009a. Endangered and threatened wildlife and plants: proposed threatened status for southern distinct population segment of eulachon. Federal Register (Docket No. 080229343-81352-02); 13 March 2009; 74(48):10857-10876.

National Oceanic and Atmospheric Administration (NOAA). 2007a. Coast Pilot 7 - 39th Edition. Office of Coast Survey, National Ocean Service, Silver Spring, Maryland.

National Oceanic and Atmospheric Association (NOAA). 2009b. California Sea Lion (Zalophus californianus). [Online] URL: http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/californiasealion.htm. Accessed July 28, 2009.

National Oceanic and Atmospheric Association (NOAA). 2009c. Northern Elephant Seal (Mirounga angustirostris). Available online at: www.nmfs.noaa.gov/pr/species/ mammals/pinnipeds/northernelephantseal.htm. Accessed July 27, 2009.

National Oceanic and Atmospheric Association (NOAA). 2009d. Dall's Porpoise (Phocoenoides dalli). Available online at: www.nmfs.noaa.gov/pr/species/mammals/ cetaceans/dallsporpoise.htm. Accessed July 27, 2009.

National Oceanic and Atmospheric Association (NOAA). 2009e. Minke Whale (Balaenoptera acutorostrata). Available online at: www.nmfs.noaa.gov/pr/species/mammals/ cetaceans/minkewhale.htm. Accessed July 27, 2009.

National Park Service (NPS). 2006. Ebey's Landing National Historical Reserve General Management Plan. Available online at: http://www.nps.gov/ebla/parkmgmt/planning.htm. Accessed January 2, 2013.

National Park Service (NPS). 2003a. Ebey's Landing National Historical Reserve. An analysis of land use change and cultural landscape integrity. April 2003.

National Park Service (NPS). 2003b. Ebey's Landing National Historical Reserve. Naturalist's Guide Spring and Summer, Fall and Winter.

Northwest Fisheries Science Center. 2008. Summary Information on 2008 Southern Resident Killer Whale Births and Deaths. Conservation Biology Division. October 28, 2008. [Online] URL: http://www.nwfsc.noaa.gov/research/divisions/cbd/marine_ mammal/documents/salmon_killer_whale_summary_sheet_oct28.pdf. Accessed: December 21, 2009.

Northwest Power and Conservation Council (NWPCC). 2004. Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan, Lower Columbia province plan. June 2004. Online at: http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/RP%20Overview.pdf.

Northwest Straits Foundation (NWSF). 2007. Derelict fishing gear priority ranking project [Unpublished report]. Mt. Vernon, WA: NWSF. 40 pp. Cited in Good et al. 2009.

Northwest Straits Foundation (NWSF). 2011. Program Accomplishments 2002-Present. [Online] URL: http://www.derelictgear.org/Progress.aspx. Accessed February 2011.

Northwest Straits Foundation (NWSF). 2012. Program Accomplishments 2002-Present. [Online] URL: http://www.derelictgear.org/Progress.aspx. Accessed January 2012.

Northwest Straits. 2009. Northwest Straights marine conservation initiative. [Online] URL: http://www.nwstraits.org/. Accessed: September 2009.

O'Connell, V.M. 1987. Reproductive seasons for some Sebastes species in southeastern Alaska. Cited in 74 FR 18516.

Orcanetwork.org. 2007. Whale sightings occurring from 2001-2007. Available online at: orcanetwork.org/. Accessed November 2007.

Orr, J.W., M.A. Brown, D.C. Baker. 2000. Guide to Rockfishes (Scorpaenidae) of the Genera Sebastes, Sebastolobus, and Adelosebastes of the Northeast Pacific Ocean, Second Edition. NOAA Technical Memorandum NMFS-AFSC-117. Cited in 74 FR 18516.

Osborne, R.J. Calambokidis, and E.M. Dorsey. 1988. A guide to marine mammals of greater Puget Sound. Island Publishers, Anacortes, WA. 191 pages.

Pacific Fishery Management Council (PFMC). 1998. The Coastal Pelagic Species Fishery 206 Management Plan: Amendment 8. Pacific Fishery Management Council, Portland, Oregon (December 1998). http://www.pcouncil.org/cps/cpsfmp.html.

Pacific Fishery Management Council (PFMC). 2000. Amendment 14 to the Pacific Coast Salmon Plan (1997): Incorporating the regulatory impact review/initial regulatory flexibility analysis and final supplemental environmental impact statement. Pacific Fishery Management Council.

Pacific Fishery Management Council (PFMC). 2003. Fishery management plan and environmental impact statement of U.S. West Coast fisheries for highly migratory species. Also, Appendix F: U. S. West Coast highly migratory species life history and essential fish habitat. Available online at: www.pcouncil.org/hms/fmp/HMS_AppF.pdf. Accessed September 2007.

Pacific Fishery Management Council (PFMC). 2008. Pacific Coast groundfish fishery management plan for the California, Oregon, and Washington groundfish fishery as amended through Amendment 19. July 2008.

Palsson W.A., T. Tsou, G.G. Bargmann, R.M. Buckley, J. E. West, M.L. Mills, Y.W. Cheng, and R.E. Pacunski. 2009. The Biology and Assessment of Rockfishes in Puget Sound. Marine Resources Unit. May 2009.

Palsson, W.A., J.C. Hoeman, G.G. Bargmann, and D. E. Day, D.E. 1997. 1995 status of Puget Sound bottomfish stocks (revised). WDFW Report No. MRD97-03. Available from Washington Department of Fish and Wildlife, Olympia, WA . Cited in Gustafson et al., 2000.

Palsson, W.A., W.T. Northup, and M. Barker. 1998. Puget Sound groundfish management plan. Washington Department of Fish and Wildlife, 43 p.

Pentilla, D. 2007. Marine forage fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03. Published by Seattle District, Army Corps of Engineers, Seattle, WA. Online at http://www.pugetsoundnearshore.org/technical_papers/marine_fish.pdf.

Pleyte, K.A., R.B. Phillips, and S. Duncan. 1992. Phylogenetic analysis of the genus Salvelinus from the first internal transcribed spacer of ribosomal DNA. Molecular Phylogenetics and Evolution 1:223-230.

Polagye B., B. Van Cleve, A. Copping, and K. Kirkendall, eds. 2010. Environmental Effects of Tidal Energy Development Proceedings of a Scientific Workshop. NOAA Technical Memorandum NMFS F/SPO-116.

Polagye, B., and J. Thomson, NNMREC. 2010. Admiralty Inlet Water Quality Survey Report: April 2009 - February 2010. University of Washington, Seattle, WA . May 29, 2010.

Polagye, B., and Thomson, J. 2012. Tidal energy resource characterization: methodology and field study in Admiralty Inlet, Puget Sound, US. Submitted to Proc. IMechE, Part A: J. Power and Energy.

Polagye, B., B. Van Cleve, A. Copping, K. Kirkendall. 2011. Environmental effects of tidal energy development. Proceedings of a scientific workshop March 22-25, 2010. NOAA technical memorandum NMFS F/SPO-116.

Polagye, B., C. Bassett, J. Wood, and S. Barr. 2012a. Detection of tidal turbine noise: A pre-installation case study for Admiralty Inlet, Puget Sound, WA (USA). In preparation.

Polagye, B., Cavagnaro, R., Wood, J., and Tollit, D. 2012b. A study of harbor porpoise responsiveness to vessel traffic noise. In preparation.

Polagye, B., M. Kawase, and P. Malte (2009) In-stream tidal energy potential of Puget Sound, Washington, Proc. IMechE, Part A: J. Power and Energy, 223(5).

Polagye, B., M. Previsic, and R. Bedard. 2007. Tidal In-Stream Energy Conversion (TISEC): Survey and Characterization of SnoPUD Project Sites in the Puget Sound. EPRI North American Tidal In Stream Power Feasibility Demonstration Project: EPRI 2007.

Polenz, M., S.L. Slaughter, and G.W. Thorsenn. 2005. Geologic Map of the Coupeville and Part of the Port Townsend North 7.5-minute Quadrangles, Island County, Washington. Washington State Department of Natural Resources. Washington Division of Geology and Earth Resources, Geologic Map GM-58.

Popper, A.N. and M.C. Hastings. 2009. The effects of anthropogenic sources of sound on fishes. Jour. Fish. Biol. 75, pp. 455-489.

Raphael, M.G.; J. Baldwin, G.A. Falxa, M.H. Huff, M. Lance, S.L. Miller; S.F. Pearson, C.J. Ralph, C. Strong; C. Thompson. 2007. Regional population monitoring of the marbled murrelet: field and analytical methods. Gen. Tech. Rep. PNW-GTR-716. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press, London.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302, U.S. Department of Agriculture Forest Service, Intermountain Research Station, Ogden, Utah.

Roberts, D.A. 1979. Food Habits as an ecological partitioning mechanism in the nearshore rockfishes (Sebastes) of Carmel Bay, California. Master of Arts, San Francisco State University/Moss Landing Marine Laboratories. Cited in 74 FR 18516.

Rosenthal, R.J., L. Haldorson, L.J. Field, V. Moran-O'Connell, and M.G. LaRiviere. 1982. Inshore and shallow offshore bottomfish resources in the southeastern Gulf of Alaska, Alaska Coastal Research, Sitka. Cited in 74 FR 18516.

Ruggerone, G.T., T.P. Quinn, I. McGregor and T.D. Wilkinson. 1990. Horizontal and vertical movements of maturing steelhead trout, Oncorhynchus mykiss, in Dean

and Fisher channels, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 47: 1963-1969.

Schultz, L.P., and A.C. DeLacy. 1935. Fishes of the American Northwest. Journal of Pan-Pacific Research Institute 10: 365-380.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin No. 184.

Seattle Audubon Society. 2007. Marbled murrelet - Birdweb. Online: http://www.birdweb.org/birdweb/bird_details.aspx?id=224. Accessed November 2007.

Shared Strategy for Puget Sound (SSPS). 2007. Puget Sound Salmon Recovery Plan. Shared Strategy Development Committee. Plan adopted by the National Marine Fisheries Service. January 19, 2007.

Skinner, J.E. 1982. Fish and wildlife problems and study requirements in relation to North Coast water development. California Department of Fish and Game Water Projects Branch Report No. 5. Skinner. 1962. Cited in NMFS 2008a.

Southall Brandon L., A. Bowles, W. Ellison, J. Finneran, R. Gentry, C. Greene Jr., D. Kastak, D. Ketten, J. Miller, P. Nachtigall, J. Richardson, J. Thomas, and P. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations.

Speich, S.M. and Wahl, T.R. 1995. Marbled murrelet populations of Washington - Marine habitat preferences and variability of occurrence. Chapter 30 in USDA Forest Service Gen. Tech. Report PSW-152.

Stahlmann, A., and T. Schlurmann. 2010, Physical modeling of scour around tripod foundation structures for offshore wind energy converters. Coastal Engineering (2010): v.2.

Steiger, G.H. and J. Calambokidis. 1986. California and Northern Sea Lions in Southern Puget Sound, Washington. The Murrelet. 67:93-96.

Strong, C.S. 1995. Distribution of marbled murrelets along the Oregon coast in 1992. Northwest. Nat. 76:99-105.

Sylwester, R. and D.P. Findley. 2011. Geophysical Investigation for Admiralty Inlet Turbine Project. Prepared for Snohomish County PUD by Golder Associates, Inc.

Thompson, S., D. McDermond, U. Wilson, and K. Montgomery. 1985. Rhinoceros auklet burrow count on Protection Island, Washington. Murrelet 66:62-65.

Tollit, D.J., E. Philpott, R. Joy, B. Polagye, and J. Thomson. 2010. Admiralty Inlet Hydrophone Monitoring Study: 2009/2010 Deployments - Final Report June 15th 2010. Prepared for Snohomish PUD June 18, 2010.

Tollit, D.J., J.D. Wood, S. Veirs, Berta, and H. Garret. 2010a. Admiralty Inlet Pilot Project Marine Mammal Pre-installation Field Studies - Final Report June 15, 2010.

Tollit, D., E. Philpott, and J. Thomson. 2010b. Admiralty Inlet Hydrophone Study: 2009/2010 POD Deployments - Final Report June 18, 2010.

U.S. Commission on Ocean Policy. 2004. An ocean blueprint for the 21st Century. Washington, D.C. 2004.

U.S. Department of Energy (DOE). 2009. Report to Congress on the potential environmental effects of marine and hydrokinetic energy technologies. Wind and Hydropower Technology Program, Washington, DC.

U.S. Department of the Navy (DON). 2006. Marine resources assessment for the Pacific Northwest operating area. Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. Contract No. N62470-02-D-9997, CTO 0029. Prepared by Geo-Marine, Inc., Plano, Texas.

U.S. Department of the Navy (DON). 2006. Marine resources assessment for the Pacific Northwest operating area. Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. Contract No. N62470-02-D-9997, CTO 0029. Prepared by Geo-Marine, Inc., Plano, Texas.

U.S. Fish and Wildlife Service (USFWS). 1997. Recovery plan for the threatened marbled murrelet (Brachyramphus marmoratus) in Washington, Oregon, and California. Portland, Oregon. 203 pp.

U.S. Fish and Wildlife Service (USFWS). 2000. Recovery plan for the golden paintbrush (Castilleja levisecta). U.S. Fish and Wildlife Service, Portland, OR. 51 pp.

U.S. Fish and Wildlife Service (USFWS). 2004. Draft recovery plan for the coastal-Puget Sound distinct population segment of bull trout (Salvelinus confluentus). Volume I (of II): Puget Sound management unit. Portland, Oregon. 289 + xvii pp.

U.S. Fish and Wildlife Service (USFWS). 2006. Designation of critical habitat for the marbled murrelet. Federal Register. Volume 71. No 176.

U.S. Fish and Wildlife Service (USFWS). 2007. 5-Year Review Summary and Evaluation for the golden paintbrush (Castilleja levisecta). Western Washington Fish and Wildlife Office, Lacey, WA. 39 pp.

U.S. Fish and Wildlife Service (USFWS). 2008. Biological Opinion, Manette Bridge Replacement Project, Kitsap County, WA . Federal Highway Administration, Olympia, WA . USFWS Log # 13410-2008-F-0160.

U.S. Fish and Wildlife Service (USFWS). 2008. Biological Opinion, Manette Bridge Replacement Project, Kitsap County, WA . Federal Highway Administration, Olympia, WA . USFWS Log # 13410-2008-F-0160.

U.S. Fish and Wildlife Service (USFWS). 2008. Biological Opinion. USFWS Log# 13410-2007-F-0641, Interstate-405, State Route 520 to Interstate-5 Improvement Project King and Snohomish Counties, Washington. December 2008.

U.S. Fish and Wildlife Service (USFWS). 2008. Biological Opinion. USFWS Log# 13410-2007-F-0641, Interstate-405, State Route 520 to Interstate-5 Improvement Project King and Snohomish Counties, Washington. December 2008.

U.S. Geological Society (U.S.G.S.). 2012b. Web Soil Survey. Online: http://websoilsurvey.nrcs.usda.gov. Accessed December 11, 2012.

U.S. Geological Survey (U.S.G.S.). 2012a. Seismic hazards investigation in Puget Sound: Puget Sound earthquake origin and occurrence. Online: http://walrus.wr.usgs.gov/ships/pastquak.html. Accessed December 11, 2012.

Van Eenennaam, J.P., J. Linares, S.I. Doroshov, D.C. Hillemeier, T.E. Willson, and A.A. Nova. 2006. Reproductive conditions of the Klamath River green sturgeon. Trans. Am. Fish. Soc. 135(1):151-163.

Volk, E.C. 2000. Using otolith strontium to infer migratory histories of bull trout and Dolly Varden from several Washington State rivers. Submitted to Olympic National Park in fulfillment of Contract #2550041. Washington Department of Fish and Wildlife, Olympia.

Wahl, Terence R., Steven M. Speich. 1994. Distribution of Foraging Rhinoceros Auklets in the Strait of Juan de Fuca, WA . Northwestern Naturalist, Vol. 75, No. 2. (Autumn, 1994), pp. 63-69.

Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW). 2008. Summary of Questions and Requested Information.

Washington Department of Fish and Wildlife (WDFW). 2008. Preliminary draft for Fish and Wildlife Commission. Oncorhynchus mykiss: assessment of Washington State's steelhead populations and programs. Washington Department of Fish and Wildlife Olympia, WA . February 1, 2008.

Washington Department of Fish and Wildlife (WDFW). 2010b. 2010 Puget Sound Commercial Salmon Regulations. Revised July 7, 2010.

Washington Department of Fish and Wildlife, FishPro Inc., and Beak Consultants. 1997. Grandy Creek trout hatchery biological assessment. Washington Department of Fish and Wildlife, Olympia, WA . Cited in USFWS 2008.

Washington Dept. of Fish and Wildlife (WDFW). 2006. Fish and wildlife geographic information system digital data documentation. Olympia, WA.

Washington Dept. of Fish and Wildlife (WDFW). 2007. Marine protected areas within Puget Sound: Admiralty Head marine preserve. Olympia, WA.

Washington Dept. of Fish and Wildlife (WDFW). 2011. Washington State Sport Catch Report 2007. WDFW, September 2011. Olympia, WA.

Washington Dept. of Fish and Wildlife (WDFW). 2011b. Final Puget Sound Rockfish Conservation Plan. WDFW, March, 2011. Olympia, WA.

Washington Dept. of Fish and Wildlife (WDFW). 2011c. Final Environmental Impact Statement for the Puget Sound Rockfish Conservation Plan. WDFW, March, 2011. Olympia, WA.

Washington GAP Analysis Project. 1996. Washington Vegetation Zones, Version 6, August 1996.

Washington State Department of Natural Resources (WSDNR). 1997. Field Guide to Selected Rare Vascular Plants of Washington - Golden Paintbrush (Castilleja levisecta).

Washington State Parks and Recreation Commission. 2008. Central Whidbey State Parks: Land Classes, Resource Issues and Management Approaches. Olympia, WA.

Weinrich, M.T., M.R. Schilling, and C.R. Belt. 1992. Evidence for acquisition of navel feeding behavior: lobtail feeding in humpback whales, Megaptera novaeangliae. Anim. Behav. 44:1059-1072.

West, J.E., R.M. Buckley, and D.C. Doty. 1994. Ecology and habitat use of juvenile rockfishes (*Sebastes* Spp.) associated with artificial reefs in Puget Sound, Washington. Bulletin of Marine Science, 55(2-3): 344-350.

Whale Museum. 2009a. Whale watching in the San Juan Islands. Web site: http://www.whale-museum.org/education/library/whalewatch/watchmain.html.

Whale Museum. 2009b. Review of historical information and site-specific synthesis. The Whale Museum, SMRU Ltd., Orca Network. October 2009.

Wiles, G.J. 2004. Washington State status report for the killer whale. Washington Department of Fish and Wildlife, Olympia. 106pp.

Wilson, M.F., R.H. Armstrong, M.C. Hermans, and K. Koski. 2006. Eulachon: a review of biology and an annotated bibliography. Alaska Fisheries Science Center Processed Report 206-12. Auke Bay Laboratory, Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Service, Juneau, AK. Online at http://www.afsc.noaa.gov/publications /ProcRpt/PR%202006-12.pdf.

Wilson, U.W. 1977. A study of the biology of the rhinoceros auklet on Protection Island, Washington. Unpubl. M.S. thesis. Univ. Washington. Seattle. 98 pp.

Yamanaka, K.L., L.C. Lacko, K. Miller-Saunders, C. Grandin, J.K. Lochead, J.C. Martin, N. Olsen and S.S. =Wallace. 2006. A review of quillback rockfish Sebastes maliger along the Pacific coast of Canada: biology, distribution and abundance trends. Canadian Science Advisory Secretariat Research Document 2006/077. 58 p. Cited in Palsson 2009.

8.0 LIST OF PREPARERS

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APPENDIX A

LICENSE ARTICLES RECOMMENDED BY STAFF

We recommend including the following license articles in any license issued for the project:

Article 2XX. *Administrative Annual Charges*. The licensee shall pay the United States annual charges as determined in accordance with the provisions of the Commission's regulations in effect from time to time, effective as of the date of commencement of project operation, to reimburse the United States for the cost of administration of Part 1 of the Federal Power Act. The authorized installed capacity for that purpose is 680 kilowatts (kW). Under the regulations currently in effect, projects with authorized installed capacity of less than or equal to 1,500 kW will not be assessed an annual charge.

Article 2XX. *Exhibit Drawings*. Within 45 days of the date of issuance of this license, the licensee shall file the approved exhibit drawings in aperture card and electronic file formats.

(a) Three sets of the approved exhibit drawings shall be reproduced on silver or gelatin 35mm microfilm. All microfilm shall be mounted on type D (3-1/4" X 7-3/8") aperture cards. Prior to microfilming, the FERC Project-Drawing Number (i.e., P-12690-# through P-12690-#) shall be shown in the margin below the title block of the approved drawing. After mounting, the FERC Drawing Number shall be typed on the upper right corner of each aperture card. Additionally, the Project Number, FERC Exhibit (i.e., F-1, G-1, etc.), Drawing Title, and date of this license shall be typed on the upper left corner of each aperture card.

Two of the sets of aperture cards shall be filed with the Secretary of the Commission, ATTN: OEP/DHAC. The third set shall be filed with the Commission's Division of Dam Safety and Inspections Portland Regional Office.

(b) The licensee shall file two separate sets of exhibit drawings in electronic raster format with the Secretary of the Commission, ATTN: OEP/DHAC. A third set shall be filed with the Commission's Division of Dam Safety and Inspections Portland Regional Office. Exhibit F drawings must be separated from other project exhibits and identified as Critical Energy Infrastructure Information (CEII) material under 18 C.F.R. § 388.113(c) (2012). Each drawing must be a separate electronic file, and the file name shall include: FERC Project-Drawing Number, FERC Exhibit, Drawing Title, date of this license, and file extension in the following format [P-12690-#, G-1, Project Boundary, MM-DD-YYYY.TIF]. Electronic drawings shall meet the following format specifications:

IMAGERY - black & white raster file
FILE TYPE – Tagged Image File Format, (TIFF) CCITT Group 4
RESOLUTION – 300 dpi desired, (200 dpi min)
DRAWING SIZE FORMAT – 24" X 36" (min), 28" X 40" (max)
FILE SIZE – less than 1 MB desired

Each Exhibit G drawing that includes the project boundary must contain a minimum of three known reference points (i.e., latitude and longitude coordinates, or state plane coordinates). The points must be arranged in a triangular format for GIS geo-referencing the project boundary drawing to the polygon data, and must be based on a standard map coordinate system. The spatial reference for the drawing (i.e., map projection, map datum, and units of measurement) must be identified on the drawing and each reference point must be labeled. In addition, each project boundary drawing must be stamped by a registered land surveyor.

(c) The licensee shall file two separate sets of the project boundary data in a geo-referenced electronic file format (such as ArcView shape files, GeoMedia files, MapInfo files, or a similar GIS format) with the Secretary of the Commission, ATTN: OEP/DHAC. The filing shall include both polygon data and all reference points shown on the individual project boundary drawings. An electronic boundary polygon data file(s) is required for each project development. Depending on the electronic file format, the polygon and point data can be included in a single file with multiple layers. The geo-referenced electronic boundary data file must be positionally accurate to ±40 feet in order to comply with National Map Accuracy Standards for maps at a 1:24,000 scale. The file name(s) shall include: FERC Project Number, data description, date of this license, and file extension in the following format [P-13305, boundary polygon/or point data, MM-DD-YYYY.SHP]. The data must be accompanied by a separate text file describing the spatial reference for the geo-referenced data: map projection used (i.e., UTM, State Plane, Decimal Degrees, etc.), the map datum (i.e., North American 27, North American 83, etc.), and the units of measurement (i.e., feet, meters, miles, etc.). The text file name shall include: FERC Project Number, data description, date of this license, and file extension in the following format [P-13305, project boundary metadata, MM-DD-YYYY.TXT].

Article 2XX. *Documentation of Project Financing*. At least 90 days before starting construction, the licensee shall file with the Commission, for approval, three copies of the licensee's documentation for the project financing. The documentation must show that the licensee has acquired the funds, or commitment for funds necessary to construct and operate the project in accordance with this license. The documentation must include, at a minimum, financial statements, including a balance sheet, income statement, and a statement of actual or estimated cash flows over the license term which provide evidence that the licensee has sufficient assets, credit, and projected revenues to

cover project construction, operation, maintenance and removal expenses, and any other estimated project liabilities and expenses.

The financial statements must be prepared in accordance with generally accepted accounting principles and signed by an independent certified public accountant. The licensee shall not commence construction associated with the project before the filing is approved.

Article 2XX. *Project Land Rights Progress Report*. No later than four years after license issuance, the licensee shall file a report with the Commission describing the status of acquiring title in fee or the rights for all the lands within the project boundary. The report must provide an overview map of each parcel and summary table identifying the licensee's rights over each parcel within the project boundary. The report shall also include specific supporting documentation showing the status of the land rights on all parcels of land within the project boundary that: (1) have been acquired up to the date of filing of the report, including pertinent deeds, lease agreements, and/or bill of sale information that specifically verify the licensee's rights; and (2) the licensee's plan and schedule for acquiring all remaining project lands prior to the five-year deadline, including a history of actions taken, current owner information, the type of ownership to be acquired whether in fee or by easement, and the timeline for completing property acquisition.

Article 3XX. *Start of Construction*. The licensee shall commence construction of the project works within two years from the issuance date of the license and shall complete construction of the project within five years from the issuance date of the license.

Article 3XX. *Cofferdam and Deep Excavation Construction Drawings*. Before starting construction, the licensee shall review and approve the design of contractor-designed cofferdams and deep excavations and shall make sure construction of cofferdams and deep excavations is consistent with the approved design. At least 30 days before starting construction of a cofferdam or deep excavation, the licensee shall submit one copy to the Commission's Division of Dam Safety and Inspections (D2SI) Portland Regional Engineer and two copies to the Commission (one of these copies shall be a courtesy copy to the Commission's Director, D2SI), of the approved cofferdam and deep excavation construction drawings and specifications and the letters of approval.

Article 3XX. *Contract Plans and Specifications*. At least 60 days prior to the start of any construction, the licensee shall submit one copy of its plans and specifications and supporting design document to the Commission's Division of Dam Safety and Inspections (D2SI) Portland Regional Engineer, and two copies to the Commission (one of these shall be a courtesy copy to the Director, D2SI). The submittal to the D2SI Portland Regional Engineer must also include as part of preconstruction requirements: a Quality Control and Inspection Program, Temporary Construction Emergency Action

Plan, and Soil Erosion and Sediment Control Plan. The licensee may not begin construction until the D2SI Portland Regional Engineer has reviewed and commented on the plans and specifications, determined that all preconstruction requirements have been satisfied, and authorized start of construction.

Article 3XX. *As-built Drawings*. Within 90 days of completion of construction of the facilities authorized by this license, the licensee shall file for Commission approval, revised Exhibits A, F, and G, as applicable, to describe and show those project facilities as built. A courtesy copy shall be filed with the Commission's Division of Dam Safety and Inspections (D2SI) Portland Regional Engineer, the Director, D2SI, and the Director, Division of Hydropower Administration and Compliance.

Article 3XX. *Navigation Safety Plan*. Upon license issuance, the licensee shall implement the *Navigation Safety Plan*, filed November 16, 2012.

Article 3XX. *Hazard Identification and Risk Assessment*. At least 30 days prior to the start of in-water construction, the licensee shall file with the Commission for approval a Hazard Identification and Risk Assessment to minimize potential hazards to PC Landing Corporation's fiber optic cable during project installation, maintenance, and removal activities. This assessment shall include and describe: (a) operational procedures for installing, maintaining, and removing the project turbines; (b) criteria for weather and wave conditions that must exist before marine operations can occur; (c) redundancy in the use of equipment and/or vessels; (d) criteria for aborting the operations; and (e) an established "port of refuge," located at least two (2) kilometers away from the PC-1 cable, in the event of unanticipated adverse weather or other event.

The licensee shall include with the assessment, documentation of consultation with the U.S. Coast Guard, the U.S. Army Corps of Engineers, and PC Landing Corporation; copies of comments and recommendations on the completed assessment after it has been prepared and provided to the consulted entities; and specific descriptions of how the entities' comments are accommodated by the assessment. The licensee shall allow a minimum of 30 days for consulted entities to comment and make recommendations before filing the assessment with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the assessment. In-water construction shall not begin until the assessment is approved by the Commission. Upon Commission approval, the licensee shall implement the procedures contained in the assessment, including any changes required by the Commission.

Article 3XX. *Removal of Obstructions to Navigation*. If the Corps determines that the project presents an unreasonable obstruction to the free navigation of navigable waters, the licensee shall, upon due notice from the Corps and upon Commission

approval, remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States.

Article 3XX. *Annual Performance Report and Certification*. Following start of operations and by December 31 of each year, the licensee shall submit one copy of a report describing the project's performance to the Commission's Division of Dam Safety and Inspections (D2SI)-Portland Regional Engineer, and two copies to the Commission (one of these shall be a courtesy copy to the Director, D2SI). The report shall include: (1) the adequacy of project monitoring and operations; (2) the findings of inspections; and (3) a summary of the major maintenance and repairs performed during the previous year. The report shall certify that the project features are being operated, monitored, inspected, and maintained in accordance with the license and approved plans.

Article 4XX. *Project and Public Safety Plan*. Upon license issuance, the licensee shall implement the Project and Public Safety Plan, filed December 7, 2012.

Article 4XX. *Project Removal and Site Restoration Plan.* The *Project Removal and Site Restoration Plan*, filed December 7, 2012, is approved with the following modifications: 1) a detailed timeline for the removal and site restoration activities shall be filed with the Commission 6 months prior to license expiration; 2) documentation of consultation with National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Coast Guard, Washington Department of Natural Resources, Washington Department of Fish and Game, and Washington Department of Ecology regarding planned removal and site restoration activities shall be filed with the Commission 6 months prior to license expiration; and 3) documentation of completion of project removal and site restoration activities shall be filed with the Commission prior to license expiration.

Article 4XX. *Emergency Shutdown Plan.* Upon license issuance, the licensee shall implement the Emergency Shutdown Plan, filed December 7, 2012.

Article 4XX. *Horizontal Directional Drilling Plan.* Upon license issuance, the licensee shall implement the Horizontal Directional Drilling Plan, filed March 1, 2012, with the following modification.

In the event that HDD drilling is required to be extended beyond the specified 12-daytime hours (e.g., 7:00 am to 7:00 pm) into evening or early morning hours, the licensee shall implement noise abatement contingency measures, such as the placement of temporary sound barrier (or appropriate alternative), to reduce noise impacts on neighboring residences. Contingency measures must be readily available to maintain sound levels below 55 dB at both the east and west property boundaries of the HDD drill site. Any implementation of contingency measures shall be reported within 48 hours to the Commission's Division of Dam Safety and Inspections (D2SI) – Portland Regional Engineer.

Article 4XX. *Water Quality Monitoring Plan.* Upon license issuance, the licensee shall implement the *Water Quality Monitoring Plan*, filed December 7, 2012, with the following modification.

The licensee shall file notify the Commission's Division of Administration and Compliance and the Commission's Division of Dam Safety and Inspections (D2SI) – Portland Regional Engineer within 24 hours of a frac-out or other release of grout material to waters into Admiralty Inlet that results in turbidity levels exceeding 250 NTUs and the steps taken to correct the problem.

Article 4XX. *Acoustic Monitoring Plan.* Upon license issuance, the licensee shall implement the *Acoustic Monitoring and Mitigation Plan*, filed on November 16, 2012.

Article 4XX. *Benthic Habitat Monitoring and Mitigation Plan.* Upon license issuance, the licensee shall implement the Benthic Habitat Monitoring and Mitigation Plan, filed November 16, 2012.

Article 4XX. *Near-Turbine Monitoring and Mitigation Plan.* Upon license issuance, the licensee shall implement the Near-Turbine Monitoring and Mitigation Plan, filed November 16, 2012.

Article 4XX. *Marine Mammal Monitoring and Mitigation Plan.* Upon license issuance, the licensee shall implement the Marine Mammal Monitoring and Mitigation Plan, filed November 16, 2012.

Article 4XX. *Derelict Gear Monitoring Plan.* Upon license issuance, the licensee shall implement the Derelict Gear Monitoring Plan, filed December 7, 2012.

Article 4XX. *In-water Construction Schedule*. All in-water construction shall be conducted between July 16 and October 14 to minimize adverse effects on salmon, bull trout, Pacific herring, and Pacific sand lance.

Article 4XX. *Reservation of Authority to Prescribe Fishways*. Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or to provide for the construction, operation, and maintenance of such fishways as may be prescribed by the Secretary of the Interior pursuant to section 18 of the Federal Power Act.

Article 4XX. *Interpretation and Education Plan.* Within six months of license issuance, the licensee shall develop and file for Commission approval an Interpretation and Education Plan that includes installation of an interpretive display at a publicly accessible site within view of the turbine locations at Fort Casey State Park, subject to state approval, that describes the project, the potential ocean energy resource in Puget Sound, and the natural and cultural environment of the project area. If a suitable site at the park is not available, another appropriate location may be proposed.

The licensee shall include with the plan, documentation of consultation with the U.S. National Park Service, Washington State Parks and Recreation Commission, Ebey's Landing Historical Reserve Trust Board, and Island County Marine Resources Committee; copies of comments and recommendations on the completed plan after it has been prepared and provided to the consulted entities; and specific descriptions of how the entities' comments are accommodated by the plan. The licensee shall allow a minimum of 30 days for consulted entities to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons based on project-specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Article 4XX. *FERC Form 80 Exemption*. There is little or no potential for recreation facilities within the project boundary. Therefore, upon the issuance date of the license, the licensee is exempt from 18 § C.F.R. 8.11, the filing of the FERC Form 80 recreation report, for the Admiralty Inlet Project.

Article 4XX. *Cultural Resources.* Prior to beginning any land-clearing or land-disturbing activities within the project boundary, other than those specifically authorized in this license, the licensee shall consult with the Washington State Historic Preservation Officer (SHPO). If the licensee discovers previously unidentified archeological or historic properties during the course of constructing, maintaining, or removing project works or other facilities at the project, the licensee shall stop all land-clearing and land-disturbing activities in the vicinity of the properties and consult with the Washington SHPO.

In either instance, the licensee shall file a historic properties management plan (plan) for Commission approval. The plan shall be prepared by a qualified cultural resource specialist after having consulted with the SHPO. The plan shall include the following items:

(1) a description of each discovered property indicating whether it is listed on or eligible to be listed on the National Register of Historic Places;

(2) a description of the potential effect on each discovered property;

(3) proposed measures for avoiding or mitigating effects;

(4) documentation of the nature and extent of consultation; and

(5) a schedule for mitigating effects and conducting additional studies.

The Commission may require changes to the plan. The licensee shall not begin land-clearing or land-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property discovered during construction, until informed by the Commission that the requirements of this article have been fulfilled.

Article 4XX. *Project Land Rights Progress Report.* No later than four years after license issuance, the licensee shall file a report with the Commission describing the status of acquiring title in fee or the rights for all the lands within the project boundary. The report must provide an overview map of each parcel and summary table identifying the licensee's rights over each parcel within the project boundary. The report shall also include specific supporting documentation showing the status of the land rights on all parcels of land within the project boundary that: (1) have been acquired up to the date of filing of the report, including pertinent deeds, lease agreements, and/or bill of sale information that specifically verify the licensee's rights; and (2) the licensee's plan and schedule for acquiring all remaining project lands prior to the five-year deadline, including a history of actions taken, current owner information, the type of ownership to be acquired whether in fee or by easement, and the timeline for completing property acquisition

Article 4XX. *Use and Occupancy*. (a) In accordance with the provisions of this article, the licensee shall have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values of the project. For those purposes, the licensee shall also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the licensee shall take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any non-complying structures and facilities.

(b) The type of use and occupancy of project lands and waters for which the licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) non-commercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 water craft at a time and where said facility is intended to serve single-family type dwellings; (3) embankments, bulkheads,

retaining walls, or similar structures for erosion control to protect the existing shoreline; and (4) food plots and other wildlife enhancement. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The licensee shall also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the licensee shall: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the impoundment shoreline. To implement this paragraph (b), the licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the licensee's costs of administering the permit program. The Commission reserves the right to require the licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The licensee may convey easements or rights-of-way across, or leases of project lands for: (1) replacement, expansion, realignment, or maintenance of bridges or roads where all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) non-project overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69-kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project impoundment. No later than January 31 of each year, the licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) non-project overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or

public marinas that can accommodate no more than 10 water craft at a time and are located at least one-half mile (measured over project waters) from any other private or public marina; (6) recreational development consistent with an approved report on recreational resources of an Exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from project waters at normal surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 60 days before conveying any interest in project lands under this paragraph (d), the licensee must submit a letter to the Director, Office of Energy Projects, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked Exhibit G map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Director, within 45 days from the filing date, requires the licensee to file an application for prior approval, the licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the licensee shall consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the licensee shall determine that the proposed use of the lands to be conveyed is not inconsistent with any approved report on recreational resources of an Exhibit E; or, if the project does not have an approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include the following covenants running with the land: (i) the use of the lands conveyed shall not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; (ii) the grantee shall take all reasonable precautions to ensure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project; and (iii) the grantee shall not unduly restrict public access to project waters.

(4) The Commission reserves the right to require the licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude

land conveyed under this article only upon approval of revised Exhibit G drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised Exhibit G drawings would be filed for approval for other purposes.

(g) The authority granted to the licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.

Document Content(s)