Volume 2

Exhibit E Environmental Report

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368

Federal Energy Regulatory Commission

Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

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TABLE OF CONTENTS

LIST OF FIGURES

Figures Page

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ADCP	Acoustic Doppler Current Profiler
AIS	Automatic Identification System
APE	Area of Potential Effect
APL-UW	Applied Physics Laboratory, University of Washington
AQI	Air Quality Index
ATB	articulated tug barges
BC	British Columbia
B-field	magnetic field
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
C&P	Cargo and Passenger ferries
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	centimeter
cm/s	centimeters per second
CPS	Coastal Pelagic Species
CSZ	Cascadia Subduction Zone
CTD	conductivity, temperature, and depth
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DAHP	Washington Department of Archaeology and Historic Preservation
dB	decibel
dB re 1V/μPa	decibel relative to 1 volt per I micropascal
DC	direct current
DMMP	Dredged Material Management Program
DNR	Washington Department of Natural Resources
DOE	U.S. Department of Energy
DPM	detection positive minutes
DPS	distinct population segment
ECDF	empirical cumulative distribution functions
Ecology	Washington Department of Ecology
EEZ	exclusive economic zone
EFH	Essential Fish Habitat
E-field	electric field
EIS	Environmental Impact Statement
ELI	Environmental Law Institute
EMEC	European Marine Energy Centre
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FMC	Fishery Management Council
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FPA	Federal Power Act
FR	Federal Register
ft	foot/feet
ft/s	feet per second
ft^2	square feet
GHG	greenhouse gas(es)
GLO	General Land Office
HAPC	Habitat Areas of Particular Concern
HF	high-frequency
HPA	Hydraulic Project Approval
HTI	High Tech, Inc.
Hz	hertz
IAP2	International Association of Public Participation
iE	induced electric
IMO	International Maritime Organization
in.	inch(es)
in./s	inches per second
IPaC	Information for Planning and Consultation
IUCN	International Union for Conservation of Nature
kHz	kilohertz
km	kilometer
km^2	square kilometers
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
lbs.	pounds
LED	light-emitting diode
LF	low frequency
m	meter
m/s	meters per second
m^2	square meter
M2USN	Marine intertidal unconsolidated shore, regularly flooded
m^3	cubic meter
m^3/s	cubic meters per second
MBE	multibeam echosounder
MBTA	Migratory Bird Treaty Act
MF	mid frequency
MHHW	mean higher high water

MHW	mean high water
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MPA	Marine Protected Area
MRE	marine renewable energy
MSA	Magnuson-Stevens Fishery Conservation and Management Act
multi-cat	multi-category
MW	megawatt
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWIFC	Northwest Indian Fisheries Commission
NWR	National Wildlife Refuge
NWSI	Northwest Straits Marine Conservation Initiative
OA	otariid pinnipeds (in-air)
ODFW	Oregon Department of Fish and Wildlife
OESE	Ocean Energy Systems- Environmental
OPALCO	Orcas Power & Light Cooperative
Orbital	Orbital Marine Power
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
ORJIP	Offshore Renewables Joint Industry Programme
OSHA	Occupational Safety and Health Administration
OW	otariid pinnipeds (under water)
PA	phocid pinnipeds (in-air)
PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PFMC	Pacific Fishery Management Council
PHS	Priority Habitats and Species
PME	protection, mitigation, and enhancement
PNNL	Pacific Northwest National Laboratory
PRMMI	Point Roberts Middle Mile Infrastructure Project
PPT	parts per thousand
Project	Rosario Strait Tidal Energy Project
PSD	pressure spectral densities
PTS	permanent threshold shift
PW	phocid pinnipeds (under water)

RCW	Revised Code of Washington
RHA	Rockfish Hot Spot Areas
RHIB	rigid-hulled inflatable boat
ROI	Region of Influence
rpm	revolutions per minute
R/V	Research Vessel
SB	surface buoy
SBP	sub-bottom profiler
SCBP	San Juan County/Cypress Island Marine Biological Preserve
SEPA	State Environmental Policy Act
Services	National Marine Fisheries Service and U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Officer
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SOP	standard operating procedure
SPL	sound pressure level
SRKW	Southern Resident Killer Whale
SS	Sea Spider
SSC	suspended sediment concentrations
SSWS	sea star wasting syndrome
STBM	StableMoor mooring
TCP	Traditional Cultural Place
TEAMER™	Testing and Access to Marine Energy Research
Treaty	Treaty of Point Elliott
TTS	temporary threshold shift
U&A	Usual and Accustomed
U.S.	United States
U.S. DOT	U.S. Department of Transportation
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
UW	University of Washington
VHF	very high frequency
W/m^2	watts per square meter
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WEMD	Washington Emergency Management Division
WISAARD	Washington Information System for Architectural and Archaeological Records Database
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries
μT	micro-Tesla

1. Introduction

1.1 Application

Pursuant to 18 Code of Federal Regulations (CFR) Part 5, Orcas Power & Light Cooperative (OPALCO) is applying to the Federal Energy Regulatory Commission (FERC) for an original hydrokinetic pilot project license for the proposed Rosario Strait Tidal Energy Project (Project). In connection with this, OPALCO submits this Draft License Application, Exhibit E, for consideration. FERC issued a preliminary permit on January 13, 2025, Project No. 15368-000, which grants OPALCO the priority to apply for a license for the proposed Project.

The Project would be located off the eastern shore of Blakely Island in Rosario Strait, Washington State (approximately 48.5611°N, 122.7679°W; see **Figure 1**). Electricity generated by the Project would be delivered via a new subsea cable to an existing substation on Blakely Island, where it would be power-conditioned and connected to the existing power grid operated by OPALCO.

The proposed Project is to investigate the feasibility of installing one Orbital Marine O2-X Floating Tidal device (Orbital O2-X) to serve as a pilot project to test the capacity of Rosario Strait for tidal turbine electricity generation that supports OPALCO's microgrid. The Orbital O2-X was designed by Orbital Marine Power (Orbital). Orbital O2 technology, an earlier model than the proposed O2-X, has been deployed for over 32 months in the Orkney Islands of Scotland. In Scotland, the Orbital O2 is connected to the European Marine Energy Centre (EMEC) grid via a subsea cable, generating enough electricity for approximately 1,700 homes.

As the first project of this type in the United States (U.S.), the goal is to emulate the current deployment off the Orkney Islands. The marine conditions in Rosario Strait are similar, and an existing subsea cable conduit is available on the south shore of Blakely Island to connect to the OPALCO grid. The electrical output would benefit a growing island community that seeks to strengthen its energy independence and improve livelihoods by divesting from the power supplied from mainland Washington State.

1.1.1 Purpose of Action

President Trump issued an Executive Order on January 20, 2025, Unleashing American Energy, acknowledging hydropower as a critical domestic energy resource (The White House 2025). Furthermore, Secretary of Energy Wright issued a Secretarial Order on February 25, 2025, establishing directives to strengthen grid reliability and support energy innovation for hydropower and other domestic resources (The White House 2025). As an island community, San Juan County is at risk of unreliable electricity. The vast majority of OPALCO's power is transmitted using subsea cables connected to the power grid on mainland Washington. When service is disrupted, San Juan County can be subjected to long wait times as repairs are beyond its control. OPALCO is committed to implementing local energy generation resources and microgrids that strengthen the resilience of infrastructure and increase safety and reliability for its service area while keeping rates affordable.

The OPALCO grid is evolving to meet the pressing needs to decarbonize and increase local energy resilience. To prepare for expected near-term electrical capacity shortfalls and long-term load doubling, OPALCO has been exploring local generation options to ensure resilience, reliability, and ability to support beneficial electrification and regulatory clean energy goals.

While solar is minimal during the Pacific Northwest winter, tidal power is strong and predictable year-round. Notably, it can also be farmed within a fraction of the surface area that solar requires. OPALCO has investigated the feasibility of installing one Orbital O2-X in the waters of the San Juan Island archipelago, Washington. This Project would serve as a pilot project to test the capacity of the Rosario Strait site and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

1.2 Geographic Region

The proposed Project would be located within Rosario Strait, a strait within the Salish Sea (**Figure 1**). This location was chosen for its favorable tidal flows, minimizing impacts on threatened and endangered species, and existing OPALCO infrastructure in the area. The Salish Sea is a marginal sea located between British Columbia (BC), Canada and Washington State. This water body includes the Strait of Georgia, Strait of Juan de Fuca, Puget Sound, and the archipelago of the San Juan Islands. It encompasses waters from Olympia (WA) to Campbell River (BC) and west to Neah Bay (WA). Puget Sound is an interconnected estuarine system of islands, waterways, and basins east of Admiralty Inlet. Ports within this sea include the ports of Tacoma, Seattle, Everett, Bellingham, Vancouver, and Victoria.

The proposed Project area and boundaries are described in **Section 2.2.2**.

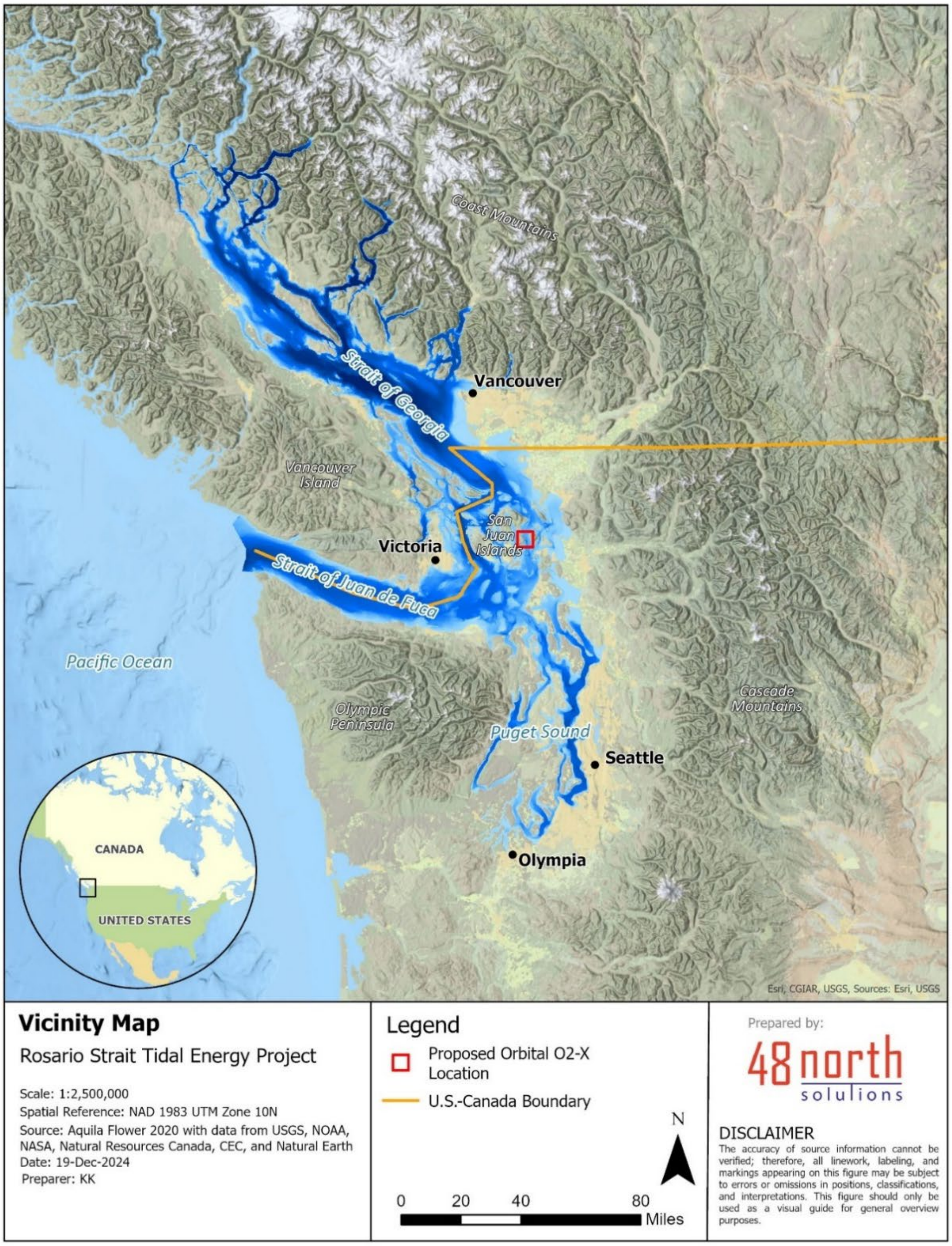

Figure 1. Vicinity Map

1.3 Statutory and Regulatory Requirements

Projects in the marine environment require review under several regulations. Engagement and coordination with Tribal Nations, federal, state, and local agencies; and stakeholders is a critical component of the regulatory process in Washington State. Consultation generally involves analysis of a proposed Project to determine any potential effects and develop effective monitoring, mitigation, and adaptive management measures necessary to prevent, minimize, and/or mitigate Project impacts on the environment. Statutory requirements applicable to the proposed Project are summarized in **Table 1** and discussed in further detail below.

In the State of Washington, Tribal Nations have legal co-management of natural resources that support their livelihoods and cultural heritage, pursuant to the landmark Boldt Decision in 1974 (see **Section 1.3.4**) and numerous subsequent decisions (United States v. Washington, 384 F. Supp. 312 [W.D. Wash. 1974]). It is necessary to engage with Tribal Nations to understand these important resources, how they are used, and how the construction and operations of a project may affect the rights that are guaranteed under these treaties and federal laws, as well as the requirements set forth by other federal laws and guidelines for identifying and assessing effects on Tribal resources and cultural resources.

Table 1. Major Statutory and Regulatory Requirements of the Project

Entity	Policy	Approval
Federal		
FERC	National Environmental Policy Act Review	Environmental Analysis (Record of Decision)
	Section 106 of the National Historic Preservation Act	Finding of Effect
	Section 10(j) Recommendations of the Federal Power Act	FERC Approval in License
USACE	Section 10 of the Rivers and Harbors Act	Individual Permit
	Section 404 of the Clean Water Act	Individual Permit
NMFS	Section 7 of the Endangered Species Act	Concurrence/Incidental Take Authorization
	Magnuson-Stevens Fishery Conservation and Management Act (Section 305(b) (2))	Concurrence
	Marine Mammal Protection Act	Incidental Harassment Authorization/Incidental Take Authorization
USFWS	Section 7 of the Endangered Species Act	Concurrence/Incidental Take Authorization
	Migratory Bird Treaty Act	Concurrence
	Bald and Golden Eagle Protection Act	Concurrence
USCG	Ports and Waterways Safety Act (33 USC 1221 et seq.)	Consultation
State		

Entity	Policy	Approval
Ecology	Coastal Zone Management Act and related requirements (Shoreline Management Act, Clean Water Act, Clean Air Act, Ocean Resources Management Act)	Consistency Determination
	Section 401 of the Clean Water Act	Water Quality Certification
	Section 402 of the Clean Water Act	National Pollutant Discharge Elimination System Permit
DNR	RCW 79.105	Aquatic Use Authorization
DAHP	Section 106 of the National Historic Preservation Act of 1966	Concurrence
WDFW	RCW 77.55	Hydraulic Project Approval
Local		
San Juan County	Chapter 197-11 WAC	State Environmental Policy Act Review
	971 Shoreline Management Act, Chapter 90.58 of the RCW	Shoreline Master Program Review

Notes: DAHP = Washington Department of Archaeology and Historic Preservation; DNR = Washington State Department of Natural Resources; Ecology = Washington Department of Ecology; FERC = Federal Energy Regulatory Commission; NMFS = National Marine Fisheries Service; RCW = Revised Code of Washington; USACE = U.S. Army Corps of Engineers; USC = United States Code; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service; WAC = Washington Administrative Code; WDFW = Washington Department of Fish and Wildlife

1.3.1 Federal Energy Regulatory Commission (FERC)

1.3.1.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to prepare an analysis for federal actions that have the potential to significantly affect the quality of the human environment, including both natural and cultural resources. Environmental Assessments are developed to determine whether an action may cause significant environmental effect. If the action is determined not to have significant impacts, then the federal agency issues a Finding of No Significant Impact (FONSI). If the action is determined to have significant impacts, then the federal agency would prepare an Environmental Impact Statement (EIS).

1.3.1.2 Federal Power Act: Section 10(j)

Under Section 10(j) of the Federal Power Act, each license issued by FERC must 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. FERC is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the Federal Power Act or other applicable laws. Before rejecting or modifying an agency recommendation, FERC is required to attempt to resolve any such inconsistency with the appropriate agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

1.3.1.3 The Services

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service (USFWS) are collectively referred to herein as the Services. As the lead regulatory agency overseeing this proposed Project, FERC would consult with the Services under the following legislation:

Endangered Species Act: Section 7

The Services share responsibility for administering Section 7 of the Endangered Species Act (ESA). The USFWS manages land and freshwater species, including sea- and shorebirds, while the NMFS manages Section 7 for marine species, such as marine mammals, sea turtles, marine and anadromous fish, and marine invertebrates and plants.

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Once designated by FERC as its non-federal representative for purposes of ESA consultation, OPALCO would begin informal ESA consultation efforts with NMFS and USFWS for the Project.

ESA-listed species and designated critical habitat in the proposed Project area are identified in **Section 3.4.6**. The effects of the proposed Project on ESA-listed species and designated critical habitat are discussed in **Section 4.3**.

Marine Mammal Protection Act

All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA). The MMPA generally prohibits the “take” of marine mammals—including harassment, hunting, capturing, collecting, or killing—in U.S. waters. NMFS, USFWS, and the Marine Mammal Commission are the federal entities that share responsibility for enforcing the MMPA.

In 1986, Congress amended the MMPA and ESA to authorize incidental takings (lethal, injurious, or harassment) of depleted, endangered, or threatened marine mammals, provided the takings were small in number and had a negligible impact on marine mammals. Analysis of potential effects of the proposed Project on marine mammals is presented in **Section 4.1** and **Section 4.3.3**.

Magnuson-Stevens Act

The Magnuson–Stevens Fishery Conservation and Management Act (MSA) and amendments require federal agencies to consult with NMFS on all proposed and/or authorized activities that may have an adverse effect on Essential Fish Habitat (EFH). EFH in the proposed Project area is described in **Section 3.4.2** and potential effects on EFH are described in **Section 4.3.4**.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA), administered by the USFWS, prohibits the take of protected migratory bird species. Any activities that may impact these birds or their habitats may be required to follow appropriate conservation measures. Avian species in the proposed Project area are described in **Section 3.5.2** and potential impacts are discussed in **Section 4.3.5**.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act provides protection of bald and golden eagles by prohibiting take, including their parts (e.g., feathers), nests, or eggs. Avian species (including eagles) in the proposed Project area are described in **Section 3.5.2** and potential impacts are discussed in **Section 4.3.5**.

1.3.1.4 Washington Department of Archaeology and Historic Preservation

As the lead regulatory agency overseeing this proposed Project, FERC would consult with the Washington Department of Archaeology and Historic Preservation (DAHP) under the following legislation:

National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their undertakings on historic properties (i.e., any district, site, building, structure, or object that is listed in, or eligible for listing in, the National Register of Historic Places [NRHP]). Undertakings include any project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by, or on behalf of, a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval. Under 36 CFR part 800.2(c) of the NHPA's implementing regulations, compliance also requires federal agencies to consult with various parties that may have consulting roles in the Section 106 process. These include the State Historic Preservation Officer (SHPO), Tribal Nations, and stakeholders and interested parties. Depending on the circumstances, this may also include the Advisory Council on Historic Preservation, which oversees the Section 106 process. Compliance with 36 CFR 800 includes these five steps:

1. Initiate process by coordinating with other environmental reviews, consulting with SHPO, identifying and consulting with interested parties, and identifying points in the process to seek input from the public and to notify the public of proposed actions.
2. Identify cultural resources and evaluate them for NRHP eligibility, resulting in the identification of historic properties.
3. Assess effects of the project on historic properties.
4. Consult with the SHPO, affected Tribes, and interested parties regarding adverse effects on historic properties, resulting in a memorandum of agreement.
5. Proceed in accordance with the memorandum of agreement, if necessary.

Historic properties are defined as archaeological sites, buildings, structures, traditional cultural places, and objects, that are eligible for listing in the NRHP. The identification of historic properties in Washington State involves the DAHP.

Tribal and cultural resources in the proposed Project area are described in **Section 3.10**. Potential effects of the proposed Project on those resources are described in **Section 5.3**.

1.3.2 U.S. Army Corps of Engineers (USACE)

1.3.2.1 Rivers and Harbors Act: Section 10

Section 10 of the Rivers and Harbors Act of 1899 provides the USACE with permitting authority over projects that include construction, excavation, or deposition of materials in, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of navigable waters, to the limit of the continental shelf. Section 10 of the Rivers and Harbors Act requires that "*regulated activities conducted below the Ordinary High Water elevation of navigable waters of the United States be approved/permitted by the USACE. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway. Navigable waters of the United States are those waters of the U.S. that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used or have been used in the past or may be susceptible to use to transport interstate or foreign commerce.*"

To prohibit the obstruction or alteration of navigable waters, any structures or activities (e.g., anchoring cables, aids to navigation) occurring in or affecting the navigable waters of the U.S. are subject to authorization by the USACE.

1.3.2.2 Clean Water Act: Section 404

Section 404 of the Clean Water Act (CWA) requires that any person, company, Tribe, or government agency planning to work in waters of the U.S. must obtain a permit from the USACE before initiating any regulated activity. The USACE, the lead agency, in partnership with the U.S. Environmental Protection Agency (EPA), is responsible for implementation of the Section 404 Program in Washington State. The Section 404 of the CWA is triggered when a proposed Project would either remove material from or place fill into navigable waters of the U.S. Proposed Project activities are not expected to trigger Section 404.

Section 401 of the CWA (the Water Quality Certification process) would be regulated by the Washington Department of Ecology (Ecology; see **Section 1.3.5.2**).

1.3.3 U.S. Coast Guard (USCG)

1.3.3.1 Ports and Waterways Safety Act

The USCG is responsible for providing FERC with an evaluation of the potential impacts of the Project on the safety of navigation and the traditional uses of Rosario Strait. The USCG must also offer recommendations to provide for navigational safety and to minimize potential adverse impacts. USCG's authority comes from the Ports and Waterways Safety Act (33 U.S. Code [USC] 1221 et seq.), which requires the USCG to consider all possible uses of a waterway to reconcile the need for safe access routes with the needs of all other waterway uses. The USCG is also authorized to approve private aids to navigation. The analysis of this Project's effect on navigation is further discussed in **Section 5.1.2.** A Navigation Safety Plan (Appendix B6) would be submitted to USCG for approval.

1.3.4 Tribal Nations

Indigenous Tribal Nations and populations have been in the Pacific Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the United States, Tribal Nations ceded 64 million acres of land to the United States for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation lands and specifically reserved the right to gather and access foods and access religious sites in their treaties with the federal government. Tribal Nations also retain rights via executive orders and legislative actions.

As a result of the Boldt Decision, the Northwest Indian Fisheries Commission was formed to support Tribal governments in managing fishing in Washington State (NWIFC 2016b). Now, co-management occurs through a government-to-government process where Tribal Nations work with Washington State to set annual fishing quotas in federal waters, sit on technical committees to pursue conservation goals, and work to restore fish habitat and stocks (NWIFC 2016c). Although coordination takes place throughout the year, it culminates with the annual North of Falcon Meeting where state, federal, and Tribal fishery managers get together to plan the Northwest's recreational and commercial salmon fisheries (WDFW 2025). The North of Falcon Meeting coincides with Pacific Fishery Management Council (PFMC) meetings, which are responsible for setting ocean salmon seasons from 3 to 200 nautical miles (NM) off the U.S. Pacific coast (WDFW 2025).

The proposed Project area is the traditional territory of several Tribal Nations who signed the Treaty of Point Elliott in 1855. Tribes and bands who were signatory to the Treaty of Point Elliott included the *"Dwamish, Suquamish, Sk-kahl-mish, Sam-ahmish, Smalh-kamish, Skope-ahmish, St-kah-mish, Snoqualmoo, Skai-wha-mish, N'Quentl-ma-mish, Sk-tah-le-jum, Stoluck-wha-mish, Sno-ho-mish, Skagit, Kik-i-allus, Swin-a-mish, Squin-ah-mish, Sah-ku-mehu, Noo-wha-ha, Nook-wa-chah-mish, Mee-see-qua-guilch, Cho-bah-ah-bish, and other allied and subordinate Tribes and bands of Indians occupying certain lands situated in said Territory of Washington, on behalf of said Tribes, and duly authorized by them"* (Washington Governor's Office of Indian Affairs, n.d.). Today, many of the Tribes and bands who signed the Treaty of Point Elliott (Treaty) are represented by modern-day federally recognized Tribal Nations, including Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Samish Indian Nation, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, and Upper Skagit Tribe. Certain Tribes and bands that signed the Treaty have reserved the right to fish, hunt, and gather including Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Stillaguamish Tribe of Indians, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, and the Upper Skagit Tribe. Treaty fishing may occur in small and large rivers as well as marine areas. Other Tribal Nations that may have an interest in the Project include the Confederated Tribes of the Umatilla, Jamestown S'Klallam Tribe, and the Port Gamble S'Klallam Tribe.

1.3.4.1 Tribal Engagement

Engagement and coordination with Tribal Nations is a key aspect of this Project. In early 2022, OPALCO began outreach with Tribal Nations in the region including the Lummi Nation, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes. OPALCO has been actively engaging with these Tribal Nations to share information about the Project, including location and technology, to seek meaningful engagement on the Project early in the process, seek feedback on the Project description, and start to identify concerns, risks, and possible effects. Representatives from these Tribal Nations have participated in meetings and correspondence. OPALCO's understanding is that these representatives have shared the Project details with the Tribal Nations' fishing community and elected officials. In August 2024, the Confederated Tribes of the Umatilla, Jamestown S'Klallam Tribe, and Port Gamble S'Klallam Tribe were contacted at the recommendation of FERC and would be engaged moving forward. In December 2024, the Northwest Indian Fisheries Commission (NWIFC) recommended expanding Tribal engagement efforts to all Tribal Nations who were signatory to the Treaty. This includes the Muckleshoot Indian Tribe, Nooksack Indian Tribe, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, and Upper Skagit Tribe. The Consultation Record (Appendix A) includes the timeline and engagement activities that have occurred with Tribal Nations.

OPALCO is continuing engagement through meetings and correspondence at key milestones throughout the duration of the development of the DLA. Ultimately, government-to-government consultation with the Tribal Nations would occur between FERC and the Tribal Nations once a DLA is submitted. The Consultation Record (Appendix A) also includes a summary of the feedback and inquiries received from the Tribal Nations to date. Determinations of significant impacts and effects on Tribal treaty rights, interests, and resources would be conducted with engagement with the Tribal Nations and through government-to-government consultation with FERC.

1.3.5 Washington State Department of Ecology

1.3.5.1 Coastal Zone Management Act (CZMA)

Section 307 of the federal CZMA mandates that any federal action occurring in or outside of a state's coastal zone must be consistent with the approved Coastal Zone Management (CZM) Program for that state. In Washington, Ecology is responsible for ensuring that federal actions comply with these standards, as well as the enforceable policies or programs that have been incorporated into the program (e.g., land use planning statutes including the Shoreline Management Act [SMA], State Environmental Policy Act [SEPA], and water quality standards). Certification under Section 307 applies to all federal permitted/licensed or federally funded projects, or any activity within the coastal zone of a state to ensure that a proposed action is consistent with the state's CZM Program.

1.3.5.2 Clean Water Act: Section 401

Section 401 of the CWA authorizes Ecology to ensure that activities meet water quality standards established by the State of Washington under the CWA. The Section 401 Water Quality Certification process is triggered when the USACE decides that an application requires a Section 404 permit (i.e., that a proposed Project would either remove material from or place fill into navigable waters of the U.S.).

1.3.6 Washington Department of Natural Resources

1.3.6.1 Revised Code of Washington (79.105)

Under Washington State law (Revised Code of Washington [RCW] 79.105), projects on or over state-owned aquatic lands, including “bedlands,” “1st class tidelands and shorelands,” and “2nd class tidelands and shorelands,” must obtain an authorization (e.g., a lease or easement) from the Washington Department of Natural Resources (DNR). The duration of use authorization would depend on the proposed uses and the class of land leased. Once a project has received all necessary permits, DNR would then finalize an agreement.

1.3.7 Washington Department of Fish and Wildlife

1.3.7.1 Revised Code of Washington (77.55)

Washington State law (RCW 77.55) requires those planning hydraulic projects in or near state waters to get a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW). A “hydraulic project” is defined as the construction or performance of work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or freshwaters of the state. A new subsea cable in state waters would be subject to an HPA to safeguard fish and their aquatic habitats from potential effects of the installation activities.

1.3.8 San Juan County

1.3.8.1 Chapter 197-11 Washington Administrative Code

San Juan County would be the likely SEPA lead for the Project. The intent of SEPA is to ensure that all environmental values are considered by the local governing agency when making decisions about a proposed project. Washington’s SEPA requires all state and local governments to ensure that *“…environmental amenities and values would be given appropriate consideration in decision making along with economic and technical considerations….”* (RCW 43.21C.030(2)(a) and (2)(b)). State or local agencies review proposals to identify potential environmental impacts associated with a Project. Chapter 197-11 of the Washington Administrative Code (WAC) contains the policies and procedures for SEPA.

1.3.8.2 Shoreline Management Act

The Shoreline Master Program (SMP) is the local instrument by which San Juan County and Ecology jointly administer the Shoreline Management Act (SMA), Chapter 90.58 of the RCW. SMPs carry out the policies of the SMA at the local level, regulating the use and development of shorelines. The overarching goal of the SMA is *"to prevent the inherent harm in an uncoordinated and piecemeal development of the state’s shorelines."*

Under the SMA, each local jurisdiction that contains “shorelines of the state” must develop and adopt its own SMP. “Shorelines of the state” generally refers to rivers, lakes, and marine waterfronts along with their associated shorelands, wetlands, and floodplains (per RCW 90.58.030[2]).

Any permanent or temporary project that interferes with the public use of shorelands requires review of the SMA by the local jurisdiction. This includes projects in or within 200 feet (ft) (61 meters [m]) of marine waters, streams, lakes, and floodplains. The San Juan County SMP was last updated in 2021 (Ordinance No. 08-2020).

1.4 Stakeholder Engagement

1.4.1 Community Engagement

OPALCO is an electric co-op serving more than 20 islands, with a primary audience of more than 11,000 co-op members. For the proposed Project, OPALCO organized specific outreach groups to engage with as outlined below. These groups are OPALCO's key stakeholders and indicate different audiences that require different outreach efforts. OPALCO would document outreach efforts to include materials, comments collected, and OPALCO's response to comments.

1.4.2 Community and Stakeholder Groups

For the Project, OPALCO has engaged with numerous regional groups, including:

- OPALCO Co-op Members
- San Juan Islands Community Organizations/Businesses/Elected Officials
- San Juan Islands Environmental Organizations/Businesses
- Regional Environmental Organizations & Related Businesses
- Regional Elected Officials

For a complete list of stakeholder organizations, names, and contacts, see the Consultation Record (Appendix A).

1.4.3 Engagement Goals

At this stage of the Project, engagement was focused primarily on informing and educating stakeholders. The intent was to increase public awareness of the Project, the importance of local renewable electricity generation, and gauge public support. Engagement goals included:

- Providing clear communications to inform co-op members and stakeholders about the benefits of this clean, renewable energy Project that would bring greater community resilience.
- Providing opportunities to gather feedback about the Project.
- Solicit, gather, and evaluate input about the benefits of this Project.
- Determine interest and necessity of advisory group.

1.4.4 Levels of Engagement

To inform engagement techniques, it is important to set clear expectations for the level of influence target audiences would have on Project decisions. A proposed level of engagement with target audiences is presented in **Table 2**.

Table 2. Proposed Levels of Engagement with Target Audience

Target Audience	Engagement with the Audience
OPALCO Co-op Members	We will actively keep you informed of the project processes and timeline. We will look to you for feedback on the importance to co-op members on the Project and to actively educate yourself and decide the level of buy in.
San Juan Islands Community Organizations	We will keep you informed on the Project process, timeline, and potential benefits with direct outreach. We look to you to opt in to learn and offer advice on ways to incorporate community.

San Juan Islands Environmental Organizations	We will provide a detailed outline of the permit process, timeline, and environmental requirements. We will listen and consider your concerns and aspirations directly related to local environmental issues.
Regional Environmental Organizations / Businesses	We will provide information documents to introduce you to the Project.
Regional Elected Officials	We will provide information documents to introduce you to the Project.

1.4.5 Engagement Activities

Table 3 includes engagement activities for the Rosario Strait Tidal Energy Project that occurred within the time period of June 1, 2024 – March 31, 2025.

Table 3. Proposed Project Phase 1 Engagement Activities

Target Audience	Activities	Details
OPALCO Co-op Members	Two virtual information workshops Three in person workshops, print and digital materials	• Present information on process and timeline • Gather feedback • Gauge interest • Track attendance and feedback themes
San Juan Island Community Organizations	In-person meeting	• Invite to informational sessions • Host meeting to review the potential benefits and gauge future participation as stakeholders
San Juan Island Environmental Organizations	Email Project facts One-on-one briefings	• Direct outreach with fact sheets and invite to one-on-one briefing of Project
Regional Environmental Organizations / Businesses	Email Correspondence	• Email correspondence introducing the Project and include flyer and facts about Project
Regional Elected Officials	Email Correspondence One-on-one briefings	• Email correspondence introducing the Project and include flyer and facts about Project
Source: IAP2 n.d.		

The following is the engagement schedule:

- March 2023: Virtual workshop (Audience: OPALCO Co-op Members)
- March 2024: Announce funding opportunity and media release (Audience: All)
- August 2024: Virtual workshop (Audience: OPALCO Co-op Members)
- October 2024: Print and digital article (Audience: Mailed to OPALCO Co-op Members)
- December 2024: In-person informative meeting (Audience: San Juan Island Community Organizations)
- January 2025: Email correspondence / one-on-one briefings as needed (Audience: San Juan Island Community Organizations, San Juan Island Environmental Organizations, Regional environmental Organizations / Businesses)
- January 2025: In-person workshop (Audience: OPALCO Co-op Members)

- May 2025: Announce grant completion and DLA submittal via media release (Audience: All)

1.4.6 Regulatory Engagement

OPALCO has engaged the following state and federal agencies to discuss regulations and authorizations that would be applicable to a tidal energy deployment in Rosario Strait:

- FERC
- NMFS
- Washington State Office for Regulatory Innovation and Assistance
- USFWS
- USACE
- USCG
- DAHP
- U.S. Department of Energy (DOE)
- DNR
- Ecology
- WDFW
- San Juan County

2. Proposed Action and Alternatives

2.1 Description of Action

In 2024, OPALCO was awarded a grant from the DOE to investigate the feasibility of deploying a pilot project demonstration of a single Orbital O2-X with two turbine rotors rated at 1.2 megawatts (MW) each in Rosario Strait. To demonstrate the commercial viability of this Marine Renewable Energy (MRE) device and allow it to connect to OPALCO's existing electrical grid, the proposed Project must be authorized by FERC. As such, OPALCO is seeking a license from FERC for this pilot hydrokinetic project.

Tidal energy is harnessed from the motion of tides turning turbines installed in the water column to convert into electricity. Unlike the variability in solar and wind conditions, tidal currents are a reliable and predictable form of energy potential. Areas with high tidal ranges and strong currents present the best potential for capturing tidal energy. As the industry is in its early stages, research is ongoing to develop technologies and optimize power output to make tidal a viable energy alternative.

The proposed Project would harness energy from the motion of the tides turning two rotors—one on each of the two legs of the Orbital O2-X—installed in the water column and converting this energy into electricity. The electricity would be transmitted via a new subsea power cable installed on the seabed and connected to the Orbital O2-X, which would feed into OPALCO's existing microgrid for its San Juan Island service area.

This Project would serve as a pilot to test the capacity of the Rosario Strait site and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

2.2 Project Location

2.2.1 Rosario Strait

Through a DOE-funded Testing and Access to Marine Energy Research (TEAMER™) project, Pacific Northwest National Laboratory (PNNL) assessed five potential locations for a tidal energy project within the waters of Washington State's San Juan Islands archipelago (Copping et al. 2021). Based on multiple factors including seasonal weather patterns (**Section 3.3**), wave height (**Section 3.2.1**), tides and current speed (**Section 3.2.2**), prevailing wave and current direction (**Section 3.2.1** and **Section 3.2.2**), proximity to shipping lanes (**Section 3.8.3**), and visibility of the Project from the shoreline (**Section 3.8.1**), and impacts to species and habitat (**Section 3.4**, **Section 3.5**, and **Section 3.7**), Rosario Strait was identified as a tidal resource hotspot and considered an optimal location for deploying floating tidal turbine technology (Yang et al. 2021; Calandra et al. 2023).

2.2.2 Proposed Project Area

The proposed Project area within Rosario Strait is located east of Blakely Island (at approximately 48.5611°N, 122.7679°W). Blakely Island is a small, sparsely populated island, approximately 2.4 kilometers (km) (1.5 miles) south of Orcas Island where OPALCO offices are located. According to the nearest tidal station at Rosario, Orcas Island, with mean lower-low water (MLLW) near the proposed Project area at 0.0 m (0.0 ft), the mean higher-high water (MHHW) is 2.4 m (7.89 ft), mean high water (MHW) is 2.2 m (7.24 ft), and mean low water (MLW) is 0.7 m (2.31 ft) (NOAA 2024a). The change in water level between low tide and high tide, as measured with the National Geodetic Vertical Datum, at the proposed Project site is 4 m (13.2 ft) (Appendix C2).

The proposed Project area is shown in **Figure 2** and includes the locations for all proposed technology components: the Orbital O2-X device, mooring lines, anchors, and transmission lines (i.e., new subsea cable); as well as an existing marine shoreline cable conduit and existing land-based shoreline conduit facility at the southern end of Blakely Island (**Figure 3**). The approximate boundaries of the proposed Project area are described in **Table 4.** The approximate locations of proposed Project components within the boundaries are listed in **Table 5**.

For the purposes of this DLA, the proposed Project boundary defines an area of approximately 500 m x 760 m (1,640 ft x 2,494 ft), or 380,000 square meters (m^2) (~94 acres), to encompass the footprint of the Orbital O2-X, its anchoring components, and a buffer area (**Figure 4**). The footprint of the proposed Project components within the boundary could range from a minimum of 280 m x 480 m (919 ft x 1,575 ft) to a maximum of 322 m x 552 m (1,056 ft x 1,811 ft), depending on the final deployment configuration.

Additionally, the proposed boundary includes an adjacent corridor area of 25,300 m^2 (~6.25 acres) for the proposed new subsea cable that would be approximately 5.3 km (3.3 mile) in length (**Figure 4**). In total, the proposed Project area would be 325,300 m^2 (~80.38 acres) before adding a buffer area. However, final determination of the area is subject to consultation with Tribal Nations and regulatory agencies. Under Preliminary Permit Project No. 15368, issued by FERC on January 13, 2025, OPALCO maintains priority in applying for a license for a hydrokinetic pilot project at this location.

Table 4. Approximate Boundaries of the Proposed Project Area

Corner (Cardinal Direction)	Latitude (°N)	Longitude (°W)
Northwest	48.566277	-122.769801
Northeast	48.566209	-122.762983
Southwest	48.559339	-122.769742
Southeast	48.559429	-122.762922
Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]. The 2.3-m (7.5-ft) buffer around the new subsea cable is excluded from the proposed Project area coordinates in this table.		

Table 5. Approximate Location of the Proposed Project Components

Project Component	Latitude (°N)	Longitude (°W)
Orbital O2-X	48.559278	-122.766336
North Point – New Subsea Cable Corridor	48.561142	-122.767909
South Point – New Subsea Cable Corridor	48.531458	-122.809621
Existing Marine Shoreline Conduit	48.531466	-122.809625
Existing Land-Based Conduit Facility	48.531896	-122.809359
Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]		

Figure 2. Proposed Project Location

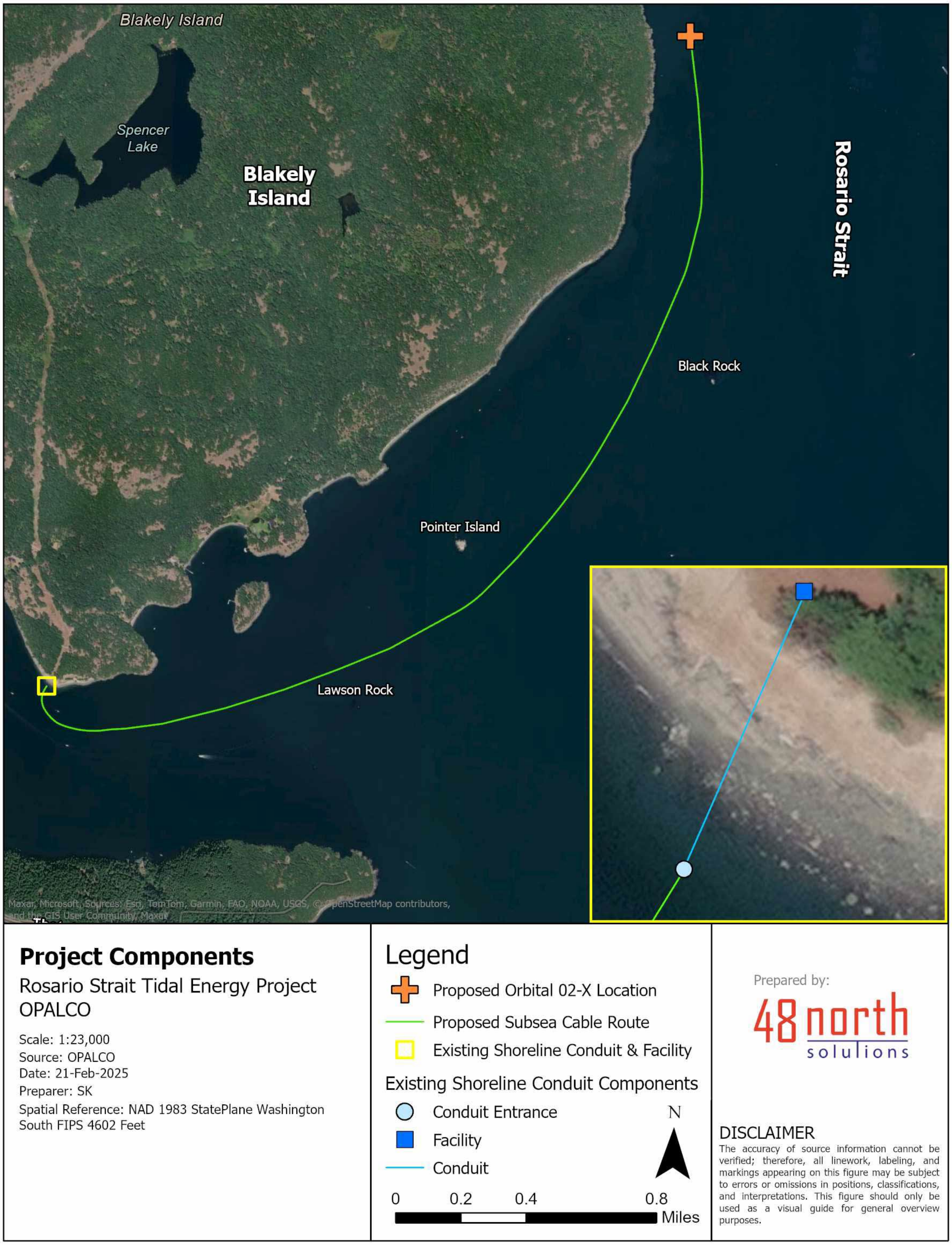

Figure 3. Proposed Project Components

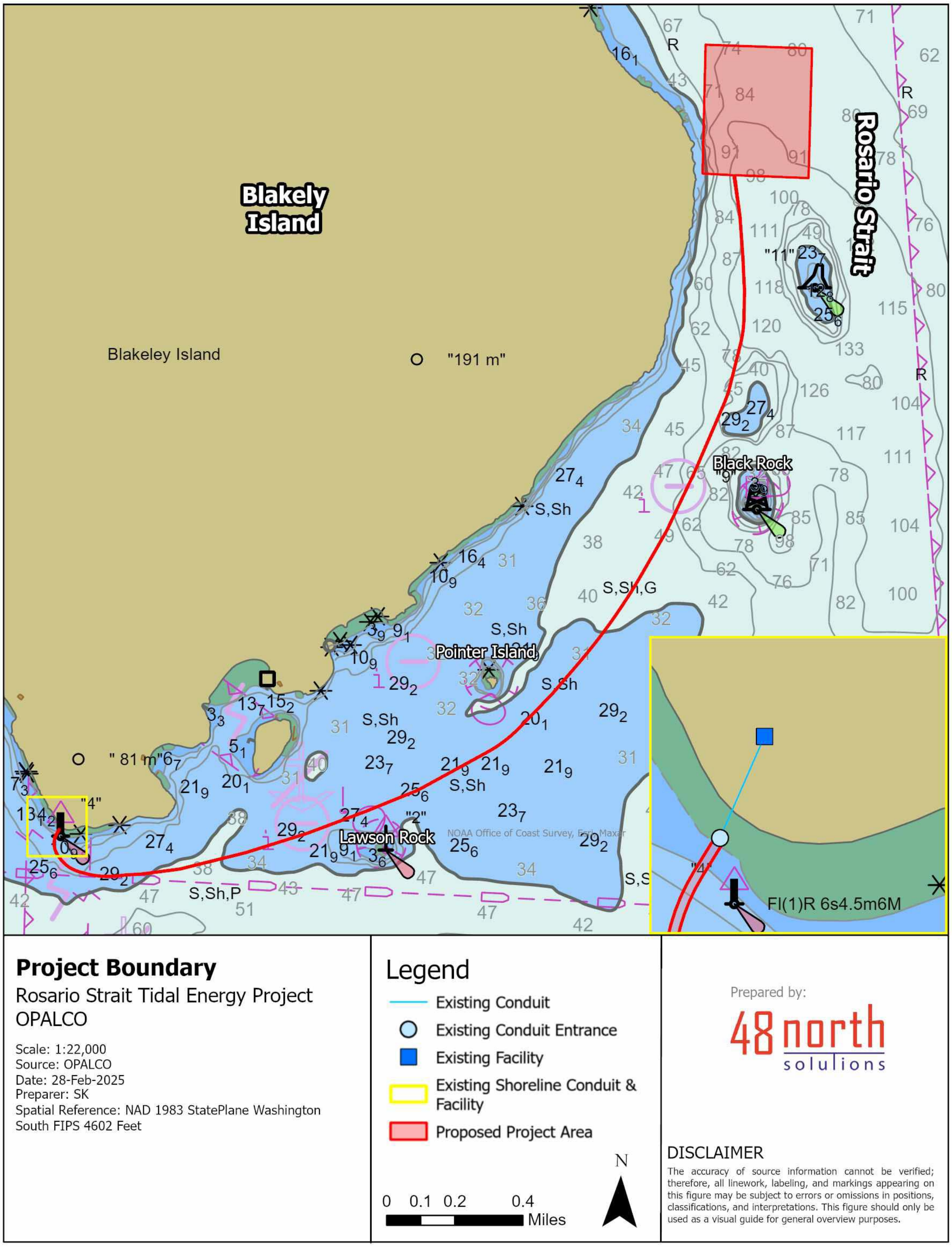

Figure 4. Proposed Project Boundary in Rosario Strait

2.3 Infrastructure

2.3.1 Proposed Infrastructure

The proposed Project infrastructure includes: one Orbital O2-X device (**Section 2.3.1.1**), four mooring lines (**Section 2.3.1.2**), four anchors (**Section 2.3.1.3**), and one new subsea power cable (**Section 2.3.1.4**). A summary of these components is found in the section below.

2.3.1.1 Orbital O2-X Floating Tidal Device (Orbital O2-X)

The Orbital O2-X is a floating tidal energy generator consisting of two 1.2 MW turbines (2.4 MW rated power combined). The main body of the Orbital O2-X consists of a cylindrical steel superstructure that houses power conversion and auxiliary systems and serves as a stable floating platform for the attachment of two leg structures with nacelles and rotors mounted at their ends. A nacelle is a container that houses the generating components of a turbine. The leg structures are attached to the main body with hinge attachments and can be used to lower nacelles and rotors in the optimal placement of the tidal stream to generate electricity. The leg structures can also be raised to bring the nacelles and rotors to the surface for servicing and towing the Orbital O2-X.

The Orbital O2-X features two twin-bladed rotors with blades that are manufactured from glass-fiber reinforced epoxy. During operation, the rotors rotate in opposing directions to support platform stability, and the blades' angles can be adjusted as needed. Exterior and interior surfaces exposed to seawater are coated with appropriate antifouling coatings to avoid permanent build-up of marine growth.

The main design parameters are listed in **Table 6,** though dimensions may change based on the site-specific characteristics of the proposed Project location. Cross sections and dimensions (in meters) of the Orbital O2-X are shown in **Figure 5** and **Figure 6.** A labeled diagram of the main internal systems is included in **Figure 7**, and an image of an Orbital O2 device in the water with legs raised is depicted in **Figure 8.**

For more design drawings please see Exhibit F. OPALCO acknowledges that FERC's regulations require Exhibit F drawings to be depicted in feet. However, the preliminary Exhibit F drawings currently available from Orbital Marine and included in this DLA are depicted in meters. OPALCO's final Exhibit F drawings to be submitted during or after the licensing process will include measurements in feet, as required by the Commission.

Table 6. Design Parameters of the Orbital O2-X

Summary of Device Characteristics	
The number of generating units including auxiliary units	One Orbital O2-X device that houses two rotor-powered generators (i.e., two turbines)
Type of each hydraulic turbine	Horizontal axis tidal turbines
Estimated minimum and maximum hydraulic capacity of the plant (flow through the plant) in cubic feet per second	127 cubic feet per second (cfs) to 65,584 cfs
Installed (Rated) Capacity	c. 2.4 MW (1.2 MW per turbine)
Average Annual Energy Production	2,100,000 kWh per turbine (4,200,000 kWh total)
Dependable Capacity	0
Displacement	1,000 tonnes (2,204,623 pounds [lbs.])

Summary of Device Characteristics	
Rated Current Speed	2.5 meters per second (m/s; 8.2 feet per second [ft/s])
Cut-In Current Speed	1 m/s (3.3 ft/s)
Shut Down Current Speed	5 m/s (16.4 ft/s)
Maximum Hull Length	85 m (279 ft)
Approximate Diameter of Hull Tube	4 m (13.1 ft)
Approx Depth to Uppermost Rotor Tip During Operation (Rotors Extended)	3 m (9.8 ft)
Approx Depth to Bottom of Rotor Tip (Deepest Point) During Operation (Rotors Extended)	33 m (108 ft)
Maximum Depth of Platform Below Waterline	2.4 m (7.9 ft)
Height of Hull Tube Exposed Above Water Surface	1.6 m (5.2 ft)
Rated Rotor Speed	9.2 revolutions per minute (rpm)
Maximum Rotor Speed	11.2 rpm
Maximum Rotor Diameter	30 m (98 ft) (each blade is 15 m [49 ft])
Maximum Rotor Swept Area	706 m^2 (7,600 ft^2) (x 2)

Notes: cfs = cubic feet per second; ft = feet; ft^2 = square feet; ft/s = feet per second; kWh = kilowatt hours; kWh = kilowatt hours; lbs. = pounds; m = meters; m^2 = square meters; m/s = meters per second; MW = megawatt; rpm = revolutions per minute

[1] A definitive average of annual energy production for this project has not yet been calculated, as the optimal rotor size and associated energy yield has not yet been determined.

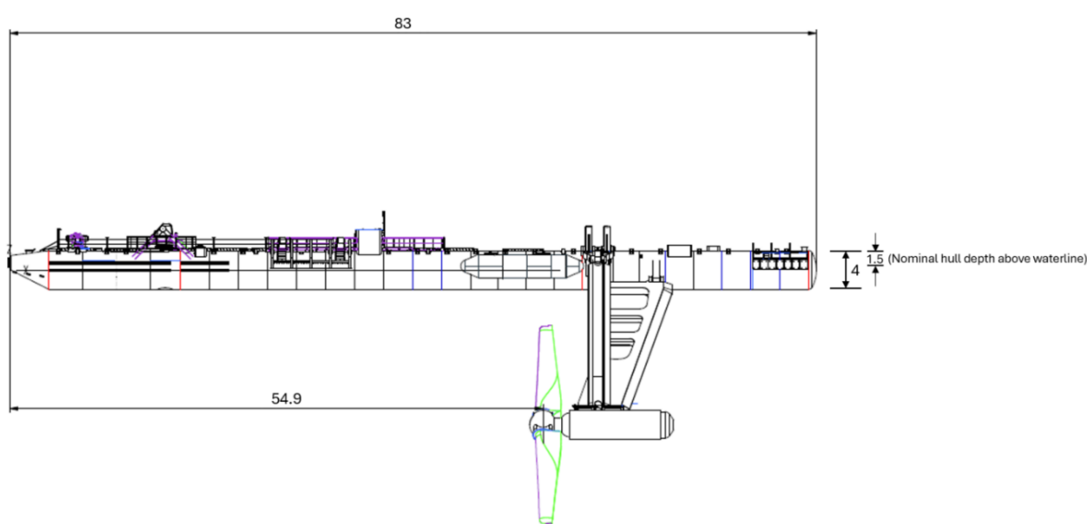

Figure 5. Orbital O2-X in Operation Mode (in meters)

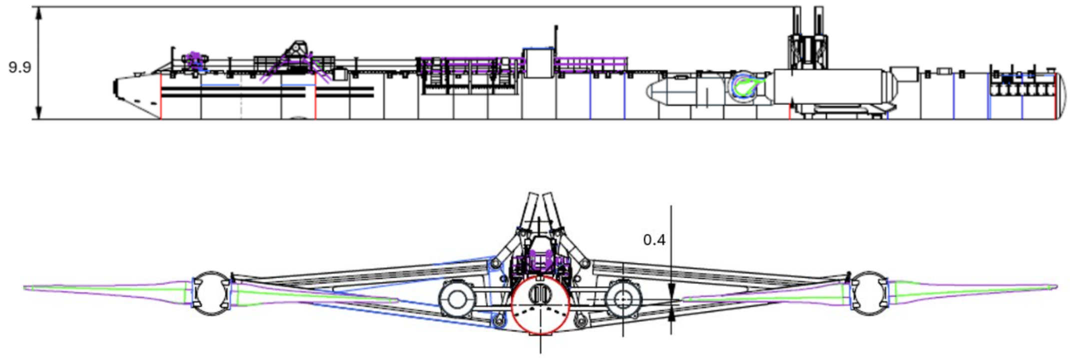

Figure 6. Orbital O2-X in Transport Mode (in meters)

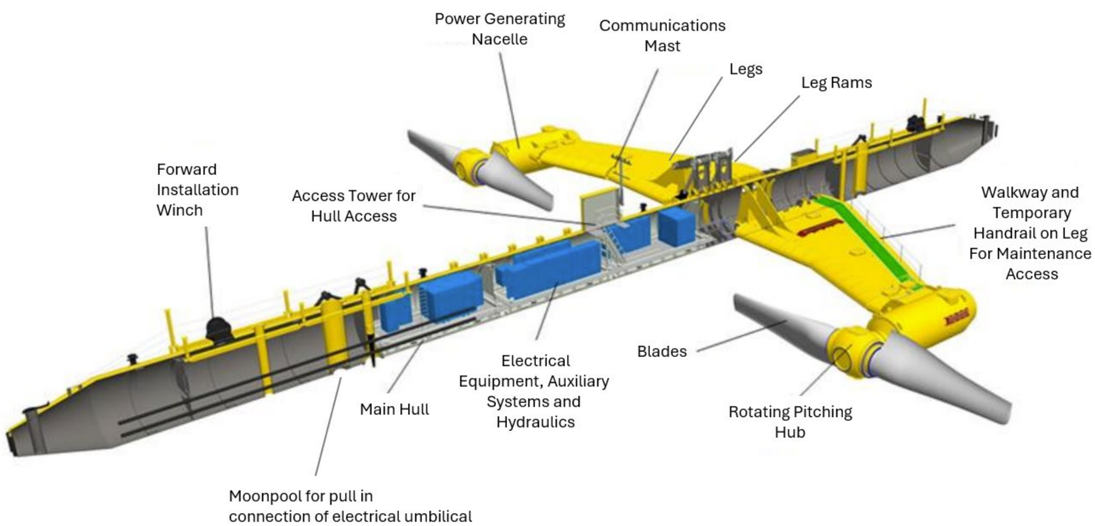

Figure 7. Main Internal Systems of Orbital O2-X

Figure 8. Orbital O2 Deployment in Orkney Islands, Scotland

2.3.1.2 *Mooring lines*

The mooring system for the Orbital O2-X would be comprised of four catenary mooring lines, which would be moored to the seabed via four separate anchors, designed in accordance with Offshore Standard DNV-OS-E301 (DNV 2013).

There would be a single-point mooring connection at the forward end of the hull that spreads out to four anchoring points (**Figure 9**). During each tidal cycle, the system would slowly pivot its position in a 360-degree manner, like a moored boat during a tide change (**Figure 10**). During the tidal changes, the turbines would not operate due to insufficient tidal current to turn the turbines.

Figure 9. Single-Point Mooring Location on Orbital O2-X Hull

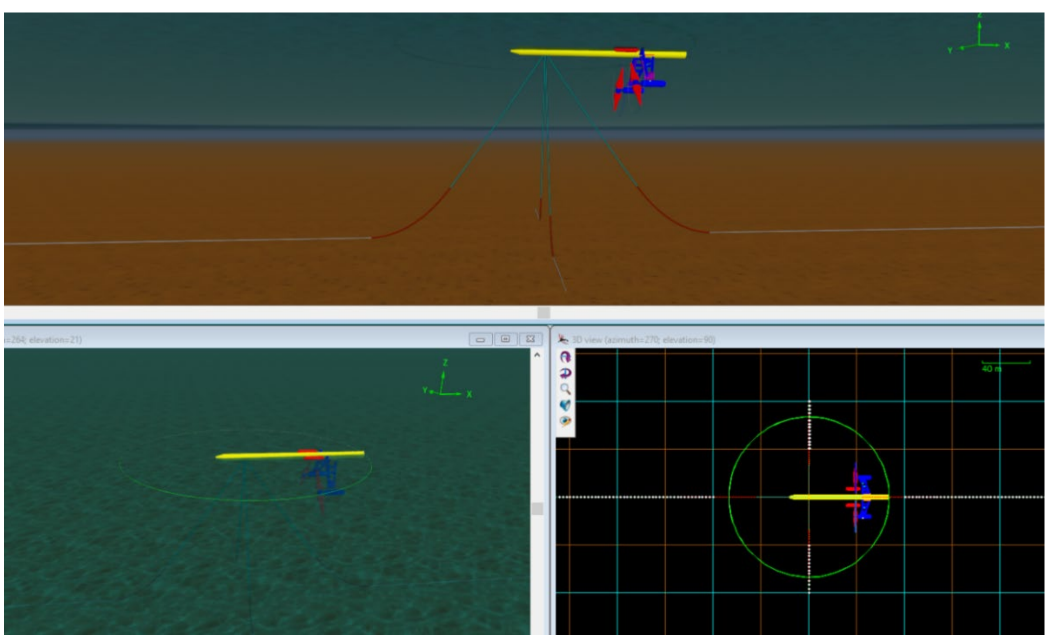

Figure 10. Mooring System and Pivot Radius

The mooring lines would be approximately 334 m (1,096 ft) in length. The maximum difference between high and low tide, or the tidal range, recorded at the Project area by the Applied Physics Laboratory, University of Washington (APL-UW), is 4 m (13.1 ft) (Appendix C2). During slack tide (the transition time between tides), a total length of approximately 246 m (807 ft) of each mooring line would be in contact with the seabed, which is represented by white dotted lines in **Figure 11** and **Figure 12**. The mooring lines remain slack when the Orbital O2-X rotates 180 degrees as the tide changes direction, and the entire mooring line spread covers a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft).

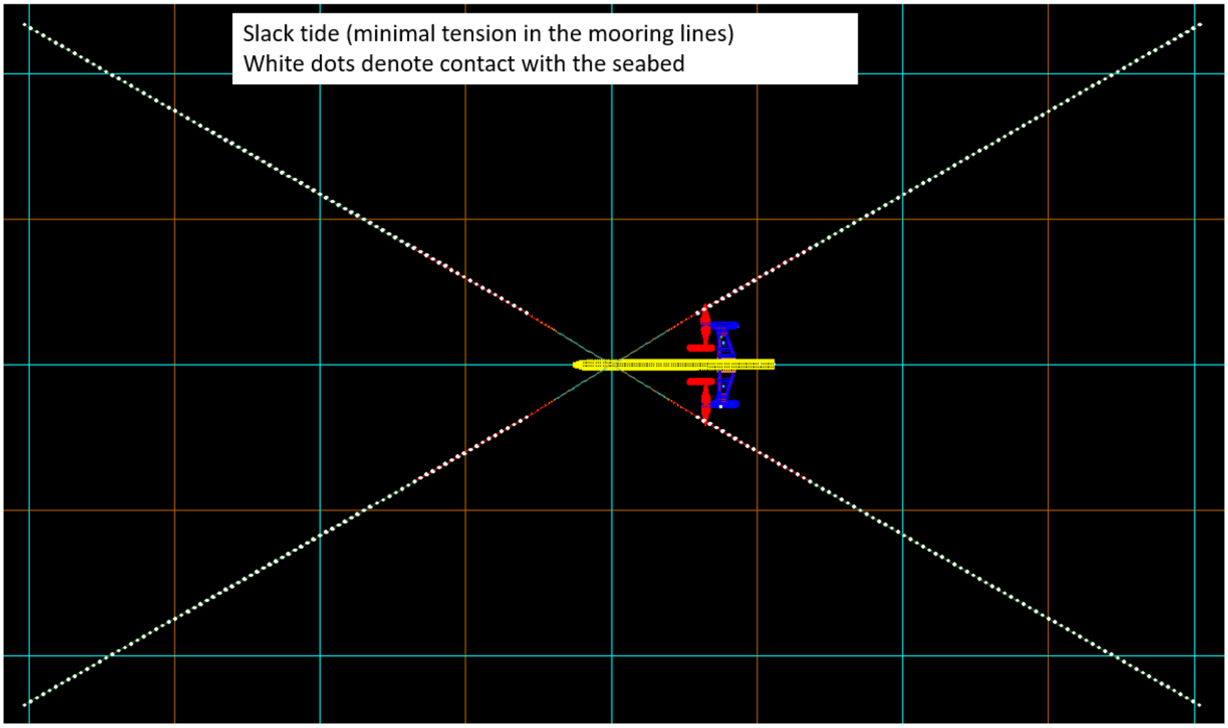

Figure 11. Mooring Lines at Slack Tide (above view)

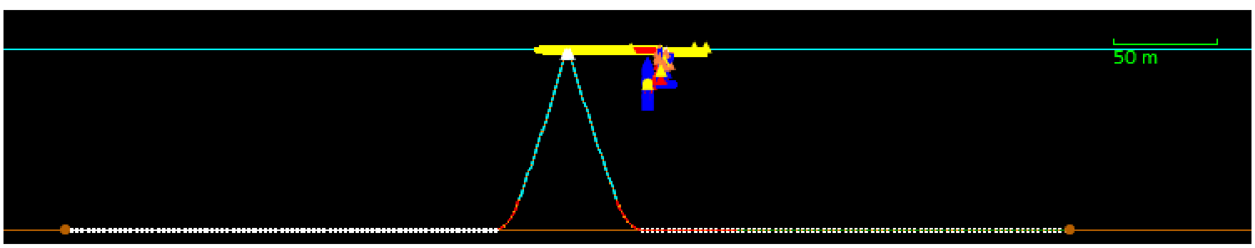

Figure 12. Mooring Lines at Slack Tide (side view)

When the mooring lines reach the position of rated power (when tidal currents are strong enough to turn the rotors), the mooring lines downstream of the Orbital O2-X would remain on the seabed while the mooring lines upstream of the Orbital O2-X would lift off the seabed (**Figure 13**). Even when the mooring lines are slack, less than 10 tonnes (22,046 pounds [lbs.]) of tension remains per line.

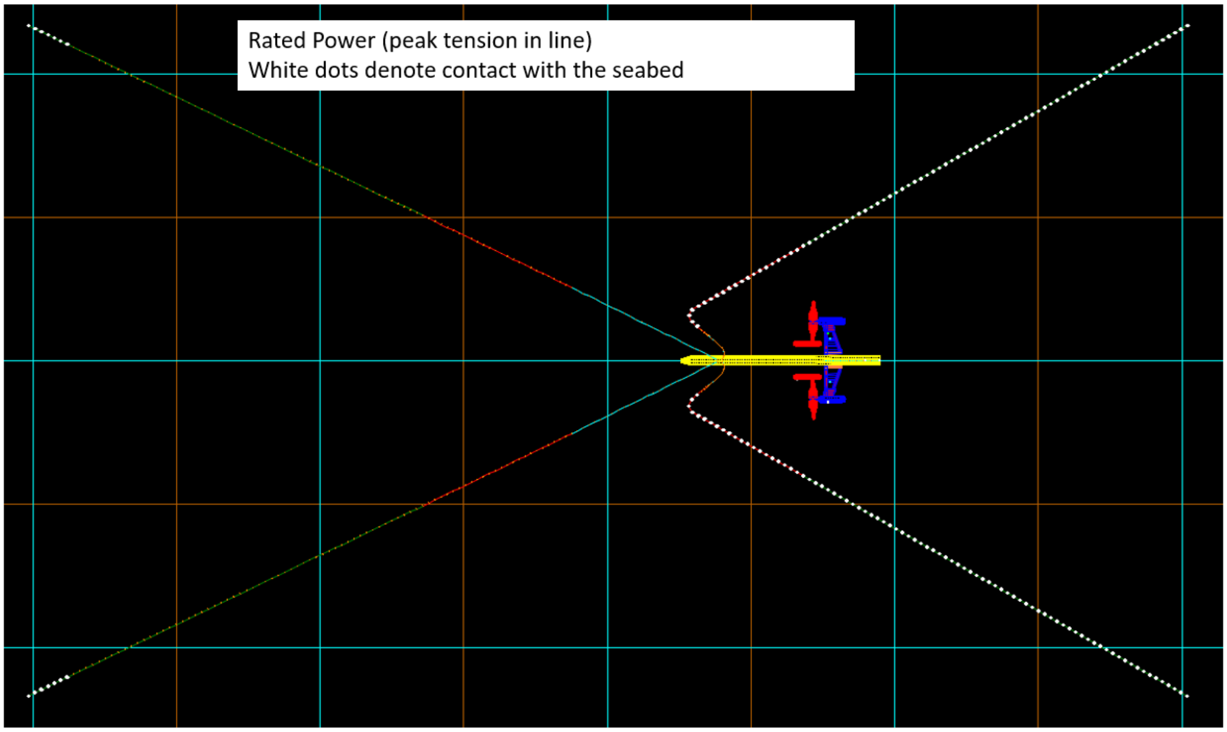

Figure 13. Mooring Lines at Rated Power

Previous deployments of the Orbital O2 exemplified that the mooring lines lift and are placed back down in approximately the same location amidst tidal cycles, showing a very narrow area of disturbance to the seabed. The width of the area where they are placed back down is less than 1 m (3 ft), so the total area of disturbance is approximately 246 m^2 (2,648 ft^2) per line, or 984 m^2 (10,592 ft^2) total for all four lines. There is one area along each mooring line where it is dragged over the seabed rather than lifted. This area is approximately 10 m^2 (108 ft^2) in size, totaling 40 m^2 (432 ft^2) across the four lines, that would be disturbed by mooring lines dragging on the seabed.

In the highly unlikely event that a mooring line failed, any single remaining mooring line can hold the entire system. The mooring spread would cover a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft). The mooring line system would consist of approximately 95 millimeter (mm) (3.7 inches [in.]) and 115 mm (4.5 in.) diameter studlink mooring chain. Synthetic or steel rope may be used in the lines as well but would be limited to the upper section of the mooring lines and would be jacketed polyester rope approximately 170 mm (6.7 in.) in diameter.

2.3.1.3 Anchors

Four gravity anchors or four drilled rock bolt anchors would likely be used to anchor the Orbital O2-X, subject to seabed conditions. Gravity anchors would be composed of a “steel basket” filled with ballast (**Figure 14**). The anchor baskets would be approximately 11 m x 11 m x 2.5 m (36 ft x 36 ft x 8.2 ft) and weigh approximately 35 tonnes (77,200 lbs.). The ballast would consist of scrap steel chain (7.6 cm [3 in.] in diameter), steel modules approximately 5.5 m x 5.2 m x 2 m (18 ft x 17 ft x 6.6 ft), or cast concrete blocks.

Rock bolt anchors are steel vertical piles that are drilled into the seabed to keep the Orbital O2-X in its designated location in the water. Rock bolt anchors can either be grouted in place in the seabed or mechanically locked in place to prevent pull out (**Figure 15**). In a mechanically locked system, the “cutting fingers” of the drilling bit are expanded within the bolt hole to secure the anchor in place.

Four rock bolt anchors are proposed, each likely 6.1 m (20 ft) in vertical length and up to 58.4 centimeter (cm) (23 in.) in diameter. Each would be drilled into the seabed with its head protruding from the seabed with a specialized mooring connector.

Each mooring point would have a single rock bolt. The exact sizing would be subject to seabed conditions analysis and detailed design.

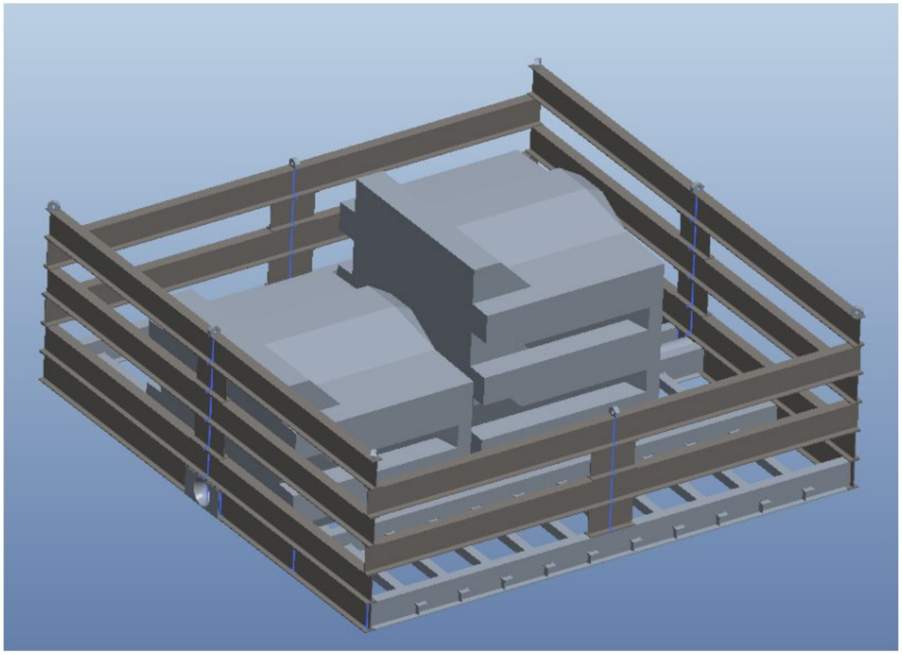

Figure 14. Anchor Basket with Ballast

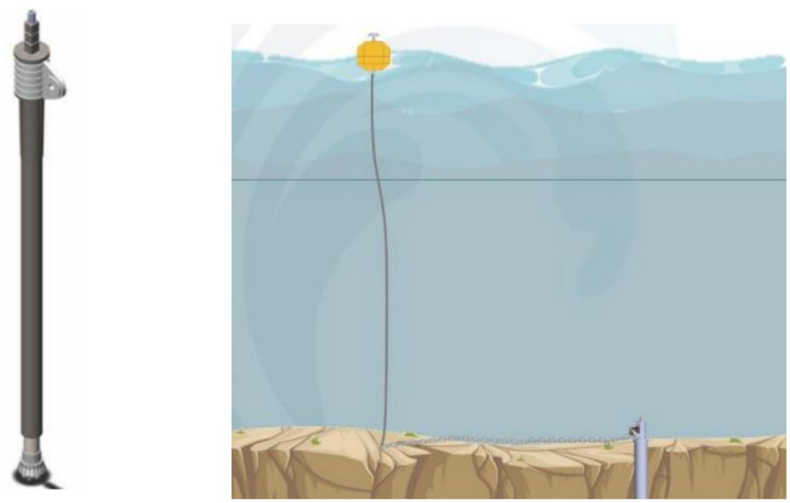

Figure 15. Example of a Rock Bolt Anchor

Mooring Connector

The mooring lines, attached to the anchors at the seabed, would terminate at a connector on the base of the Orbital O2-X (**Figure 9**). The connector has four places for mooring lines to attach, designed to allow the device to rotate 180 degrees with the changes of the tide, and has a full rotational range of 360 degrees.

During the Orbital O2-X installation and mooring line connection procedure, the connector would be situated on the seabed directly below the final proposed location for the Orbital O2-X device. There on the seabed, the four mooring lines would be attached to the connector. Once the anchors are installed and the mooring lines attached, the connector would be lifted via chain to its final position in a receptacle in the hull of the Orbital O2-X via a winch system on the Orbital O2-X platform. A hydraulic system would lock the connector in position within the hull.

If the Orbital O2-X needs to be removed, first the electrical connections would be disconnected, then the connector would be released from the hydraulic system on the Orbital O2-X hull, and finally the on-platform winch system would lower the connector to the seabed. This connector, its chain, and the mooring lines would have sufficient mass to remain in place on the seabed until they are either reconnected to the Orbital O2-X or recovered when the project components are removed.

When the Orbital O2-X reaches its destination orientation during peak tidal currents, it would excurse (i.e., leave or deviate from) its usual radius of its watch circle. As the tidal current speed increases from slack tide and the Orbital O2-X starts to generate power, it would slowly drift backwards from its watch circle radius by approximately 30 m (98 ft) over a period of 45 minutes to 1 hour. When the tidal current changes direction at slack tide, the Orbital O2-X would slowly turn with the tide, like a moored boat would, over a period of about 30 minutes. The Orbital O2-X would not generate power during this period, as the tidal speeds are too low to turn the rotors.

2.3.1.4 Subsea power cable

Power is exported from the Orbital O2-X via a dynamic cable from the Orbital O2-X device to the seabed where a new subsea cable would traverse approximately 5.3 km (3.3 miles) to export power ashore to the existing shoreline conduit, connecting the tidal system to OPALCO's microgrid.

The proposed Project would incorporate a new one-cross-linked polyethylene subsea power cable with a voltage of 12.5 kilovolts (kV). The cable would extend from the electrical port on the Orbital O2-X where it would travel down the umbilical portion of the cable (i.e., the portion that is vertical in the water column) to the seabed where it would traverse 5.3 km (3.3 miles) along the seabed and connect to OPALCO's electrical grid via an existing shoreline conduit at the south end of Blakely Island (**Figure 3**). The power cable would consist of multiple layers including conductor, insulation, and armoring. Depending on seabed survey results, the cable would be up to 17.8 cm (7 in.) in diameter and weigh up to 25 kilograms (kg) per m (kg/m) (16.8 lbs./ft) in water. A 2.3-m (7.5-ft) buffer area on either side of the cable would be reserved for placing the cable around sensitive habitat during deployment, if necessary.

The umbilical portion of the cable is 105 m (344 ft) long and reaches a depth of 87 m (285 ft) (**Figure 16**). Once installed, the umbilical would have a sweep area of approximately 314 m^2 (3,380 ft^2) (**Figure 17**), though the cable would only be in contact or drag along the seabed at this location during slack tide. During peak tide when the Orbital O2-X is at rated power, the umbilical is taught and lifts entirely off of the seabed (**Figure 18**). The remainder of the new subsea cable is expected to remain in the location it was laid on the seabed for the duration of the Project.

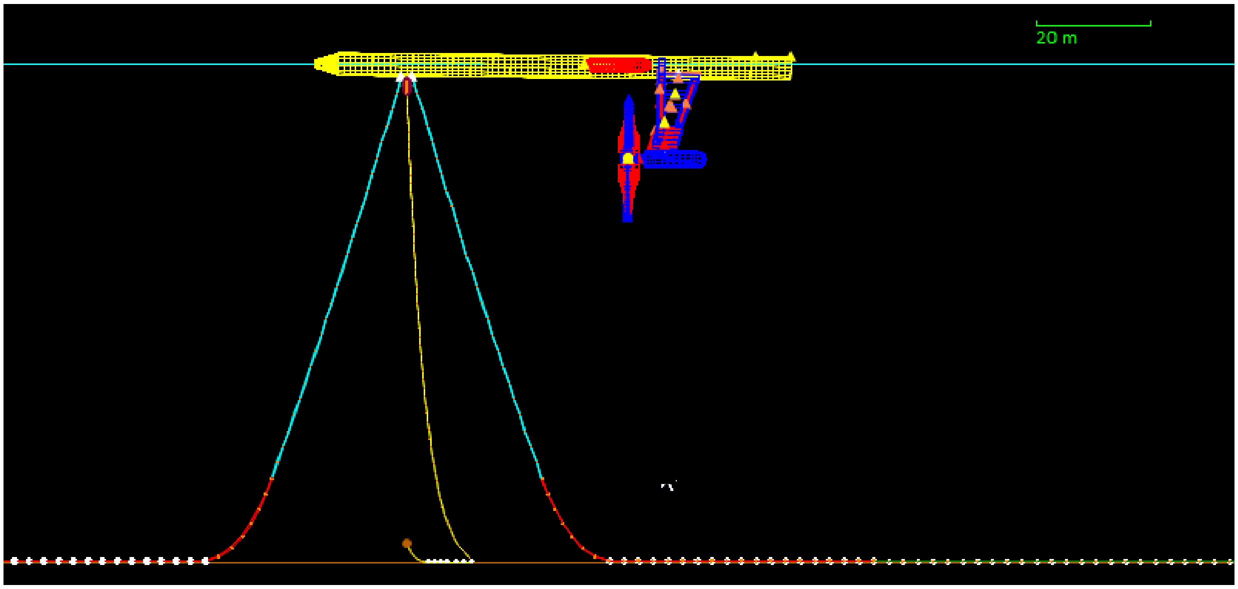

Figure 16. Umbilical Sweep Area During Slack Tide (side view)

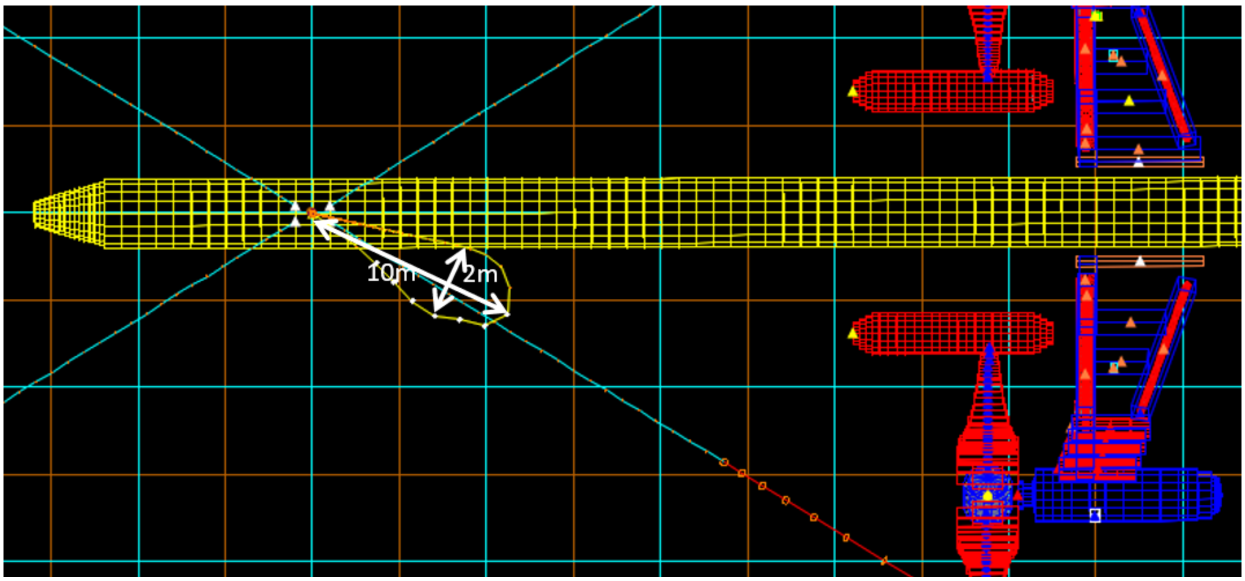

Figure 17. Umbilical Sweep Area During Slack Tide (above view)

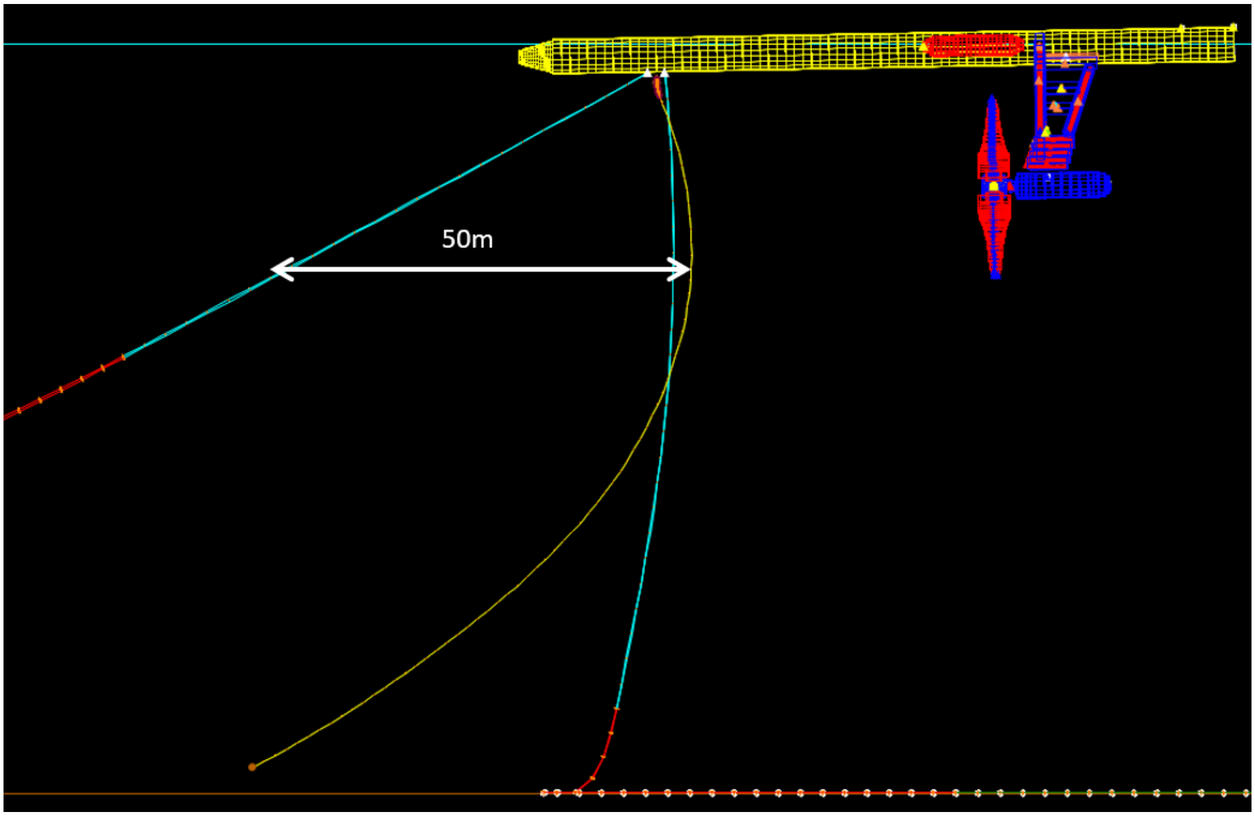

Figure 18. Umbilical During Peak Tide (side view)

2.3.2 Existing Infrastructure

The proposed Project would utilize the following existing infrastructure at Blakely Island:

- 45.7-centimeter (cm) (18 in.) diameter shoreline conduit off the south shore of Blakely Island.
- A land-based shoreline conduit facility on the southern end of Blakely Island.

The interconnection between the Orbital O2-X and OPALCO's microgrid would be via the existing 45.7 cm (18 in.) shoreline conduit off the south shore of Blakely Island, which was installed by OPALCO in 2004. The conduit is buried in the slope of Blakely Island with an opening on land near OPALCO's substation, and the other end emerging underwater offshore Blakely Island. The subsea cable would be threaded through the existing shoreline conduit so that energy generated by the Orbital O2-X would be transmitted from the Orbital O2-X to OPALCO's transmission system and the surrounding islands along existing power cables.

2.4 Project Installation

Project components and installation methods are described below. For all Project activities using vessels, trained onboard crew will visually monitor the area for protected species (see **Section 3.6**). An estimated schedule for the proposed Project is presented in **Table 7**. If a situation arises where emergency removal of all Project components is necessary, the removal process will take approximately 2-3 weeks (Appendix B4 and Appendix B7).

Table 7. Estimated Project Schedule

Activity	Location	Approximate Duration
Anchor Installation	Blakely Island	8 days (2 days per anchor)
Mooring Installation	Blakely Island	4 days (1 day per mooring line)
New Subsea Power Cable Installation	Blakely Island	1 week
Turbine Delivery from Anacortes to Blakely Island	Anacortes	1 day
Orbital O2-X Install on Moorings	Blakely Island	2 days (during slack periods)
First Grid Connection	Blakely Island	2 days
Commissioning	Blakely Island	12 weeks
Operation	Blakely Island	Up to 10 years
Decommissioning	Blakely Island	6 months
Removal	Blakely Island	2-3 weeks

2.4.1 Anchor Installation

Anchors to moor the Orbital O2-X would be composed of modular heavy ballast sections installed into single holding structures located on the seabed. The anchor and mooring installation would be conducted using a single standard multi-category (multi-cat) vessel or similar.

If rock bolt anchors are required, a submersible and remotely operated drill rig would be deployed from a multi-cat vessel or similar inshore construction vessel. The drill rig would embed the rock anchor in the seabed. The anchors would be positioned using a Global Navigation Satellite System, a heading sensor, and cameras installed on the drilling rig. After installation of each anchor, the drill rig would be recovered before the support vessel's position is changed, using a pre-laid arrangement of moorings.

2.4.2 Mooring Line Installation

There are four mooring lines. Each would take 1 day to install using a multi-cat vessel.

2.4.3 New Subsea Cable Installation

The new subsea cable would first be fed into the existing conduit off the south end of Blakely Island. Divers would uncover the conduit end offshore and attach the cable to a pully fed through the top end on shore. Then, the cable would be pulled through the existing conduit where it can be hooked up to the existing shoreline facility.

The cable would be spliced to the static cable on the seabed. A vessel platform, such as a multi-cat vessel, would be configured for cable laying and splicing operations. The new subsea cable would be laid on the surface of the seabed and create only minimal temporary disturbance via potential short-term turbidity in the water column upon impact with the seabed. After installation, the cable is expected to remain in place until it is removed during future Project decommissioning.

2.4.4 Orbital O2-X Installation

The Orbital O2-X would be installed in the proposed Project are during a neap tidal cycle (i.e., two slack periods). The Orbital O2-X would be put in the water in Anacortes and towed by vessel to the proposed Project area. Once locked into position by the mooring lines and anchors, the Orbital O2-X would pick up the power cable from the seabed using a winching system and install it in the hull where it would remain in place until the Orbital O2-X is removed from the proposed Project area. After commissioning, Project operation would begin, and the turbines would generate energy to transmit to the electrical grid.

2.4.5 Project Operation

During operation, the power conversion system applies loading torque to the generators based on the tidal flow and pitch angle. The blade pitch is adjusted to maximize power generation during low tidal flows and limit power during high tidal flows.

To support platform stability, the rotors rotate in opposing directions. The revolutions per minute (rpm) and tip speed of the rotors increase and decrease with the speed of the tidal currents, meaning the Orbital O2-X turbine generates power any time the tidal current speed is higher than the cut-in speed (0.5 meter per second [m/s] [1.6 feet per second (ft/s)]), or the minimum tidal current speed required to generate electricity. Under expected conditions in the deployment area in Rosario Strait, the turbine would operate most of the time, as the average cross-sectional tidal current speed in Rosario Strait is 0.88 m/s (Yang et al. 2021), with a maximum tidal current speed during spring tides of 3.14 m/s (10.30 ft/s).

Importantly, the mechanics of crossflow turbine design mean that essentially no suction or entrainment force is created during operations. Water is decelerated as it approaches the rotors. The turbine is designed to operate at a rated rotation speed of 9.2 rpm, with a maximum rotation speed of 11.2 rpm, which is relatively slow in comparison to ship and boat propellers that operate at higher velocities of 1,000 rpm. In lab-scale experiments, this effect is apparent at 1 to 2 diameters upstream, such that deceleration would begin 30 m to 60 m (98 ft to 197 ft) upstream of the rotors. During operation, the rotors would be halted or paused if a collision were to occur (with debris for example). A collision would be an extremely rare event. At the site of the Orbital O2 deployment in the Orkney Islands in Scotland, which has been in operation for more than 32 months, no collision with debris has been recorded.

For more information on Project operations, see the Project and Facilities Operations Monitoring Plan (Appendix B1).

2.4.6 Project Maintenance

The Orbital O2-X components, including the platform, rotors, and mooring systems, are designed for low-cost maintenance with easy access for annual servicing requirements. The leg structures can be raised to bring the legs, nacelles, and rotors to the surface for servicing. Typical operation and maintenance for the Orbital O2-X is outlined in **Table 8**.

As a floating device, scheduled and unscheduled maintenance operations on electrical, control, and hydraulic systems can be carried out onboard the device by transferring personnel from a small vessel onto the hull of the Orbital O2-X. Throughout deployment, regular maintenance would be performed to maintain structural integrity and high uptime for maximum power generation.

Regular maintenance would be conducted using a variety of survey systems such as side scan and multibeam sonar, drop-down camera, and inspections of biofouling coatings to ensure they remain intact. Sensors would also be integrated with the main control system to provide feedback from several parts of the system.

For more significant maintenance operations or when weather conditions preclude a personnel transfer, the Orbital O2-X can be disconnected from its mooring and towed to a maintenance location. Once disconnected from its mooring and the rotor legs are retracted, the low transport draught of the turbine allows the use of local shallow bays/pontoon facilities for maintenance.

As part of the control system, certain parameters would be monitored solely for the safe and reliable operation of the Orbital O2-X, including:

- Hydraulic pressure, temperature, and reservoir levels.
- Cooling water temperature.
- Equipment space temperature/humidity.
- Generator temperature.
- Generator voltage and current.
- Bilge level alarms.

Additional details about project maintenance activities can be found in the Project and Public Safety Plan (Appendix 5).

Table 8. Frequency of Operational Maintenance Service Tasks

Maintenance Type	Frequency	Effort
Mooring Survey	Periodically	• Checking the integrity and conditions of the moorings and anchors.
Orbital O2-X Inspection at Site	12 months	• Cleaning with high-pressure water/steam cleaner. • Inspect corrosion protection. • Visual inspection of all rotors, blades, etc. • Check lube oil level, magnetic plugs, take samples. • New lube oil filling.
Orbital O2-X Overhaul	5–8 years	• Inspection and exchange of worn parts. • Test runs after assembly. • Refurbishment of corrosion protection system.
Platform Inspection	12 months	• Checking and cleaning the platform hull and structures. • Repairs and replacement carried out as required.
Electrical Inspection at Site	6 months	• Check the ventilation system/changing ventilator mats. • Inspect critical electronics installations. • Inspection for corrosion. • Optical inspection.
Major Inspection	5 years	• Inverter inspection and maintenance.
Automatic Condition Monitoring System	Continuous	• Automatic data recording. • Frequent reports.

Maintenance Type	Frequency	Effort
(i.e., Mechanical monitoring and early fault detection)		• Alarm if defined threshold values are exceeded.

2.4.7 Project Removal

Protocols for Project removal due to the end of the license term or an emergency would be developed prior to commencement of the Project and included in the Project Removal, Site Restoration, and Financial Assurance Plan (Appendix B4) and the Emergency Shutdown Plan (Appendix B7), and the entire decommissioning process is expected to take up to six months. At the end of the Project, all components, including but not limited to the mooring lines, anchors, and subsea cables, would be removed in accordance with the requirements of the applicable federal and state agencies, and the specific requirements determined through the relevant permitting processes. A summary of the Project removal process is shown in **Table 9.**

Post-decommissioning seabed surveys would be undertaken to ensure that all equipment has been removed from the site. The post-decommissioning survey would also record any potential impacts on the seabed at the anchoring points and along the mooring lines where there has been contact with the seabed. Currently, all evidence indicates that given the nature of the seabed and proposed non-invasive works, no restoration work would be required.

Table 9. Summary of Project Removal Process

Activity Type	Effort
Pre-removal	• Complete environmental effects analysis of occupational health and safety.
Removal of Project Components	• Remove the electrical connection of the platform. • Tow Orbital O2-X off-site and store at an appropriate harbor or sheltered bay location.
Removal of Platform	• Remove the mooring shackles to the seabed and the navigation/pick-up buoys attached to enable recovery. • Recover gravity anchor cages and ballasts, including mooring lines. • If rock bolt anchors are used instead, the mooring lines would be removed and the anchors left on the seabed (unless removal is required by FERC). • Recycle, reuse, or dispose of old parts.
Post-removal	• Complete post-decommissioning seabed surveys. • Complete restoration work to the seabed, if necessary.

2.5 Alternatives to the Action

2.5.1 No-action Alternative

Under the no-action alternative, all proposed Project activities would not be constructed. San Juan County is at risk of unreliable electricity, as the vast majority of OPALCO's power is transmitted using subsea cables connected to the grid on mainland Washington State. When service is disrupted on the mainland, San Juan County can be subjected to long wait times as repairs are beyond their control. Therefore, if the proposed Project were not to occur, OPALCO would not be able to test the feasibility of tidal power as a local energy generation resource that could strengthen the resilience of infrastructure and increase safety and reliability for its service area. The no-action alternative would mean that the installation of the Orbital O2-X in Rosario Strait would not occur and OPALCO would continue to rely on mainland Washington State for electricity.

Additionally, data from this proposed Project would be used to inform future tidal power projects in the U.S. If this proposed Project were not to occur, the U.S. may not have the same opportunity to position itself as a renewable energy leader. This no-action alternative is not evaluated further in the DLA.

2.5.2 Alternatives Considered but Eliminated

2.5.2.1 Alternative Location

In 2021, PNNL created a report with support from the DOE Waterpower Technologies Office through the TEAMER program that analyzed two potential locations in the U.S. for Orbital O2-X deployment: San Juan Islands, Washington and Western Passage, Maine (Copping et al. 2021). After an in-depth analysis of bathymetry, tidal resources, protected and sensitive marine animals and habitats, seabird habitat, environmental data, and environmental effects, it was determined that Rosario Strait in Washington State is a better potential site. The Western Passage, Maine location was eliminated from consideration.

3. Affected Environment

3.1 Geology and Soils

The Salish Sea is a section of a larger geological province of the Puget Lowland Formation, located between the Cascade and Olympic Mountain ranges. The region is in the fore-arc basin between the Juan de Fuca tectonic plate subduction zone and the Cascade mountain range volcanoes (**Figure 19**).

The area was carved out by massive glaciers that extended south past Olympia, Washington, covering the landscape in ice thousands of feet thick (Shipman 2008). Poorly sorted glacial sediments were deposited over the past 2 million years by several glacial events, forming the main landscape. This was subsequently eroded by the Vashon Glaciation circa 15,000–12,000 years ago, which shaped the deep troughs throughout the Salish Sea and Puget Sound as they exist today (Shipman 2008). Glacial scouring of the area resulted in the development of deep basins separated by sills of variable depth, which confine water to the individual basins (Banas et al. 1999). The most abundant and widespread geologic units found today in the Puget Lowland are the unconsolidated deposits of sediments that were left by the glaciers as they receded (**Figure 20**).

Since the Vashon Glaciation, the major rivers in the area have further altered the landscape by carrying sediments from the mountains into Puget Sound, and through deposition, forming alluvial valleys and deltas. The sediments in this basin are poorly sorted, mainly mud and clay, with some sand and shell debris.

The San Juan Islands consist of an archipelago in the northern Puget Lowland and are composed of metamorphic rocks that were accreted onto North America 160 million years ago. The islands represent the highest points of a submerged mountainous area that extends across the Puget Lowland from the mainland to Vancouver Island, BC. Channels between the islands attain depths of 200 m (656 ft) and in some places exceed 300 m (984 ft) (Easterbrook 2015).

Blakely Island is 17.9 km^2 (6.9 square miles [$miles^2$]) in area and is highest in elevation at Blakely Dome at 323 m (1,060 ft), the northeast region of the island (NPS 2006). There is an additional mountain, Bald Bluff, on the west side of the island that has an elevation of 268 m (880 ft) (NPS 2006). Glacial sediment remains at the southern end of the island, but the land is generally rocky with steep shorelines (NPS 2006). Some of the steepest shorelines are situated on the east side of the island near the proposed Project area where the shore rises 238 m (780 ft), and the southern end of the island consists of a smaller hill with an elevation of 79 m (260 ft) (NPS 2006).

The shorelines adjacent to the proposed Project area are composed of bedrock (**Figure 21**) and therefore has limited to no littoral drift or accretion potential (i.e., little potential for changes to the local beach sedimentation) (**Figure 22**). According to Ecology, slope failure along the east shore of Blakely Island is an intermediate risk (Ecology 2023a; **Figure 23**). See **Section 3.2.3** for more information about the slope and sediment of the seafloor.

Methane gas plumes occur along three major faults in the seafloor of the Puget Sound estuary. The methane from these bubble plumes is mixed throughout the estuary by tides and local currents (Johnson et al. 2021). Single-beam sonar was used to collect data in 2011, 2018, 2019, 2020, and 2021, and the acoustic signature of 349 individual bubble plumes was mapped (Johnson et al. 2021). There are no major faults located in or near to the Project area that would impact, or be impacted by, the proposed Project. and there is no oil and gas production in Washington State (Johnson et al. 2021).

Studies indicate that the chemical characteristics of marine sediments around the San Juan Islands are generally of high quality (Long et al. 2008; Partridge et al. 2014). The majority of samples studied contained background levels of trace metals, including copper, lead, zinc, cadmium, and mercury (Long et al. 2008; Partridge et al. 2014). Results from the study conducted by Partridge et al. (2014) indicate that the concentrations of chromium and certain polycyclic aromatic hydrocarbons (PAHs) did not increase significantly over the study period from 2003 to 2012, and overall sediment quality remained high in 2012. No chemical concentrations in the samples exceeded Washington State thresholds. Concentrations of these chemicals in the substrate of the proposed Project area are currently unknown; however, they are expected to be similar in quality to the sediments around the San Juan Islands archipelago.

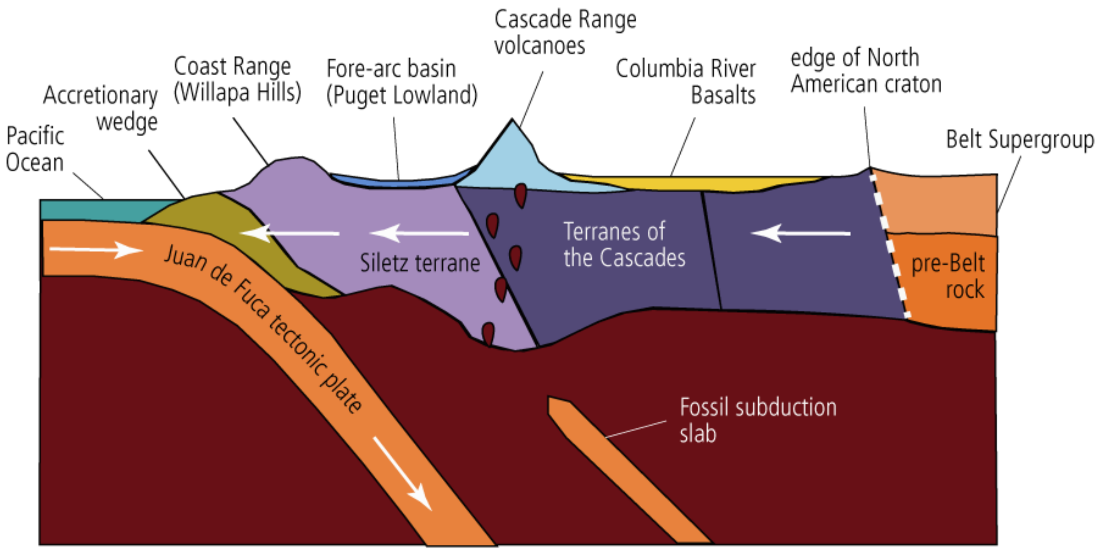

Figure 19. Puget Lowland Location in the Fore-arc Basin, Cascadia Subduction Zone
Source: DNR 2024a

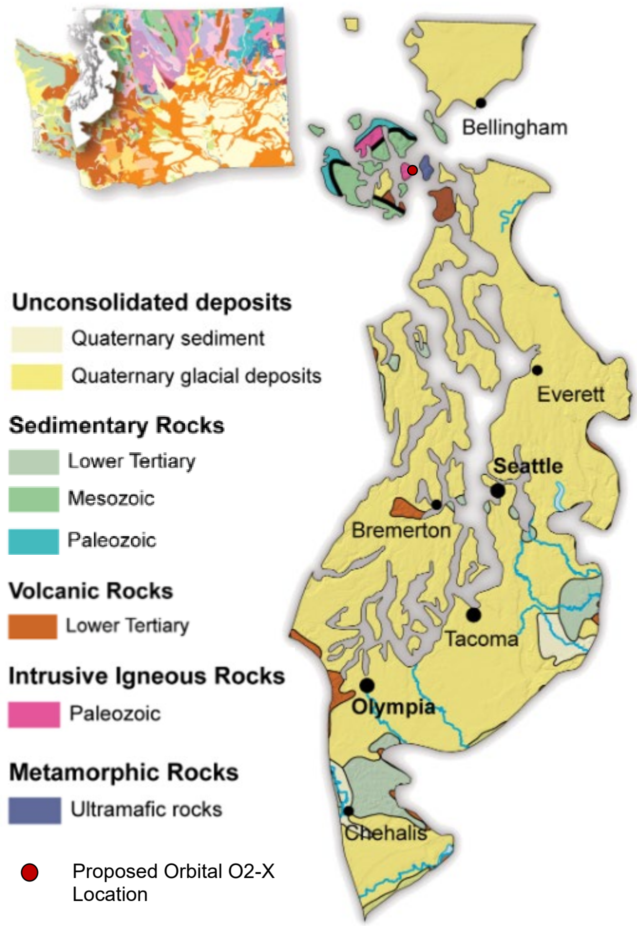

Figure 20. Rock Types in the Puget Lowland
Source: DNR 2024b

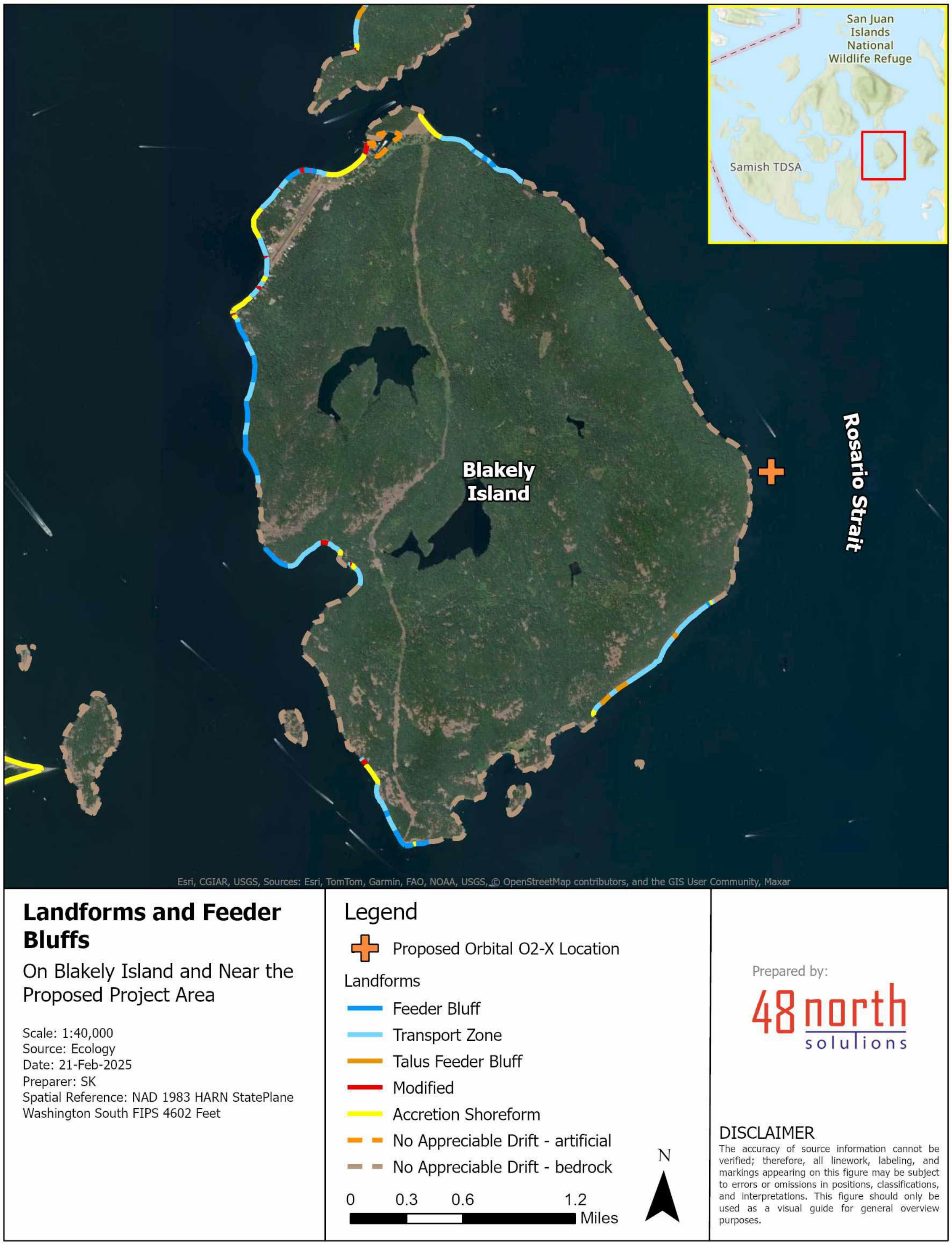

Figure 21. Landforms and Feeder Bluffs on Blakely Island

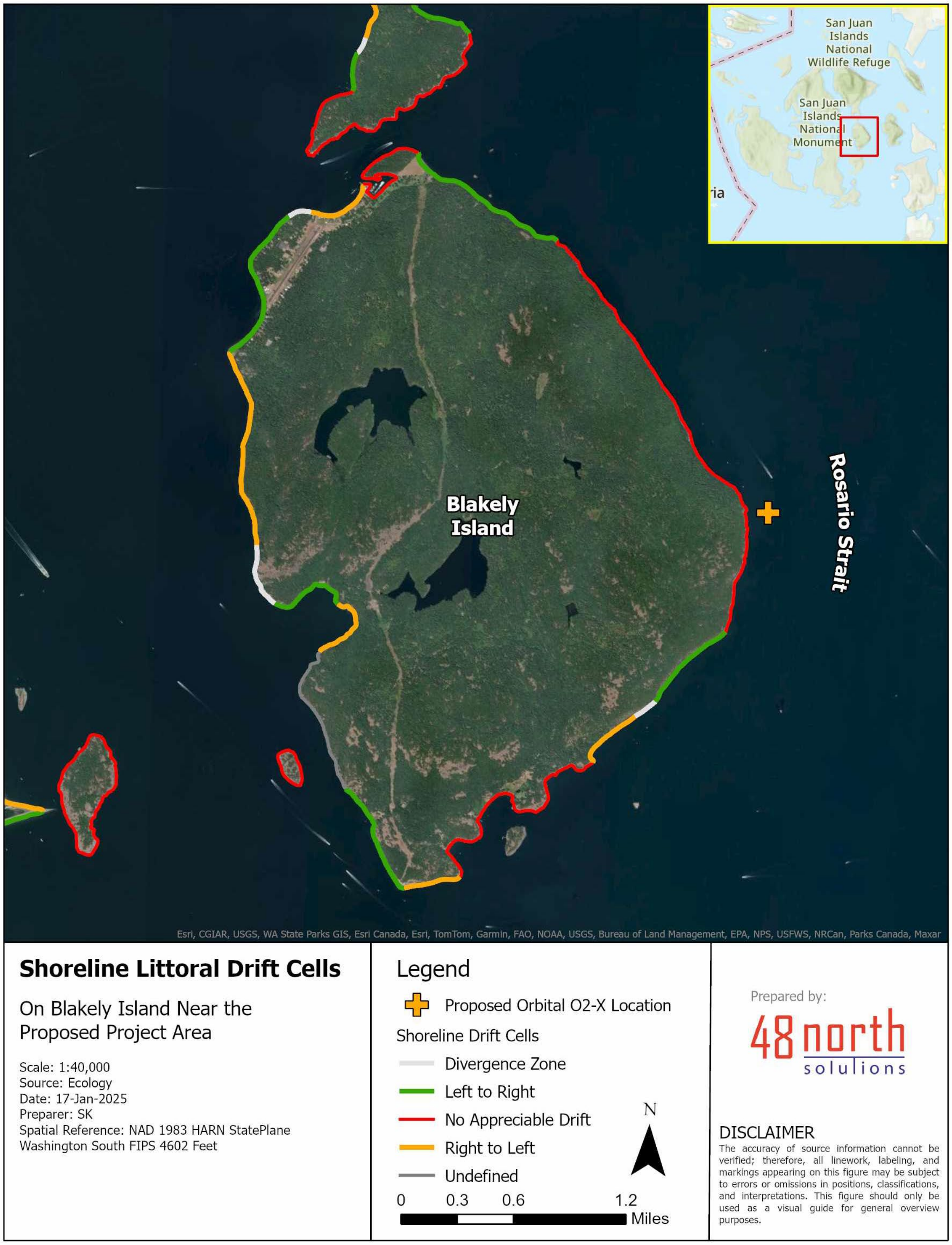

Figure 22. Shoreline Drift Cells on Blakely Island

Figure 23. Slope Stability and Topography on Blakely Island

3.1.1 Geologic Hazards

Due to its location on the Ring of Fire, a major area of the Pacific Ocean basin characterized by numerous volcanoes, Washington State can experience varying intensities of geologic hazards such as landslides, earthquakes, tsunamis, and volcanic activity that could have varying impacts on the proposed Project area.

3.1.1.1 Landslides

Washington State is one of the most landslide-prone states due to the mountainous regions of the Cascades, Olympics, and surrounding foothills, but the San Juan Islands themselves are at low risk for landslides (WEMD and Washington Military Department 2023). No evidence of submarine landslides was observed in the bathymetric data collected by Tetra Tech, Inc. in October 2024 in support of this Project (Appendix C1), but landslides are possible along the steep, sedimented edges of Blakely Island.

3.1.1.2 Faults and Earthquakes

There are hundreds of active faults in and within the vicinity of Washington State, the largest being the Cascadia Subduction Zone (CSZ) in the Pacific Ocean. Small earthquakes occur in Washington State daily, but large ones from the CSZ occur about once every 247 years (**Figure 24**; WEMD and Washington Military Department 2023). Since the 1870s, 27 moderate earthquakes of magnitude 5 or higher on the Richter scale have occurred (WEMD and Washington Military Department 2023). Active faults are more likely to cause earthquakes; while there are no active faults within the San Juan Islands, there are many surrounding them (WEMD and Washington Military Department 2023). The DNR rates the San Juan Islands with a medium level Shaking Hazard risk (DNR 2024c).

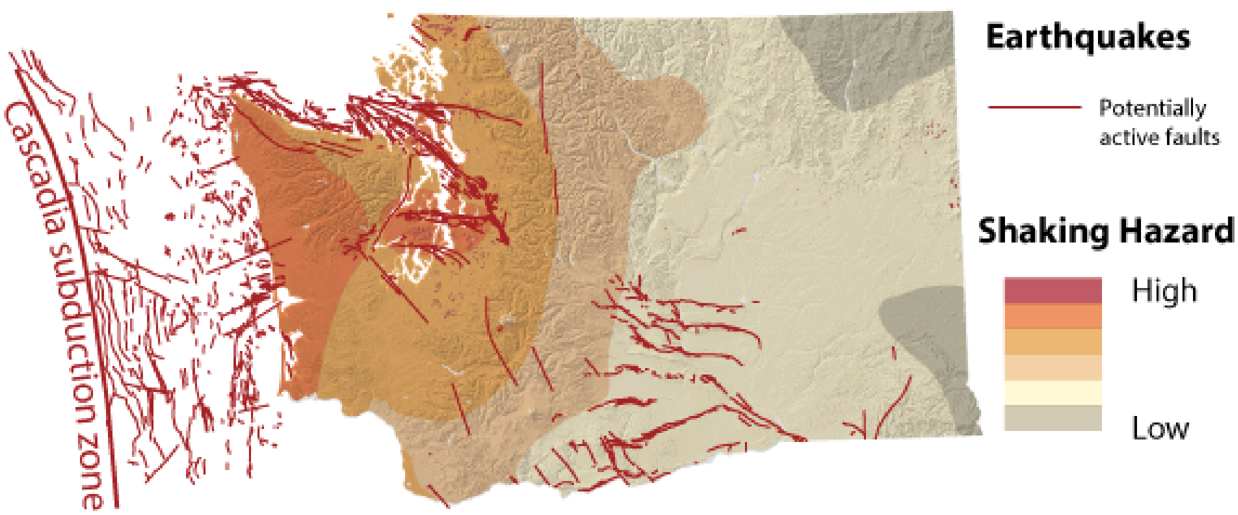

Figure 24. Earthquake Hazard Potential in Washington State
Source: DNR 2024c

In 2012 and 2013, DNR analyzed 20 earthquake scenarios in Washington State with a variety of intensities and epicenter locations (Washington Geological Survey 2017). Of those 20 scenarios, eight were projected to impact the San Juan Islands, including: (1) the Boulder Creek fault zone, (2) CSZ, (3) north CSZ, (4) Darrington-Devils Mountain fault zone, (5) Darrington-Devils Mountain fault zone west, (6) Lake Creek-Boundary Creek fault zone, (7) the Seattle fault, and (8) the south Whidbey Island fault scenarios (Washington Geological Survey 2017). The expected impacts of seismic activity include liquefaction, landslides, tsunamis, aftershocks, property damage, and the loss of lives (DNR 2013).

Figure 25 displays all known faults near the San Juan Islands, with black lines representing faults that have no evidence of being active within the Quaternary (Czajkowski and Bowman 2014). There are no active faults within the center of the San Juan Islands; however, there are active faults on the periphery of the Islands, including many faults that last ruptured during the Holocene (red), the latest Pleistocene (orange), during the mid to late Pleistocene (blue), during the Pleistocene (purple), and class B faults (green) (Czajkowski and Bowman 2014).

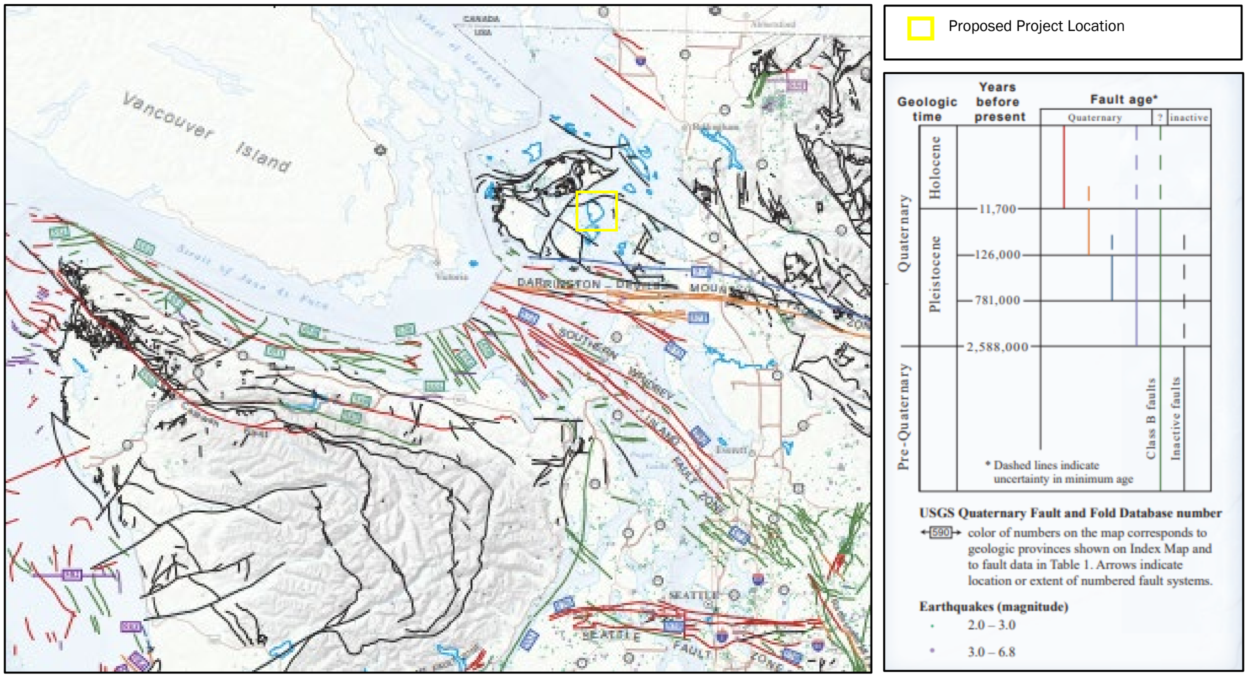

Figure 25. Faults and Earthquakes in Washington State
Source: Czajkowski and Bowman 2014

3.1.1.3 Tsunamis

Due to the large amount of earthquake activity in Washington State and its proximity to the Pacific Ocean, tsunamis could occur in the proposed Project area. The CSZ earthquake and resulting tsunami is predicted to have a 10 to 14 percent chance of occurrence by 2050 (Peterson et al. 2002).

According to 2020 research by the NOAA Pacific Marine Environmental Laboratory, a modeled 9.0 magnitude earthquake on the CSZ would create a tsunami that would take more than 1.25 hours to reach the San Juan Islands (Arcas et al. 2020). The maximum amplitude of the modeled tsunami occurred at Eastsound on Orcas Island at 4.91 m (16.1 ft), and the maximum current speed does not occur until the third wave at 40 centimeters per second (cm/s) (1.3 ft/s) (**Figure 26**; **Figure 27**; Arcas et al. 2020). According to **Figure 26** and **Figure 27**, the modeled amplitude near the proposed Project area is estimated to be between 3.2 and 4.2 m (10.5 to 13.8 ft), and the maximum wave current is estimated to be between 2.0 and 4.0 m/s (6.6 to 13.1 ft/s). Although this model gives estimates of what could be expected during a 9.0 magnitude earthquake on the CSZ, it did not include the impact of tides, sea level rise, or the possible locations of eddies that may form in the channels during a tsunami of this scale (Arcas et al. 2020).

Models of coastal inundation during the CSZ tsunami show that the most inundation to occur on Blakely Island would be on the northwest tip of the island (Arcas et al. 2020).

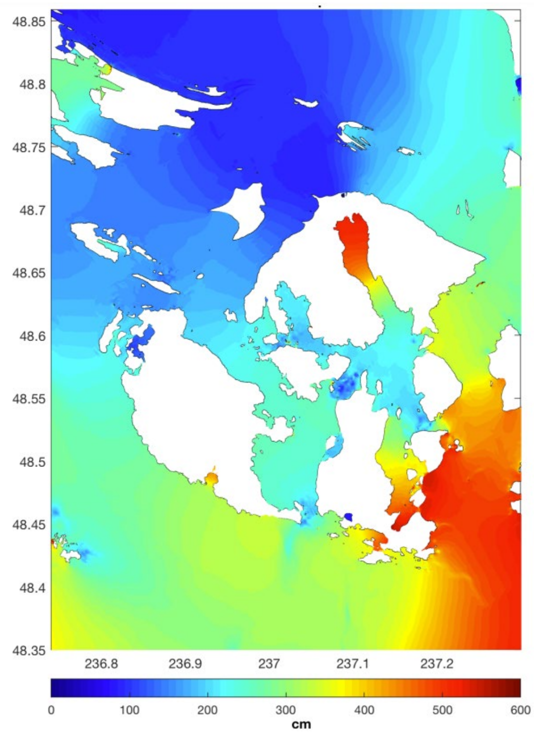

Figure 26. Maximum Modeled Tsunami Wave Amplitude Distribution for the San Juan Islands
Source: Arcas et al. 2020

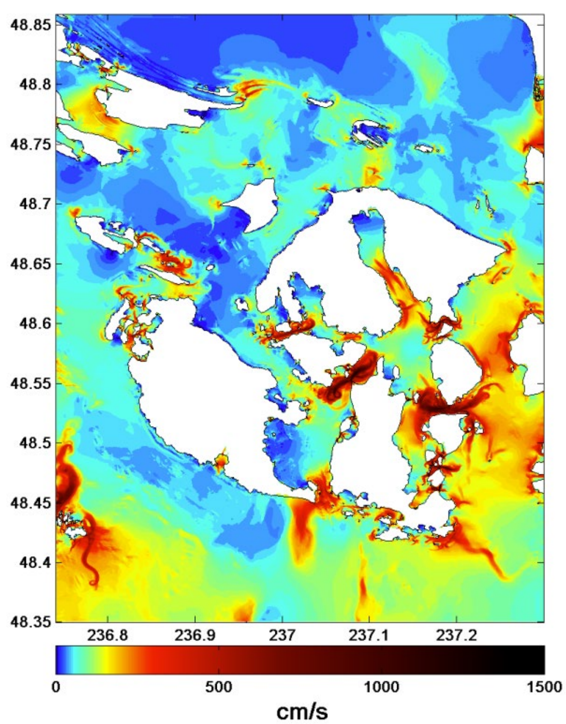

Figure 27. Maximum Modeled Tsunami Wave Current Distribution
Source: Arcas et al. 2020

3.1.1.4 Volcanic Activity

In Western Washington, there are five active volcanoes: Mount Adams, Mount Baker, Glacier Peak, Mount Rainier, and Mount St. Helens. They are associated with seismic activity that occurs in the region. Mount St. Helens was the most recent to erupt in 1980, destroying more than 200 homes and killing 57 people (WEMD and Washington Military Department 2023).

With the San Juan Islands being located offshore, the lahar flows (mudflows) from the nearest possible eruptions of Mount Baker or Glacier Peak would not reach them, and the main immediate impact of an eruption would likely be from suspended ash and earthquakes (**Figure 28**). However, the San Juan Islands receive most of their electricity from mainland Washington State via subsea cables, so if power sources or lines are damaged during an eruption event, the Islands could temporarily lose power access.

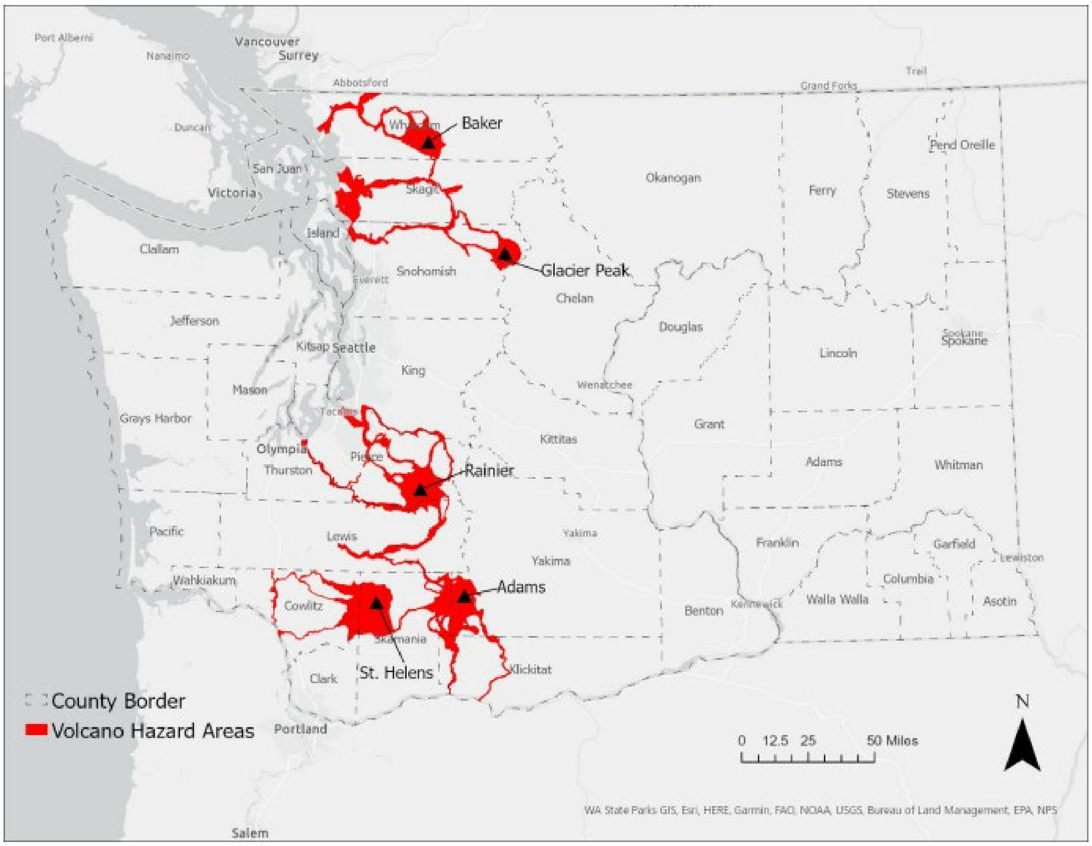

Figure 28. Volcanic Hazard Areas for Washington State including Lava, Rock Falls, and Lahar Zones
Source: WEMD and Washington Military Department 2023

3.2 Water Resources

Information in this section was obtained through and combination of desktop research and additional Project location-specific water resource data collected during a site survey and characterization study conducted by the APL-UW between October 2024 and January 2025 (103 days) (Appendix C2). To make a full-depth profile of water resources in the area, APL-UW deployed the following (water depth of 80 to 95 m [262 to 311 ft]): (1) a Nortek Signature 250 kilohertz (kHz) Acoustic Doppler Current Profiler (ADCP) attached to a fiberglass tripod (i.e., Sea Spider; SS) on the seafloor; (2) a Stablemoor mooring (STBM) with a pair of down-looking and up-looking Nortek Signature 500 kHz ADCPs; and (3) a surface buoy (SB) to support an additional down-looking ADCP

(Nortek Aquadopp 1 megahertz [MHz]) (**Figure 29**). All work was completed by APL-UW from the Research Vessel (R/V) Jack Robertson, which is owned and operated by APL-UW.

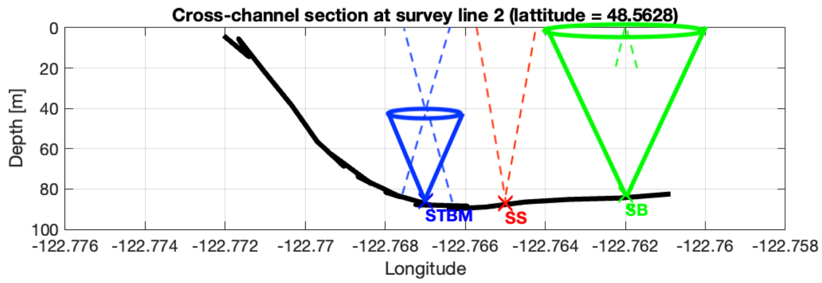

Figure 29. Side View of the Stationary Platforms Including Watch Circles and ADCP Beam Cones

3.2.1 Waves

Swells from the Pacific Coast must travel far to reach the shores throughout the Salish Sea. While sizable waves can enter the Salish Sea from the Strait of Juan de Fuca, wave energy is significantly diminished before reaching the San Juan Islands and surrounding channels.

Within the eastern portion of the Strait the Juan de Fuca, wave heights can be 1.5 m (4.9 ft), and up to 2.7 m (8.9 ft) (Thomson 1981). Rips occur off prominent points and are especially heavy at the approaches to Haro Strait and Rosario Strait (Thomson 1981). Research has also indicated that significant wave height (i.e., the mean wave height of the highest third of waves) in the region would not exceed approximately 2 m (6.6 ft) due to fetch limitations (i.e., length of water a given wind can blow without obstruction) (Gemmrich and Pawlowicz 2020).

STBM surface wave data was collected by APL-UW (Appendix C2). Due to the limited fetch distances for wave generation and the minimal propagation of swell to the protected site, the waves at the Project area are small in height and short in period, compared to open ocean conditions. **Figure 30** shows the time series of surface wave heights (H_s, in m) and peak wave periods (T_p, in seconds [s]). The wave activity in the Project area is irregular, since the waves are generated by local wind and weather patterns. From October 2024 to January 2025, the largest waves observed were H_s = 1.8 m (5.9 ft) on December 14, 2024, during a historic storm with significant regional impact (i.e., an extreme event). This maximum observed wave height (1.8 m [5.9 ft]) can be considered a global maximum for all months of the year, though the summer months are expected to have far less wave activity. The wave minimum in any month is nominally zero. Note that there is a known data gap due to file corruption from November 21-29, November 2024.

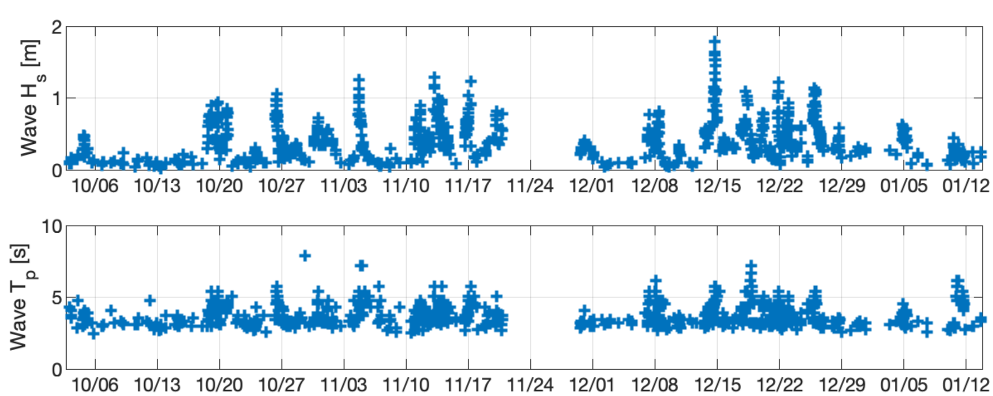

Figure 30. Time Series of Surface Wave Height (H_s, [m]) and Peak Period (T_p, [s]) Measured from STBM

Figure 31 shows a joint histogram of surface wave heights (H_S) and peak periods (T_p). The correlation of H_s, T_p is expected based on both fetch-limited wave evolution (Dobson et al. 1989; Thomson and Rogers 2014) and the steepness limitation of deep-water waves (Schwendeman et al. 2014; Schwendeman and Thomson 2015). The scare observations of small H_S and longer T_p may be small amounts of swell energy refracting to the Project area, but the effect is minimal.

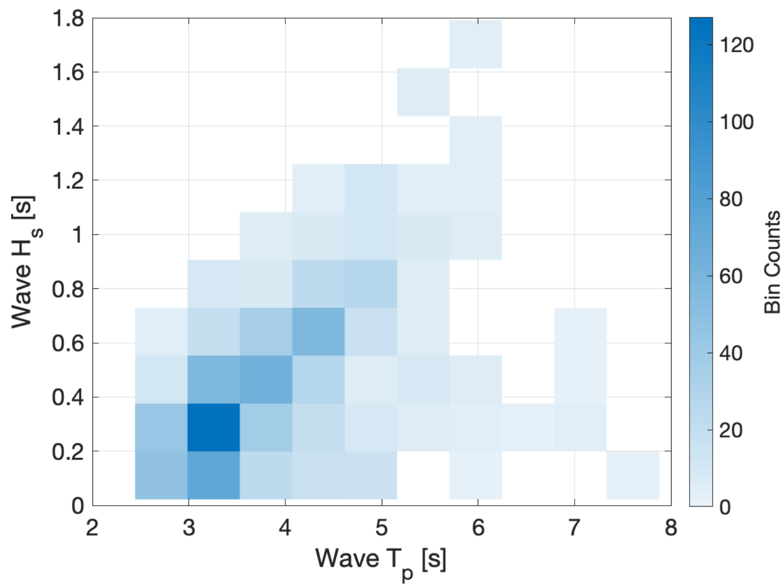

Figure 31. Joint Histogram of Surface Wave Heights (H_S) and Peak Periods (T_p) Measured from the STBM

APL-UW's STBM wave observations confirm previous wave climatology studies conducted in the region (Yang et al. 2019; Gemmrich and Pawlowicz 2020). These studies indicate that this resource characterization spans the portion of the annual cycle with the most storm activity (i.e., fall and winter), while the other seasons (i.e., spring and summer) are expected to have less wave activity. Given the short periods and rapid depth attenuation of such waves, the wave climate is unlikely to be a significant concern for the operation of a tidal turbine at this site. For the extreme condition of H_s = 1.8 m (5.9 ft), T_p = 5.8 s on December 14, 2024, the orbital velocities are approximately 1 m/s (3.3 ft/s) at the surface and approximately 0.12 m/s (0.39 ft/s) at hub depth (wavelength is 51 m [167 ft] for T_p = 5.8 s).

3.2.2 Tides and Currents

Tides in the Salish Sea are (predominantly) semi-diurnal and mixed diurnal patterns, that enter from the Pacific Ocean as progressive long waves and propagate through the San Juan Islands archipelago. This produces a complex current pattern in this region, with strong tidal currents in both Haro and Rosario Strait (Yang and Wang 2013; Cannon et al. 1978). Consequently, tides in the Salish Sea exhibit a strong spring-neap tidal cycle and diurnal inequality (Yang et al. 2021).

The tidal conditions of the proposed Project location in Rosario Strait were assessed to determine the optimal location for tidal energy within the Salish Sea. The following factors were considered:

- The magnitude of tidal current speed and any temporal and spatial variabilities (e.g., tidal asymmetries in flow direction and magnitude).
- Spring-neap tidal cycle.
- Eddy currents.
- Diurnal inequality.

Site characteristics were measured and modeled for Rosario Strait and used to determine tidal power density, kinetic energy flux, and generation potential for tidal channel cross section.

The maximum tidal current speed in Rosario Strait exceeds 2 m/s (6.6 ft/s); however, tidal current speed exceeds 1 m/s (3.3 ft/s) approximately 20 percent of the time (i.e., greater than 80 percent of the time, current speed is less than 1 m/s [3.3 ft/s]) (Yang et al. 2021). The average cross-sectional current speed in Rosario Strait is 0.9 m/s (2.9 ft/s; Yang et al. 2021), although it varies considerably both temporally and spatially through the channel. Tidal current magnitude in Rosario Strait exceeds 2.5 m/s (8.2 ft/s) during both peak flood and ebb, displaying stronger currents toward the western (deeper) side of the channel (Yang et al. 2021). During peak ebb, positive velocities occur on the eastern (shallower) side of the channel, indicating eddy currents are produced by the presence of Cypress Island across the channel (**Figure 32**; Yang et al. 2021). During spring and neap ebb, Rosario Strait has a maximum tidal energy at spring tide of 3.17 m/s (10.4 ft/s), and minimum tidal energy at neap tide of 1.8 m/s (5.9 ft/s) (**Figure 32**; Yang et al. 2021).

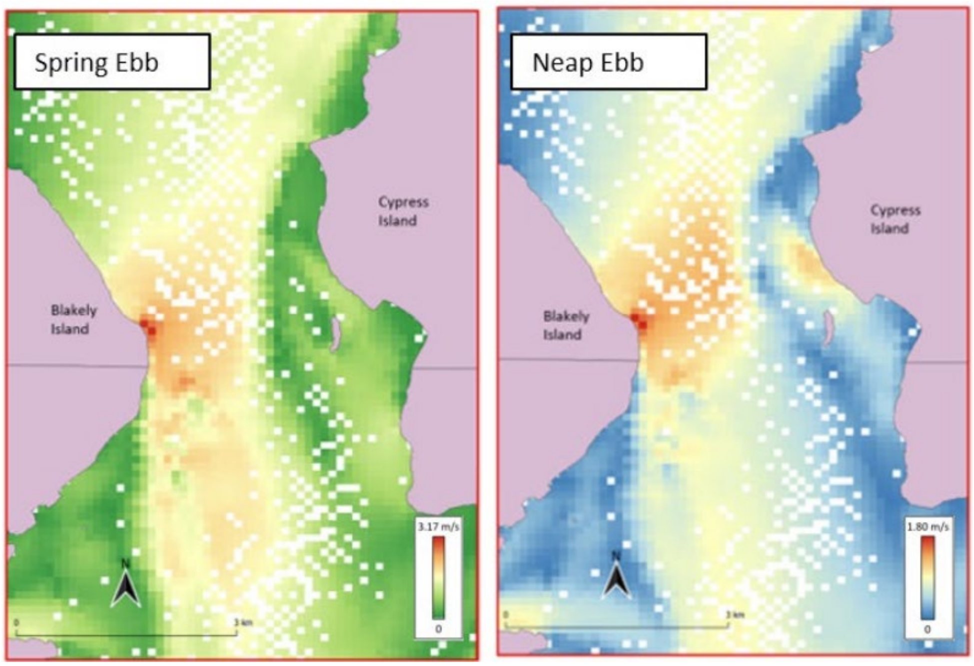

Figure 32. Tidal Current Velocity (m/s) Maps for Rosario Strait
Source: Yang et al. 2021

Yang et al. (2021) characterize a tidal energy hotspot as a tidal channel, or section of a channel, that has strong tidal currents exceeding a mean current speed criterion of 0.5 m/s (1.64 ft/s). Tidal power density (measured in watts per square meter [W/m^2]) is a function of both seawater density and current speed. Mean kinetic energy flux (measured in kilowatts [kW]) through a channel cross section is a function of the time-averaged tidal power density (W/m^2) and area (m^2) of the cross section (Yang et al. 2021).

Rosario Strait is an identified tidal energy hotspot with a mean kinetic energy flux of 72,833 kW (Yang et al. 2021). Rosario Strait has a maximum tidal power density slightly greater than 3 kW/m^2 near the western side of the channel, which was selected as the proposed Project location (**Figure 33**; Yang et al. 2021, Calandra et al. 2023). The mean tidal range in Rosario Strait south of Orcas Island is 1.5 m (4.94 ft) (NOAA 2024a).

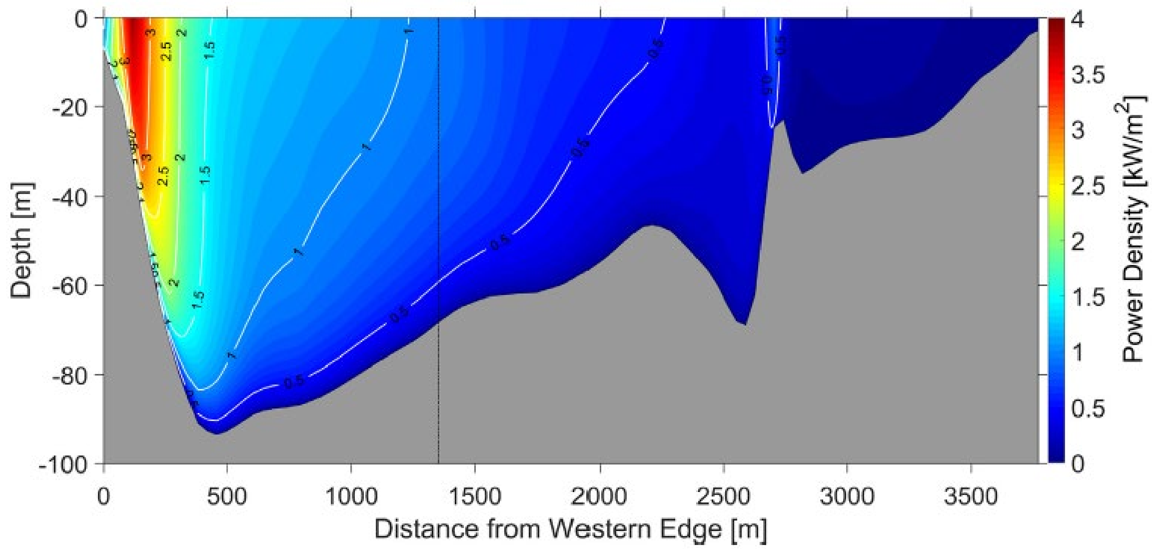

Figure 33. Power Density Profile for Rosario Strait
Source: Calandra et al. 2023

Project area-specific stationary measurements of tidal currents were collected by APL-UW from October 2, 2024 through January 13, 2025 (103 days). This duration was sufficient to determine at least 20 tidal constituents using classic tidal harmonic analysis and purely statistical description of tidal currents.

Regarding a monthly water velocity duration curve based on available flow data and the correlation of flow (in cfs) to velocity (ft/s) at in the Project area, tidal channels are not monitored for volumetric flow rates in the same manner that rivers are monitored. The flow in Rosario Strait (in m^3/s or cfs) can only be crudely estimated using a tidal prism analysis. There is a relationship between the volume flow rate of Rosario Strait and the current speed in the Project area, but it cannot be robustly determined from observations.

An alternative is presented that shows the relation between tidal stage (elevation) and current speed at turbine hub depth (U_{hub}; ft/s) (**Figure 34**). As shown in the right panel of **Figure 34**, the current speeds are fastest (approximately 3 m/s [9.8 ft/s]) at the lowest tidal stage. The apparent "scatter" in the right panel of **Figure 34** is the phasing of tidal stage and tidal flow, which is not 1:1 depending on spring-neap cycles, diurnal inequalities, and basin geometry. While these patterns are shown for October 2024 through January 2025, these patterns and distributions are expected to be similar for any other 3-month window throughout the year.

Results show that the maximum tidal elevation range is 4 m (13 ft) in the Project area, and an average tidal elevation change of 2.1 m (6.9 ft) (Appendix C2). Regarding the monthly minimum, maximum, and mean for temporal current speed (in ft/s), as shown in the left panels of **Figure 34**, tidal flows in the Project area were determined to be highly periodic and without the strong seasonal variations of a river basin hydrograph. The monthly minimum temporal current speed is zero (m/s), given the lack of slack tides that occur each day, and the monthly maxima will only vary slightly based on lunar and solar perigee-apogee cycles. The strongest tides (3.2 m/s [10.6 ft/s]), will occur during full and new moons, and during the solstice and equinox.

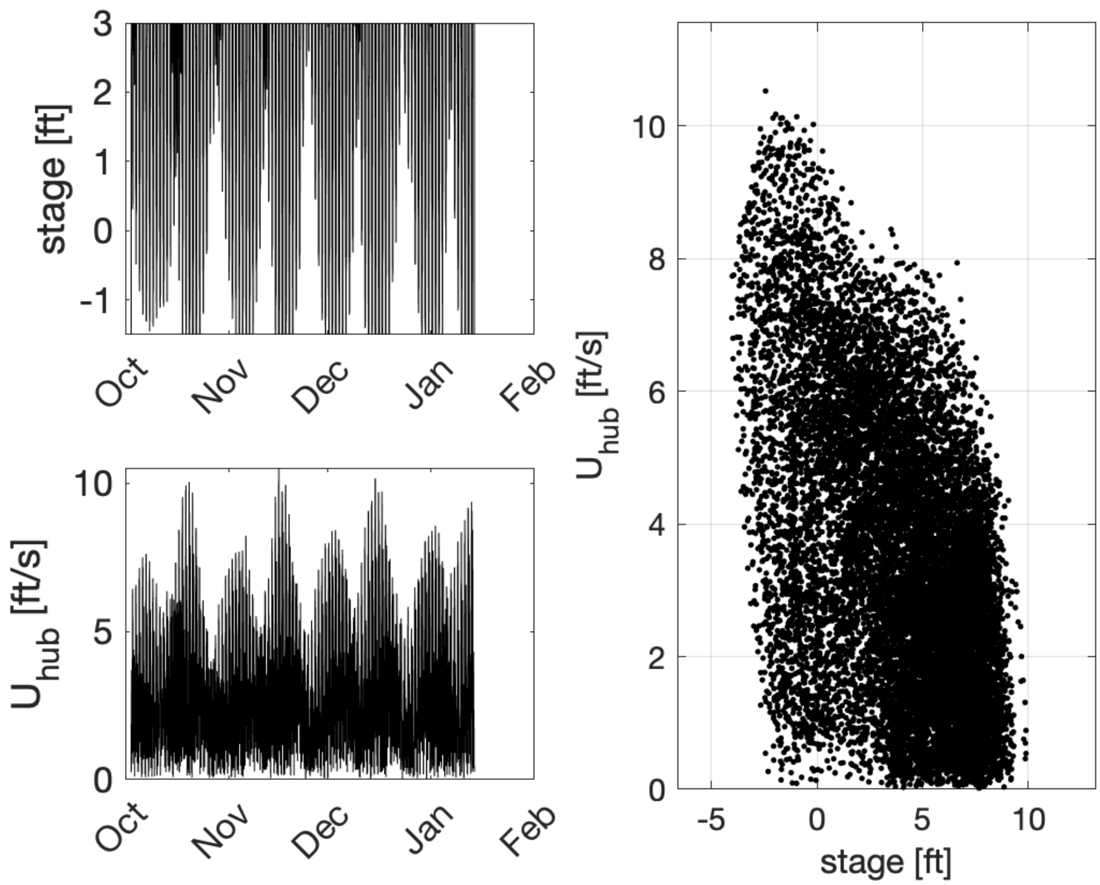

Figure 34. Time Series of Water Depth (Upper Left, [ft]) and Current Speed (Lower Left, U_{hub} [ft/s]), and Current Speeds Versus Tidal Stage (ft; Right)

Data from NOAA station 9449771 in Rosario Strait were also obtained to show changes in water surface levels between low and high tides for MHW, MHHW, MLW, and MLLW — shown in **Figure 35**, **Figure 36**, **Figure 37**, and **Figure 38,** respectively (NOAA 2024a).

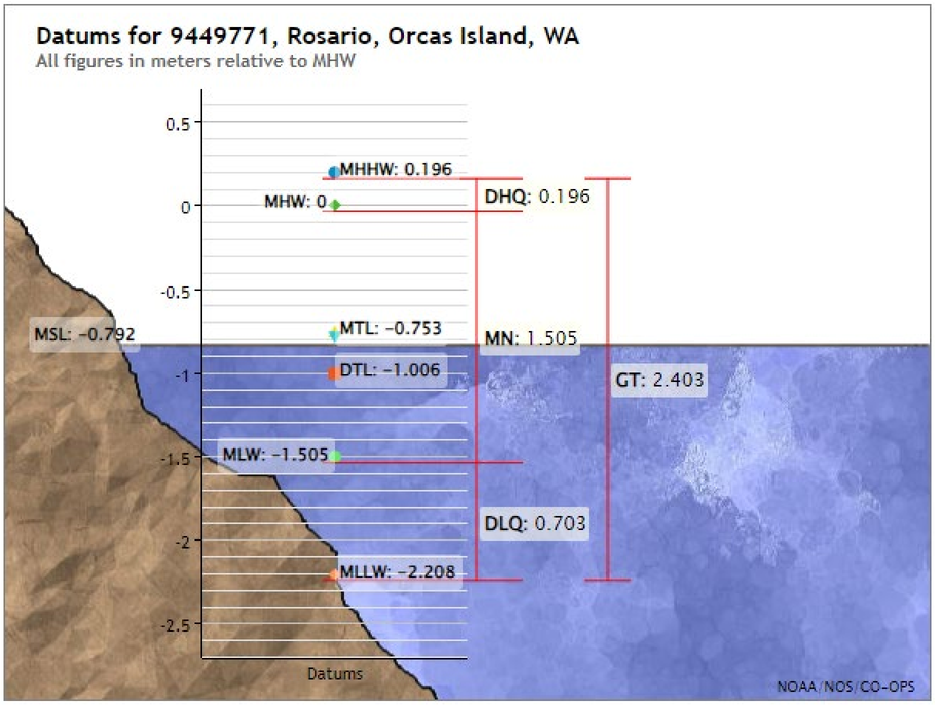

Figure 35. Water Surface Elevation Data in Rosario Strait Relative to MHW
Source: NOAA 2024a

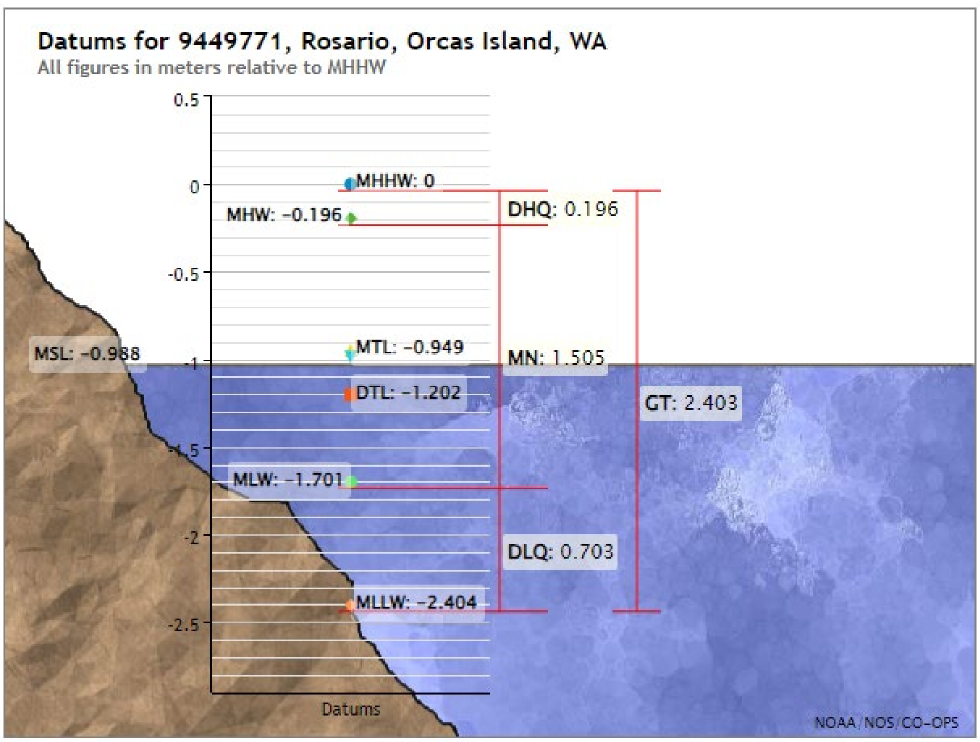

Figure 36. Water Surface Elevation Data in Rosario Strait Relative to MHHW
Source: NOAA 2024a

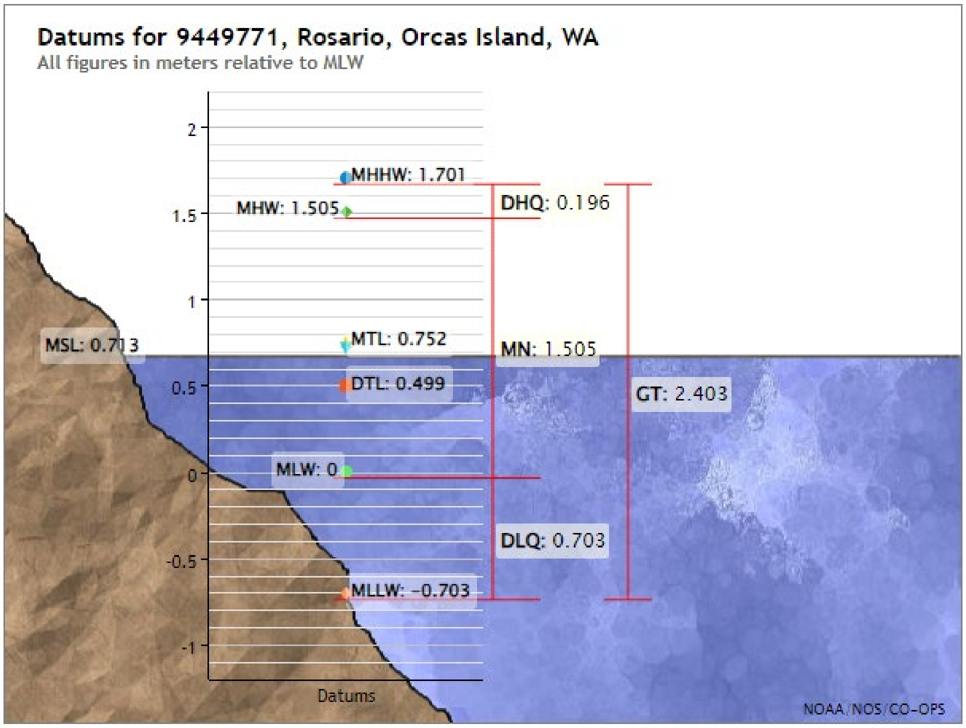

Figure 37. Water Surface Elevation Data in Rosario Strait Relative to MLW
Source: NOAA 2024a

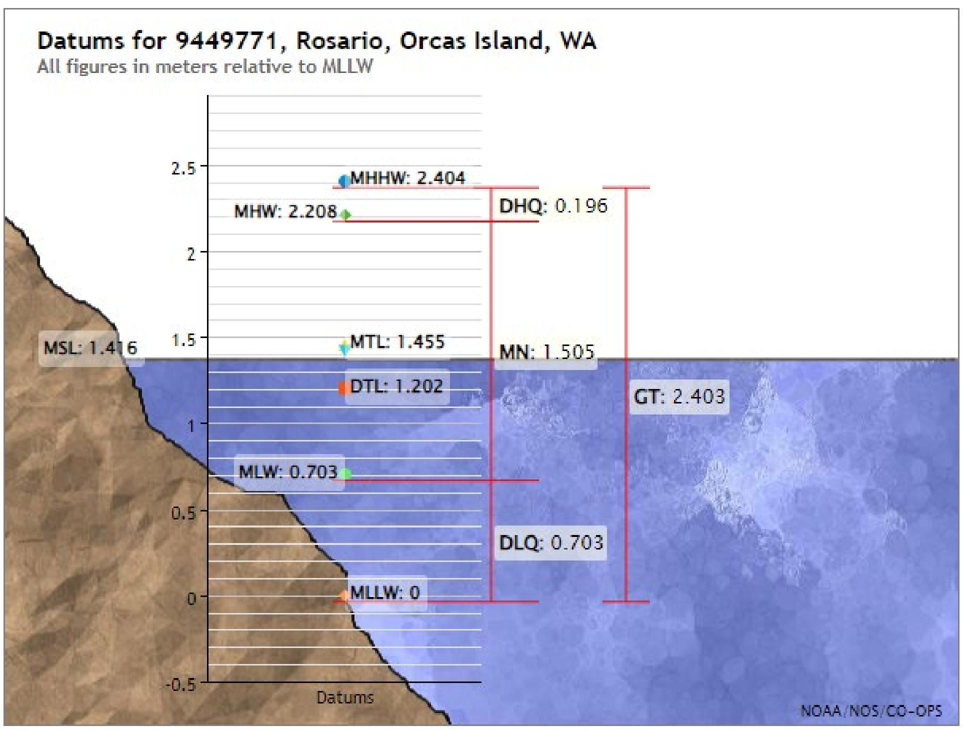

Figure 38. Water Surface Elevation Data in Rosario Strait Relative to MLLW
Source: NOAA 2024a

While tidal currents dominate the flow patterns in most coastal areas, the primary controls of physical oceanography between the Strait of Juan de Fuca, Strait of Georgia, and the San Juan Islands are estuarine circulation and wind-driven currents superimposed on tidal currents (Cannon et al. 1978). The San Juan Islands contain a complex series of channels and passageways, which result in complex circulation dominated by tidal forcing. The three most significant flow channels are Haro Strait, Rosario Strait, and Middle Passage.

Two-layer estuarine flow dominates the San Juan Island basin within the Salish Sea, driven by the outflow of freshwater at the surface from the Fraser River into the Strait of Georgia and an inflow of saline water at depth from the Pacific Ocean, forcing a reverse current in deep water (Kammerer et al. 2021; Masson 2006; Davenne and Masson 2001; Thomson 1994; LeBlond et al. 1983). Estuarine circulation in the San Juan Islands is seasonal, and river inflow can fluctuate from 1,000 cubic meters per second (m^3/s) (35,315 cubic feet per second [cfs]) in the winter to more than 10,000 m^3/s (353,147 cfs) in late spring (Thomson 1994). Additionally, wind forcing and coastal ocean effects from the Strait of Juan de Fuca vary seasonally and can alter circulation as well as intermediate and deep-water replacement. Dilution of the Strait of Georgia waters by Fraser River runoff, together with intense tidal mixing in Haro and Rosario Straits and inward movement of oceanic water along the Strait of Juan de Fuca, lead to water renewal within the deeper portions of the basin.

In Rosario Strait, the diurnal constituent is nearly as great as the mixed constituent, and the tidal current ellipses for each constituent can vary dramatically over short distances, resulting in opposite flow and strong tidal rips or convergence zones (Parker 1977; Kammerer et al. 2021). According to PNNL, the surface currents in Rosario Strait alternately flow north to south and south to north depending on the timing of the tidal cycle (PNNL 2020). In the Strait of Juan de Fuca, currents are essentially parallel to the axis of the channel. Near the surface, the residual current has a speed of 10 to 20 cm/s (3.9 to 7.9 inches per second [in./s]) toward the west, concentrated in the middle of the channel. In deep water, the residual current is stronger on the sides of the channel, flows toward the east, and has a typical speed of 10 cm/s (3.9 in./s) (Davenne and Masson 2001). Within the Strait of Georgia, residual circulation follows a similar path, but complex bathymetry and strong tidal currents influence residual currents.

Project area-specific SS data collected by APL-UW (Appendix C2) for horizontal water speed (m/s) and velocities (m/s) are shown as a time series between October 2, 2024 and January 13, 2025; 103 days) in **Figure 39** and **Figure 40**. Collected data recorded horizontal current speeds reaching up to 3.5 m/s (11.5 ft/s) in the project area (**Figure 39**). The data show a strong spring-neap cycle and diurnal inequality of the tides, with the strongest tides observed near the winter solstice, as expected. Additionally, the ebbs (toward the southeast) are slightly stronger then the floods (toward the northwest).

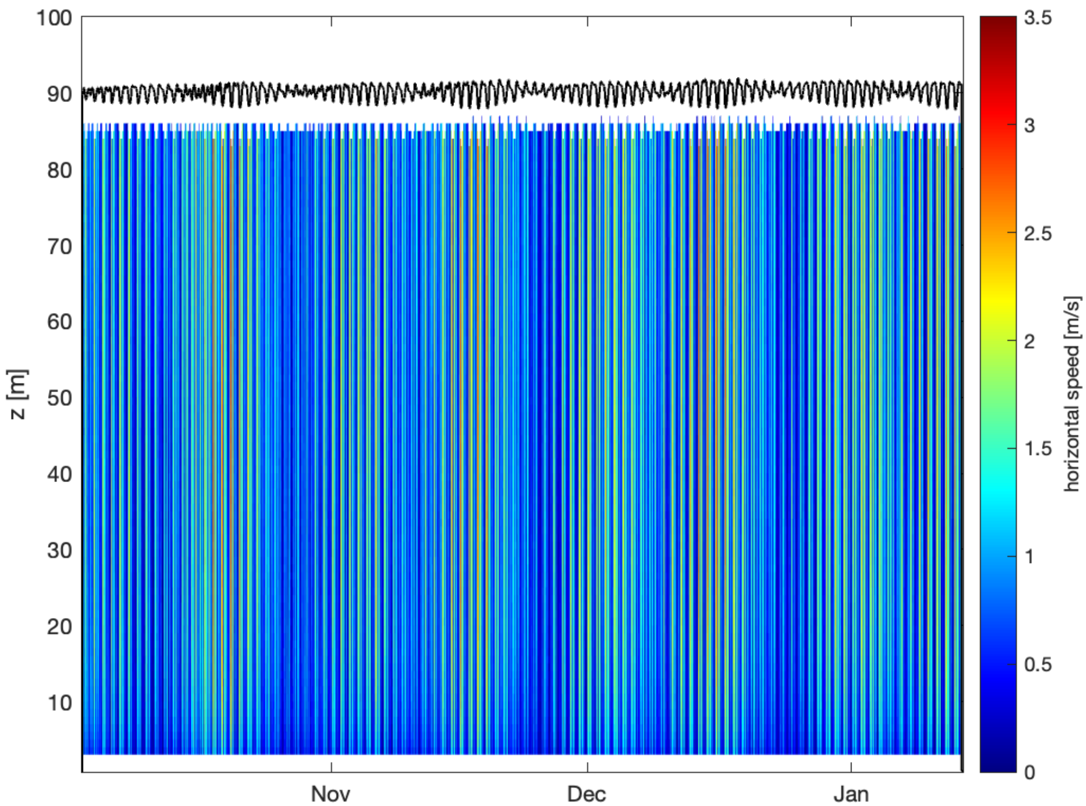

Figure 39. SS Profile of Horizontal Current Speed

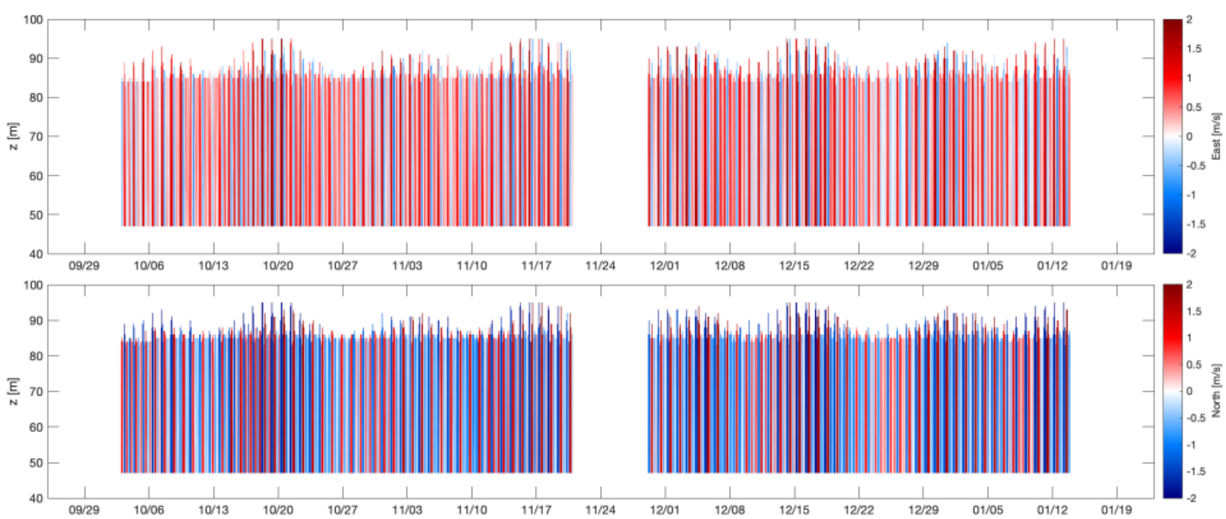

Figure 40. Components of currents measured by the Signature 500s on the Stablemoor

Winds can also have a direct influence on surface flow in the Strait of Juan de Fuca but are less predictable than tidal currents. Surface winds typically blow from high to low pressure in a direction dictated by topography and transfer momentum downward by vertical mixing (Thomson 1981). In Rosario Strait, winds move from south or southeast to north through the strait (**Figure 41**). In the winter, winds are greater than 15 m/s (29 knots) approximately 10 to 15 days per month, compared to only 1 to 2 days per month in the summer (Thomson 1981). A maximum westerly sea breeze (exceeding 15 to 20 m/s [49 to 66 ft/s]) can result in surface flow on the order of 0.5 m/s (1.6 ft/s) (Cannon et al. 1978; Thomson et al. 2007; NOAA 2021).

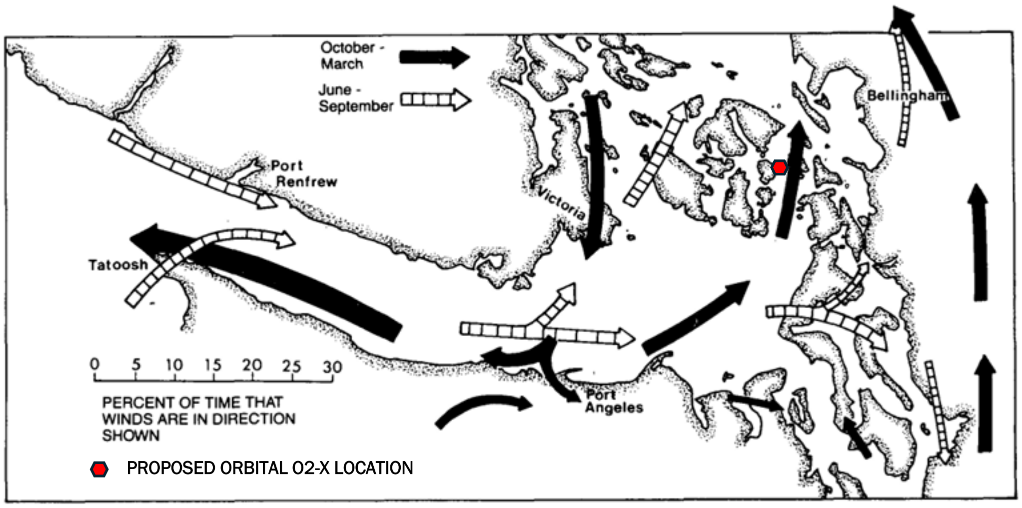

Figure 41. Surface Winds over the Strait of Juan de Fuca in Winter and Summer

Thick arrows correspond to wind speeds over 9 m/s, medium arrows for speeds between 4.5 and 9.0 m/s, and thin arrows for speeds less than 4.5 m/s. The red dot represents the location for the proposed Project.

Source: Thomson 1981

3.2.3 Bathymetry

The bathymetry of the Salish Sea is characterized by steep-sided slopes that transition to a gently sloping flat seafloor, with Rosario Strait having a mean water depth of 60 m (197 ft) (Donnelly et al. 1988; Yang et al. 2021).

In October 2024, Tetra Tech, Inc. performed bathymetric multibeam echosounder (MBE; using R2Sonic 2026 system) and sub-bottom profiler (SBP; using Innomar medium-100 system) geophysical surveys of the proposed Project area and a 200-m (656-ft) wide corridor centered on the new subsea cable route for the proposed Project (**Figure 42** and **Figure 44**; Appendix C1). Innomar SBP was used to investigate the shallow subsurface and assess sediment stratigraphy and depth to bedrock (when possible). Following the survey, the data were processed and additional quality control measures (e.g., using SonarWiz software) were performed to confirm accuracy and precision (Appendix C1).

Survey results indicate sediment movement (i.e., carried by waves) in the area and numerous boulders assumed to be carried by historical glaciers. These boulders range in size from approximately 1 m (3.3 ft) to nearly 15 m (49 ft), with the greatest concentration in Thatcher Pass at the south end of Blakely Island, which would be avoided by the new subsea cable route. Survey results also indicate that at the proposed Project Orbital O2-X location, there exists a uniform hard bottom such as glacial till, and strong currents are likely to prevent the accumulation of fine-grained sediments over the hard base layer of gravels and glacial deposits.

MBE survey data show that a distinct change in seabed texture occurs where the area wraps around the easternmost point on Blakely Island (**Figure 44**). To the north, the seabed is relatively smooth with some undulations that suggest underlying bathymetric features close to the surface. To the south, the overlying sediment layer has been scoured away, revealing a textured hard bottom that extends between and around the outcrops of Black Rock. Inshore of the Black Rock, the seabed again is smooth and sedimented. Collected SBP data indicate that while the northern part of the studied area appears sedimented, this sediment layer is likely very thin.

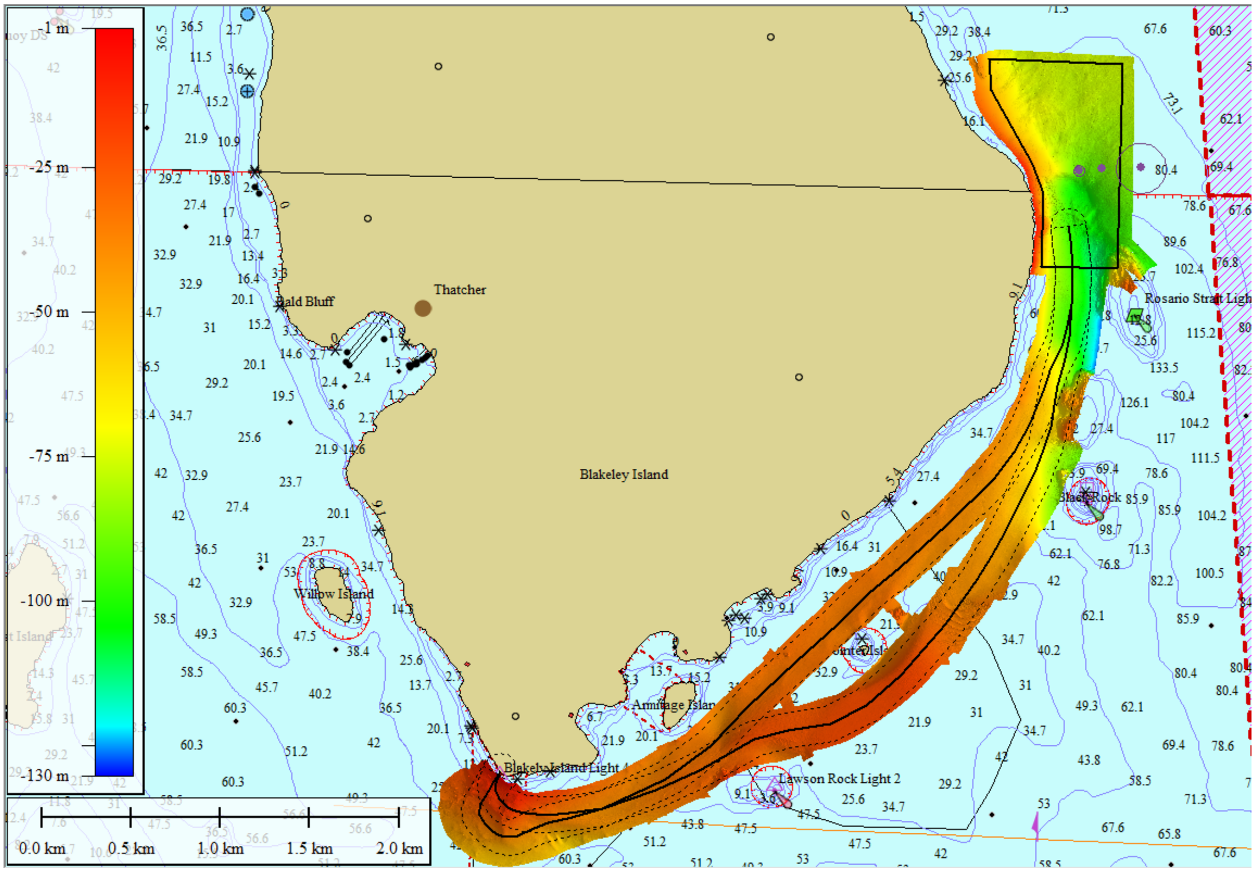

Figure 42. Bathymetric Rendering of the Survey Area off Blakley Island
Source: Appendix C1

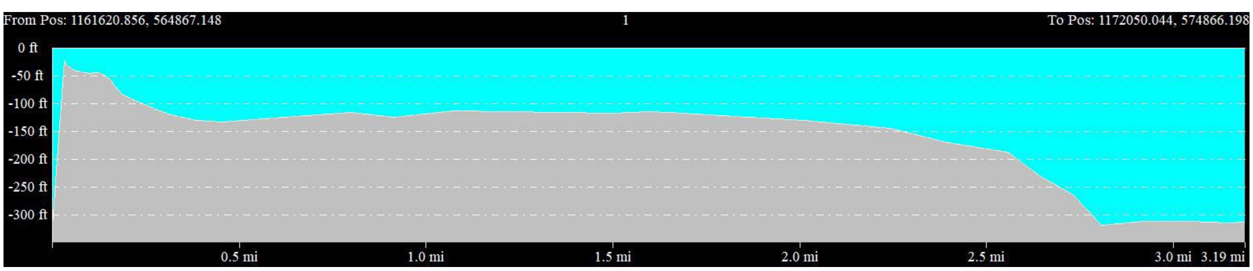

Figure 43. Bathymetric Profile Along Preferred Route (New Subsea Cable Landing to Turbine Area)
Source: Appendix C1

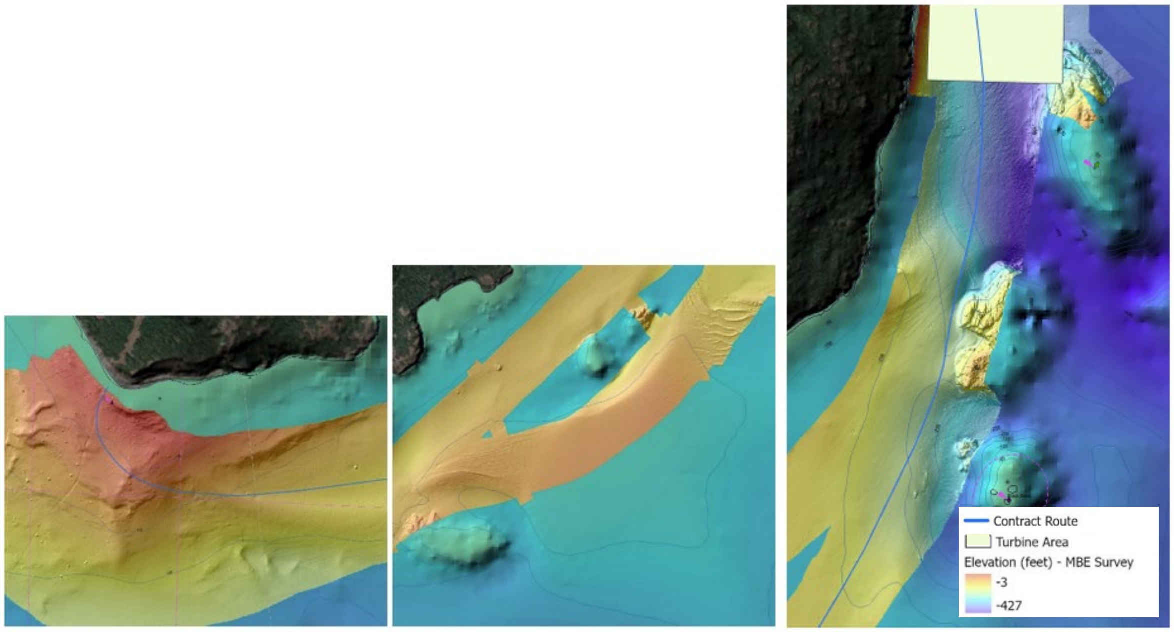

Figure 44. MBE Data Collected in and Along the Proposed Subsea Cable Route
Source: Tetra Tech, Inc. 2024

3.2.4 Water Quality

3.2.4.1 Water Temperature

Water temperature in the eastern portion of the Strait of Juan de Fuca and Rosario Strait is strongly influenced by oceanic conditions, river runoff, and tidal processes. It ranges between 7 degrees Celsius (°C) and 11˚C (45 degrees Fahrenheit [°F] and 52˚F), although surface temperatures occasionally reach as high as 14˚C (57˚F) (Ecology 1999; Thomson 1981).

For regional context, in early spring, colder water (6–7˚C [43–45˚F]) from the Pacific Ocean penetrates up-channel along the bottom of the Strait of Juan de Fuca, even though surface temperatures remain slightly below 10˚C (50˚F). There is no significant change in surface temperatures until the beginning of the spring in the Strait of Georgia, when large volumes of freshwater begin discharging from the Fraser River. Most of this water, which may warm to over 20°C (68˚F) in the near-surface layer of the Strait of Georgia, works its way southward through the three main channels (i.e., Haro Strait, Rosario Strait, and Middle Passage) into the eastern basin of the Strait of Juan de Fuca and is tidally mixed along the way. Even with tidal mixing, the total heat content of the water increases in the Strait of Juan de Fuca and raises average temperatures throughout its entire depth (Thomson 1981). By mid-August, patches of surface water in the Strait of Juan de Fuca can attain temperatures of 12–14˚C (54–57˚F) from local solar heating, but bottom values continue to be cold. In the fall, surface water temperatures return to between 8 and 10˚C (46 and 50˚F) in combination with enhanced wind activity and colder ocean water. In contrast, bottom water temperatures increase as warmer water slowly moves inland from the Pacific Ocean, causing temperatures to return to nearly uniform throughout the region (Thomson 1981).

In Rosario Strait, seasonal variability in temperature is generally insignificant because the waters are vertically well-mixed from intense tidal processes, so temperatures remain relatively uniform (Thomson 1981, 1994). APL-UW measured water temperature in the Project area, showing tidal variations in the early autumn, then well-mixed conditions (i.e., no variations) in the late fall and early winter (**Figure 45**). This is expected as autumn storms drive mixing of the full water column, coincident with a lack of solar radiation to provide surface warming.

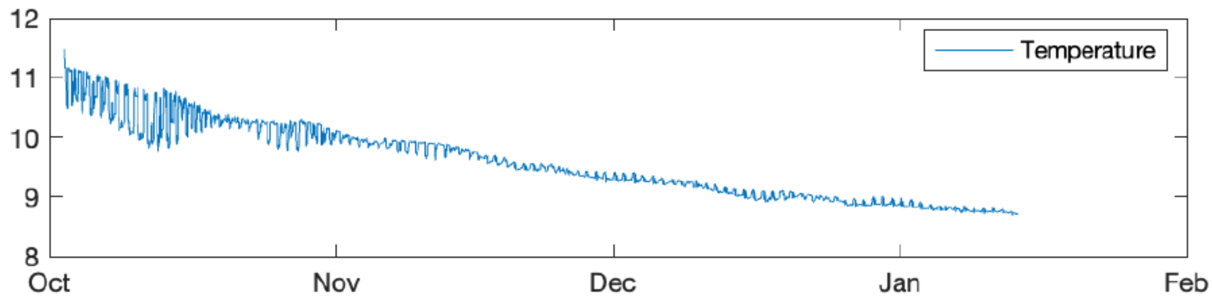

Figure 45. Temperature at the Project Area (October 2024 through January 2025)

3.2.4.2 Stratification

The San Juan Islands are known to have stratification and estuarine circulations in addition to strong tidal flows (MacCready and Geyer 2010), with stratification monitored at repeat stations throughout the region by Ecology. Typical values are a few parts per thousand (PPT) salinity change and a few degrees °C change over 50 to 200 m (164 to 656 ft) depth. The associated estuarine conditions are weak, relative to the tidal currents, and are most prominent during neap tidal cycles (Deppe et al. 2017). Thus, seasonal variations in stratification in the Project area are not expected to have a significant effect on the currents or annual energy production estimates. **Figure 46** shows APL-UW collected data from a conductivity, temperature, depth (CTD) sensor mounted on the STBM, which are typical variations for a tidal channel in this region. The clusters, or stripes, in **Figure 46** are mixing lines along which water masses are evolving while advecting through the region.

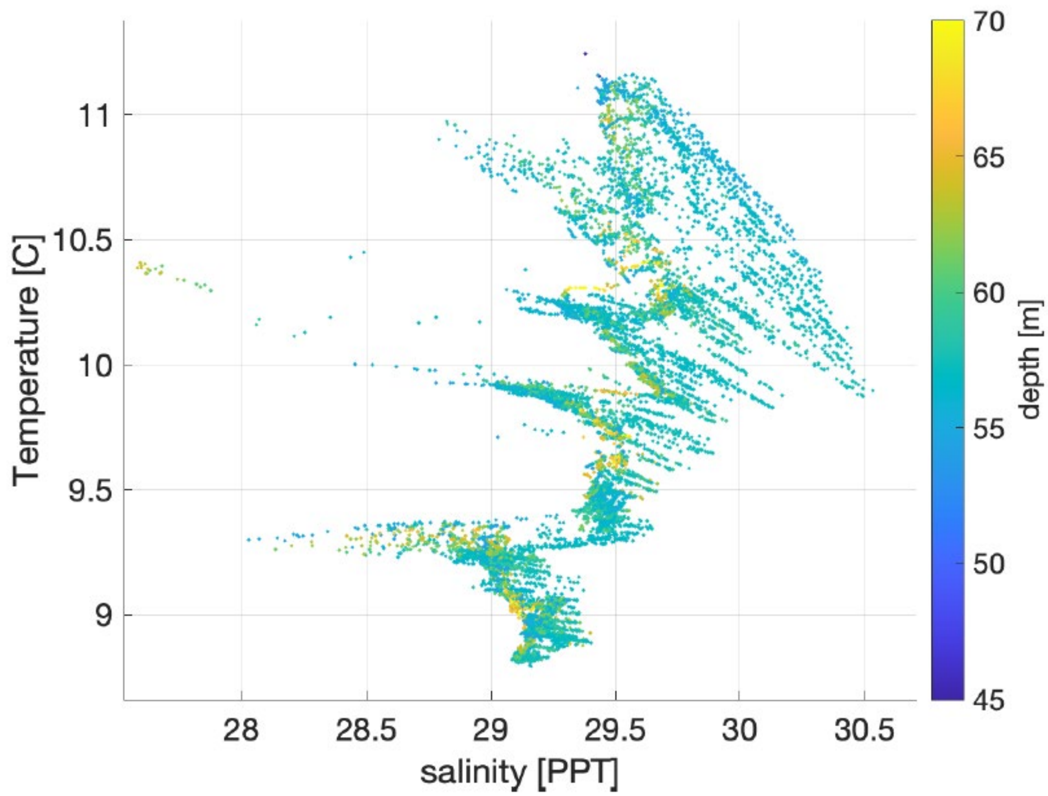

Figure 46. Temperature Versus Salinity Measured on APL-UW's STBM

3.2.4.3 Dissolved Oxygen

Ecology's Water Quality Assessment of Washington was approved by the EPA in 2016, with standards that are intended to protect all indigenous fish and non-fish aquatic species in waters of the state (Ecology 2022). According to that assessment, the dissolved oxygen (DO) numeric criteria applied to the waters of the Project area indicate an 'extraordinary' DO standard (7 milligrams/liter [mg/L] (Ahmed et al. 2019). A DO criteria (one-day minimum) of 7.0 mg/L indicates "*extraordinary quality salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning*" (WAC 173-201A-210(1)(d)).

3.3 Climate and Weather

3.3.1 Geography and Climate

The State of Washington is known for its wide range of terrain and climates, varying regional weather patterns, and rich ecosystem biodiversity. Key regional features contribute to its diverse climate and moderate weather patterns, including the Pacific Ocean, Olympic Mountains, Cascade Mountain Range, and the large estuary of the Salish Sea. The Cascade Mountain Range divides the state vertically down the middle, creating a coastal climate in Western Washington influenced by the Pacific Ocean and Salish Sea, while Eastern Washington experiences a rain shadow effect causing a continental climate. Elevations in Washington State range from sea level to 4,392 m (14,410 ft) at the top of Mount Rainier where glaciers are situated and five major rivers spawn (NPS 2024). The proximity of Washington State to large bodies of water provides a moderating effect on the climate and on regular weather patterns (Overland and Walter 1983).

Topographical features both deter and channel pressure systems and airflow in a manner that contributes to the moderate climate and weather patterns of the region. The mountain ranges in Washington State impact airflow and the migration of pressure systems in the state. The Cascades, Olympics, and the Canadian Rocky Mountains protect the Salish Sea from cold air masses traveling south across Canada toward Washington State (Overland and Walter 1983). Additionally, Willapa Hills, the Olympic Mountains, and the Vancouver Island Mountain Ranges shelter Washington State from intense winter storms (Overland and Walter 1983). The Strait of Juan de Fuca, Strait of Georgia, and Chehalis River Valley provide low-elevation passages for maritime air to funnel into inland areas and deter surface winds (Overland and Walter 1983). The proposed Project area is within Rosario Strait in the Salish Sea where weather systems are channeled over and between the steep cliffs of the San Juan Islands.

3.3.2 Weather

Surrounded by nearby mountain ranges and the channels of the Salish Sea, the San Juan Islands are located inside of a rain shadow, which means they receive significantly less rainfall than the rest of Western Washington (**Figure 47**; NPS 2022). When warm winds off the Pacific Ocean hit the Olympic Mountains and Vancouver Island, the air cools as it rises up the slopes and releases its moisture as precipitation. By the time the air masses pass over the mountain ranges, they are much drier. This results in the San Juan Islands having an annual rainfall per year that tends to be less than 76.2 cm (30 in.), while the Olympic Mountains receive approximately five times as much precipitation at 381 cm (150 in.) per year (NPS 2022).

From October to April, about 70 percent of annual precipitation falls on the San Juan Islands (NPS 2022). In the summertime, winds shift to westerly-northwesterly airflows and influence a dry period from June to August. The San Juan Islands also have a greater number of sunny days than other portions of Western Washington, with an annual average of about 247 sunny days (NPS 2022; San Juan Island Visitors Bureau 2024).

Daily temperatures in the San Juan Islands tend to be moderate in the summers and winters. The mean annual temperature range from 1991 to 2020 was 6.7°C to 14.1°C (44°F to 57°F). Winter temperatures tend to stay above freezing, although occasionally they may drop below freezing and bring about a hard frost (NPS 2022).

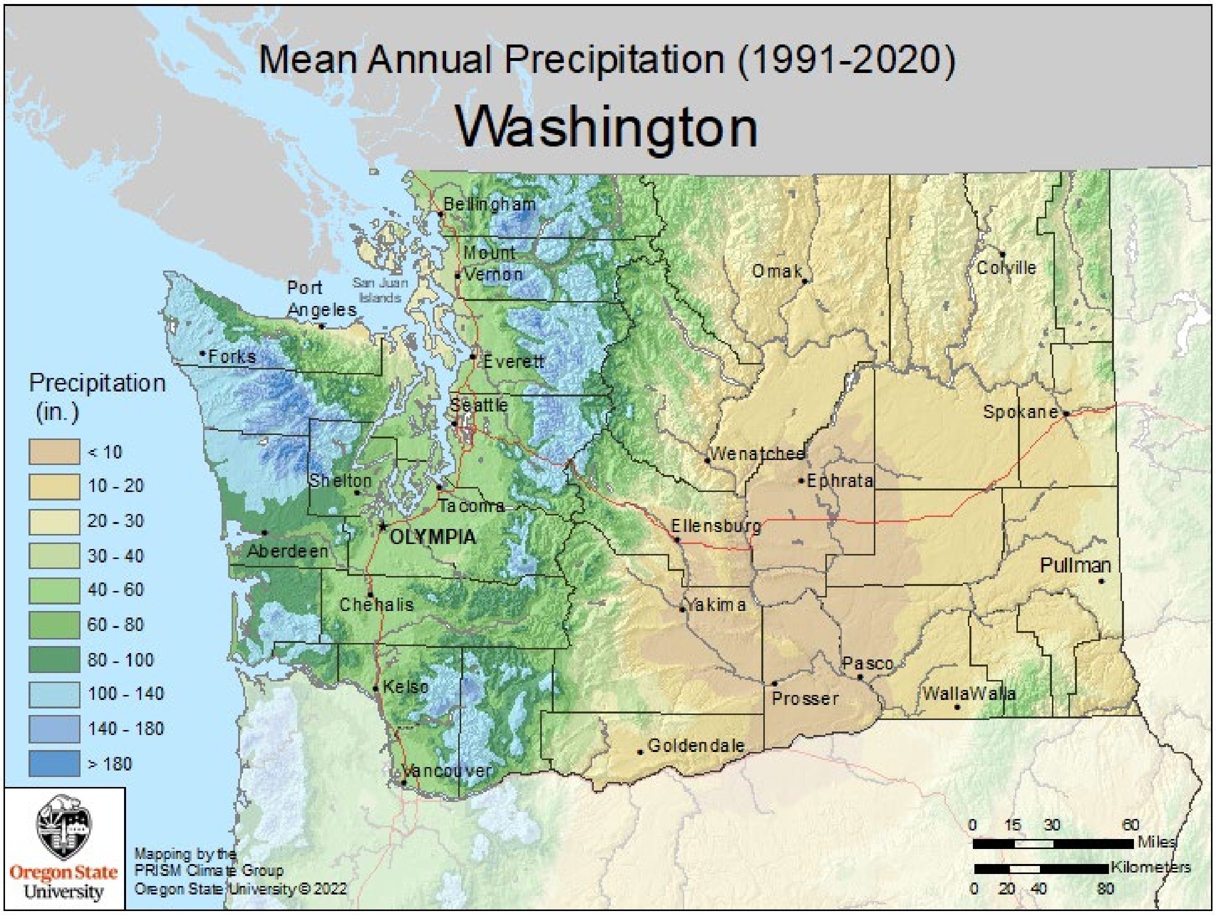

Figure 47. Mean Annual Precipitation in Washington from 1991 – 2020
Source: PRISM Climate Group 2022

3.4 Fish and Aquatic Resources

The fish and aquatic resources described include the federally listed fish and (proposed) echinoderm species that may occur within the project area, as well as important habitats such as designated critical habitat, EFH, and Habitats of Particular Concern (HAPC) for spawning, rearing, feeding, and refugia. The existing underwater acoustic environments, including estimated decibel levels, are also described. APL-UW also took opportunistic measurements for tagged fish using a Vemco receiver on the SS tripod, and did not detect any tagged fish from October 2024 through January 2025.

3.4.1 Federally Listed Aquatic Species

Federally ESA-listed fish species that may occur within the project area include Puget Sound-Georgia Basin distinct population segment (DPS) bocaccio (*Sebastes paucispinis*) and yelloweye rockfish (*Sebastes ruberrimus*), Puget Sound evolutionarily significant unit (ESU) Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound DPS steelhead (*O. mykiss*), Southern DPS eulachon (*Thaleichthys pacificus*), Southern DPS green sturgeon (*Acipenser medirostris*), and Coterminous U.S. Population (Coastal Recovery Unit) bull trout (*Salvelinus confluentus*). Additionally, the proposed threatened sunflower sea star (*Pycnopodia helianthoides*) may also occur within the project area.

3.4.1.1 Fish Species

Bocaccio, Puget Sound-Georgia Basin DPS

NMFS listed the Puget Sound-Georgia Basin DPS of bocaccio (*Sebastes paucispinis*) as endangered on April 28, 2010, effective July 27, 2010 (75 Federal Register [FR] 22276), re-affirmed and effective March 24, 2017 (82 FR 7711). The Puget Sound-Georgia Basin DPS of bocaccio includes fish residing within the Puget Sound-Georgia Basin to the western boundary of the Strait of Juan de Fuca; northern boundary of the Strait of Georgia; along the southern contours of Quadra Island, Maurelle Island, and Sonora Island; and all of Bute Inlet.

Bocaccio are large rockfish that live along the Pacific coast. They have long, flattened bodies and very large mouths. They can reach up to 1 m (3 ft) in length and have a distinctive long jaw extending to at least their eye socket. Their appearance varies among individuals, ranging in color from olive to burnt orange or brown. They are suspected to live up to 54 years (Drake et al. 2010). Breeding occurs in the fall, generally between August and November, with embryonic development taking 1 month. In Washington State, female bocaccio release larvae in January through April, peaking in February (Drake et al. 2010). Bocaccio larvae are planktivores that feed on larval krill, diatoms, and dinoflagellates (Drake et al. 2010). Pelagic juveniles are opportunistic feeders, consuming fish larvae, copepods, krill, and other prey, while larger juveniles and adults are primarily piscivores, eating other rockfishes, hake, sablefish, anchovies, lanternfishes, and squid (Love et al. 2002; Drake et al. 2010).

Larvae are found throughout the water column, and the highest densities of pelagic juveniles tend to be found close to the surface in areas with floating kelp mats and submerged kelp habitat (Love et al. 2002; 74 FR 18516). Most bocaccio remain pelagic for 3.5–5.5 months prior to settling in shallow, intertidal, nearshore waters in rocky, cobble, and sand substrates with or without kelp (Love et al. 2002; 74 FR 18516). Several weeks after settlement, bocaccio move to deeper waters in the range of 18–30 m (60–100 ft) and are found on rocky reefs (Carr 1983; Feder et al. 1974; Johnson 2006; Love and Yoklavich 2008), sandy substrates, kelp forest habitat, and artificial structures (Love et al. 2002; 74 FR 18516). Adults inhabit deeper waters as they increase in size, ranging from 12–478 m (40–1,570 ft) in depth, but are most common at depths of 50–250 m (164–820 ft) (Feder et al. 1974; Love et al. 2002). Adults usually exhibit strong site fidelity to rocky bottoms and outcrops but will occasionally wander from hard substrata into mudflats (74 FR 18516).

Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska, but are most common from Oregon to northern Baja California (Love et al. 2002). Their occurrence within the Georgia Basin is limited to certain areas. Their relationship between habitat preference and distribution within the Georgia Basin is not fully understood, with available information indicating bocaccio are frequently found in areas lacking hard substrate, potentially due to their pelagic behavior or prey availability (74 FR 18516). Based on surveys of the recreational fishery, bocaccio in Washington State's inland waters are rare north of Puget Sound and are mostly found south of the Tacoma Narrows (Drake et al. 2010). Analysis of Rockfish Hot Spot Areas (RHAs) has shown that bocaccio hot spots occur in Puget Sound south of Whidbey and Camano Islands, and just east of Kingston, Washington on the Kitsap Peninsula (NRC 2016). There are no bocaccio RHAs in or around the San Juan Islands (NRC 2016); however, since the project area overlaps with their designated critical habitat (79 FR 68041), there is the potential for bocaccio to occur within the project area.

The primary factors responsible for the decline of the Puget Sound-Georgia Basin DPS of bocaccio are degradation of rocky habitat, loss of eelgrass (*Zostera marina*) and kelp, introduction of non-native species that modify habitat, and degradation of water quality.

Critical Habitat

On November 13, 2014, NMFS designated critical habitat for bocaccio, effective February 11, 2015 (79 FR 68041). The proposed Project area overlaps with marine nearshore and deepwater designated critical habitat for Puget Sound-Georgia Basin DPS bocaccio. NMFS does not currently have sufficient information regarding the habitat requirements of larval bocaccio to determine which features are essential for conservation; thus, they do not identify critical habitat specifically for this life stage.

The essential physical or biological features (PBFs) of deepwater sites or benthic habitats (i.e., sites deeper than 30 m [98 ft]) are areas of complex bathymetry consisting of rocky and/or highly rough habitat. These features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfish to avoid predation, seek food, and persist for decades. PBFs specific to the conservation of the Puget Sound-Georgia Basin DPS include sites and habitat components that support the adult life stage, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.
- The type and amount of structure and rugosity that support feeding opportunities and predator avoidance.

Settlement habitats for juveniles are located in the nearshore (i.e., the area of extreme high tide to a depth of 30 m [98 ft]) with substrates such as sand, rock, and/or cobble compositions that also support kelp (families Chordaceae, Alariaceae, Lessoniacea, Costariaceae, and Laminaricea). These areas are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. PBFs specific to the conservation of this DPS include sites and habitat components that support the juvenile life stage, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

Yelloweye Rockfish, Puget Sound-Georgia Basin DPS

The Puget Sound-Georgia Basin DPS of yelloweye rockfish (*Sebastes ruberrimus*) was listed as threatened by NMFS on April 28, 2010, effective July 27, 2010 (75 FR 22276). On January 23, 2017, NMFS updated and amended the Puget Sound-Georgia Basin DPS of yelloweye rockfish, reaffirming its status as threatened, effective March 24, 2017 (82 FR 7711). The listing description for yelloweye rockfish Puget Sound-Georgia Basin DPS includes fish residing within the Puget Sound-Georgia Basin, inclusive of the Queen Charlotte Channel to Malcom Island, in a straight line between the western shores of Numas and Malcom Islands.

Yelloweye rockfish can weigh up to 18 kg (40 lbs.), are orange red to orange yellow in color, with bright yellow eyes, and can reach up to 1 m (3 ft) in length (NMFS 2024e). They are among the longest-lived rockfish, living up to at least 118 years (potentially 150 years), are slow growing, and late to mature, beginning to reproduce at 5 to 20 years of age (Love 1996; Love et al. 2002; NMFS 2024e). Their fertilization and embryo development are internal, and females give birth to live larval young (Love et al. 2002). After birth, larvae are pelagic for several months prior to settling into a demersal habitat (Drake et al. 2010).

Yelloweye rockfish are opportunistic feeders. Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages (Sumida and Moser 1984; 74 FR 18516). Larger adult yelloweye rockfish consume bottom and mid-water dwelling invertebrates and small fishes including sand lance, gadids, flatfishes, shrimps, crabs, gastropods, and other rockfish species associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (Sumida and Moser 1984; Love 1996; Love et al. 2002; Yamanaka et al. 2006).

Larvae are widely dispersed on the surface and can occupy the full water column but are generally found in the upper 80 m (262 ft). They have been observed under free-floating algae, seagrass, and detached kelp (Love et al. 2002; Weis 2004). Juveniles and subadults are generally found in shallower waters, around rocky reefs, kelp canopies, and artificial structures (Love et al. 2002; 74 FR 18516). Adults generally move into deeper waters, 24 to 475 m (80 to 1,560 ft) depth, but are most common in depths ranging from 91 to 180 m (300 to 590 ft) (Love 1996; 74 FR 18516). In Washington State's inland waters, adults have been documented in non-rocky areas such as sand, mud, and other unconsolidated sediments (Washington 1977; Miller and Borton 1980; Reum 2006). Many adults exhibit strong site fidelity to rocky bottoms and outcrops, and some may live their entire life on a single rock pile (Yoklavich et al. 2000; 74 FR 18516).

Yelloweye rockfish range from northern Baja California to the Aleutian Islands, Alaska, but are most common from central California northward to the Gulf of Alaska (Love 1996; 74 FR 18516). They are distributed throughout the Salish Sea, including around the San Juan Islands, in areas most frequently coinciding with high relief, complex rocky habitats, and are observed more frequently in north Puget Sound and the Strait of Georgia (Miller and Borton 1980; Yamanaka et al. 2006; 74 FR 18516). Yelloweye rockfish are potentially present in Rosario Strait based on an RHA analysis, with RHAs east and southeast off the coast of Blakely Island (**Figure 48**) (NRC 2016). Additionally, the project area overlaps with designated critical habitat for yelloweye rockfish juveniles and adults (79 FR 68041). Therefore, it is anticipated that yelloweye rockfish could occur within the project area.

The primary factors responsible for the decline of the yelloweye rockfish Puget Sound-Georgia Basin DPS are depletion from commercial and recreational fishing, rocky habitat degradation that includes loss of eelgrass and kelp, water quality problems and elevated contaminant levels, and inadequate existing regulatory mechanisms (75 FR 22276).

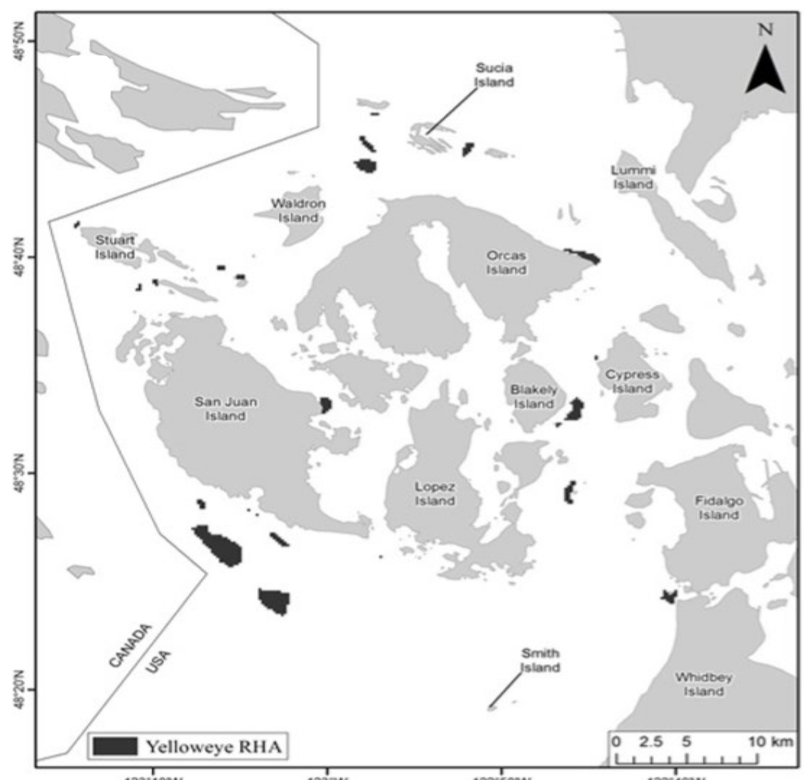

Figure 48. Spatial Distribution of Yelloweye Rockfish Hotspot Areas (RHA) Around the San Juan Islands
Source: NRC 2016

Critical Habitat

On November 13, 2014, NMFS issued its final rule designating critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish, effective February 11, 2015 (79 FR 68041). The proposed Project area is within the deepwater critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish. NMFS does not currently have sufficient information regarding the habitat requirements of larval yelloweye rockfish to determine which features are essential for conservation; thus, they do not identify critical habitat specifically for this life stage. However, NMFS notes that larvae of yelloweye rockfish are very likely use the areas designated as critical habitat.

Benthic habitats or sites deeper than 30 m (98 ft) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rough habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfishes to avoid predation, seek food, and persist for decades. Specific PBFs essential to the conservation of the Puget Sound-Georgia Basin DPS of yelloweye rockfish include sites and habitat components that support adult and juvenile life stages, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.
- The type and amount of structure and rugosity (roughness) that supports feeding opportunities and predator avoidance.

Chinook Salmon, Puget Sound ESU

On March 24, 1999, NMFS listed the Puget Sound ESU of Chinook salmon (*Oncorhynchus tshawytscha*) as threatened (effective May 24, 1999 [64 FR 14308]), reaffirmed on June 28, 2005, and effective August 29, 2005 (70 FR 37159). The listing was again reaffirmed, effective April 14, 2014 (79 FR 20802). The Puget Sound ESU of Chinook salmon includes naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound, and the Strait of Georgia, as well as Chinook salmon from 26 artificial propagation programs (NMFS 2016a; 79 FR 20802).

Chinook are the largest of the Pacific salmon (i.e., king salmon) (Netboy 1958), reaching approximately 0.9–1.5 m (3–5 ft) in length. They regularly weigh more than 18 kg (40 lbs.) and can potentially reach up to 58.5 kg (129 lbs.) (Shared Strategy for Puget Sound 2007; NMFS 2024a). They reach maturity at 3-4 years when they return to freshwater to spawn (Myers et al. 1998). Chinook salmon dig out redds (i.e., gravel nests) on streambeds where they lay their eggs (63 FR 11482). All Chinook die after spawning, with their carcasses providing a valuable source of energy and nutrients (e.g., nitrogen, phosphorous) to river ecosystems, leading to improved newly hatched salmon growth and survival (NMFS 2024a).

Chinook salmon are anadromous, meaning they incubate, hatch, and emerge in freshwater streams and rivers before migrating out to the oceanic saltwater environment to feed and grow, before returning to their natal freshwater streams to spawn (Myers et al. 1998). In the ocean, Chinook appear blue-green on the back and top of their head, with silvery flanks and white bellies and have small black spots on both lobes of their tail, as well as black pigment along the base of their teeth (Shared Strategy for Puget Sound 2007; NMFS 2024a). Spawning adult males can be distinguished by a hooked upper jaw, and females by their torpedo-shaped body, robust mid-section, and blunt nose. Freshwater juveniles (i.e., fry) have well-developed parr marks on their sides that they lose when migrating out to sea, then gain the dark back and light belly characteristic of fish living in open water (Healey 1991; NMFS 2024a).

Chinook fry feed on forage fish eggs in large aggregations along sheltered shorelines. Young Chinook salmon feed on terrestrial and aquatic insects, amphipods, crustaceans, annelids, arachnids, playhelminthes, gastropoda, rotifera, and osteichytes (Levy et al. 1979; Levings et al. 1991). Older Chinook primarily feed on other fish, such as bocaccio, herring, anchovy, and sardines (Love et al. 2002). Chinook are the primary year-round prey of Southern Resident Killer Whales (SRKWs), comprising approximately 50 percent of their diet in the fall, 70 to 80 percent in mid-winter/early spring, and nearly 100 percent in the spring (Hanson et al. 2021). They are also eaten by other marine mammals such as sea lions, sharks and other fish (e.g., whiting, mackerel), and birds (NMFS 2024a).

In North America, Chinook salmon range from Monterey Bay, California to the Chukchi Sea region of Alaska (Myers et al. 1998) but have diverse migration patterns due to a complex blend of environmental and genetic factors (Healey 1991; Quinn et al. 2005). Chinook salmon also exhibit two distinct juvenile life history patterns—ocean-type and freshwater stream-type—with ocean-type being the most common in the southern portion of their range (Washington State, Oregon, and California) (Gilbert 1912; Healey 1983; Taylor 1990). The ocean-type Chinook salmon tend to stay in protected inland and coastal areas, including nearshore estuaries found in Washington State (Healey 1983; Sharma 2009; 63 FR 11482).

The Salish Sea is a migratory corridor for adult Chinook and provides habitat for out-migrating juveniles from rivers to their oceanic phase as adults. Adults typically spawn in the mainstems and larger tributaries of Puget Sound and greater Salish Sea, preferring clean gravel riffles with moderate water velocity (WDF et al. 1992). Early-timed Chinook salmon tend to enter freshwater as immature fish in the spring, migrate far upriver, and spawn in the late summer and early fall. Late-timed Chinook enter freshwater in the fall at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within days to weeks of freshwater entry (Myers et al. 1998).

The return of adult Chinook salmon to freshwater within Washington State occurs from late March to early December and varies considerably across and within major river basins. Fall run Chinook salmon are the most common group of Chinook on the U.S. west coast, spending 3 to 4 years in the ocean prior to migrating to their spawning grounds. They journey to their spawning grounds beginning in late July, peaking in September, and ending in December (NMFS 2022c). According to WDFW and NMFS, there are no freshwater spring, summer, or fall Chinook streams, nor is there designated freshwater critical habitat for Chinook salmon on Blakely Island (NMFS 2024g; WDFW 2024q, 2024r). However, Chinook salmon do have designated critical habitat (70 FR 52629) along the nearshore waters of Blakely Island, which overlaps with the Project area in part; therefore, they may occur within the Project area.

Critical Habitat

On September 2, 2005, NMFS issued a final rule designating critical habitat for 12 ESUs of west coast salmon, including the Chinook salmon Puget Sound ESU, effective January 2, 2006 (70 FR 52629). Designated critical habitat for the Chinook salmon Puget Sound ESU includes approximately 3,824 km (2,376 miles) of nearshore marine areas. In nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high tide out to a depth no greater than 30 m (98 ft) relative to the MLLW (70 FR 52629).

Specific critical habitat PBFs essential for conservation of the Chinook salmon Puget Sound ESU are those sites and habitat components that support one or more life stages, including:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natura cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
- Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Steelhead, Puget Sound DPS

On May 11, 2007, NMFS listed the Puget Sound DPS of steelhead (*O. mykiss*) as threatened, effective June 11, 2007 (72 FR 26722), updated and effective on April 14, 2014 (79 FR 20802). The Puget Sound steelhead DPS includes more than 50 stocks of summer- and winter-run fish, the latter being the most widespread and numerous of the two run types (72 FR 26722).

Steelhead are in the salmon family (i.e., salmonid). They have dark spots scattered over their entire body, including the tail, with slight to pronounced rainbow coloring. They have a life span of approximately 4 to 6 years in the wild and can weigh up to approximately 14 kg (30 lbs.) or more but are between 3.6 and 5 kg (8 and 11 lbs.) on average. Steelhead have a varied diet, eating zooplankton when young, then fish eggs, small fish, crustaceans, mollusks, and insects as they mature.

Steelhead distribution extends from Kamchatka Peninsula of Russia east to Alaska, and south along the Pacific coast to the U.S.-Mexico border (Busby et al. 1996; 67 FR 21586). *O. mykiss* exhibit the most complex life history of any Pacific salmonid and can be either anadromous (steelhead) or freshwater residents (rainbow or redband trout [*O. mykiss gairdnerii*]) and can yield offspring of the alternate life history form (72 FR 26722). Anadromous *O. mykiss* may spend up to 7 years in freshwater prior to smoltification and spend up to 3 years in saltwater prior to migrating back to their natal streams to spawn and may spawn more than once in their lifetime (72 FR 26722).

Within the range of west coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity (72 FR 26722). In Washington State, steelhead are divided into two basic reproductive ecotypes — summer or winter run — based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner et al. 1992). The summer run or "stream-maturing" type enters freshwater in a sexually immature condition between May and October and requires several months to mature and spawn (72 FR 26722). The winter run or "ocean-maturing" type enters freshwater between November and April with well-developed gonads and spawns shortly thereafter (72 FR 26722).

Winter runs spawn close to the ocean—requiring less travel time—and prefer fast-flowing water in small-to-large mainstem rivers and medium-to-large tributaries (Myers et al. 2015). Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966; Roelofs 1983). When spawning, females dig out a redd in the gravelly bottom of a stream riffle and the male fertilizes them. The redd is covered by gravel until the eggs hatch.

The boundaries of a steelhead population are influenced in part by the spatial confines of its spawning habitat (Myers et al. 2015). Each river basin may have one or more peaks in migration activity, and the runs are usually named for the season in which the peak occurs (e.g., winter, spring, summer, or fall steelhead) (72 FR 26722). In areas with both summer and winter steelhead runs, the summer run usually happens where the winter run does not fully use the habitat, or where a temporary barrier, such as a seasonal waterfall, separates them. In Washington State, most steelhead summer runs occur east of the Cascade Mountains, entering streams in the summer to reach spawning grounds by the following spring (Myers et al. 2015). According to WDFW, there are no winter or summer steelhead streams on Blakely Island, making it unlikely that steelhead would migrate to and from Blakely Island for spawning or rearing reasons (WDFW 2024q). However, given the prominence of steelhead migrating and foraging throughout the Salish Sea, particularly to freshwater streams to the east of the San Juan Islands (e.g., Nooksack and North Fork Skagit Rivers), there is the potential for Puget Sound DPS steelhead to occur within or near the project area.

Factors leading to the decline of Puget Sound DPS steelhead and limiting their recovery include the following:

- Habitat destruction and modification.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel availability, and reduced movement of large woody debris.
- Continued urban development in the lower reaches of many Puget Sound rivers and tributaries, causing increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows.
- Altered stream hydrology from dikes and hardening riverbanks with riprap, resulting in gravel scour, bank erosion, disrupted sediment deposition, channelization, reduced river braiding and sinuosity, and increased likelihood of displacing rearing juveniles (NMFS 2016a).

Critical Habitat

On February 24, 2016, NMFS issued a final rule designating critical habitat for Puget Sound DPS steelhead, effective March 25, 2016 (81 FR 9251). The specific areas designated include approximately 3,269 km (2,031 miles) of freshwater and estuarine habitat in Puget Sound (81 FR 9251). The designated critical habitat for the Puget Sound DPS of steelhead does not overlap with the proposed Project area.

Eulachon, Southern DPS

On March 18, 2010, NMFS listed the Southern DPS of eulachon (*Thaleichthys pacificus*) as threatened, effective May 17, 2010 (75 FR 13012). The Southern DPS of eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to the Mad River in California (74 FR 10857). Within the range of the Southern DPS, core populations for this species include the Columbia and Fraser rivers and may have historically included the Klamath River (74 FR 10857).

Eulachon are anadromous smelt in the family Osmeridae. They are distinguished from other smelts by having four to six gill rakers on the upper half of the gill arch (others have eight to 14 gill rakers), and distinctive circular lines on the gill plate and the area below it (NMFS 2024s). Eulachon have a prominent adipose fin and exhibit strong blue and silver countershading (darker coloration on the top of the body and lighter on the bottom). Juvenile eulachon from 30–100 mm (1.2 to 4 in.) in length disperse within the first year of life to open marine waters on the continental shelf and reside near the bottom at depths of 50 to 200 m (164 to 656 ft), then mature when they are about 160 to 250 mm (6 to 10 in.) in length. Adults typically spawn at 2 to 5 years of age in the lower portions of rivers (NMFS 2024s). Many rivers within the range of eulachon have consistent yearly spawning runs; however, eulachon may appear in other rivers only on an irregular or occasional basis. The spawning migration usually occurs between December and June.

Eulachon are basically a cold-water species and are adapted to feed on a northern assemblage of copepods in the ocean during the critical transition period from larvae to juvenile (and much of their recent recruitment failure may be traced to mortality during this critical period) (75 FR 13012). Post-larval and juvenile (20–157 mm [0.8–6 in.]) eulachon consume various planktonic crustaceans, particularly adult copepods, and adult eulachon primarily consume euphausiids (krill) as well as cumaceans (small shrimp-like crustaceans) and copepods (NMFS 2022a).

Southern DPS eulachon can be found in the northeastern Pacific Ocean, from the Mad River in northern California to the Nass River in British Columbia, Canada (NMFS 2024s). Most of the eulachon production in Washington State originates in the Columbia River Basin, including the Columbia River, the Cowlitz River and Grays River, the Kalama River, Lewis River, and Sandy River (Gustafson et al. 2010; NMFS 2017). While eulachon spend 95 to 98 percent of their lives at sea (Hay and McCarter 2000; NMFS 2017), little is known concerning their saltwater life stage. However, eulachon have occurred as bycatch in some U.S.-based groundfish fisheries (NMFS 2017). The species may potentially be found through the Salish Sea, as the entirety of Washington's inland waters are within the Southern DPS eulachon's range (NMFS 2024s). However, there is scant evidence suggesting that Southern DPS eulachon would occur within the Project area, as their presence has been primarily observed within and near the Elwha River, which flows into the Strait of Juan de Fuca approximately 75 km (47 miles) away from the project area (Shaffer et al. 2007). Therefore, it is anticipated that Southern DPS eulachon would not occur within the Project area, or that it would be an extremely rare event.

The most significant threat to the Southern DPS of eulachon is the changing of ocean conditions due to climate change (e.g., a warming ocean leading to reduced foraging success) (74 FR 10857; NMFS 2024s). Distribution shifts result in increased predation of eulachon by Pacific hake, as well as increased competition for food resources with other species. The other two primary factors responsible for the decline of the Southern DPS of eulachon are the destruction, modification (e.g., river dams), or curtailment of habitat (in part due to climate change) and inadequacy of existing regulatory mechanisms (75 FR 13012). Climate-driven changes in streamflow timing and intensity impact eulachon spawning times, creating a mismatch in timing between their life history and prey species (Gustafson et al. 2010).

Critical Habitat

On October 20, 2011, NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon, effective December 19, 2011 (76 FR 65324). NMFS designated 16 specific areas as critical habitat within the states of California, Oregon, and Washington, consisting of a combination of freshwater creeks and rivers and their associated estuaries, encompassing approximately 539 km (335 miles) of habitat (76 FR 65324). The designated critical habitat for the Southern DPS of eulachon does not overlap with the proposed Project area.

Green Sturgeon, Southern DPS

There are two DPSs of North American green sturgeon (*Acipenser medirostris*): Northern DPS and Southern DPS. The Southern DPS has been listed as a threatened species under the ESA, whereas the Northern DPS of green sturgeon remains a federal Species of Concern. NMFS published a final rule on April 7, 2006, listing the Southern DPS as threatened, effective June 6, 2006 (71 FR 17757).

Southern DPS green sturgeon reach sexual maturity at about 15 years of age or a length of 150–155 cm (59–61 in.) (Van Eenennaam et al. 2006). They typically spawn every 3–5 years, primarily in the Sacramento River and its tributaries in California (Brown 2007; Mora et al. 2018; NMFS 2024b). Green sturgeon prey includes benthic invertebrates and fish, such as shrimp, mollusks, amphipods, crabs, anchovies, and sand lances (Moser and Lindley 2007; Dumbauld et al. 2008).

Green sturgeon typically occupy depths of 20–70 m (66–230 ft) in marine habitats (Erickson and Hightower 2007; Huff et al. 2011), quickly swimming up toward the surface at night (Erickson and Hightower 2007). They are found in high concentrations in coastal bays and estuaries along the North American west coast during the summer and fall, particularly in Washington State's Willapa Bay and Grays Harbor, and the Columbia River estuary (Lindley et al. 2008; Moser et al. 2016;

Schreier et al. 2016). Tagged individual green sturgeon released in the Sacramento River have been captured as far north as Willapa Bay, and those from the Columbia River have been captured from Vancouver Island to the Sacramento River (ODFW 2005; Moser and Lindley 2007).

Green sturgeon range from Mexico to Alaska in marine waters, foraging in estuaries and bays from San Francisco Bay, California to British Columbia, Canada (Houston 1988; Moyle and Leidy 1992; NMFS 2024b), travelling vast distances in the open ocean between freshwater rivers. Southern DPS green sturgeon spawn in the Sacramento River, then enter San Francisco Bay in late winter through early spring, migrate upstream, and spawn from April through early July (Heublein et al. 2009; Poytress et al. 2015; Miller et al. 2020). They spawn in deep pools within large, turbulent, freshwater river mainstems, and their eggs mainly stick to gravel or rocks, or settle in small cracks (Van Eenennaam et al. 2001). Upon hatching, they move downstream as they transition from larvae into juveniles.

Green sturgeon frequent Washington State's coastal waters and enter estuaries during summer when water temperatures are more than 2°C (3.6°F) warmer than adjacent coastal waters (Moser and Lindley 2007). Green sturgeon are present within the Strait of Juan de Fuca in greater numbers than Admiralty Inlet and Puget Sound (Moser et al. 2021), and they have designated critical habitat within the southern end of Rosario Strait, east of Lopez Island (74 FR 52299), that does not overlap with the project area. Given their presence within Washington State's coastal waters and estuarine systems and close proximity of designated critical habitat, with no barriers impeding their movement between their critical habitat and the project area, there is the potential for Southern DPS green sturgeon to occur within the project area.

The main threats to the Southern DPS of green sturgeon are dams and other impassible barriers, altered flows, and entrapment in water diversions that impede or inhibit their migration (NMFS 2024b), insufficient freshwater flow rates in spawning areas, contaminants, fisheries bycatch, poaching, invasive species, and unfavorable water conditions (NMFS 2021c, 2024g).

Critical Habitat

Critical habitat for the Southern DPS of green sturgeon was designated by NMFS on October 9, 2009, effective November 9, 2009 (74 FR 52299). The designated critical habitat for the Southern DPS of green sturgeon does not overlap with the proposed Project area.

Bull Trout, Coterminous U.S. Population (Coastal Recovery Unit)

On November 1, 1999, the USFWS listed all populations of bull trout (*Salvelinus confluentus*) within the coterminous U.S., including the Coastal-Puget Sound DPS, as threatened, effective December 1, 1999 (64 FR 58910). This final listing added bull trout in the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) to the previous listing of three DPSs of bull trout in the Columbia River, Klamath River, and Jarbidge River basins (80 FR 58767). The Coastal Recovery Unit of bull trout is located within western Oregon and Washington State, with the greater Puget Sound region being a major geographic region of the unit (USFWS 2015).

Bull trout size and age at maturity depend on habitat capacity and subsequent life history strategy, but resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard 1989; Al-Chokhachy and Budy 2008; USFWS 2015). Bull trout frequently live for 10 years, but occasionally for 20 years or more (McPhail and Baxter 1996; Al-Chokhachy and Budy 2008). Bull trout are opportunistic feeders in freshwater systems, preying on terrestrial and aquatic insects, macro-zooplankton, and small fish (Goetz 1994; Donald and Alger 1993). Adult fluvial migratory bull trout in Western Washington's coastal areas feed on Pacific herring, Pacific sand lance, and surf smelt (Goetz et al. 2004; USFWS 2015).

Bull trout exhibit resident and migratory life history strategies throughout much of their range, using small streams, large rivers, lakes, and marine waters to rear, mature, and spawn (Rieman and McIntyre 1993; USFWS 2015). Migratory bull trout spawn in tributary streams where juveniles stay from 1–4 years before migrating to either a lake (adfluvial) (Downs et al. 2006), river (fluvial form) (Fraley and Shepard 1989), or in certain coastal areas, to saltwater where maturity is reached (Goetz et al. 2004; Brenkman et al. 2007; USFWS 2015). Resident and migratory forms of bull trout may be found together, with either form producing offspring that exhibit either resident or migratory behavior (Brenkman et al. 2007; Homel et al. 2008; USFWS 2015). The amphidromous (fish that migrate between freshwater and saltwater, but not for reproduction) life form of bull trout is specific to the Coastal-Puget Sound DPS (64 FR 58921), often migrating seasonally to freshwater as sub-adults before returning to spawn (Willson 1997; Brenkman and Corbett 2005).

In freshwater systems, their specific habitat requirements have been described as the "Four C's:" cold, clean, complex, and connected habitat (USFWS 2015). They are seldom found in waters exceeding 15 to 18°C (59 to 64°F) and are often found in waters less than 12°C (54°F; USFWS 2015). Anadromous bull trout enter marine waters in early spring, with residence time in saltwater averaging 2 to 4 months (Goetz 2016). Bull trout's use of marine habitats in the Salish Sea is likely limited to nearshore areas with lower salinity levels. However, because bull trout are primarily a freshwater species, the extent to which they utilize nearshore marine habitats is not well understood.

Bull trout are a char native to western North America. Their range includes the Columbia River and Snake River basins, extends east to headwater streams in Idaho and Montana, into Canada and southeast Alaska, and to the Puget Sound and Olympic Peninsula watersheds of western Washington and Klamath River basin of south-central Oregon (USFWS 2015). Bull trout have been documented as being most abundant in Washington State's inland waters during spring and late summer, with relatively few captured during winter months (Goetz et al. 2004). They require stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors (USFWS 2008). Bull trout are present throughout freshwater streams and rivers in western Washington, including those east of the San Juan Islands (e.g., Samish and North Fork Skagit Rivers) that flow into Bellingham, Samish, and Skagit Bays (WDFW 2024q). Because there are no streams in the San Juan Islands known to be occupied by or serve as migration routes for bull trout, it is unlikely that they would be found in the Project area, though it is still possible.

The most significant threats that bull trout face are historical habitat loss and fragmentation, interaction with non-native species, and fish passage issues (USFWS 2008, 2015).

Critical Habitat

On September 26, 2005, critical habitat was designated for the Coterminous U.S. DPS (Coastal Recovery Unit) of bull trout, effective October 26, 2005 (70 FR 56211). On October 18, 2010, the USFWS revised the critical habitat designation, effective November 17, 2010 (75 FR 63897). The designated critical habitat for the Coterminous U.S. DPS (Coastal Recovery Unit) of bull trout does not overlap with the proposed Project area.

3.4.1.2 Echinoderms

Sunflower Sea Star (Proposed)

A petition to list the sunflower sea star (*Pycnopodia helianthoides*) under the ESA was submitted on August 18, 2021. On March 16, 2023, NMFS proposed to list the sunflower sea star as a threatened species under the ESA throughout its range (88 FR 16212). Sunflower sea stars are native to marine waters along the Pacific Coast, from northern Baja California to the central Aleutian Islands, including the Salish Sea. The species is most abundant in the waters off eastern Alaska and British Columbia (Lowry et al. 2022).

Adult sunflower sea stars have up to 24 arms and range in color from purple to brown, orange, or yellow. Using their 15,000 individual tube feet, they can move up to 1 m (3.3 ft) per minute, helping their ability to capture prey (Monterey Bay Aquarium 2024). The sunflower sea star is an opportunistic predator and generalist feeder that exploits diverse intertidal and subtidal habitats (Galloway et al. 2023). They use chemosensing (ability to sense chemicals) to locate prey, and their diet includes benthic and mobile epibenthic invertebrates (e.g., sea urchins, snails, crab, sea cucumbers, sea stars), sessile invertebrates (e.g., barnacles, bivalves), and dead or dying fish, seabirds, and octopus (Shivji et al. 1983; Mauzey et al. 1968; Brewer and Konar 2005; Lowry et al. 2022).

Sunflower sea stars are broadcast spawners, releasing large amounts of eggs and sperm into the water column to reproduce, which requires proximity to other individuals for successful fertilization (86 FR 73230). Although reproductive seasonality is largely undocumented, localized studies have documented breeding from December through June (Feder and Christensen 1966; Morris et al. 1980; Gravem et al. 2021). Egg fertilization is followed by a free-floating larval period that can last 50-146 days (Strathmann 1978; Gravem et al. 2021). Individuals then settle and transform into juveniles, which continue to feed and grow (86 FR 73230).

Sunflower sea stars are a broadly distributed, occurring on mud, sand, shell, gravel, rocky bottoms, kelp forests, and the lower rocky intertidal area (Mauzey et al. 1968; Lambert 2000; Galloway et al. 2023). Sunflower sea stars can live in waters ranging from a few feet deep to greater than 427 m (1,400 ft) deep but are most abundant in depths shallower than 25 m (82 ft) and rarely in depths greater than 120 m (394 ft) (Lambert 2000; Hemery et al. 2016; Gravem et al. 2021).

The sunflower sea star may occur within the project area, however, their abundance in the Salish Sea is generally considered to be very low since the outbreak of sea star wasting syndrome (SSWS), the primary threat to their existence. Since the outbreak of SSWS in 2013, through 2020 there was an estimated decline in density of approximately 92 percent in the Salish Sea, even with recent settlements having been recorded (Hamilton et al. 2021; Gravem et al. 2021; Lowry et al. 2022). While anecdotal evidence indicates sunflower sea star recruitment continues in the Salish Sea, few juveniles appear to survive until adulthood (Lowry et al. 2022). Despite substantial population declines from 2013 to 2017, sunflower sea stars still occupy the entirety of their range from Alaska to northern Mexico, including the Salish Sea (88 FR 16212). While it is anticipated that sunflower sea stars are unlikely to be present within the project area due to the decimated population numbers, given that they are habitat generalists with a preference for depths at which the project would occur, there is the potential for them to occur within the project area.

Critical Habitat

NMFS has not proposed designating critical habitat because it is not currently determinable (88 FR 16212).

3.4.2 Essential Fish Habitat

Section 3 of the MSA defines EFH as "*those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*" (50 CFR § 600.10). For the purposes of this definition: "*Waters*" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "*substrate*" includes sediment, hard bottom, structure 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; "*spawning, feeding, and breeding*" is meant to encompass the complete life cycle of a species (50 CFR § 600.10).

EFH is determined by identifying spatial habitat and habitat characteristics that are required for each federally managed species through a cooperative effort by NMFS, Fishery Management Councils (FMCs), and federal and state agencies. These descriptions provide the basis for assessing development and other activities in specified marine areas. Further, EFH is designated based on best available scientific information and the levels defined by the MSA:

- Level 1 information corresponds to distribution.
- Level 2 information corresponds to density or relative abundance.
- Level 3 information corresponds to growth, reproduction, or survival rates.

- Level 4 information corresponds to production rates.

The PFMC has jurisdiction over federal waters off the coasts of Washington State, Oregon, and California. Specifically, the PFMC has jurisdiction over the management of fisheries for species such as groundfish, salmon, coastal pelagic species, and highly migratory species like tunas and sharks. Section 305(b)(2) of the amended MSA directs each federal agency to consult with NMFS with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by such agency that may adversely affect any EFH. Implementing regulations for this requirement are at 50 CFR 600 of the MSA.

EFH is found within the proposed Project area for Pacific Coast Groundfish (all life stages), Pacific Coast Salmon, and Pacific Coastal Pelagic Species (CPS) for finfish and market squid (all life stages), the *Thysanoessa Spinifera* and *Euphausia Pacifica* species of krill (all life stages), and other krill species (all life stages) (**Table 10**). All the species are managed by PFMC.

Table 10. EFH Within the Proposed Project area

Common Name (*Scientific Name*)	Fishery Management Plan
Species	
Pacific Coast Groundfish (all life stages)	Pacific Coast Groundfish FMP
Pacific CPS (all life stages)	CPS FMP
Finfish and Market Squid	CPS FMP
Krill (*Thysanoessa Spinifera*)	CPS FMP
Krill (*Euphausia Pacifica*)	CPS FMP
Other Krill Species	CPS FMP
Pacific Coast Salmon	Pacific Coast Salmon FMP
Chinook Salmon (*Oncorhynchus tshawytscha*)	Pacific Coast Salmon FMP
Coho Salmon (*O. kisutch*)	Pacific Coast Salmon FMP
Pink Salmon (*O. gorbuscha*)	Pacific Coast Salmon FMP
Notes: CPS = Coastal Pelagic Species; EFH = essential fish habitat; FMP= Fishery Management Plan	

3.4.2.1 Habitat Areas of Particular Concern (HAPC)

In addition to EFH designations, regional FMCs designate HAPC. Designated HAPC are discrete subsets of EFH that provide highly important ecological functions or are especially vulnerable to degradation (50 CFR § 600.805–600.815). Categorization of an area as HAPC does not confer additional protection or restriction to the designated area. HAPC include estuaries, canopy kelp, seagrass, rocky reefs, and “areas of interest” for groundfish. In Washington State, “areas of interest” refer to all waters and sea bottom in state waters shoreward to the MHHW. FMCs may designate a specific habitat area as a HAPC based on one or more of the following reasons:

1) Importance of the ecological function(s) provided by the habitat.
2) The extent to which the habitat is sensitive to human-induced environmental degradation.

3) Whether, and to what extent, development activities are, or will, stress the habitat type.
4) Rarity of the habitat type.

No HAPCs were identified within the proposed Project area. Eelgrass presence at the new subsea cable landing site has been designated as “patchy” by DNR (2025); however, surveys conducted by Tetra Tech, Inc. in October 2024 detected no eelgrass in the MBE data, nor were any observed (**Figure 49**; Appendix C1). Patchy and continuous kelp beds are also present along the Blakely Island coastline (DNR 2025), but survey results indicate that they are not near the existing conduit (**Figure 50** and **Figure 51**).

Figure 49. Eelgrass on the Blakely Island Shoreline

Figure 50. Kelp Beds on the Blakely Island Shoreline

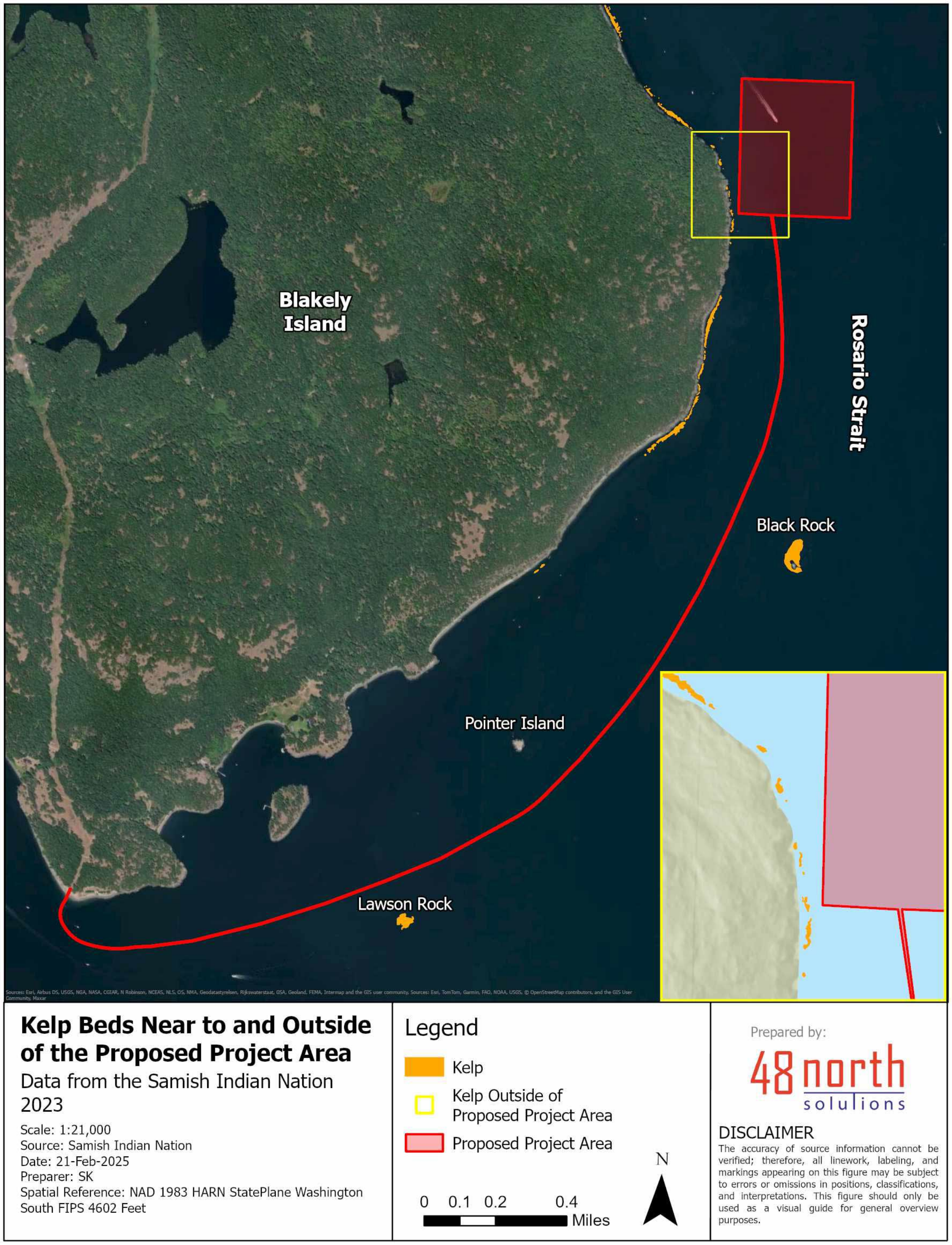

Figure 51. Kelp Beds Surveyed by the Samish Indian Nation in 2023

3.4.2.2 Pacific Coast Groundfish

The management unit in the Pacific Coast Groundfish Fishery Management Plan (FMP) includes more than 90 groundfish species over the entire U.S. west coast Exclusive Economic Zone (EEZ; an area of coastal water and seabed that the U.S. claims exclusive rights for fishing and other economic activities). Groundfish include many species of rockfish, sablefish, flatfish, and Pacific whiting that are often, but not exclusively, found on or near the ocean floor or other structures. Groundfish that may be present within the proposed Project area include:

- Dover sole (*Microstomus pacificus*)
- Starry flounder (*Platichthys stellatus*)
- Sand sole (*Psettichthys melanostictus*)
- English sole (*Parophrys vetulus*)
- Lingcod (*Ophiodon elongatus*)
- Pacific cod (*Gadus macrocephalus*)

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 other species. Therefore, the FMP 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.

The Pacific Coast Groundfish EFH consists of the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. The PFMC identifies the overall area designated as groundfish EFH for all species covered in the FMP as all waters and substrates within the following areas: depths less than or equal to 3,500 m (11,500 ft) to MHHW level, 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 during the period of average annual low flow; seamounts in depths greater than 3,500 m (11,500 ft); and areas designated as HAPC not identified by the above criteria (PFMC 2024c).

This PFMC groundfish EFH identification follows a precautionary approach because uncertainty still exists about the relative value of different habitats to individual groundfish species and life stages, and thus the actual extent of groundfish EFH (PFMC 2024c). The primary habitats designated as EFH for groundfish include: the epipelagic zone (sunlight zone) of the water column, including macrophyte canopies (seaweed) and drift algae; unconsolidated sediments consisting of mud, sand, or mixed mud/sand; hard bottom habitats composed of boulder, bedrock, cobble, gravel, or mixed cobble/gravel; mixed sediments composed of sand and rocks; vegetated bottoms consisting of algal beds, macrophytes (aquatic plants), or rooted vascular plants. The entirety of the Project area lies within Pacific Coast Groundfish EFH, including the epipelagic zone of the water column, hard bottom habitats, and mixed sediment areas.

3.4.2.3 Pacific Coastal Pelagic Species (CPS)

CPS have value to commercial fisheries and are important prey species for other fish, marine mammals, and birds. The CPS FMP specifies a management framework for four finfish, invertebrate market squid, and all euphausiid krill species in the U.S. west coast EEZ (PFMC 2024a), listed below:

- Northern anchovy (*Engraulis mordax*, central and northern populations).
- Pacific sardine (*Sardinops sagax*).
- Pacific (chub) mackerel (*Scomber japonicus*).
- Jack mackerel (*Trachurus symmetricus*).
- Market squid (*Doryteuthis opalescens*).
- Krill: *Euphasia pacifica*, *Thysanoessa spinifera*, *Nyctiphanes simplex*, *Nematocelis difficilis*, *T. greagaria*, *E. recurve*, *E. gibboides*, and *E. eximia.*

CPS finfish are pelagic (i.e., in the water column near the surface and not associated with substrate). CPS are grouped together as a single species complex due to similarities in life history, habitat requirements, and/or overfishing pressures.

The PFMC defines the EFH for CPS finfish based on thermal range bordered by the geographic area where finfish occur at any life stage, where CPS have historically occurred during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS (PFMC 2024a). The identification of EFH for CPS accommodates the fact that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean (PFMC 2024a).

According to the PFMC (2024a), the east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of Washington State, Oregon, and California offshore to the boundaries of the EEZ and above the thermocline (where sea surface temperatures range between 10°C and 26°C [50°F and 79°F]). The southern boundary is the U.S.-Mexico maritime boundary. The northern boundary is more dynamic and is defined as the position of the 10°C (50°F) isotherm (a line on a map that connects points that have the same mean temperature), which varies seasonally and annually (PFMC 2024a).

The EFH designation for krill extends the length of the U.S. west coast from the shoreline to the 1,000-fathom isobath (approximately 1,830 m or 6,000 ft) and to a water depth of 400 m (1,312 ft) and is based on information for the two principal species, *Euphausia pacifica* and *Thysanoessa spinifera* (PFMC 2024a). CPS are considered sensitive to overfishing, loss of habitat, reduction in water and sediment quality, and changes in marine hydrology (PFMC 2024a). The Project area lies entirely within Pacific CPS EFH, particularly the components that would reside within the water column.

3.4.2.4 Pacific Coast Salmon

The FMP for Pacific Coast Salmon covers all natural and hatchery salmon species caught by fisheries in the waters off the coasts of Washington State, Oregon, and California (PFMC 2024b). Chinook salmon, coho salmon (*Oncorhynchus kisutch*), and pink salmon (*O. gorbuscha*) are the main species covered by the plan.

Chinook and coho salmon EFH includes all water bodies currently or historically occupied by PFMC-managed Chinook and coho salmon and includes the estuarine and marine areas extending from the extreme hightide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the EEZ (200 NM) offshore of Washington State, Oregon, and north of Point Conception in California (50 CFR §660.412). Puget Sound pink salmon EFH includes all water bodies currently or historically occupied by PFMC-managed Puget Sound pink salmon in Washington State, and includes the estuarine and marine areas extending from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters north and east of Cape Flattery, Washington, including Puget Sound, the Strait of Juan de Fuca, and Strait of Georgia; and the waters of the U.S. EEZ north of the 48°N latitude to the U.S.-Canada border (50 CFR §660.412). According to the definition (50 CFR §660.412), the Project area would lie within Pacific Coast Salmon EFH.

For Pacific salmon, the PFMC has designated five HAPC prioritized for conservation and management efforts (PFMC 2014):

1) Complex channels and floodplain habitats.
2) Thermal refugia.
3) Spawning habitat (low gradient stream reaches [less than 3 percent], containing clean gravel with low levels of fine sediment and high inter gravel flow).
4) Estuaries (nearshore areas such as bays, sounds, inlets, river mouths and deltas, pocket estuaries, and lagoons influenced by ocean and freshwater).
5) Marine and estuarine submerged aquatic vegetation (e.g., canopy kelps and eelgrass).

Except for estuaries, none of these HAPCs have been comprehensively mapped, and some may vary in location and extent over time. The Project area is not anticipated to overlap with HAPCs for Pacific Coast Salmon.

3.4.3 Acoustic Environment

To measure ambient noise levels within the Project area, APL-UW deployed two Loggerhead Snap recording hydrophones 3 m (9.8 ft) above the seabed (Appendix C2). The units were equipped with High Tech, Inc. 96-min hydrophones (serial numbers 4371090 and 4371088) with nominal sensitivities of approximately -170 decibels relative to 1 volt per I micropascal (dB re 1V/μPa), including internal preamplifiers. The units were programmed with an additional 11.1 dB gain applied by the analog to digital converter prior to data storage. Sampling with hydrophones was carried out for 30 s every 10 minutes throughout the deployment at a sampling rate of 44.1 kHz. Recordings produced data for pressure spectral densities (PSDs; in dB re 1 μPa^2/Hz) and sound pressure level (SPL; in dB re 1μPa) calculations, all derived from frequency-domain analysis of each recording. PSD curves were integrated to calculate SPLs.

SPL is a means of characterizing the amplitude of sound. Noise levels exhibited some dependence on velocity that was not clearly attributed to flow noise, as demonstrated by the distributions in **Figure 52** and **Figure 53**. The distributions in **Figure 52** indicate that the overall impact of flow noise at frequencies greater than 500 hertz (Hz) is relatively small. All plots in **Figure 52** show that for currents below 0.4 m/s (1.3 ft/s) the upper and lower limits of measured noise do not change, suggesting flow noise is minimal. This may be attributed to sediment generated noise (Basset et al. 2013), bubbles entrained due to turbulence, and other identified noise sources.

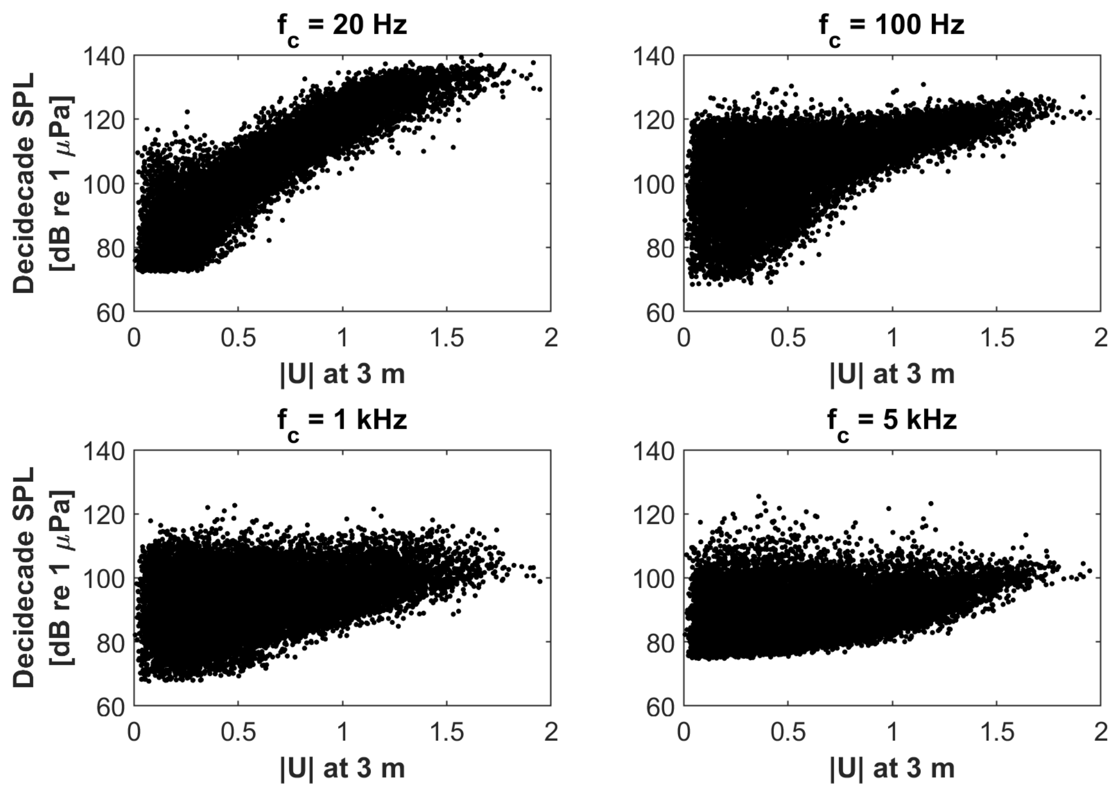

Figure 52. Distribution of Decidecade SPLs as a Function of Frequency, at Four Frequencies (20 Hz, 100 Hz, 1 kHz, and 5 kHz)

A time series of broadband SPLs (500 Hz to 20 kHz) is shown in **Figure 53**. Throughout the hydrophone deployment (October 2024 to January 2025), SPLs on the order of 85 dB re 1µPa were recorded regularly, while the maximum broadband SPL recorded was approximately 134 dB re 1µPa.

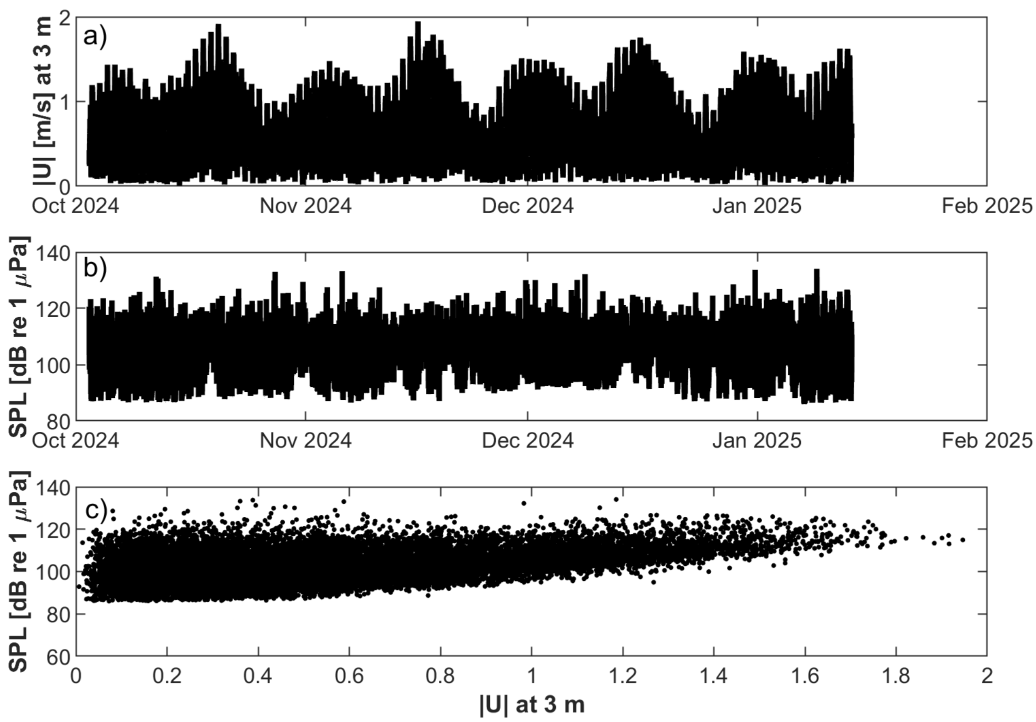

Figure 53. (a) Current Speed at 3 m (9.8 ft) Above Seabed; (b) Broadband SPLs (500 Hz to 20 kHz); (c) Broadband SPLs as a Function of Current Speed

A shorter time series (one day, November 2, 2024) of current speed and broadband SPLs in shown in **Figure 54**. The data show that while increases in inflow speed do result in higher noise floor, the highest levels of ambient noise that are observed are not correlated with the inflow conditions. Noise measurements were taken every 10 minutes and **Figure 54** shows broadband SPLs regularly changed substantially during these periods. While this reveals that the variability in the soundscape was under-resolved at short time scales, it is hypothesized that over the multi-month APL-UW data sampling period, the broader statistics likely capture the full distribution of noise at the Project area.

Broadband (10 Hz to 22 kHz) SPL distributions for the velocity threshold data APL-UW collected are shown in **Figure 55**. The mean broadband SPL calculated for low speeds throughout the hydrophone deployment was 120.3 dB re 1µPa, while the median value was 110.2 dB re 1µPa. The impact of the high intensity levels on the mean is shown in the empirical cumulative distribution functions (ECDF; **Figure 55** [right]), which show that although the mean broadband SPL is approximately 120 dB re 1µPa, SPLs are lower than the mean approximately 78 percent of the time (during low flow period). These are relatively noise conditions that are consistent with prior observations in the Salish Sea, which are attributed primarily to vessel traffic (Bassett et al. 2012).

Empirical probability density functions (EPDFs) for spectral levels at frequencies between 10 Hz and 20 kHz are shown in **Figure 56** (white and red lines show the median and mean values, respectively), calculated for data with current speeds below 0.4 m/s (1.3 ft/s). The highest PSDs that are regularly observed occur below 100 Hz are likely attributed to vessel traffic in Rosario Strait. The distribution of observed noise levels generally decreases with frequency with the highest probability spectral densities occurring between approximately 70 and 0 dB re 1 µPa^2/Hz around 100 Hz, 60 and 80 dB re 1 μPa²/Hz around 1,000 Hz, and between 45 and 55 dB re 1 μPa²/Hz around 10 kHz. At frequencies near 10 kHz, high structure noise exists that creates frequency-dependent patterns in the data, likely attributable to self-noise from an instrument or other equipment that was part of the hydrophone deployment. Decidecade SPL Statistics and a Contour Plot of EPDFs of Decidecade SPLs are shown in **Figure 57** and reflect the broader trends identified in the statistics for PSDs.

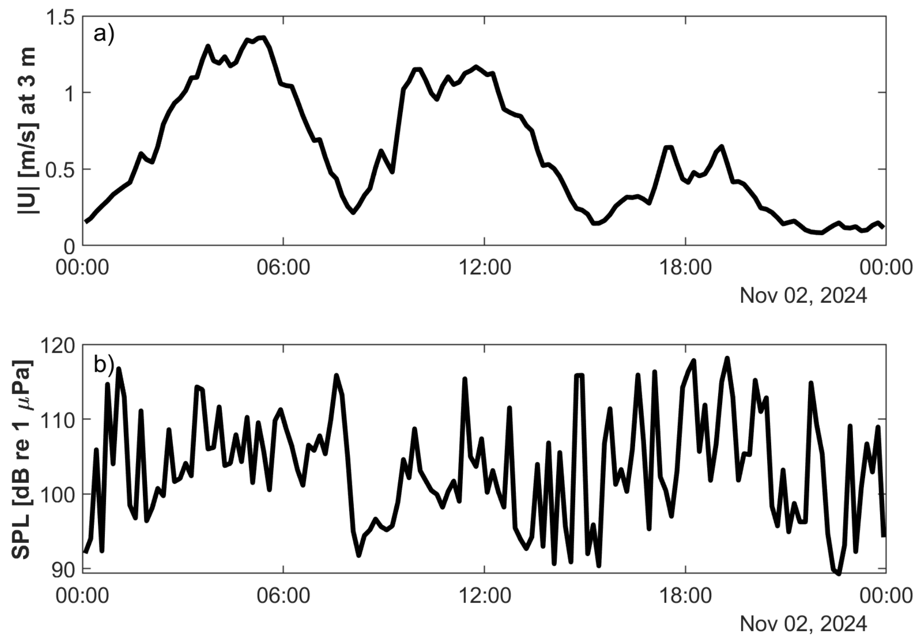

Figure 54. Time Series Data for a Single Day (November 2, 2024)

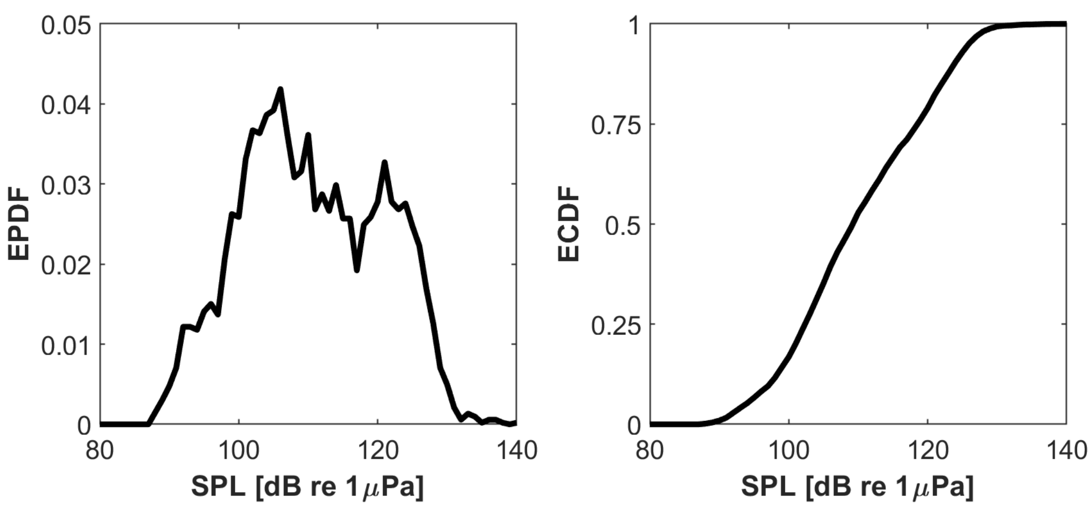

Figure 55. (Left) EPDFs and (Right) ECDFs for Broadband Noise at Low Current Speeds in Project Area

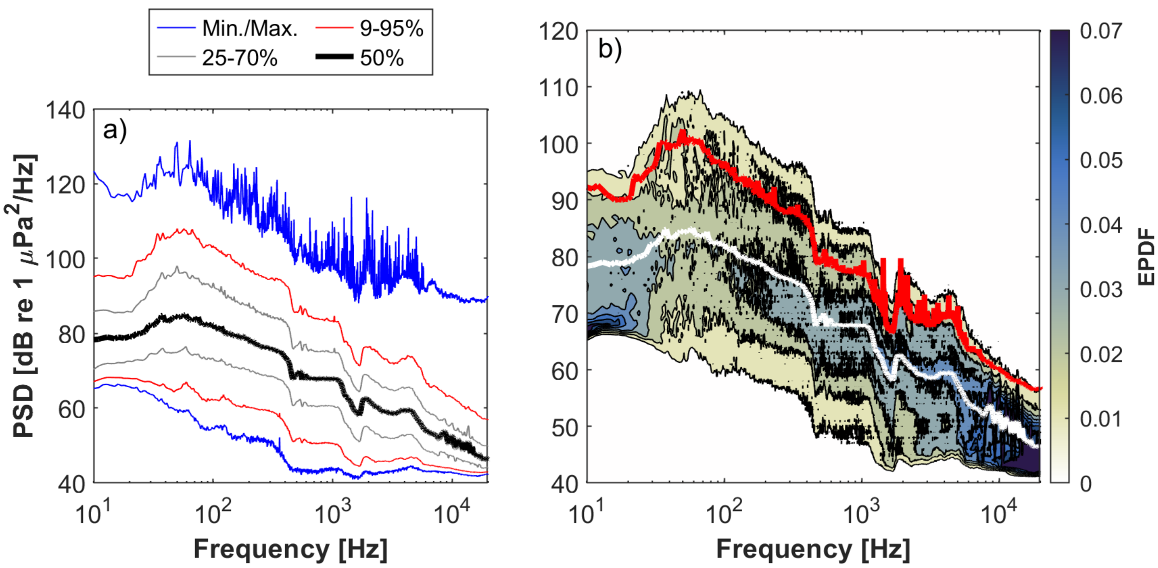

Figure 56. (a) PSD Statistics and (b) Contour Plot of EPDFs of Pressure Spectral Densities

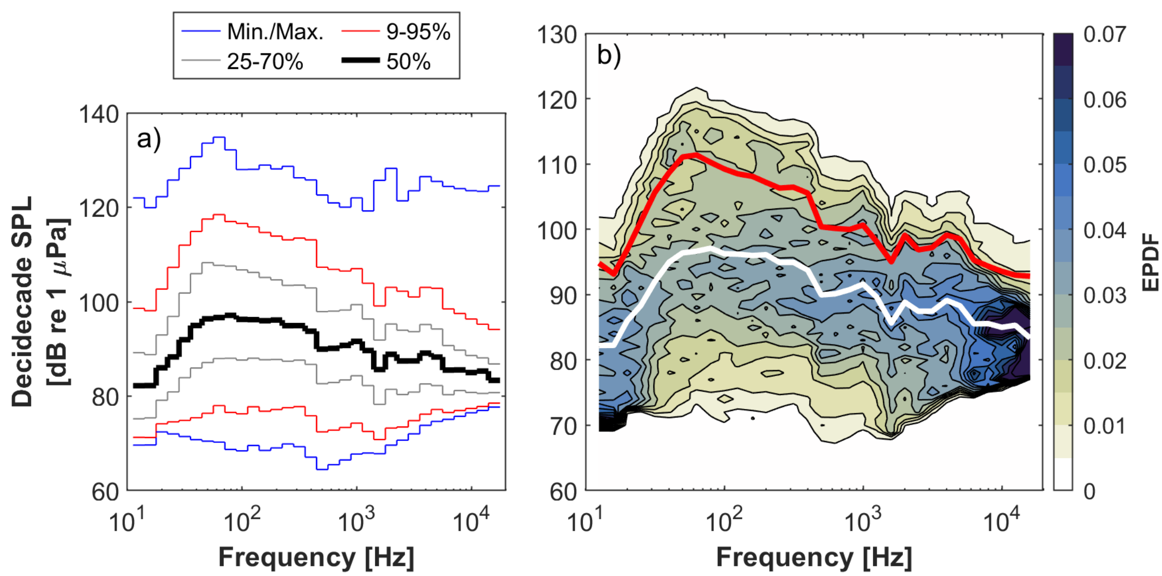

Figure 57. (a) Decidecade SPL Statistics and (b) a Contour Plot of EPDFs of Decidecade SPLs

3.5 Wildlife and Botanical Resources

The wildlife resources described include marine mammal species, avian (including seabird) species, Washington state's Priority Habitats and Species (PHS), aquatic invasive species of greatest concern, and insects (monarch butterfly) that may occur within the project area. This Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island itself; therefore, terrestrial resources are only briefly addressed. The existing below- and above-water acoustic environments, including estimated decibel levels, are also described.

3.5.1 Marine Mammals

The Marine Mammal Protection Act (MMPA) (**Section 1.3.1.3**) prohibits the take of marine mammals. Thirteen marine mammal species occur within the Salish Sea (**Table 11**) with the possibility that they could occur within the vicinity of the Project area, with varying degrees of likelihood. The federally threatened southern sea otter (*Enhydra lutris nereis*)—also protected under the MMPA—is not included because its range is predominantly on Washington's outer coast and lies outside of the Salish Sea (Hale et al. 2022). The North American river otter (*Lontra canadensis*), while abundant throughout the Salish Sea and San Juan Islands, is not included because it is primarily a terrestrial animal not protected under the MMPA.

Table 11. Marine Mammals in the Salish Sea

Common Name (*Scientific Name*)	Protection	Presence in Proposed Project Area
Whales		
Humpback Whale, Mexico and Central America DPSs (*M. novaeangliae*)	ESA, MMPA	Uncommon
Gray Whale (*Eschrichtius robustus*)	MMPA	Uncommon
Minke Whale (*Balaenoptera acutorostrata*)	MMPA	Uncommon
Dolphins and Porpoises		
Killer Whale, Southern Resident DPS (*Orcinus orca*)	ESA, MMPA	Uncommon
Bigg's (Transient) Killer Whale (*Orcinus rectipinnus*)	MMPA	Uncommon
Short-finned Pilot Whale (*Globicephala macrorhynchus*)	MMPA	Uncommon
Dall's Porpoise (*Phocoenoides dalli*)	MMPA	Uncommon
Harbor Porpoise (*Phocoena phocoena*)	MMPA	Common
Pacific White-sided Dolphin (*Lagenorhynchus obliquidens*)	MMPA	Uncommon
Pinnipeds		
California Sea Lion (*Zalophus californianus*)	MMPA	Common
Harbor Seal (Washington Inland Waters Stock) (*Phoca vitulina*)	MMPA	Common
Northern Elephant Seal (*Mirounga angustirostris*)	MMPA	Uncommon
Steller Sea Lion (*Eumetopias jubatus*)	ESA[1], MMPA	Uncommon

Common Name (*Scientific Name*)	Protection	Presence in Proposed Project Area
Notes: ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act 1. The Steller Sea Lion is split into two populations: Eastern (not ESA-listed) and Western DPSs (endangered). The Eastern DPS is the population east of 144°W; however, Western DPS Steller Sea Lions do also occur east of 144°W. NMFS (Alaska Region) offers guidance on the occurrence of Western and Eastern DPSs east of 144°W (2020), but these occurrences primarily occur within Alaska and are not within the proposed Project area, San Juan Islands, or Salish Sea (NMFS 2020). Therefore, the Western DPS (endangered) of the Steller Sea Lion is not considered to be present within or anywhere near the proposed Project area.		

3.5.1.1 Federally Listed Marine Mammals

Federally ESA-listed marine mammals that may occur within the Project area include the Southern Resident DPS of killer whales (SRKW; *Orcinus orca*) and Central America and Mexico DPSs of humpback whales (*Megaptera novaeangliae*).

Killer Whale, Southern Resident DPS

The SRKW was listed by NMFS as endangered on November 15, 2005, effective February 16, 2006 (70 FR 69903), and updated on April 4, 2014 (79 FR 20802). The SRKW is one of four distinct and recognized communities of resident killer whales in the northeastern Pacific: Southern, Northern, Southern Alaska, and Western Alaska (NMFS 2021b, 2024f). The Southern Resident DPS consists of three pods—J, K, and L—which are frequently sighted near the San Juan Islands (Olson et al. 2018).

SRKWs have a lifespan of approximately 30–90 years. Mating and calving seasons often span several months, with a 17- to 18-month gestational period (Krahn et al. 2002). In Washington State waters, most SRKW births occur between October and March, indicating a mating season from May to September (Olesiuk et al. 1990). SRKWs usually give birth to a single calf every 3 to 10 years. SRKWs prey on salmonids, in particular Chinook salmon (Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016) and to a lesser extent steelhead (*Oncorhynchus mykiss)* (Hanson et al. 2021). They are highly mobile, travelling up to 160 km (99 miles) in a 24-hour period (Baird and Whitehead 2000).

The SRKW range extends from southeastern Alaska to central California. Historically, SRKWs have spent a significant portion of the year in Washington State's inland waterways, having been consistently present during the spring, summer (especially August), and fall, when all three pods regularly occur around San Juan Islands (Felleman et al. 1991; Heimlich-Boran 1988; Osborne 1999; Olson et al. 2018). During the warmer months, all three pods would concentrate their activities in Haro Strait, Boundary Passage, the southern Gulf Islands, the eastern end of the Strait of Juan de Fuca, and several localities in the southern portion of the Strait of Georgia (Felleman et al. 1991; Heimlich-Boran 1988; Ford et al. 2011). Rosario Strait would be used by SRKWs with less frequency than other areas of the Salish Sea (**Figure 58**; Olson et al. 2018).

However, recent shifts in the availability and presence of SRKWs' preferred prey, particularly Fraser River Chinook Salmon, within the central Salish Sea, is believed to have resulted in shifting SRKW presence throughout Washington's inland waters (Ettinger et al. 2022; Shields 2023). The K and L pods would typically arrive in May or June and remain until October or November, making frequent trips lasting a few days to Washington State's outer coast (Ford et al. 2011). The J pod has typically occurred intermittently in the Georgia Basin during late fall, winter, and early spring. Recent studies have suggested that this seasonal trend has essentially reversed over the course of the past 20 years, with summer presence declining and May to August being the time in which SRKWs are least present in central Salish Sea, while their late fall and winter (October through February) presence has been increasing (Ettinger et al. 2022; Shields 2023).

One of the most important habitat features for SRKWs is the availability of salmon prey, with the occurrence of SRKWs in the Salish Sea being strongly correlated with salmon migration (Heimlich-Boran 1988; Felleman et al. 1991; Bubac et al. 2021). Major corridors for migrating salmon and SRKW presence are primarily in Haro Strait and west of San Juan Island (J, K, and L pods), but much less in Rosario Strait (J and L pods) (Ford et al. 2011; Hauser et al. 2007; Bubac et al. 2021). Therefore, while there is the potential for SRKWs to occur within or near the project area, given their more heavily used migration and foraging routes, they are not anticipated to be common within the project area.

The three main causes of SRKW decline are:

- Reduced prey quantity and quality leading to poor body conditions (Durban et al. 2009; Fearnbach et al. 2011, 2018; Wasser et al. 2017; Matkin et al. 2017).
- Persistent organic pollutants causing immune or reproductive system dysfunction (NMFS 2021b).
- Vessel noise and disturbance (NMFS 2014b, 2024f).

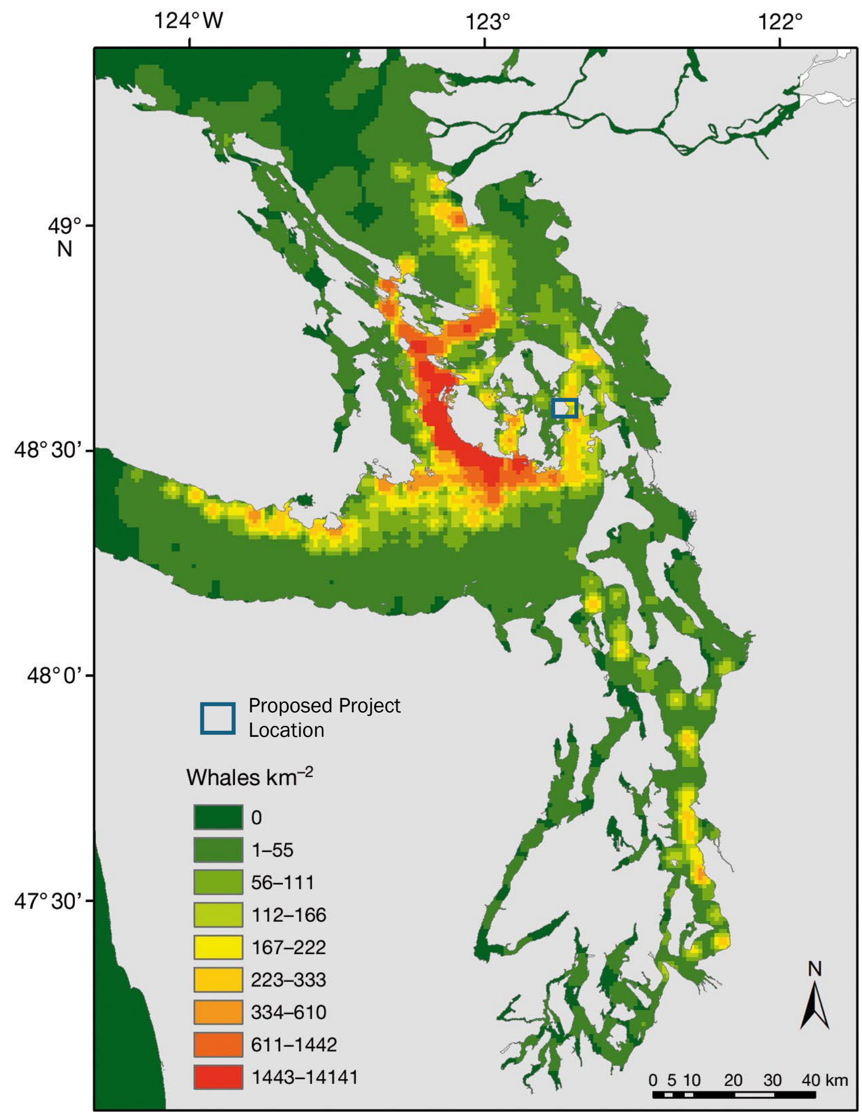

Figure 58. SRKW Density Based on Effort-Corrected Data in the Salish Sea from 1976–2014
Source: Olson et al. 2018

Critical Habitat

Critical habitat for SRKWs was designated on November 29, 2006, effective December 29, 2006 (71 FR 69054). It was expanded on August 2, 2021, effective September 1, 2021 (86 FR 41668). Designated SRKW critical habitat includes the marine waters of Washington State, including "*waters relative to a contiguous shoreline delineated by the line at a depth of 6.5 m [21.3 ft] relative to extreme high water*." The proposed Project area lies within SRKW designated critical habitat, as part of the *Summer Core Area*. The *Summer Core Area* consists of all U.S. marine waters in Whatcom and San Juan counties; and all marine waters in Skagit County west and north of the Deception Pass Bridge (Highway 20) (48°24'25" N/122°38'35" W) (86 FR 41668).

The PBFs essential for conservation of the SRKW are (86 FR 41668):

- 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.
- Passage conditions to allow for migration, resting, and foraging.

Humpback Whale, Central America and Mexico DPSs

On September 8, 2016, NMFS designated four DPSs of the humpback whale (*Megaptera novaeangliae*) as either threatened or endangered, effective October 11, 2016 (81 FR 62259). The Mexico DPS of humpback whales was designated as threatened and the Central America DPS as endangered. NMFS, Alaska Region, have published Section 7 guidance for humpback whale consultations, updated on August 6, 2021 (NMFS 2021a). Within it, NMFS lists the probability of encountering different humpback whale DPSs in inland Washington State waters (including the San Juan Islands) summer feeding area as follows: Hawaii DPS (not ESA-listed) at 69 percent; Mexico DPS (listed threatened) at 25 percent; and Central America DPS (listed endangered) at 6 percent (Wade 2021; NMFS 2021a).

Humpback whales can live up to 90 years, grow to a length of 18 m (60 ft), and weigh up to approximately 40 tons (NMFS 2024c). Their bodies are primarily black, but individuals have different amounts of white on their pectoral fins, bellies, and the undersides of their flukes (tails). Their flukes can be up to 5.5 m (18 ft) wide and are serrated along the trailing edge and pointed at the tips (NMFS 2024c). Female humpbacks mature and reproduce between approximately 5 and 11 years of age (Chittleborough 1955; Gabriele et al. 2017), producing a single calf every 2–3 years (Clapham et al. 2003). Humpback whales forage either at or below the water surface, feeding on benthic and pelagic organisms including euphausiids, copepods, and other crustacean zooplankton; small schooling fish (e.g., sand lance and herring); and salmonids, pollock, capelin, and some cephalopod mollusks (Perry et al. 1999).

Humpback whales primarily congregate along the continental shelf in coastal habitats that are highly productive and provide available prey. The west coast of Washington State is a corridor for humpback whale annual migration from their northern feeding grounds to their southern breeding grounds. The Mexico DPS population breeds along the Pacific Coast of Mexico and the Revillagigedo Islands, transits the Baja California Peninsula, and feeds across a broad range from California to the Aleutian Islands in Alaska (81 FR 62259; NMFS 2024c). The Central America DPS breeds along the Pacific coast of Central America and primarily feeds off the coast of California and Oregon, with a few entering northern Washington State and southern British Columbia waters (81 FR 62259; NMFS 2024c).

Sightings of humpbacks in the Salish Sea have been historically rare; however, they have been increasing since the late 1990s. A total of 13 unique individual humpback whales were sighted in 2003 and 2004, 11 of which could be identified in inside waters of British Columbia or Washington State (primarily in the Strait of Juan de Fuca and Strait of Georgia), including one juvenile in the San

Juan Islands (Falcone et al. 2005). In both 2014 and 2015, there were more than 500 sighting reports of humpback whales in the Salish Sea (Calambokidis et al. 2017). Most of the humpback sightings have occurred within the Strait of Juan de Fuca, Haro Strait, Moresby Passage, and Southern Puget Sound (Calambokidis et al. 2017). It is anticipated that a Mexico and/or Central America DPS humpback whale occurrence within the project area would be a rare event; however, there is the possibility that it could occur given their increasing presence within the Salish Sea and passages around the San Juan Islands.

Increased vessel strikes and fishing gear entanglement are the primary threats to the Mexico and Central America DPSs, especially in areas with large vessel traffic (Carretta et al. 2010, 2019; Neilson et al. 2012; Douglas et al. 2008; Bettridge et al. 2015; 81 FR 62259). Vessel noise from whale watching activities has been shown to be a driver of behavioral changes in humpback whales, resulting in decreased resting time, increased respiration rate, increased swim speed, and altered group cohesiveness (Senigaglia et al. 2016; Machernis et al. 2018; Sprogis et al. 2020).

Critical Habitat

On October 9, 2019, NMFS proposed designated critical habitat for the endangered Central America DPS and threatened Mexico DPS of humpback whales (84 FR 54354), publishing their final rule on April 21, 2021, effective May 21, 2021 (86 FR 21082). The designated critical habitat for the Central America DPS and Mexico DPS does not overlap with the proposed Project area.

3.5.1.2 MMPA Species

Whales

Whale species present within the Salish Sea include the gray whale (*Eschrichtius robustus*), minke whale (*Balaenoptera acutorostrata*), and humpback whale (*Megaptera novaeangliae*). The fin whale (*Balaenoptera physalus*) is extremely rare within the Salish Sea, with an anomalous sighting in 2016 in the Strait of Juan de Fuca and none confirmed between then and 1930 (Towers et al. 2018). Therefore, the fin whale is not further discussed in this document.

Gray Whales

Gray whales are between 13 and 15 m (43 and 49 ft), weighing up to 40,823 kg (90,000 lbs.), with a mottled gray body and small eyes above just above the corners of their mouth, broad pectoral flippers, and dorsal humps (NMFS 2024h). They are frequently observed traveling alone, or in small and mostly unstable groups. They inhabit shallow coastal waters in the North Pacific Ocean. Most of the eastern North Pacific stock, found along the west coast of North America, migrate north to the Bering and Chukchi Seas during the summer to feed. In the fall, gray whales migrate south to Baja California to breed, with calves born during migration or in Mexico's shallow lagoons and bays in January to mid-February (NMFS 2024h). They are primarily bottom feeders, consuming benthic and epibenthic invertebrates such as amphipods. Gray whales are observed in the spring and summer in Washington State's inland waters, and the areas around the San Juan Islands are important for their migration and feeding (Copping et al. 2021). Therefore, while it is anticipated that they are not common, there is the potential for gray whales to be present within or near the project area.

Minke Whales

Minke whales are the smallest species of rorqual baleen whales in North American waters (i.e., whales that have pleats or grooves on their throats and bellies, known for their ability to take in large amounts of water and food when feeding). They have dark, sleek bodies that can reach up to 11 m (36 ft) in length and weigh up to 9,072 kg (20,000 lbs.), with black to dark gray-brown in color with a white underbelly and a pale chevron on their back behind their head (NMFS 2024i). Minkes vocalize and create sounds that include clicks, grunts, pulse trains, ratchets, thumps, and "boings." They are usually sighted individually or in small groups of two or three but have been observed in groups as large as 400 in feeding areas near the Earth's poles. They most likely mate and calve in the winter and opportunistically feed on crustaceans, plankton, and small schooling fish (e.g., anchovies, dogfish, coal fish, cod, eels, mackerel, and more) (NMFS 2024i).

Minke whales are found in coastal and oceanic areas globally but prefer temperate to boreal waters. They feed in cooler waters at higher latitudes and can be found in both inshore coastal and offshore oceanic areas. Minke whales are present within the inland waters of Oregon, California, and Washington State—including around the San Juan Islands—and are considered "residents" because they have an established home range (i.e., not all migrate) (Towers et al. 2013). Minke whales can be seen during the summer months (April through October) in the waters of the San Juan Islands (Towers et al. 2013). Therefore, it is anticipated that Minke whales could potentially be present within or near the project area.

Dolphins and Porpoises

Dolphins and porpoise species present within the Salish Sea include the Bigg's (Transient) killer whale, short-finned pilot whale (*Globicephala macrorhynchus*), Dall's porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*).

Killer Whale, Bigg's (Transient)

Bigg's (also known as "Transient") killer whales (*Orcinus rectipinnus*) are considered a separate killer whale ecotype than SRKWs (Morin et a. 2024). Bigg's killer whales differ slightly in size and appearance from SRKWs within the Salish Sea. Male transients can grow to lengths exceeding 8 m (27 ft) and have a tall dorsal fin (at least 1.5 m [5 ft]), while female transients can grow to lengths greater than 7 m (23 ft) and have a slightly triangular dorsal fin with a pointed tip and wider base. Bigg's killer whales are highly social, have a smaller group size than SRKWs, and offspring of either sex may disperse from their mother's group (Morin et al. 2024). Bigg's are typically silent while foraging and roam widely in search of prey, with some seasonal patterns.

Bigg's killer whales have a range in the North Pacific Ocean basin that spans the coasts off Northern Mexico, north along the U.S. West Coast to the Aleutian Islands, Alaska, to waters off the eastern coast of Russia and northern Japan (Morin et al. 2024). They have had an increasing presence within the Salish Sea over the past four decades, with record sightings beginning in the late 2010s (Shields et al. 2018). Historically, Bigg's killer whale presence in the Salish Sea has peaked during the months of August to September but starting in the 2000s they began to peak a second time of the year during April to May (Houghton et al. 2015; Shields et al. 2018). Unlike SRKWs, which primarily feed on Chinook salmon, Bigg's have a diet that consists mostly of other marine mammals. Bigg's feed on harbor seals, a species which comprises just over 50 percent of their diet, but they also occasionally feed on squid (Ford et al. 2013; Shields et al. 2018). Bigg's killer whales have been observed within the Salish Sea feeding on harbor seal at haul out sites (e.g., around Protection Island) (McInnes et al. 2020). Considering that harbor seals are considered common in and around the Salish Sea and project area, and the occurrence of Bigg's killer whales throughout the Salish Sea, there is the potential that they may be present in or near the project area.

Short-finned Pilot Whale

The short-finned pilot whale is one of two species of pilot whales, the other being the long-finned pilot whale. Short-finned pilot whales are long-lived, slow to reproduce, and are highly social. They have a bulbous head without an obvious rostrum and have a black or dark brown body with a large gray saddle behind their dorsal fin. They are between 3.5 and 7.5 m (11.5 and 24.6 ft) in length and weigh between 1,000 and 3,000 kg (2,200 and 6,600 lbs.), living for 35 -60 years (NMFS 2024j). Females have calves every 5 to 8 years, with a 15-month gestational period. Short-finned pilot whales live in stable groups of about 15–30 individuals comprised of close family relatives, and typically live in localized, resident populations. Their diet consists mainly of squid, also feeding on octopuses and small fish, in water depths below approximately 305 m (1,000 ft; NMFS 2024j).

Short-finned pilot whales are found around the globe but tend to prefer warmer tropical and temperate waters. Three stocks are found in U.S. waters: east coast, west coast, and Hawaii. Once abundant, the west coast stock has plummeted, currently estimated at approximately 800 individuals (Barlow 2016). While the range of the short-finned pilot whale does include the Salish Sea, it is highly unlikely that any would be present within or near the Project area since they virtually disappeared from the U.S. west coast after a strong El Niño event in 1982-1983, after which, sightings and takes have been rare (Barlow 2016; NMFS 2016c).

Dall's Porpoise

Dall's porpoises are common throughout the northern Pacific Ocean along the U.S. west coast, between California and the Bering Sea in Alaska. They reach 2.1–2.4 m (7–8 ft) in length, weighing up to 181 kg (400 lbs.), and live for 15–20 years. They are relatively fast swimmers that can achieve 55 km per hour (34 miles per hour) in short bursts (NMFS 2024k). They have a small and triangular head with little-to-no beak, and a thick robust body, sometimes mistaken for baby killer whales. Dall's porpoises are typically found in groups averaging between 2 and 12 individuals but can be found in groups of hundreds or even thousands. Dall's porpoises can dive to depths of 500 m (1,640 ft) to prey on small schooling fish (e.g., anchovies, herring, and hake), mid- and deep-water fish (e.g., lantern fish and smelts), cephalopods (e.g., squids and octopuses), and crustaceans (e.g., crabs and shrimp) (NMFS 2024k).

Dall's porpoises live in temperate to boreal waters greater than 183 m (600 ft) deep, with temperatures ranging from 2–17°C (36–63°F). They are found in offshore, inshore, and nearshore waters between 30°N and 62°N latitudes (NMFS 2024k). They occur throughout the coastal and pelagic waters of the northern Pacific Ocean, commonly found in the Gulf of Alaska, Bering Sea, Okhotsk Sea, and Sea of Japan. They are also commonly seen in the inshore waters of Washington State, British Columbia, and Alaska, with migration patterns based on morphology, geography, and seasonality (NMFS 2024k). Dall's porpoise is considered a prominent species in the San Juan Islands archipelago and are present year-round (Teller 2012). Dall's porpoises tend to be found in deeper waters around the San Juan Islands (e.g., those in the Haro Strait), but can be present within shallower waters (Calambokidis et al. 2004; Teller 2012). Given their presence around the San Juan Islands, there is the potential for Dall's porpoise to be present within or near the Project area; however, given their preference for deeper waters (e.g., approximately 183 m [600 ft]) than exist at the Project area, it is anticipated that they would be uncommon, if present.

Harbor Porpoise

Harbor porpoises are not ESA-listed but are protected by the MMPA. They have a small, robust body with a short blunt beak and medium-sized triangular dorsal fin. They reach 1.5–1.7 m (5–5.5 ft) in length, weighing between 61 and 77 kg (135 and 170 lbs.), and have a lifespan of approximately 24 years (NMFS 2024l). Their back is dark gray, which fades to lighter gray along their sides, and their belly and throat are white with a dark gray chin patch. They are shy animals, most often seen in groups of two or three, but have been reported in groups of 10 or up to 200. Harbor porpoises primarily consume schooling fish (e.g., herring and mackerel) and occasionally eat squid and octopus.

Harbor porpoises live in northern temperate and subarctic waters, including arctic coastal and offshore waters. Off the west coast of North America, they are found from Point Conception (off of Central California) to the Beaufort Sea in Alaska. They inhabit waters east of Cape Flattery, Washington, year-round and are often found in harbors, bays, and estuaries in waters shallower than 200 m (656 ft; NMFS 2024l). Historically, harbor porpoises have been in higher densities than other marine mammal species (e.g., Dall's porpoise) around the San Juan Islands, and are considered a prominent species throughout the archipelago (Teller 2012). Harbor porpoises are more common in shallow waters, such as the San Juan Channel, (Calambokidis et al. 2004; Hayes 2014) and have a high probability of presence within the coastal waters of each major island of the San Juan Islands, including Blakely Island (Cox 2021). Therefore, it is considered likely that harbor porpoises would be present within and near the Project area.

Pacific White-sided Dolphin

Pacific white-sided dolphins have a robust body, short rostrum (nose), and large dorsal fin relative to their body size. Their bellies are white; their back, fluke, and lips are black; and their sides, dorsal fin, and flippers are gray. They also have a white or light gray stripe that extends from their eye to their tail. The typical adult is 1.7–2.4 m (5.5–8 ft) in length, weighs 136–181 kg (300–400 lbs.), and has a lifespan of 36–40 years (NMFS 2024m). Females have a 9-month gestation period, giving birth in late spring to fall (except in the central Pacific, where calves are born in late winter to spring). Their diet consists of squid and small schooling fish (e.g., capelin, sardines, and herring). They eat up to 9 kg (20 lbs.) of food daily and are considered a playful and social animal.

Pacific white-sided dolphins live in the open ocean and the nearshore waters of the temperate north Pacific Ocean but are unlikely to be very close to shore. In the U.S., the Pacific white-sided dolphin lives off the coasts of California, Oregon, Washington State, and Alaska, and can usually be seen in group sizes of 10–100 (NMFS 2024m). Their range includes Washington State's inland waters, including the Salish Sea. Pacific white-sided dolphins occupy a similar ecological niche as harbor porpoises and occur in greater densities throughout the Salish Sea during the fall and winter (Cox 2021). While they may be present throughout the Salih Sea, it is unclear how probable their presence would be within the San Juan Islands, given the lack of observations and recent scientific evidence. It is considered unlikely that Pacific white-sided dolphins would occur within the Project area.

Pinnipeds

Seals and sea lions (i.e., pinnipeds) are present within the Salish Sea, including the California sea lion (*Zalophus californianus*), harbor seal (Washington State Inland Waters Stock; *Phoca vitulina*), northern elephant seal (*Mirounga angustirostris*), and Steller sea lion (*Eumetopias jubatus*).

California Sea Lion

California sea lions are "eared seals" native to the west coast of North America, living in coastal waters and hauling out to move around on beaches, docks, buoys, and jetties. Females are 1.8 m (6 ft) in length and can weigh up to 109 kg (240 lbs.), while males are 2.3 m (7.5 ft) in length and can weigh up to 318 kg (700 lbs.; NMFS 2024n). They have a lifespan of approximately 20–30 years. Adult females and juveniles are slender-bodied and blonde to tan in color, while adult males are mostly dark brown and black. They have broad front flippers and long, narrow snouts, visible ear flaps, and three to five claws on their hind flippers. They are social on land and in water, and bark like dogs to communicate with one another. California sea lions are deep-diving animals that prey on squid, anchovies, mackerel, rockfish, and sardines in offshore coastal upwelling areas (NMFS 2024n).

California sea lions range from southeast Alaska to the Pacific coast of central Mexico. Their breeding range is from the Channel Islands in southern California to central Mexico. There are no major breeding colonies located near Washington State's coast or in the Salish Sea. Males migrate during the winter to feeding areas off California, Oregon, Washington, British Columbia, and southeast Alaska, but females and pups stay near the breeding colonies until pups are weaned (NMFS 2024n). In warm water years (such as an El Niño event), they can be found as far north as Oregon and Washington, including throughout the Salish Sea and San Juan Islands where they have been observed during spring months (Jefferson et al. 2023). California sea lions are considered common throughout the Salish Sea and are anticipated to potentially occur within and around the Project area.

Harbor Seal (Washington State Inland Waters Stock)

Harbor seals are one of the most common marine mammals along the U.S. west and east coasts, commonly seen resting on rocks and beaches. NMFS has identified 16 stocks of harbor seals, with the Washington State Inland Waters Stock present within the Salish Sea (NMFS 2024o).

Harbor seals are part of the “true seal” family. They have short forelimbs (i.e., flippers) and lack external ear flaps, instead having a small hole on either side of their head. They have two basic fur color patterns: light tan to silver, or blue-gray with dark speckling or spots and a dark background with light rings. Adult harbor seals weigh approximately 82–130 kg (180–285 lbs.), reaching 1.5–1.8 m (5–6 ft) in length, and have a lifespan of approximately 25–30 years (NMFS 2024o).

Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice to regulate their body temperature, molt (shed old fur and grow new fur), socialize, give birth, and nurse their pups. They make shallow dives to hunt for fish, shellfish, and crustaceans.

Harbor seals live in temperate coastal habitats along the northern coasts of North America, Europe, and Asia. Along the U.S. west coast, harbor seals are found from Baja California to the Bering Sea. They are considered non-migratory, generally remaining within 24–50 km (15–31 miles) of their natal area; however, tracking data have shown that they sometimes travel 100–784 km (62–487 miles) to exploit seasonally available food or birth their pups (NMFS 2024o). Females typically give birth during the spring and summer months, but seals of the Washington State Inland Waters Stock are born approximately 2 months later than seals along Washington State’s outer coast. Harbor seals are abundant throughout the Salish Sea, and surveys have confirmed their presence throughout the San Juan Islands (numbering in the thousands) (Jefferson et al. 2021). Therefore, it is considered likely that harbor seals could occur within and near the Project area.

Northern Elephant Seal

The northern elephant seal is the largest of the “true seals” of the northern hemisphere. Fully grown adult males weigh up to 2,000 kg (4,400 lbs.) and can reach lengths surpassing 4 m (13 ft). Females are significantly smaller, weighing up to 590 kg (1,300 lbs.) and reaching approximately 3 m (10 ft) in length (NMFS 2024p).

They have a lifespan of approximately 13 years (males) to 19 years (females). Adult northern elephant seals are dark brown or gray. When males reach puberty at approximately 7 years of age, they develop a proboscis (large inflatable nose) and a thick neck with calloused skin to protect them when fighting other males. Pups are born in early winter, from December to January, after an 11-month gestation period. Females have smaller noses and smoother necks. Northern elephant seals primarily consume squid and fishes, as well as rays and sharks. Males typically feed near the eastern Aleutian Islands and in the Gulf of Alaska, while females feed farther south in the offshore waters of Washington State and Oregon. In March to August, adults return to land to molt (males later than females) and return to their feeding areas between their spring-summer molt and winter breeding season (NMFS 2024p).

Northern elephant seals are found in the eastern and central North Pacific Ocean, ranging from Baja California to Alaska, and typically breed in the southern portion of their range from December to March (NMFS 2024p). Their range includes the Salish Sea (NMFS 2024p); however, they appear to occur mostly off the outer coast of California, Oregon, and Washington, and at the southern end of their range off the coast of Baja California, Mexico and southern California, particularly on the Channel Islands (Lowry et al. 2014; NMFS 2024p). Therefore, it is anticipated that it would be unlikely that northern elephant seals occur within or near the Project area.

Steller Sea Lion (Eastern DPS)

The Steller sea lion is the largest member of the "eared seals," which include all sea lions and fur seals. They are split into two populations—Eastern DPS (not ESA-listed) and Western DPS (listed endangered)—which differ genetically and morphologically.

Steller sea lions are sexually dimorphic. Males can weigh up to 1,134 kg (2,500 lbs.) and reach approximately 3.4 m (11 ft) in length, while females can weigh up to 363 kg (800 lbs.) and reach 3 m (9.8 ft) in length (NMFS 2024q). They have a lifespan of 20 (males) to 30 (females) years and molt every year. Adult males have long, coarse hair on their chest, shoulders, and back, and have a chest and neck more massive and muscular than a female's. Both males and females have light blonde to reddish brown coats that are slightly darker on the chest and abdomen. Steller sea lions have a wide diet that varies in different parts of their geographic range. They forage and feed both nearshore and offshore, in benthic and pelagic zones, on more than 100 species of fish (e.g., Atka mackerel, walleye pollock, salmon, Pacific cod, Pacific herring, rockfish) and cephalopods (e.g., squid and octopus) (NMFS 2024q).

Steller sea lions are colonial breeders, mating and giving birth on land at traditional sites known as rookeries, typically coming back to mate on their natal rookery site (e.g., beaches, ledges, and rocky reefs) each year. Pupping occurs from mid-May to mid-July, peaking in June (NMFS 2024q).

Steller sea lions are distributed along the coast and also inhabit deeper continental slope and pelagic waters during the non-breeding season. Previous survey efforts showed Steller sea lions to be uncommon, but they have been observed in the San Juan Islands, mostly during the autumn months but also spring and winter (Gaydos and Pearson 2011; Jefferson et al. 2023). They also have a population within the nearby San Juan Channel (Wilkins 2011) and can be found throughout the Salish Sea (Gaydos and Pearson 2011; Cox 2021). Therefore, it is anticipated that there is the potential for Steller sea lions to be present within and near the Project area.

3.5.1.3 Porpoise clicks

Additional opportunistic measurements conducted by APL-UW used 'C-POD' (Chelonia) click detectors with automated onboard processing to listen for marine mammal echolocation and record the details of the click trains associated with each echolocation event. Figure 59 shows detections by species class reported by the manufacturer software. Each click event is assigned a certainty value based on its acoustic characteristics, with subsequent analysis restricted to events with "Hi(gh)" and "Mod(erate)" certainties. Click events are statistically represented through "detection positive minutes" (DPM), i.e., a minute with at least one click event at a given certainty level. As shown in Figure 59, the only species with routinely high certainty classifications are harbor porpoises. The "low" certainty click events mirror those with "Mod" certainty. "Dolphin" click events, which would be indicative of SRKW echolocation, are generally absent in the data (only possible classifications are low certainty). Sonars are intermittently detected with moderate to high certainty, potentially associated with subsistence fishing or deployment/retrieval operations by the R/V Jack Robertson. The "No Species" click events are all low certainty and, given the roughly 14-day oscillations, may be "clicks" associated with sediment transport during period with stronger currents (Bassett et al. 2013).

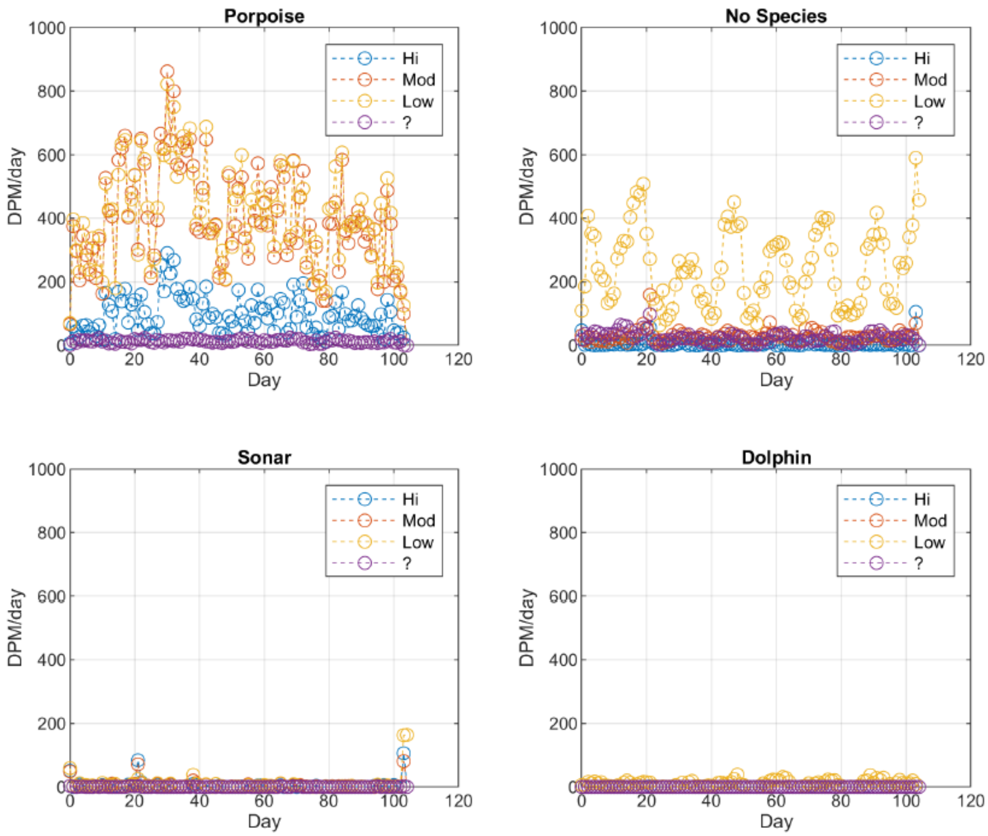

Figure 59. C-POD Detections by Certainty Level and Click Event Type

3.5.2 Avian Species

Numerous avian species are present on and/or around Blakely Island and the proposed Project area within Rosario Strait. However, the suitability of larger islands for nesting, including Blakely Island, within the San Juan Islands archipelago has been reduced due to habitat loss and threats associated with development and disturbance (Copping et al. 2021). The avian species listed in **Table 12** are birds that: (1) are of particular concern, warranting special attention within the proposed Project area; (2) may be present on and/or around Blakely Island; or (3) may have nearby nesting sites within the San Juan Islands National Wildlife Refuge (NWR). Blakely Island is not part of the San Juan Islands NWR. While there are no terrestrial portions of the Project, migratory avian species found on Blakley Island are included due to their proximity to the proposed Project area and potential for flying in relatively proximity to Project components, including offshore areas.

An increased probability of presence for each species, as identified by the USFWS, is included where possible in **Table 12**. The increased probability of presence approximately corresponds to migration timing through the proposed Project area, as determined by USFWS survey efforts (USFWS 2024b, 2024c). Note, however, that data gaps exist for certain time periods for each species; therefore, these time windows are approximations, and it is possible that there are times outside of them in which these avian species may be present within the proposed project area.

Table 12. Avian Species that May Be Present within the Proposed Project Area

Common Name (*Scientific Name*)	San Juan Islands NWR Common Nesting Species[1]	Occurrence on Blakely Island and/or Offshore Proposed Project area[2]	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Eagles				
Bald Eagle (*Haliaeetus leucocephalus*)	No	Blakely Island	Resident (year-round)	Mar. 1 to Aug. 31
Golden Eagle (*Aquila chrysaetos*)	No	Blakely Island	Early- to Mid-Apr.	Mar. 1 to Aug. 31
Migratory and Seabirds				
Ancient Murrelet (*Synthliboramphus antiquus*)	No	Blakely Island	Mid-Nov. to Early-Jan; Early-May	Mar. 10 to Sept. 10
Black Oystercatcher (*Haematopus bachmani*)	No	Blakely Island	Resident (year-round)	Apr. 15 to Oct. 31
Black Swift (*Cypseloides niger*)	No	Blakely Island	Mid-Sept.	June 15 to Sept. 10
Black Turnstone (*Arenaria melanocephala*)	No	Blakely Island	Early- to Mid-March; End-July to Mid-Apr.	Breeds elsewhere
Brandt's Cormorant (*Phalacrocorax penicillatus*)	No	Blakely Island	Mid-Oct. to Early-Jan; Early-Mar. through Apr.; Early-July; Mid-Aug. to Mid-Sept.	Apr. 15 to Sept. 15
California Gull (*Larus californicus*)	No	Blakely Island	Mid-July to Mid-Nov.; Early-Mar., Apr, and May	Mar. 1 to July 31
Chestnut-backed Chickadee (*Poecile rufescens rufescens*)	No	Blakely Island	Resident (year-round)	Mar. 1 to July 31
Common Loon[3] (*Gavia immer*)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-May; Early Oct.	Apr. 15 to Oct. 31
Common Murre (*Uria aalge*)	No	Blakely Island, Offshore Proposed Project area	End-Oct. to End-Jan.; Early Mar. to End-April; End-July through Sept.	Apr. 15 to Aug 15.[1]

Common Name (*Scientific Name*)	San Juan Islands NWR Common Nesting Species[1]	Occurrence on Blakely Island and/or Offshore Proposed Project area[2]	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Double-crested Cormorant (*Phalacrocorax auritus*)	Yes	Blakely Island, Offshore Proposed Project area	Early Mar. to End-Apr; Early-July; Mid-Aug. to Early Jan.	Apr. 20 to Aug. 31
Evening Grosbeak (*Coccothraustes vespertinus*)	No	Blakely Island	Early-May; June	May 15 to Aug. 10
Lesser Yellowlegs (*Tringa flavipes*)	No	Blakely Island	Early-May and Early-Aug.	Breeds elsewhere
Long-tailed Duck (*Clangula hyermalis*)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-April; Dec.	Breeds elsewhere
Marbled Godwit (*Limosa fedoa*)	No	Blakely Island	Early-Sept.	Breeds elsewhere
Marbled Murrelet[3,4] (*Brachyramphus marmoratus)*	No[5]	Blakely Island, Offshore Proposed Project area	Apr to mid-May; End-June to End-Oct.	Breeds elsewhere
Olive-sided Flycatcher (*Contopus cooperi*)	No	Blakely Island	Mid-May to Mid-Aug.	May 20 to Aug. 31
Red-breasted Merganser (*Mergus serrator*)	No	Blakely Island, Offshore Proposed Project area	Early Dec. to End-April; Early Oct.	Breeds elsewhere
Red-necked Phalarope (*Phalaropus lobatus*)	No	Blakely Island, Offshore Proposed Project area	End-July to Early-Sept.	Breeds elsewhere
Red-throated Loon (*Gavia stellata*)	No	Blakely Island, Offshore Proposed Project area	Early-Mar. to Mid-April; Early-Dec.	Breeds elsewhere
Ring-billed Gull (*Larus delawarensis*)	No	Blakely Island, Offshore Proposed Project area	Early-Jan.; Early-Aug. to Early-Oct; End-Nov.	Breeds elsewhere
Rufous Hummingbird (*Selasphorus rufus*)	No	Blakely Island	End-March to Early-Aug.	Apr. 15 to July 15
Short-billed Dowitcher (*Limnodromus griseus*)	No	Blakely Island	Mid-July to Mid-Aug.	June 1 to Aug. 10

Common Name (*Scientific Name*)	San Juan Islands NWR Common Nesting Species[1]	Occurrence on Blakely Island and/or Offshore Proposed Project area[2]	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Surf Scoter (*Melanitta perspicillata*)	No	Blakely Island, Offshore Proposed Project area	End-Nov. to End-Apr.; Early-July; Mid-Sept. to Mid-Oct	Breeds elsewhere
Tufted Puffin[3] (*Fratercula cirrhata*)	Yes	Blakely Island, Offshore Proposed Project area	End-June	Breeds elsewhere
Western Grebe[3] (*Aechmophorus occidentalis*)	No	Blakely Island	End-Sept., Oct., Nov., Dec., and Jan.	June 1 to Aug. 31
Western Gull (*Larus occidentalis*)	No	Blakely Island	End-Jan.; Mid-Apr.; Early-Mid Aug.	Apr. 21 to Aug. 25
Western Screech-owl (*Megascops kennicotti cardonensis*)	No	Blakely Island	End-May and Early-Aug.	Mar. 1 to June 30
White-winged Scoter (*Melanitta fusca*)	No	Blakely Island, Offshore Proposed Project area	Early- to Mid-Dec.	Breeds elsewhere

Notes: ESA = Endangered Species Act; NWR = National Wildlife Refuge; IPaC = Information for Planning and Consultation; PHS = Priority Habitats and Species; USFWS = U.S. Fish and Wildlife Service; WDFW = Washington Department of Fish and Wildlife

1. There are additional San Juan Islands NWR common nesting species that do not appear in this table, but may be present within the project area, including the following: rhinoceros auklet (*Cerorhinca monocerata*), pigeon guillemot (*Cepphus columba*), pelagic cormorant (*Phalacrocorax pelagicus*), and glaucous-winged gull (*Larus glaucescens*). These species are present and known to nest in the San Juan Islands, or within the Salish Sea more generally, but they do not appear when using agency tools (e.g., USFWS's IPaC and WDFW PHS range mapper) on Blakely Island or the offshore project area.
2. Some species were identified as being located on Blakely Island, but not offshore (and vice versa), using USFWS's IPaC planning tool (USFWS 2024b, 2024c). Species located on Blakely Island may also potentially appear within the offshore project area (e.g., ancient murrelets) while foraging or migrating to and from Blakely Island and other areas.
3. Species is also listed as a PHS (Larsen et al. 2004; WDFW 2008).
4. Species is also protected under ESA.
5. Marbled murrelets are not observed on San Juan Island NWR islands, but forage in waters around refuges (USFWS 2010).

Sources: Larsen et al. 2004; WDFW 2008; USFWS 2010, 2024b, 2024c

There are additional avian species that may be present within the San Juan Islands archipelago, or are San Juan Islands NWR common nesting species, that do not appear in **Table 12**, but have the potential to occur within the project area due to their general presence in the Salish Sea, including the following: rhinoceros auklet (*Cerorhinca monocerata*), pigeon guillemot (*Cepphus columba*), pelagic cormorant (*Phalacrocorax pelagicus*), and glaucous-winged gull (*Larus glaucescens*). These species are present and known to nest in the San Juan Islands, or within the Salish Sea more generally (e.g., on Protection Island near Admiralty Inlet), but they do not appear when using agency tools (e.g., USFWS's IPaC and WDFW's PHS range mapper) on Blakely Island or the offshore project area.

3.5.2.1 Federally Listed Avian Species

The federally listed marbled murrelet (*Brachyramphus marmoratus*) may occur within the project area, as they are known to forage in nearshore waters throughout the San Juan Islands. According to the USFWS (2024b), species lists, and information gathered from existing wildlife resource agency databases, the yellow-billed cuckoo (*Coccyzus americanus*) and northern spotted owl (*Strix occidentalis caurina*) may also occur within portions of the proposed Project area. However, existing evidence indicates that these species are extremely unlikely to be present within the proposed Project area or affected by project activities (Forsman et al. 2002; Carroll and Johnson 2008; USFWS 2011; Wiles and Kalasz 2017; 79 FR 59992).

Marbled Murrelet

The USFWS listed the marbled murrelet (*Brachyramphus marmoratus*) as threatened in Washington State, Oregon, and California on October 1, 1992, effective November 2, 1992 (57 FR 45328). In 2015, the estimated Washington State population was about 7,500 birds, concentrated near the Strait of Juan de Fuca and northern Puget Sound (Desimone 2016; WDFW 2024l). As of 2021, WDFW surveys have estimated approximately 3,100 murrelets in the Strait of Juan de Fuca, San Juan Islands, and Puget Sound (McIver et al. 2021).

Marbled murrelets are small diving seabirds, living up to 15 years and reaching maturity at the age of 2–3 years. Their breeding season occurs from early April through late September. Most of the marbled murrelet's biological and physical interactions occur at sea, usually within 2 km (1.2 miles) of the shoreline where they spend time foraging, loafing, molting, preening, and exhibiting courtship behavior (USFWS 1997; McShane et al. 2004). They prefer sheltered foraging grounds within 1.6–4.8 km (1–3 miles) from shore, diving to feed on small fish (e.g., surf smelt, sand lance, herring) and invertebrates (e.g., mysids, euphausiids, amphipods) (Burkett 1995; Desimone 2016; Pearson et al. 2022). They forage at all times of the day and in some cases during night hours (Ralph et al. 1995). Diving depth varies and may depend on location of prey species but typically occurs in waters less than 30 m (98 ft) deep (McShane et al. 2004; Desimone 2016; WDFW 2024l).

Marbled murrelets come inland to nest in forest stands with late-successional and dense old-growth forest, characterized by large trees with large branches or deformities for use as nesting platforms (Ralph et al. 1995; McShane et al. 2004; Piatt et al. 2007; USFWS 2024a). Large and unfragmented stands of old-growth, dominated by Douglas-fir, appear to be the highest quality habitat for marbled murrelet nesting. Marbled murrelets nest in old-growth forests on the Olympic Peninsula, Washington State and Vancouver Island, British Columbia (USFWS 2010). The highest nesting presence is on the Olympic Peninsula, the northern Cascades, and in limited remaining habitat in southwest Washington State (WDFW 2024l). Marbled murrelets are not known to nest within the San Juan Islands archipelago, and it seems unlikely that they do as their preferred nesting and critical habitat primarily is located on the Olympic Peninsula and Cascade Mountain Range; however, they do forage in the waters near the San Juan Islands NWR (61 FR 26256; USFWS 2010).

The largest portion of the marbled murrelet population occurs in Alaska and British Columbia, Canada. In Washington State, the current and historical marine distribution of marbled murrelets includes northern Puget Sound, the Strait of Juan de Fuca, and along the northwestern coast (Desimone 2016; DNR 2018). While at-sea distribution varies over time and location, there is a general shift in winter abundance eastward from the Strait of Juan de Fuca to Puget Sound and the San Juan Islands. In fall and winter, British Columbia's populations move southward toward Puget Sound (DNR 2018). The range for marbled murrelets includes the Rosario Strait and San Juan Islands (USFWS 2024a), including marine waters off the southeast shore of Blakely Island (Lorenz et al. 2016; Lorenz and Raphael 2018). The San Juan Islands provide breeding and marine foraging habitat for marbled murrelets, and they have been observed and recorded as extensively using the marine waters throughout the archipelago (Lorenz et al. 2016; Lorenz and Raphael 2018) making it likely that they would be present around the project area.

Continued threats to marbled murrelet recovery include forest fragmentation and loss (particularly due to commercial timber harvest and wildfires) and nesting habitat degradation, climate change impacts on marine and forest habitats, pollutants, and mortality from commercial fishing nets (Desimone 2016; USFWS 2024a).

Critical Habitat

The USFWS designated critical habitat for the marbled murrelet on May 24, 1996, effective June 24, 1996 (61 FR 26256), revised it on October 5, 2011 (effective November 4, 2011) (76 FR 61599), and then on August 4, 2016, confirmed the effective date of November 4, 2011 (81 FR 51348). There is no designated critical habitat for the marbled murrelet within the proposed Project area.

Yellow-Billed Cuckoo

Only 20 sightings of yellow-billed cuckoos have been documented in Washington State since the 1950s, 16 of which occurred in Eastern Washington, with nineteen occurring from 1974 to 2016 at an average rate of one sighting every 2.3 years (Wiles and Kalasz 2017). The last confirmed breeding occurred in Washington State in the 1930s, thereby making it likely that they are extirpated as a breeder in Washington (79 FR 59992; Wiles and Kalasz 2017). Records of yellow-billed cuckoos in nearby Whatcom and Skagit counties pre-date 1950, and no historical detections have occurred on the San Juan Islands (Wiles and Kalasz 2017). In western Washington, yellow-billed cuckoos are strongly associated with large patches of low to mid-elevation riparian habitat characterized by high humidity (79 FR 59992). Yellow-billed cuckoos are not expected to occur within the Project area due to their extremely low numbers in Washington State, lack of historical record of appearing on the San Juan Islands, and lack of any suitable habitat, such as riparian corridors, since the Project occurs offshore.

Northern Spotted Owl

Northern spotted owls generally rely on old-growth forest habitats (Carroll and Johnson 2008) because such forests contain the structures and characteristics required for their nesting, roosting, and foraging (USFWS 2011). They also disperse through highly fragmented landscapes typical of mountain ranges found in Washington State and Oregon (e.g., Cascade Range) (USFWS 2011). However, large bodies of water, such as those found in Washington State's inland waters (e.g., Hood Canal, Puget Sound, etc.), as well as large tracts of unforested land, act as barriers to movement and dispersal of northern spotted owls (USFWS 2011). Radio telemetry suggests that northern spotted owls move around large bodies of water, rather than through them, and do not typically cross them (Forsman et al. 2002). Therefore, it is very unlikely that the northern spotted owl would be present within or near the proposed Project area.

3.5.2.2 Bald and Golden Eagles

The MBTA and Bald and Golden Eagle Protection Act of 1940 (**Section 1.3.1.3**) were established to protect avian species by minimizing harmful disturbances due to anthropogenic activities. It is expected that both Bald and Golden eagles may occur within and/or near the Project area.

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) are widely distributed across North America and area associated with aquatic habitats, including marine coasts (e.g., oceans, bays, and estuaries), rivers, and lakes (Kalasz and Buchanan 2016). Their breeding range extends from Alaska south through northern Canada and the lower 48 states, with the largest populations along coasts and large inland waterways (Kalasz and Buchanan 2016). Their average home range within Washington State during breeding season is 4.9 square kilometers (km^2) (1.9 $miles^2$) (Watson 2002). Post-breeding dispersal is complex in Washington State, but after nestlings have fledged, breeding bald eagles migrate north to British Columbia and Alaska to forage on late summer and fall run salmonids, returning in the early winter to their nesting territories (Watson and Pierce 2001; Stinson et al. 2001, 2007).

Washington State also supports a substantial population of wintering bald eagles, as well as others that remain year-round near where they nested (Stinson et al. 2007).

Bald eagles are well-distributed throughout Washington State and have year-round presence within the San Juan Islands. They primarily occur west of the Cascade Mountain Range, with most nesting sites near the marine environment, including the Salish Sea and San Juan Islands (Kalasz and Buchanan 2016). They typically nest in large trees but are known to nest in suburban landscapes near human activity (Parson 1994; Millsap et al. 2004). Greater than 50 percent of their diet consists of fish, with one study in Washington State showing their diet to contain 78 percent fish, 19 percent birds, and 3 percent mammals (Watson 2002). Overwintering bald eagles in Washington State depend on chum salmon (*Oncorhynchus keta*) and other salmonids in the fall and early winter (Stinson et al. 2007) and rely more heavily on waterfowl in mid- to late-winter, as well as carrion (Watson 2002). Bald eagles occur on or near Blakely Island year-round, and there is the potential for them to migrate through, or forage, in the coastal waters within or near the project area (USFWS 2024c).

Golden Eagle

Golden eagles (*Aquila chrysaetos*) have been identified as a Species of Greatest Conservation Need under Washington State's Wildlife Action Plan and are a Priority Species under WDFW's PHS program. In Washington State, breeding golden eagles are non-migratory (Watson et al. 2014). They are associated with steep terrain and found mostly in dry open forests of Eastern Washington, shrubsteppe (grassland), canyonlands, in high-alpine zones, and sparsely in clearcut areas in Western Washington, with nests situated on cliffsides, rocky outcrops, large trees, and human-made structures (e.g., power poles and transmission towers) (WDFW 2024k). There are over 300 documented breeding territories in Washington State, 80 percent of them in Eastern Washington. They are known to breed and nest irregularly in the rain shadows of the Olympic and Cascade Mountains, and San Juan Islands, although it is unknown if any sites are located on Blakely Island itself (WDFW 2024k). There is the potential for golden eagles to be present on Blakely Island, or nearby, particularly during early to mid-April (USFWS 2024c).

3.5.2.3 San Juan Islands NWR Seabirds

Seabirds spend most of their time on the ocean and return to land only to reproduce and raise their young (USFWS 2010). They have very specific nesting requirements, primarily a habitat free of predators and human disturbance (especially for ground or crevice nesting species), and with suitable soils for burrow nesting species (USFWS 2005, 2010). They also tend to be site-faithful, returning each year if they were successful in fledging young the previous year (USFWS 2010).

The San Juan Islands NWR provides important habitat for migratory birds, including black oystercatchers (*Haematopus bachmani*), double-crested and pelagic cormorants (*Phalacrocorax auritus* and *P. pelagicus*), rhinoceros auklets (*Cerorhinca monocerata*), and pigeon guillemots (*Cepphus columba*), and other marine mammal wildlife (e.g., harbor and elephant seals). While Blakely Island itself is not part of the San Juan Islands NWR, three nearby islands/rocks in Rosario Strait are part of the NWR: (1) Lawson Rock, (2) Pointer Island, and (3) Black Rock (USFWS 2010). These three NWR locations, along with the Project area's shoreline area on Blakely Island, may provide habitat for several seabird species of the Salish Sea. Six seabird species that commonly nest on San Juan Islands NWR areas that may be present within the project area include the following (USFWS 2010):

- rhinoceros auklet,
- tufted puffin,
- pigeon guillemot,
- pelagic cormorant,
- double-crested cormorant, and

- glaucous-winged gull (*Larus glaucescens*)

Note that of the six species listed above, only the double-crested cormorant and tufted puffin appear as being potentially present within the offshore project area and/or on Blakely Island, according to USFWS (USFWS 2024b, 2024c). The rhinoceros auklet, pigeon guillemot, pelagic cormorant, and glaucous-winged gull may potentially be present within the project area, e.g., during foraging activities, but it is unclear what their presence may be on Blakely Island and its offshore waters. Additionally, Brandt's cormorant (*Phalacrocorax penicillatus*) is typically observed within the Salish Sea during the breeding season, but they very rarely breed in the project area, primarily doing so along Washington State's west coast (USFWS 2010).

3.5.3 Washington State Priority Habitats and Species

Within Washington State, PHS (which may or may not be also federally listed under the ESA), require protective measures for their survival due to their population status, sensitivity to habitat alterations, and/or recreational, commercial, or Tribal importance. The PHS program is WDFW's primary means of sharing fish and wildlife information to protect Priority Habitats for land use planning.

Three PHS species have ranges that overlap with and may be present within the proposed Project area: pandalid shrimp (family *Pandalidae*), pinto abalone (*Haliotis kamtschatkana*), and Townsend's big-eared bat (*Corynorhinus townsendii*) (WDFW 2024p; **Table 13**). Of these three species, the Townsend's big-eared bat is a Washington State candidate for being listed, and the pinto abalone is designated as endangered in Washington State. In addition to the PHS listed in **Table 13** and avian species in **Table 13**, there are priority avian species that may potentially occur within or near the project area due to their known presence in or near San Juan County, but do not have information specific to Blakely Island or the project area: Cassin's Auklet (*Ptychoramphus aleuticus*), Short-tailed Albatross (*Phoebastria albatrus*), Great Blue Heron (*Ardea herodias*), Harlequin Duck (*Histrionicus histrionicus*), cavity-nesting ducks (e.g., Wood Duck [*Aix sponsa*], Barrow's Goldeneye [*Bucephala islandica*], Common Goldeneye [*B. clangula*], Bufflehead [*B. albeola*], and Hooded Merganser [*Lophodytes cucullatus*]), Snow Goose (*Chen caerulescens*), Trumpeter Swan (*Cygnus buccinator*), Tundra Swan (*C. columbianus*), Western High Arctic Brant (*Branta bernicla*), Band-tailed Pigeon (*Columba fasciata*), Vaux's Swift (*Chaetura vauxi*), and Oregon Vesper Sparrow (*Pooecetes gramineus affinis*) (Larsen et al. 2004; WDFW 2008).

The proposed Project area is located within Rosario Strait, an aquatic habitat (M2USN: Marine intertidal unconsolidated shore, regularly flooded). However, no new terrestrial infrastructure is planned for this Project; therefore, no terrestrial wetlands are present in the proposed Project area.

Table 13. Washington State PHS that may be in the Proposed Project Area

Occurrence Name (*Scientific Name*)	Federal Status	State Status	Site Name	Sensitive Location
Species				
Pandalid Shrimp (family *Pandalidae*)	N/A	N/A	Not Given	No
Pinto Abalone (*Haliotis kamtschatkana*)	N/A	Endangered	Orcas and Blakely Islands, Lawson Rock (Thatcher Pass)	No
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	N/A	Candidate	Not Given	Yes
Habitat				
Estuarine and Marine Wetland - NWI Wetlands	N/A	N/A	N/A	No
Notes: N/A = Not applicable; NWI = National Wetlands Inventory, PHS = Priority Habitats and Species. Source: WDFW 2024p				

The pinto abalone ranges from Baja California to Alaska and is the only abalone species found in Washington State (WDFW 2024n). NOAA has listed the pinto abalone as a Species of Concern since 2004, and while NOAA did receive petitions to list the species under the ESA, it was determined that the pinto abalone did not meet the criteria of being endangered throughout the entirety of its range (WDFW 2024n). In Washington State, pinto abalone are generally found between water depths of 2.7 and 18.3 m (9 and 60 ft), aggregating in areas of complex rocky reef habitat (WDFW 2024n). these depths are shallower than the depth of the where the Orbital O2-X would be located within Rosario Strait (approximately 61 m [200 ft]), but within the depth that the subsea power cable would be located.

3.5.4 Invasive Species

While 251 aquatic species are considered invasive in Washington State, there are four aquatic invasive species of greatest concern: European green crab (*Carcinus maenas*), zebra mussel (*Dreissena polymorpha),* quagga mussel (*Dreissena bugensis*), and northern pike (*Esox lucius*) (WDFW 2024b). The WDFW Western Washington State Regional Invasive Species list also contains several insects (e.g., emerald ash borer, Japanese beetle, spotted lanternfly), plants (e.g., butterfly bush, purple loosestrife, Scotch broom), disease (e.g., white nose syndrome), and other species (e.g., feral swine, nutria).

3.5.5 Insects

According to the USFWS (2024b), the monarch butterfly (*Danaus plexippus*) may occur within portions of the proposed Project area.

3.5.5.1 Monarch Butterfly

On December 12, 2024, USFWS proposed to list the monarch butterfly as a threatened species and designate critical habitat under the ESA, as amended (89 FR 100662). Monarch butterflies are found throughout North America to southern Canada (up to about 50° N latitude), but are uncommon in western Washington (i.e., west of the Cascade Mountain Range), northwest Oregon, and western British Columbia, where native milkweeds are currently and generally absent (Pyle et al. 2015) and there are no breeding areas (Western Association of Fish and Wildlife Agencies 2019). Although monarchs have occasionally been observed in western Washington in the spring months, their host plants (milkweed [*Asclepias syriaca*]) and breeding habitat occur naturally in only the eastern half of the state (i.e., east of the Cascade Mountain Range) (Western Association of Fish and Wildlife Agencies 2019). Given their lack of suitable habitat and host plants in western Washington, and that there would be no new terrestrial components associated with the proposed project, it is considered extremely unlikely that the monarch butterfly would occur within the project area. Therefore, the monarch butterfly will not be discussed any further.

3.5.6 Terrestrial Resources

This Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island itself. Therefore, the proposed Project would not have any effect on any terrestrial cover type, wildlife habitat, botanicals, wetlands, or terrestrial mammals. The only terrestrial portion of the Project would be an existing 46 cm (18 in.) diameter conduit on southwest Blakely Island, which would be used as an interconnection between the new Orbital O2-X and OPALCO's grid. This interconnection would connect to an existing substation on Blakely Island where the electricity would then be transmitted via OPALCO's 69 kV transmission system to the surrounding islands along existing subsea power cables. Terrestrial resources on Blakely Island will not be discussed further.

3.5.7 Acoustic Environment

For a description of below-water acoustic environment in the proposed Project area, see **Section 3.4.3** (Acoustic Environment; Fish and Aquatic Resources). For a description of the above-water acoustic environment in the proposed Project area, see **Section 3.8.2** (Acoustic Aesthetics; Aesthetic Resources).

3.6 Aesthetic Resources

The San Juan Islands are known for their aesthetic value (i.e., their intrinsic beauty), and conscious efforts are taken by Washington State residents to preserve it. The following section describes the current visual, acoustic, and light aesthetics in the proposed Project area and the vicinity.

3.6.1 Visual Aesthetics

The visual components of the proposed Project area (**Figure 60**) include the adjacent waters of Rosario Strait (**Figure 61**) and the scenic coastline on the east side of Blakely Island (**Figure 62**). The east side of Blakely Island has no residential homes or built areas, thus no residence or community centers with regular views of the proposed Project area. Further south from, and outside of, the proposed Project area is Black Rock (**Figure 63**). Past the south end of Blakely Island, WSDOT automobile ferries pass regularly throughout the day and the preexisting conduit is buried in the cliffs (WSDOT 2024; **Figure 64**). Other private ferries occasionally run past the proposed Project area and around the north side of the island. There are temporary increases in human activity when recreational boats (including kayaks), fishermen, shipping vessels, or ferries transit the region. Recreational vessel use is most popular from July to September, while oceangoing vessels pass through Rosario Strait year-round (NOAA 2024e). The passengers on these vessels are the most likely to view and interpret the visual aesthetic of the proposed Project area regularly.

The presence of species that may be seen in the Project area fluctuates as they migrate throughout the year. Potential species include avian species, cetaceans, pinnipeds, and fishes (see **Section 3.4**, **Section 3.5**, and **Section 3.6** for more details about local species).

Blakely Island is heavily forested, with few maintained roads or paths. There is one main road, Spencer Road, which travels north and south through the center of the island, with few side streets. The highest point of elevation is Blakely Peak at 318 m (1,042 ft) on the northeast corner of the island, and the total area of the island is 16.9 km² (6.5 miles²). The island also includes two freshwater lakes, Horseshoe Lake and Spencer Lake, as well as Spencer Creek that flows from Spencer Lake to Thatcher Bay (Blakely Island Field Station 2018).

Figure 60. Visual Aesthetics in the Project Area

Figure 61. Rosario Strait Looking South (with Blakely Island to the Right)

Figure 62. Proposed Orbital O2-X Location East of Blakely Island

Figure 63. Black Rock Southeast of Blakely Island

Figure 64. Ferry Passing South of Blakely Island (View from Southwest Side of Island)

3.6.2 Acoustic Aesthetics

Anthropogenic noise in the vicinity of the proposed Project area is primarily generated by small-engine boats (typically 125 - 165 dB) and large passenger or oceangoing vessels in the distance, with noise levels of up to 192 dB (Barlett and Wilson 2002). The above-water ambient noise levels in the Project area largely consist of wave noise, which is typically 60 dB at 0.4 m (1.3 ft) waves to 78 dB at 2.0 m (6.6 ft) waves (Bolin and Abom 2010). **Table 14** outlines the dB level of typical anthropogenic noise sources in the proposed Project area.

Table 14. Common Noise Sources and Typical Levels

Source	Noise Level (dB)
Conversational Speech	60
Small Piston-Powered Airplane	65
Business Jet Plane	75
Street Traffic	85
Single Engine Boat	125 – 165
Large Cargo Vessel	192
Notes: dB = decibel Sources: Aircraft Owners and Piolets Association N.D.; Barlett and Wilson 2002; Hildebrand 2009	

From October 2024 to January 2025, APL-UW conducted the Rosario Strait Characterization Study in collaboration with OPALCO to collect baseline data for the proposed Orbital O2-X site. Data collected in the proposed Project area includes underwater ambient noise, providing baseline data of current underwater ambient sound at the site (see **Section 3.4.3**).

3.6.3 Light Aesthetics

On the east side of Blakely Island, the proposed Project area consists of a natural coastline along the Salish Sea. Most of the light in the area is ambient – bright during the day from sunlight and dark at night from lack thereof. No residential or commercial buildings along the coast contribute lux to the proposed Project area.

The current lighting buoys and beacons near the proposed Project area include lighted buoys at Lawson Rock, Black Rock, and the outcrop north of Black Rock. The Blakely Island light beacon is located at the subsea cable landing on the south end of the island.

There are currently two marine lights near the proposed Project area. One is a warning float that is located 280 m (919 ft) southeast of the proposed Orbital O2-X location that flashes a green light every 2.5 seconds (s) and is bright enough to be seen 4 NM away (NOAA 2024c). The other light is farther south at about 2,500 m (8,202 ft) away and flashes a green light every 4 s, also visible 4 NM away (NOAA 2024c). These lights mark both a shallow water area and a group of small islands to warn vessels to stay away.

Figure 65 displays the existing night lights impact in the San Juan Islands per the National Aeronautics and Space Administration (NASA) Visible Infrared Imaging Radiometer Suite data. Most of the artificial light comes from various vessels that pass through the area – the brightest coming from automobile ferries and cargo ships, and the dimmest from fishing or recreational boats.

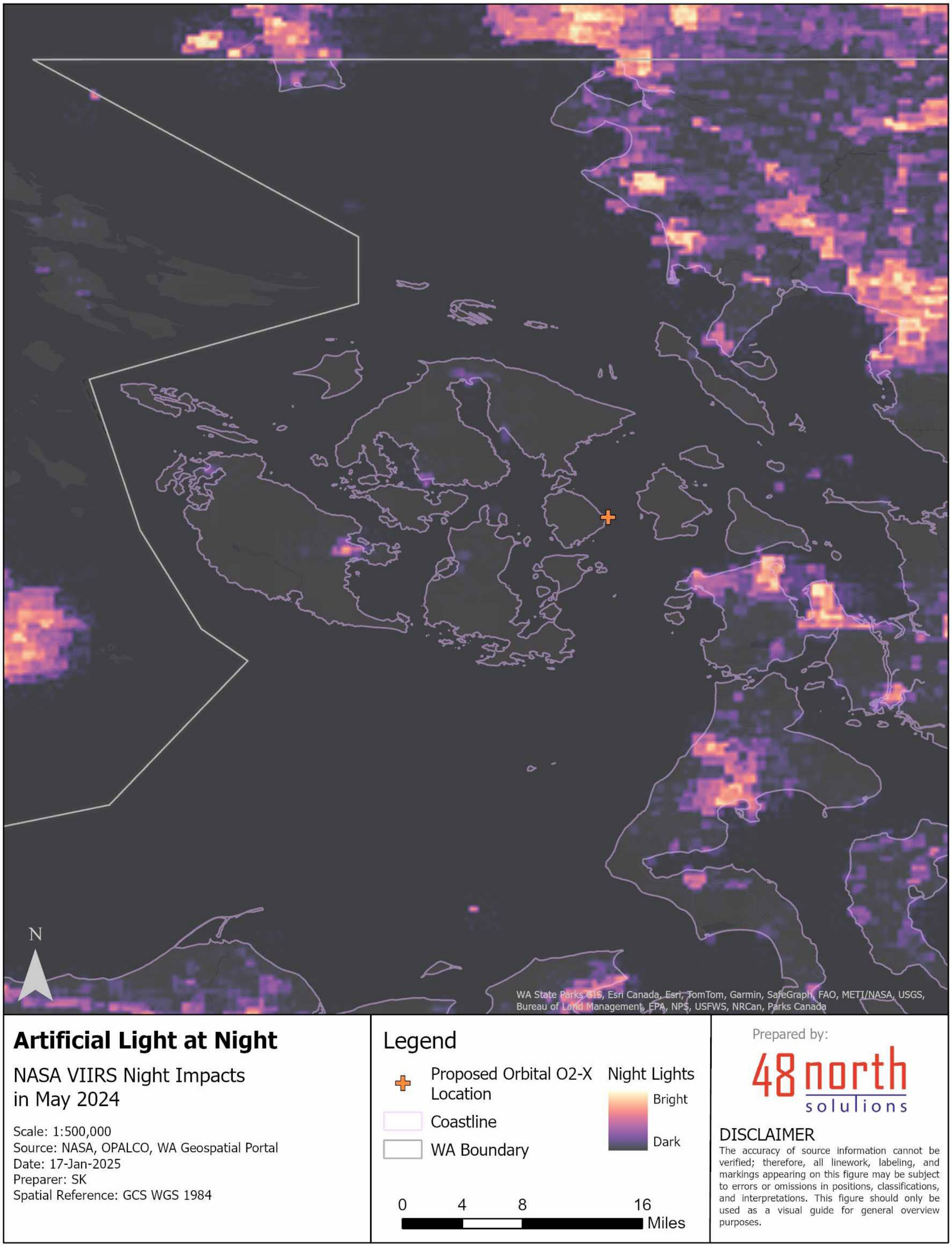

Figure 65. Existing Artificial Light Impact in the Vicinity of the Proposed Project Area

3.7 Federally Listed Species and Habitats

This section highlights the species and designated critical habitats listed under the ESA that may be present within the Project area, as described throughout the previous sections (**Section 3.4.1**, **Section 3.5.1.1**, **Section 3.5.2.1**, and **Section 3.5.5.1**). All ESA-listed species included were identified using scientific literature, and tools and records published by the Services (NMFS 2024d, 2024g; USFWS 2024b). Each of the twelve species shown in **Table 15** either has critical habitat within the proposed Project area or may be present within the proposed Project area (e.g., migrating or foraging). As previously mentioned, it is considered extremely unlikely that the yellow-billed cuckoo, northern spotted owl, and monarch butterfly would be present within and/or near the Project area.

The Project area overlaps with designated critical habitat for four species: SRKWs, Puget Sound-Georgia Basin DPS of bocaccio and yelloweye rockfish, and Puget Sound ESU of Chinook salmon (**Figure 66**). There are no terrestrial or freshwater components of the proposed Project; therefore, no threatened or endangered terrestrial species (e.g., animal, plant, or insect) are included in this section.

Table 15. Federally Threatened and Endangered Species that May Occur in the Project Area

Common Name (*Scientific Name*)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Marine Mammals			
Killer Whale, Southern Resident DPS (*Orcinus orca*)	Endangered	NMFS	Yes
Humpback Whale, Mexico DPS (*Megaptera novaeangliae*)	Threatened	NMFS	No
Humpback Whale, Central America DPS (*M. novaeangliae*)	Endangered	NMFS	No
Fishes			
Bocaccio, Puget Sound-Georgia Basin DPS (*Sebastes paucispinis*)	Endangered	NMFS	Yes
Yelloweye Rockfish, Puget Sound-Georgia Basin DPS (*S. ruberrimus*)	Threatened	NMFS	Yes
Chinook Salmon, Puget Sound ESU (*Oncorhynchus tshawytscha*)	Threatened	NMFS	Yes
Steelhead, Puget Sound DPS (*O. mykiss*)	Threatened	NMFS	No
Eulachon, Southern DPS (*Thaleichthys pacificus*)	Threatened	NMFS	No
Green Sturgeon, Southern DPS (*Acipenser medirostris*)	Threatened	NMFS	No
Bull Trout, Coterminous U.S. Population (coastal Recovery Unit) (*Salvelinus confluentus*)	Threatened	USFWS	No
Birds			

Common Name (*Scientific Name*)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Marbled Murrelet (*Brachyramphus marmoratus*)	Threatened	USFWS	No
Yellow-billed Cuckoo[1] (*Coccyzus americanus*)	Threatened	USFWS	No
Northern Spotted Owl[1] (*Strix occidentalis caurina*)	Threatened	USFWS	No
Echinoderms			
Sunflower Sea Star (*Pycnopodia helianthoides*)	Proposed Threatened	NMFS	None Designated
Insects			
Monarch Butterfly[1] (*Danaus plexippus*)	Proposed Threatened	USFWS	None Designated

Notes: ESA = Endangered Species Act; ESU = Evolutionarily Significant Unit; DPS = Distinct Population Segment; IPaC = Information for Planning and Consultation; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service

1. The species is considered extremely unlikely to occur within the project area, but does appear when using agency tools (e.g., USFWS's IPaC) to determine species' presence.

Source: NMFS 2024d, 2024b; USFWS 2024b

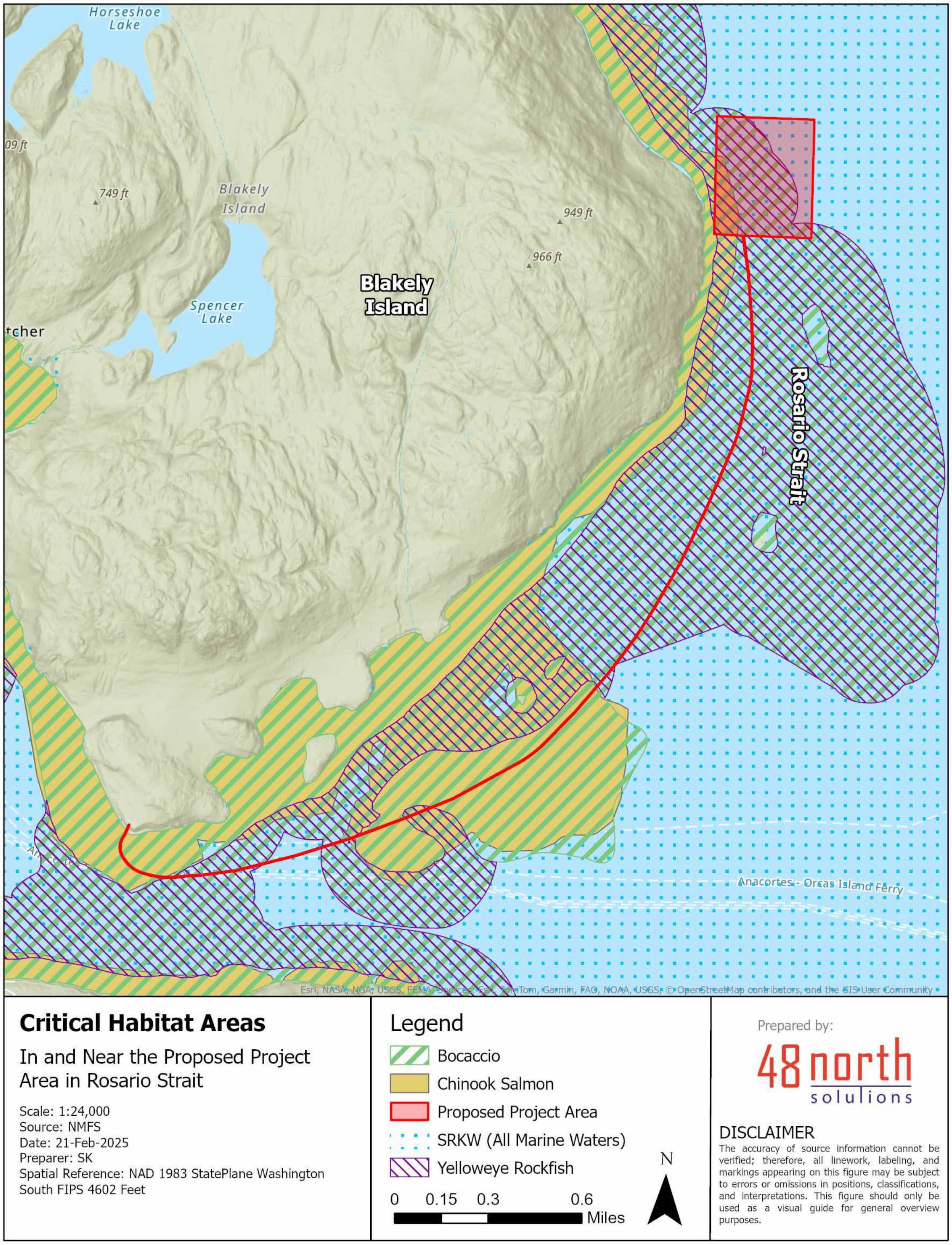

Figure 66. Designated Critical Habitat Areas

3.8 Recreation, Land Use, and Ocean Use

The proposed Project area is in Rosario Strait, within WDFW designated Marine Area 7, which includes all marine waters north of Trial Islands to the U.S.-Canada border, including the San Juan Islands, Haro Strait, Rosario Strait, Bellingham Bay, the southern Strait of Georgia, and the northeastern portion of the Strait of Juan de Fuca (WDFW 2024m, 2024u). Due to the mixed use of the area, activities in Marine Area 7 are co-managed by multiple agencies, included in this section.

3.8.1 Recreation

In WDFW Marine Area 7, recreators take part in activities such as SCUBA, freediving, kayaking, boating, and fishing. Whale watching tour companies commonly operate throughout the county. Recreators enjoy the scenic views of the San Juan Islands and high levels of biodiversity in the area.

SCUBA and freediving occur throughout the region, but Rosario Strait and the proposed Project area are unpopular due to the danger of diving in the strong dynamic currents. Strawberry Island on the eastern side of Rosario Strait is a popular diving spot.

Kayaking is popular throughout the San Juan Islands, and there are few limits as to where kayakers can travel. Knowledge of tides and currents is necessary to navigate the waters, and private kayak tours and parties travel past all sides of Blakely Island at various times of the day depending on their route and the time of day and year. The proposed Project area is not a particularly popular kayak destination due to Blakely Island consisting of private residences and no public parks, but kayakers may occasionally pass through on their way to visit other areas of the San Juan Islands.

Marinas, docks, and beaches in the San Juan Islands are operated by San Juan County, Washington State Parks, the San Juan Islands National Monument, and the San Juan Island National Historical Park (WDFW 2024m). In the San Juan Islands, there are 16 Washington State Parks, and boat launches are scattered throughout the region at public locations in nearby Anacortes, Deception Pass State Park, Burrows Bay, La Conner, Bellingham, and Blaine (Washington State Parks 2024b; WDFW 2024m). San Juan County owns and maintains eight docks with floats and eight boat ramps, and leases two outer island moorage docks (WDFW 2023). Private docks and marinas also exist throughout the region.

The marina on northern Blakely Island is the only public access point to the upper terrestrial portion of the island. Though there are beaches around the remaining permitter of the island, they too are private, bordered by steep cliffs and most are only accessible during low tide. Visitors can stop at the Blakely Island General Store and Marina to re-fuel, shop at the store, eat at the restaurant, or reserve an overnight boat slip moorage (Blakely Island General Store and Marina 2024). Since the island is entirely private property, travel beyond the marina is prohibited without a property owner's permission. There is no public lodging on the island. The asphalt airstrip on the island is for private use only.

Blakely Island is in Game Management Unit 415 and the greater WDFW management District 13, which includes all of Snohomish, Island, and San Juan counties, along with the islands of Skagit County (WDFW 2023). As per the *2023 District 13 Hunting Prospects Report and San Juan County Ordinance*, all hunting within San Juan County requires written permission from the landowner (WDFW 2023). Deer hunting is permitted on Blakely Island in some years. The deer are smaller than their relatives on the mainland, but access to hunting them can vary year-to-year depending on deer populations and the permission of landowners (WDFW 2023).

See **Section 3.8.2.1** for information about recreational fishing and shellfish gathering.

In conclusion, the most likely marine recreation in and around the proposed Project area includes fishing, boating, and kayaking which could temporarily traverse the proposed Project area (**Figure 67**).

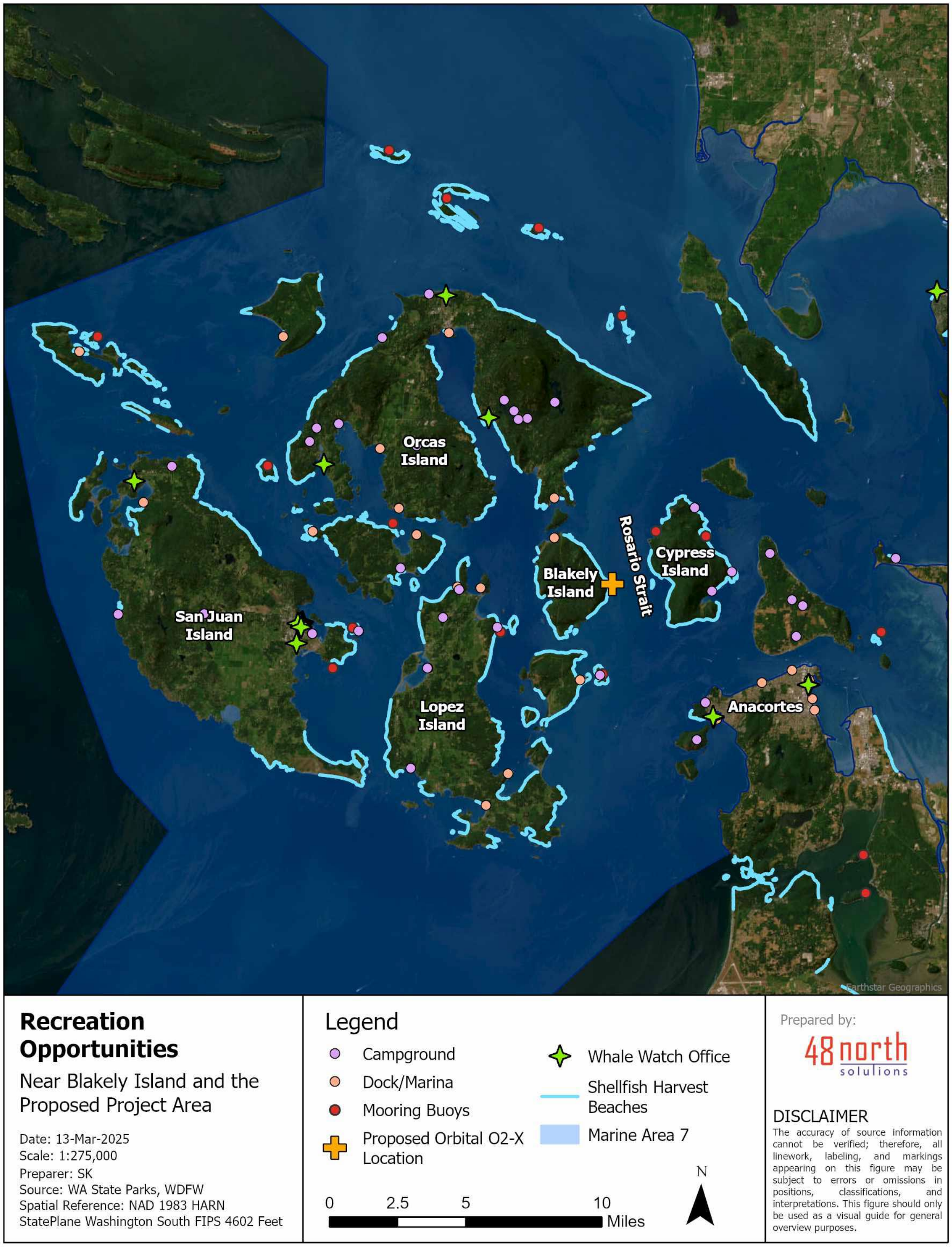

Figure 67. Marine Recreation Opportunities in the Proposed Project Area

3.8.2 Fisheries

3.8.2.1 Recreational Fishing

Many recreators visit the San Juan Islands to fish. Boats and recreators with fishing permits can set up to fish most anywhere in the waters that weave between the San Juan Islands, except for in Lummi Bay, the Lummi Nation reservation, and the San Juan Islands Marine Preserve (WDFW 2024u). The most popular fishing spots in the San Juan Islands are Hein Bank and Bellingham Bay (WDFW 2024m). Fishing is permitted around Blakely Island, and boats can be launched at marinas in the region to take trips to destinations throughout the San Juan Islands (**Figure 67**). Blakely Island is privately owned, so only residents and their guests can take part in fishing on the island. With permits, shellfish harvesting can occur on four WDFW beaches on Blakely Island that are only accessible via boat for clam, mussel, crab, and oyster harvest (see the defined "Shellfish Harvest Beaches" in **Figure 67**). A recreational license is required to fish in Washington State.

The best time for salmon fishing begins in July, but the timing of their presence varies each year (WDFW 2024m). Due to the convergence of multiple large bodies of water in the San Juan Islands, there are many places to fish for Chinook salmon and baitfish (WDFW 2024m). In late-summer and early fall, coho salmon arrive in the exterior of the San Juan Islands and in Rosario Strait, and pink salmon run from mid-July into early-September in odd-numbered years (WDFW 2024m). Trout, steelhead, sturgeon, mackerel, herring, anchovy, sardine, sand lance, smelt, Pacific halibut, and bottom fish species are also popular recreational fish in the region (Washington Fishing 2023).

Many of these species have fishing seasons that are year-round, except for Pacific halibut, salmon species, and bottomfish (Washington Fishing 2023). While salmon fishing is popular, fisheries have been more limited in recent years due to concerns about species conservation (WDFW 2024m). See **Table 16** for a summary of legal fishing seasons and additional rules for fish species in Marine Area 7, although it is important to note that emergency rule changes can occur throughout the year and are updated regularly on the WDFW website (WDFW 2024u).

Table 16. Marine Area 7: Fishing Rules in the San Juan Islands

Species	Season	Additional Rules
Trout	Year-round	Catch-and-release
Steelhead	Year-round	Daily limit two hatchery steelhead
Sturgeon	Year-round	Catch-and-release
Mackerel	Year-round	No minimum size and no daily limit
Herring, Anchovy, Sardine, Sand Lance, and Smelt	Year-round	No minimum size, with daily limit of 10 lbs., all species combined. All smelt caught must be kept and count toward the daily limit except fishing for eulachon is closed (Columbia River smelt). Herring - Closed year-round north of a line from Sandy Point to Patos Island to the Canadian boundary. For smelt: Jig gear may be used 7 days a week. Dipnets may be used from 6:00 a.m. until 10:00 p.m. Fridays through Tuesdays.
Pacific Halibut	Check the WDFW website at https://wdfw.wa.gov/fishing/regulations/halibut or call (360) 902-2700 in April for information on Pacific halibut seasons and	

Species	Season	Additional Rules
	regulations. No min. size. Daily limit 1. Annual limit 6. Descending device required onboard vessels.	
Other Food Fish	Year-round	No minimum size. Daily limit 2 of each species.
All Other Fish	CLOSED	CLOSED to fishing for, retaining, or possessing.
Salmon		
Entire Area	July 18 – July 20	Chinook - minimum size 22”. Other salmon species - no minimum size. Daily limit two including no more than one Chinook. Release chum, sockeye, wild coho, and wild Chinook. Additional Chinook openings may occur based on available quota. Check the WDFW website at wdfw.wa.gov.
	July 21 – July 31	CLOSED
	Aug. 1 – Aug. 31	No minimum size. Daily limit two. Release Chinook, chum, sockeye, and wild coho.
	Sept. 1 – Sept. 29	No minimum size. Daily limit two. Release Chinook, sockeye, and chum.
Bottomfish		
Lingcod	May 1 – June 15	Hook and line season. Minimum size 26”. Maximum size 36”. Daily limit one.
	May 21 – June 15	Spearfishing season. Maximum size 36”. Daily limit one.
Surfperch	Year-round	No minimum size. Daily limit 10. Except shiner perch daily limit 15: not included in bottomfish limit.
Rockfish	CLOSED	This fishery is CLOSED to fishing for, retaining, or possessing this species.
Pacific Cod, Pollock, Hake	Year-round	No minimum size. Daily limit two of each species.
Cabezon	May 1 – Nov. 30	Minimum size 18” and daily limit one.
Wolf-Eel	Year-round	CLOSED to retention.
Sixgill, Sevengill, and Thresher Sharks	Closed	This fishery is CLOSED to fishing for, retaining, or possessing these species. Sixgill shark may not be removed from the water.

Source: WDFW 2024u

Shellfish harvesting occurs throughout the year in Washington State. In the San Juan Islands, shrimping is productive during spring and early-summer, and crabbing is popular from mid- to late-summer through early fall (WDFW 2024u). Recreators who harvest shellfish or crabs must obtain a recreational license (WDFW 2024i).

The only crabs permitted for harvesting are Dungeness crab, red rock crab, and tanner crab, and they may only be harvested with a pot, by hand, or with a dipnet; gear is not allowed to pierce the shell to harvest (WDFW 2024i). When it comes to gear, one unit of gear is one trap, one ring net, and one pot (WDFW 2024r). In Marine Area 7 (San Juan Islands), the maximum units of gear per person for shrimp are two pots per person, with no more than four shrimp pots per boat (WDFW 2024r). The maximum units of gear per person for crabbing have no limit, but traps must be ring nets or start traps that lie flat on the seafloor (WDFW 2024r). Additionally, every shellfish pot, ring net, or star trap left unattended must have its own buoy line and a separate buoy that is permanently marked with the owner and operator's first name, last name, and permanent address (WDFW 2024r).

The waters of the proposed Project area are not used in any greater intensity than recreational fishing, shellfish, and crab harvesting in and around the greater San Juan Island region.

3.8.2.2 Tribal Fishing

Indigenous Tribal Nations and populations have been in the Pacific Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the United States, such as the Treaty of Point Elliott in 1855, Tribal Nations ceded 64 million acres of land to the United States for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation land and specifically reserved the right to gather and access foods and religious sites in their treaties with the federal government. Tribal Nations retain treaty-reserved fishing rights and rights via executive orders and legislative actions that are distinct from recreational fishing regulations. Tribal Nations still use traditional fishing practices to harvest half of annual salmon each year in Washington State, as affirmed by the Boldt Decision.

In the State of Washington, Tribal Nations have legal co-management of all natural resources that support their livelihoods and cultural heritage, confirmed by the Boldt Decision and several subsequent decisions (United States versus Washington 1974; United States versus Washington 1995). In 1974, Judge George Boldt issued what is now known as the Boldt Decision in the federal court case *US. v. Washington*, in which Tribal treaty fishing rights were reaffirmed. The decision included (1) an interpretation of the original Treaty of Point Elliott language to mean that the Tribes are entitled to half the harvestable number of salmon returning to or passing through the Tribes' usual and accustomed fishing areas (U&A), which are harvest areas that reflect the historical region in which natural resources were collected by Tribes, (2) established the Tribes as co-managers of the salmon resource with the state, and (3) established conservation standards that restricted the ability of the state to regulate Treaty Tribal fishing (NWIFC 2016a).

Tribes have deep spiritual and cultural connections to salmon and other aquatic species that have been used for religious ceremonies, cultural practices, subsistence, and trade dating back thousands of years (PFMC n.d.). Fishing continues to play a meaningful role in Tribal culture for commercial purposes, ceremony, and subsistence. Tribal Nations in the Pacific Northwest historically and presently fish for salmon, Pacific halibut, blackcod, Pacific whiting, species of rockfish and flatfish, as well as shellfish such as clams, crab, oysters, and shrimp, in addition to other species (NWIFC 2016d; NWIFC 2016e). Tribal fishing techniques include hook, line, and sinker, traps, weirs, nets (reef, dip, seines, and gill), spears, rakes, wheels, crab pots, and more, depending on whether species are in open water or bottomfish (Bohan 2009; NWIFC 2016d; Wild Salmon Center 2020). Several of the Tribal Nations engaged on the proposed Project have shared that Tribal fishing activities in the vicinity of the Project include, but are not limited to, crab pot deployment and gillnet fishing, specifically.

Each Treaty Tribe has staff who sample salmon, and fish tickets are collected with data that is shared daily with state co-managers, while sport fishermen report their catches months after their outing. Respect for Tribal fishing regulations are upheld by Tribal enforcement officers, and citations are issued if someone is not following Tribal regulations (NWIFC 2016f).

Tribal Nations in Washington State are also guaranteed the right to harvest shellfish. In May of 1994, the Rafeedie Decision affirmed the right to harvest half of shellfish on both public and private beaches down to the low tide watermark. To this day, Tribes coordinate with property owners and WDFW to perform a shellfish population survey and schedule a time to harvest (NWIFC 2016g). A total of 15 Tribes are included in the ruling, including Jamestown S'Klallam, Lummi, Muckleshoot, Nooksack, Port Gamble S'Klallam, Skokomish, Suquamish, Swinomish, Tulalip, and Upper Skagit, and as a result they can continue to harvest shellfish in their U&A territory (NWIFC 2016g; NWIFC 2016h).

3.8.2.3 Commercial Fishing

The state's commercial fishing industry is structured around a multi-species fishery. Commercial fishing in Washington State includes the following fisheries: Dungeness crab, Puget Sound salmon, Willapa Bay and Grays Harbor gillnet salmon, wild stock geoduck clam, Puget Sound herring, Puget Sound smelt, razor clam, sea urchin, sea cucumber, coastal hagfish, shrimp, albacore tuna, Pacific sardine, coastal salmon, and scallops (WDFW 2024c). Only some of the fisheries are active within and around the proposed Project area in Rosario Strait, and they are summarized in **Table 17**. Each of the fisheries listed above has its own seasons and regulations.

Table 17. Commercial Fisheries in the Proposed Project Area

Fishery	Season	Gear	Additional Rules
Dungeness crab	Jan. – Sept.	Crab pots	In 2024, the season opened October 1 and was later closed due to an Emergency Ruling.
Puget Sound salmon	Varies	Purse seine, gillnet, reef net, beach seine	Rules are updated as the season progresses.
Puget Sound smelt	Year Round	Drag (beach) seine gear	Closes via Emergency Regulation when 60,000-pound annual quota is reached.
Sea urchin	Oct. – Feb.	Gloves, knife, garden tiller, diving gear	The season depends on the current health of the sea urchin population.
Sea cucumber	Aug. – Nov (15 weeks)	Hand-held prying tool, diving gear	The season depends on current conditions and biotoxin levels.
Scallop	Closed	Scallop net, diving gear	This fishery is currently closed and has been for years, but the main harvest area is in the San Juan Islands.
Source: WDFW 2024a, 2024c, 2024d, 2024f, 2024g, 2024t			

In 2022, non-Tribal commercial fish landings from Washington State fisheries totaled 72,521 tonnes (approximately 159,887,000 lbs.) for a total value of $325,410,000 (NMFS 2022b). In terms of regional catch, the coastal area is by far the largest contributor to commercial fish harvesting, accounting for 85 percent of total pounds landed. Vessels in the Puget Sound make up approximately two-thirds of the vessels under 12.2 m (40 ft) in Washington State (WDFW 2012).

While some commercial fishing occurs within the Salish Sea, no data are publicly available on commercial fishing intensity in Rosario Strait.

3.8.3 Vessel Traffic

The San Juan Islands region is valuable for the commercial and economic port infrastructure in Washington State; thus, a variety of vessel types pass by the proposed Project area regularly. International container ships, the municipal ferry service, cruise liners, Navy surface/subsurface vessels, fishing vessels, and recreational boaters regularly transit the region.

The U.S. Coast Guard (USCG) cooperatively manages the vessel traffic in this area through the establishment and operation of the Vessel Traffic Service Puget Sound or "Seattle Traffic" under the Ports and Waterways Safety Act to continue safe use of waters in the U.S. (USCG 2021). This is part of the greater Traffic Separation Scheme that is recognized by the International Maritime Organization (IMO) (Ecology 2009). The waters of Puget Sound are a regulated navigation area per 33 CFR § 165.1303, which limits tank vessel size.

Ecology publishes Vessel Entry and Transits data annually to share a summary of vessel traffic statistics with the public (Ecology 2023b). According to Ecology, the types of vessels that pass through the region include articulated tug barges (ATB), cargo and passenger vessels (C&P), ferries, fishing vessels, tank barges, and tanker ships (Ecology 2023b). The types of tanker ships include chemical tankers, liquid natural gas, liquified petroleum gas, liquified gas, oil, and tankers bound for layup or shipyards (Ecology 2023b). The closest principal port to the proposed Project area is in Anacortes (NOAA and BOEM 2024). See **Table 18** for more information about statistics on vessel types present in 2023.

Table 18. Vessel Entries and Transits in Washington State Salish Sea Waters in 2023

Vessel Type	Entering Transits	Individual Vessels
C&P bound for Washington ports	1,918	854
Tank ships bound for Washington ports	413	150
Tank barges/ATB	2,805	1,256
Tank barges/ATB companies	8	5
Ferries	144,284	22
Commercial fishing vessels	39	28
Factory fishing vessels/fish processors	91	36

Notes: ATB = articulated tug barges; C&P = cargo and passenger vessels

Entering Transit = A vessel traveling from sea or Canada waters into Washington waters, regardless of destination. The trip back out to see is not counted.
Individual Vessel = A unique vessel, counted only once even if it enters Washington waters more than once in the calendar year.

Source: Ecology 2023b

The U.S. Marine Highway system includes 31 "U.S. Marine Highway Routes" that serve as extensions of the surface transportation system, with each all-water route (designated by the Secretary of Transportation) offering relief to landside corridors suffering from traffic congestion, excessive air emissions, or other environmental challenges (U.S. DOT 2025). The U.S. Marine Highway Program was created by the U.S. Department of Transportation (U.S. DOT) and is used to transport goods around the U.S. via waterways instead of highways to reduce motor vehicle traffic (U.S. DOT 2025). The nearest Marine Highway route does not pass through the San Juan Islands and Rosario Strait and instead routes southbound through the Strait of Juan De Fuca to Seattle (NOAA and BOEM 2024). There is, however, a designated traffic lane and two-way route that runs between Puget Sound and Rosario Strait (NOAA and BOEM 2024). The closest approach of the main north-south shipping lane through Rosario Strait is located approximately 0.4 km (0.25 mile) from the east boundary of the proposed Project area.

Washington State Ferries (WSF), a government agency as part of the Washington State Department of Transportation (WSDOT), runs ten routes serving 20 terminals around Puget Sound and the San Juan Islands. **Figure 68** displays the WSDOT-managed automobile and passenger ferry system from Anacortes on Fidalgo Island to Lopez Island, Shaw Island to Orcas Island, and to Friday Harbor on San Juan Island (WSDOT 2024). These routes travel through Rosario Strait and south of Blakely Island, but do not cross through the proposed Project area. Blakely Island itself does not have a ferry terminal or public ferry service (WSDOT 2024). According to WSDOT, other ferry routes traverse the region, but they do not stop at Blakely Island and instead pass from Bellingham north of Blakely Island to Friday Harbor and beyond.

Access to Blakely Island is only accessible by private plane at Blakely Island’s airstrip, or private boat arriving at the marina at the northern end of the island. Mariners should be aware the Washington State Ferries may deviate from published standard routes due to inclement weather, traffic conditions, navigational hazards, or other emergency conditions.

The Marine Cadastre inventory AccessAIS mapper demonstrates a visual representation of transit paths through the San Juan region using annual vessel transit track data (BOEM et al. 2024). As shown in **Figure 69**, which includes a visual distribution of all marine traffic transits from 2023, most marine traffic passes to the south of Blakely Island, with the second most popular route being along the north end of the island near the Blakely Island General Store and Marina.

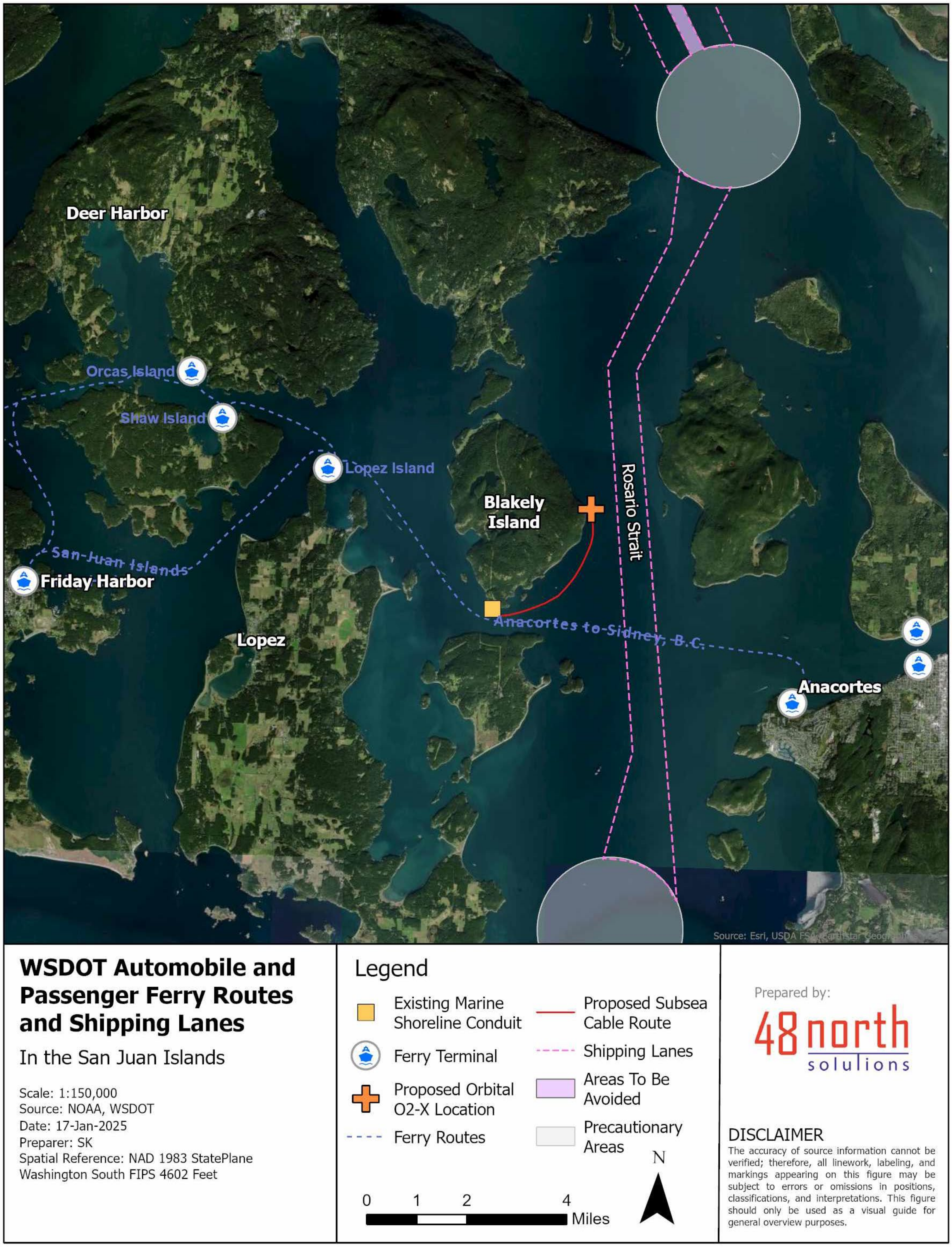

Figure 68. Vessel Traffic Near the Proposed Project Area

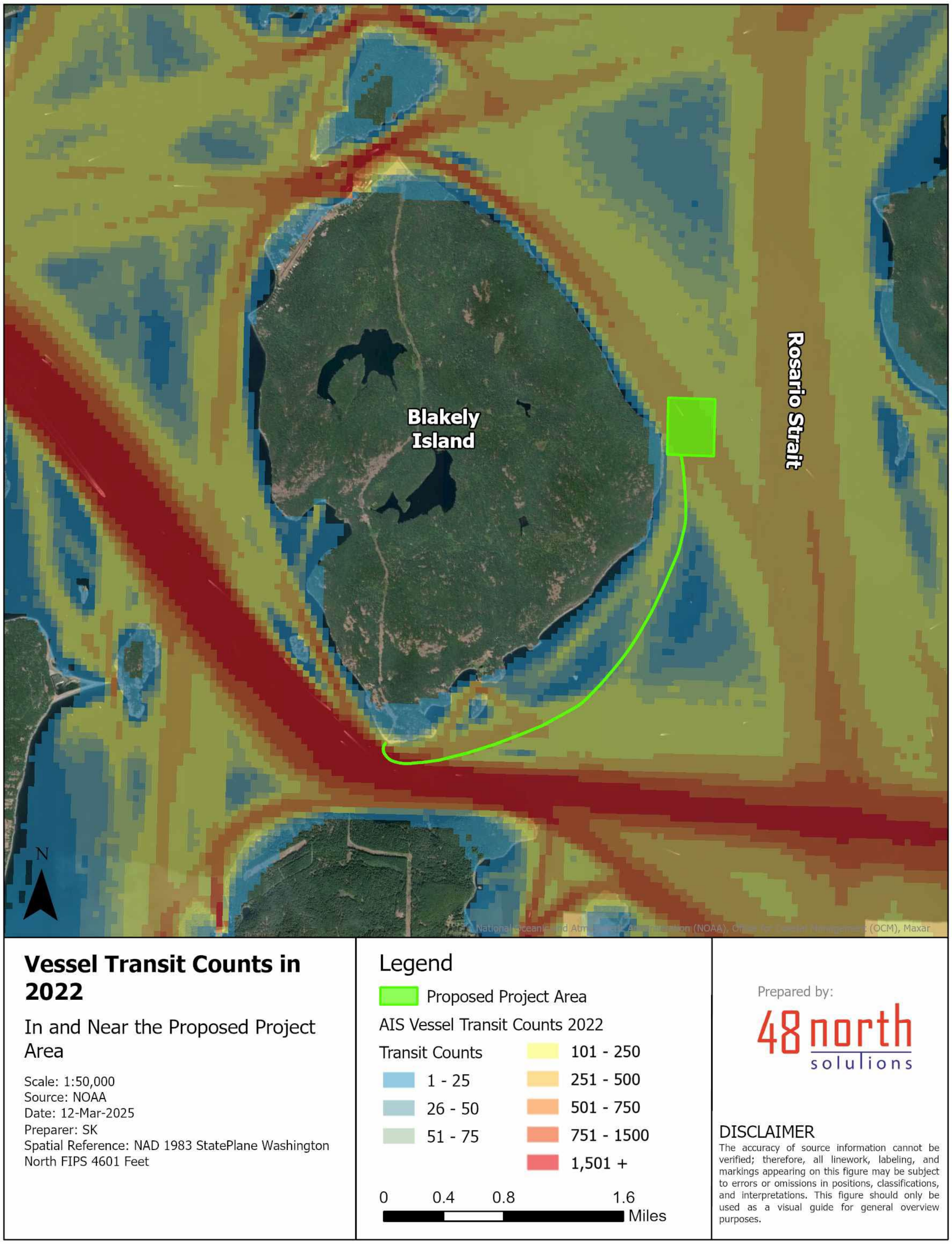

Figure 69. Marine Cadastre AccessAIS Vessel Transit Counts 2023
Source: BOEM et al. 2024

Spring and summer are the busiest time of year for vessel traffic in the San Juan Island region. In 2018, peak fishing and passenger vessel transit through the region was during April–June and July–September. This increase reflects the timing of fisheries openings and favorable boating conditions during the spring and summer. Seasonal marine events, including sailing regattas and fishing derbies, take place mostly during the spring and summer months. The increase in passenger vessels also indicates peak tourism season, with cruise ship passengers arriving to participate in water-based activities like whale watching season. Recreational vessel traffic also significantly increases between July and September, likely due to favorable boating weather in the late summer months (Ecology 2021).

The current lighting buoys and beacons near the proposed Project area include lighted buoys present at Lawson Rock, Black Rock, and the outcrop north of Black Rock. The Blakely Island light beacon is located at the subsea cable landing on the south end of the island.

3.8.4 Marine Protected Areas

Marine Protected Areas (MPAs) are defined by the Washington State Legislature as *"a geographic marine or estuarine area designated by a state, federal, Tribal, or local government in order to provide long term protection for part or all of the resources within that area."* (Substitute Senate Bill 6231, 2008). In Washington State, a total of 127 MPAs are managed by 11 federal, state, and local agencies, 83 percent of which are managed by the state.

The terminology defining Washington State's MPAs is not standardized because each MPA was created on an individual (ad-hoc) basis. Therefore, not all of Washington State's MPAs meet the international protected area definition that was established by the International Union for Conservation of Nature (IUCN), which is that protected areas are *"a clearly defined geographical space, recognized, dedicated, and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."* NOAA's MPA Inventory in western Washington State is depicted in **Figure 70**. **Figure 71** shows the MPAs near the proposed Project area (NOAA 2023).

Table 19 provides an overview of the categories of MPAs in Washington State. These sites span an area of approximately 260,618 hectares (644,000 acres), including more than 1,828 km (1,136 miles) of shoreline.

There is one MPA in the proposed Project area: the San Juan County/Cypress Island Marine Biological Preserve (NOAA 2023). There are also two MPAs near Blakely Island and the proposed Project area: Cypress Island Aquatic Reserve, and San Juan Islands NWR (NOAA 2023). Each is managed by a different agency and follows its own distinct management plan. MPAs near the proposed Project area can be seen in **Figure 71**, and additional details about each are presented in **Section 3.8.4.1** and **Section 3.8.4.2** below.

3.8.4.1 MPAs in the Proposed Project Area

San Juan County/Cypress Island Marine Biological Preserve

The San Juan County/Cypress Island Marine Biological Preserve (SCBP) shares a border with San Juan Island County. The Washington State legislature created it in 1923 as a *"preserve of marine biological materials useful for scientific purposes, except when gathered for human food"* including the marine waters, beds, and shores of the San Juan Islands and Cypress Island (Environmental Law Institute [ELI] 2014). The SCBP is managed by the University of Washington Friday Harbor Laboratories, is categorized as an IUCN MPA, and its primary conservation focus is natural heritage (NOAA 2023). The provision that developed the SCBP made it a criminal misdemeanor to take non-food materials, although the collection of non-food materials for scientific purposes is arranged through the Laboratories "on a case-by-case basis" (ELI 2014). The SCBP is to be managed for *"research and education, conservation of bottomfish, invertebrates, and marine plants, and habitat protection"* (ELI 2014).

Since the SCBP shares a border with San Juan County, the entire proposed Project area on the east side of Blakely Island is within the SCBP.

3.8.4.2 MPAs near the Proposed Project area

Cypress Island Aquatic Reserve

The Cypress Island Aquatic Reserve was created in 2007 when 2,454 hectares (6,065 acres) of state-owned lands were designated as the reserve (DNR 2024d). It surrounds the nearly 32 km (20 miles) of Cyprus Island's shoreline and is the largest, relatively undeveloped island in the San Juan Islands (DNR 2024d). The reserve qualifies as an IUCN MPA with a focus on natural heritage and is managed by DNR (NOAA 2023).

The boundary of the reserve is approximately 2.5 km (1.6 miles) east of Blakely Island, which does not overlap with the proposed Project area.

San Juan Islands National Wildlife Refuge

The San Juan Wilderness, a portion of the San Juan Islands NWR, was established in 1976 in support of the Wilderness Act, which *"secure[d] for the American people of present and future generations the benefits of an enduring resource of wilderness"* (USFWS 2024d). Today there are 83 units of the San Juan Islands NWR, which is composed of many islands that, combined, total 143 hectares (353 acres) of land (USFWS 2024d). As a NWR, the mission in managing this land is to contribute an effort *"to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the US for the benefit of present and future generations of Americans"* (USFWS 2024f). The San Juan Islands NWR is managed by the USFWS and categorized as an IUCN MPA, with a primary conservation focus of natural heritage (NOAA 2023).

Blakely Island and the proposed Project area are not within the San Juan Islands NWR, but some small island areas offshore Blakely are included. The proposed new subsea cable may pass between some of them on the southeastern side of Blakely Island but would not cross the boundaries or fall within these MPAs.

Table 19. Types of Marine Protection in Washington State

	Aquatic Reserves Program	MPAs: Conservation Areas/Marine Preserves	San Juan County/Cypress Island Marine Biological Preserve	Underwater Parks and Marine Parks	Natural Area Preserves/ Natural Resources Conservation Areas
Authority	DNR	WDFW	State Legislature	Washington State Parks	DNR
Jurisdiction and Boundaries	State land from high tide waterward, including estuarine	Intertidal and subtidal areas in Puget Sound	Salt waters, beds, and shores of San Juan County and Cypress Island	State waters, with priority on "unique or diverse marine life" or underwater features	Representative areas of land or water which retain natural character or important for conservation
Prohibited Uses	Activity conflicting with educational, scientific, or environmental purpose	Conservation Areas: no take of fish, shellfish, or wildlife; Marine Parks: species- or gear-based restrictions	No take of "marine biological materials useful for scientific purposes" without permit	Protection of "natural, cultural, and recreational resources"; invertebrate harvest prohibited	Limited public access other than for education or low impact use

Notes: DNR = Washington State Department of Natural Resources; MPA = marine protected area; RCW = Revised Code of Washington; WAC = Washington Administrative Code; WDFW = Washington Department of Natural Resources

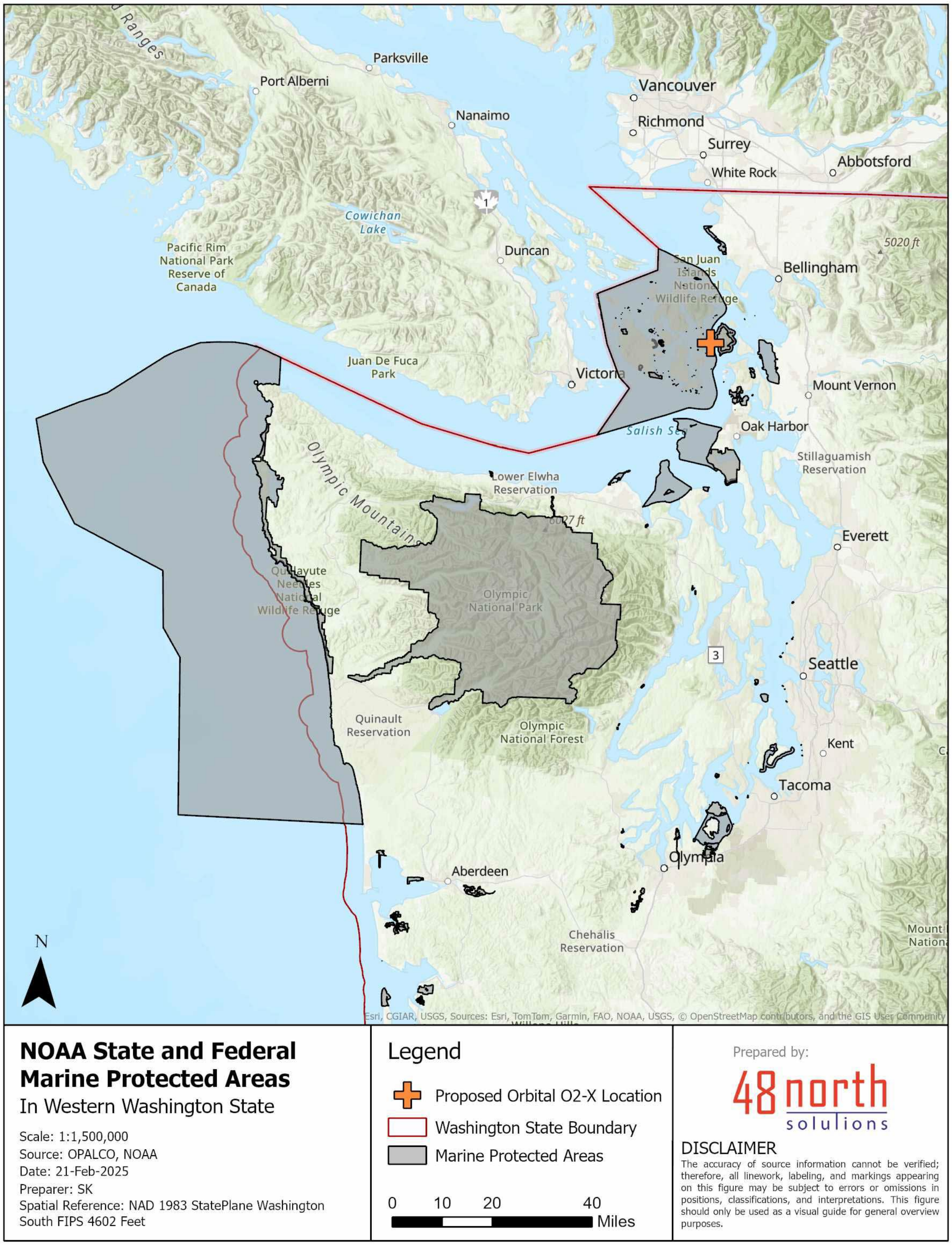

Figure 70. All Marine Protected Areas in Western Washington

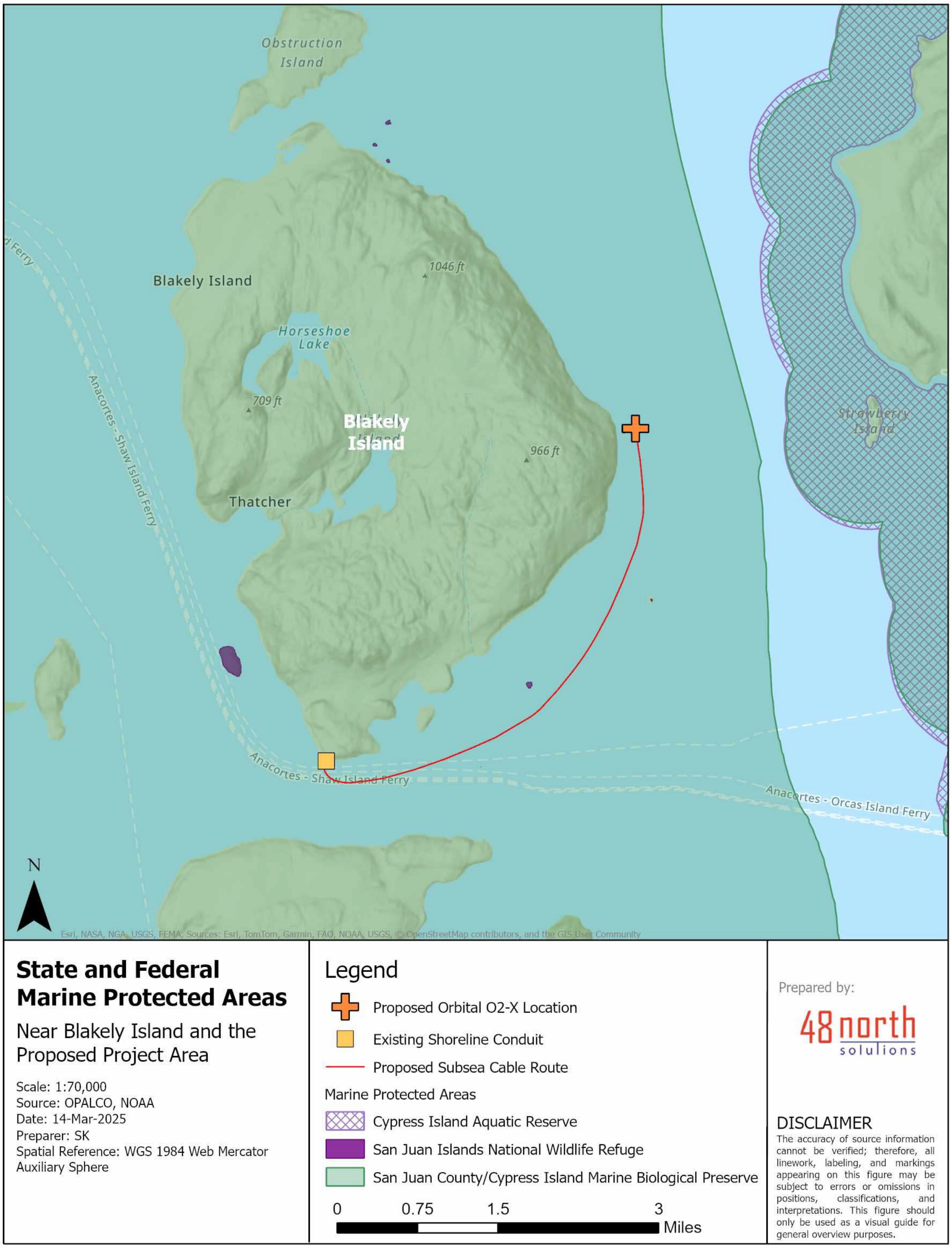

Figure 71. MPAs Near Blakely Island and the Proposed Project Area

3.8.1 Restricted Areas

The proposed Project area is not in or near any restricted areas. No military zones are near or within the proposed Project area, and there are no shipwrecks or obstructions in the water (NOAA and BOEM 2024). There is one dispersive dredged material disposal site in Rosario Strait, southeast of Blakely Island, approximately 5 km (3 miles) away from the proposed Project area (USACE 2024). Restricted areas will not be discussed further in this document.

3.9 Air Quality

The baseline air quality in the area east of Blakely Island is considered good. As a privately owned island, there are no residential subdivisions or commercial built areas. There are temporary increases in human activity when recreational boats, shipping vessels, or ferries transit the surrounding area. The WSDOT passenger ferry system has routes along the south of Blakely Island through Rosario Strait (see **Figure 68**). Blakely Island does not have a WSDOT ferry terminal or public ferry service. There is some residential car traffic on Blakely Island, with a small number of maintained roads or paths. Blakely Island Marina is the only public access to the island with occasional recreational pleasure boat presence.

The Air Quality Index (AQI) ranges from 0 to 500 and is regulated by the EPA under the Clean Air Act. The AQI tracks pollutants (carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter of 10 micrometers or less) that are considered harmful to public health and the environment. There is no AQI station on Blakely Island, but readings from Decatur Island (just south of Blakely Island) have historically remained below an AQI rating of 50 (indicating “good” air quality) according to PurpleAir, a community-based system of low-cost sensors that measure harmful pollutants in the air (Johnson et al. 2019).

3.10 Tribal and Cultural Resources

This section describes the Tribal resources and cultural resources within the proposed Project area. The information presented in this section is based on the existing information available and includes input received from several of the Tribal Nations. OPALCO has led Tribal engagement to identify potential effects early in the process. FERC would conduct formal consultation on potential effects on Tribal resources and cultural resources. Consultation with the Tribal Nations would continue as the Project moves through NEPA review, compliance with Section 106 of the NHPA, as well as permitting and construction.

3.10.1 Tribal Resources

The term “Tribal resources” refers to the collective rights and access to traditional areas and times for gathering resources associated with a Tribe’s sovereignty since time immemorial. It also includes inherent rights or formal treaty rights associated with U&A territories and lands formally ceded by the Tribes and bands under the Treaty of Point Elliott in 1855. Tribal resources may also include archaeological or historic sites, elements of the built environment, and Traditional Cultural Places (TCPs) associated with Tribal use, and sites considered sacred by Tribes.

It is important to engage with Tribal Nations to identify and understand these important resources and areas, how they are used, and how the construction and operations of a project may affect the rights that are guaranteed under these treaties and federal laws.

The identification and analysis of Tribal resources is based on published materials as well as information shared by Tribal Nations. To incorporate the perspective of Tribal Nations, the analysis considered natural resources and cultural resources associated with Tribal interests and treaty rights. This section includes consideration of the unique perspectives and potential effects on the Tribal Nations when evaluating Project effects. This analysis has identified Tribal resources as plants, wildlife, and areas important to traditional cultural practices and those associated with treaty rights related to U&A places. Technical reports, correspondence from the Tribal Nations, publicly available sources, and unpublished ethnographic data were used to develop the list of resources. The following sources were reviewed:

- Letter from Swinomish Tribe dated October 29, 2024.
- "White Paper" provided by the Samish Indian Nation dated April 5, 2024.
- Published ethnographic studies and historic contexts.

Natural resources are inextricably linked with the lives of Indigenous peoples. All animal species have some connection to Indigenous people through traditional stories or practice. Plant gathering is an essential subsistence and cultural activity that is documented in ethnographic literature, Tribal legend and stories, and archaeological sites. Plants were historically and are currently gathered for food, medicine, and ritual uses, as well as raw material for tools, clothing, basketry and mats, and other uses. Participation by Tribal members in those gathering activities is a part of cultural identity. Aquatic habitats in the proposed Project area support a variety of wildlife species. Section 3.4, Section 3.5, and Section 3.6 provide lists of protected wildlife species likely to occur in the proposed Project area.

During early coordination with DAHP, State Archaeologist Dr. Rob Whitlam recommended the formation of a working group including the Tribal Historic Preservation Officers, DAHP, FERC, and OPALCO once Section 106 consultation is initiated. OPALCO would work with the Tribal Nations and DAHP to bring together this working group in coordination with FERC early in the process.

3.10.1.1 Usual & Accustomed Treaty Fishing Rights

Indigenous Tribal Nations and populations have been in the Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the U.S., Tribal Nations ceded 64 million acres of land to the U.S. for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation land and specifically reserved the right to gather and access foods and access religious sites in their treaties with the federal government. Tribal Nations also retain rights via executive orders and legislative actions.

In Washington State, Tribal Nations have legal co-management of all natural resources that support their livelihoods and cultural heritage, affirmed by the Boldt Decision and subsequent decisions that determined the Tribes are entitled to half the harvestable number of salmon returning to or passing through the Tribes' U&A. The proposed Project area is the traditional territory of several Tribal Nations who signed the Treaty of Point Elliott in 1855.

Fishing strategies used by many Tribal fisherpeople can include the use of weirs, fish traps, reef nets, dip nets, and fish wheels (Wild Salmon Center 2020). Section 3.8.2.2 provides a detailed discussion on the types of Tribal fishing that may be occurring in the proposed Project area.

Based on the information received from the Tribal Nations, the proposed Project could affect Tribal interests, treaty rights, and resources in and around the areas where facilities are located. See Appendix A – Consultation Record for a detailed summary of the comments and/or concerns received.

3.10.1.2 Tribal Canoe Journey

Canoe travel has been a cultural practice of Indigenous people on the West Coast since time immemorial. Canoes play a meaningful role in Indigenous culture beyond a means of transportation. The U.S. and Canadian governments restricted canoe travel in the twentieth century. In 1989, Indigenous people revitalized the Canoe Journey, or Tribal Journey, in coastal communities of the Pacific Northwest to heal and preserve this cultural practice (Masterman 2024).

Each year, various Indigenous groups from the Pacific Northwest's Coast Salish Tribes travel by traditional canoes along ancestral waterways, stopping along the way until they converge at a host nation's destination. Protocol plays an important role in the Canoe Journey and serves as a system of rules that help participants honor Indigenous teachings. Once participants arrive, they ask for permission to land on another's Tribal territory and follow protocol to share their identity and culture through songs, dances, traditional greetings, and other cultural practices (The Intertribal Canoe Society and American Friends Service Committee 2011).

In 2023 the Canoe Journey took place again after a 4-year break due to the COVID-19 pandemic. The event was called "Paddle to Muckleshoot" and hosted by the Muckleshoot Indian Tribe. In 2024, the event was known was "Power to Paddle to Puyallup" and hosted by the Puyallup Indian Tribe. As many as 25 canoes, each carrying up to 43 people, participated in the Canoe Journey (Washington State Parks 2024a).

In 2025, the Canoe Journey will be hosted on the Olympic Peninsula in Washington State by the Lower Elwha Klallam Tribe. The event is tentatively scheduled for August 1, 2025 (Montesano 2024). OPALCO will continue engagement with the Tribal Nations to learn about future dates and routes to work to avoid, minimize, or mitigate effects on the Canoe Journey. It's possible the route has gone through Rosario Strait (and will do so again) and Tribal Nations from the north travel to host areas in Puget Sound and south.

3.10.2 Cultural Resources

For this document, the term "cultural resources" is used to describe resources that are evidence of past human activity including archaeological sites, districts, buildings, structures, and objects that have not been evaluated for eligibility for listing in the NRHP. Cultural resources also include non-Native American built environment and archaeological resources that would not likely be considered Tribal resources by the Tribal Nations.

The San Juan Islands are the traditional territory of the Central Coast Salish peoples who spoke Straits Salish (or Northern Straits), one of the five different languages that divided the territory (Samish Indian Nation 2017; Suttles and Lane 1990). Blakely Island was the traditional territory of the Samish Indian Nation; historically, their territory also included the eastern half of Lopez Island, "Guemes, Cypress and other islands between Lopez and the mainland and portions of Samish Bay, Padilla Bay and Fidalgo Island" (Lane 1975). Several other Tribes also lived throughout the San Juan Islands, including the Lummi, Klalakamish, Saanich, Semiahmoo, Songhees, and Swallah (Suttles 1990). Like other Coast Salish groups, the specific territory of each Tribe was ambiguous, and resources were often shared; no borders were formerly drawn until the 1854–1855 treaties (Suttles and Lane 1990). There are no identified village locations on Blakely Island, but there is ethnographic information of villages on Orcas, Waldron, Guemes, Lopez, and San Juan islands (Lane 1975; Sam 1933; Suttles 1974; 1990).

Like other Coast Salish groups, people living in the San Juan Islands traveled mainly by canoe, with several different styles for traveling on saltwater and on rivers. Canoes and other cultural materials such as cordage, baskets, clothing, mats, towels, mattresses, and even seasonal huts were made with western redcedar. Continued creations include intricate blankets woven from the hair of a now-extinct wooly dog, mountain goat wool, waterfowl down, and fireweed cotton (Samish Indian Nation 2017; Suttles and Lane 1990). Villages occupied by the Coast Salish people were often along the water at an access point where their canoes could easily be beached (Suttles and Lane 1990). The Samish, as well as the Lummi and Semiahmoo, engaged in reef-netting (Lane 1975).

The San Juan Islands became the subject of a boundary dispute between Great Britain and the United States in the mid-1800s. Until the boundary dispute was mediated in 1871, Great Britain and the United States held their established positions at opposite ends of San Juan Island. In 1874, Euro-Americans, comprised of a high number of former soldiers, began to lay claim on land left vacant by British troops (Thompson 1972). Once the boundary conflict concluded, Euro-Americans began to formally settle the San Juan Island archipelago.

On Blakely Island, the first recorded white settler was Paul K. Hubbs, Jr., who moved to the island in 1850. A mill was established on Thatcher Bay, on the west side of the island, and operated from 1879 – 1942 (Regional Fisheries Coalition 2024). While there was some settlement on the island, it was relatively minimal; the school that opened in 1889 closed in 1949. An airport was built that same year (1949). Harold Bartram and Floyd Johnson made plans to develop the island in the mid-1950s, but shortly thereafter sold their land to the Puget Sound Pulp & Timber Company of Bellingham (Bishop 2024). In 1993, half of the island was placed in trust, and trust lands were expanded in 2010.

The identification and analysis for cultural resources is based on technical reports, correspondence from the Tribal Nations, publicly available sources, and unpublished ethnographic and scientific data. This existing information was used to identify cultural resources and the potential for cultural resources eligible for listing in the NRHP to conduct a cultural resources assessment of the proposed Project area. OPALCO would comply with Section 106 of the NHPA, which would be initiated following submittal of the DLA and complete a full and comprehensive cultural resources assessment to identify historic properties in the Area of Potential Effects (APE) in consultation with Tribal Nations and the DAHP. Since the Project is a federal undertaking, FERC is the lead federal agency responsible for complying with Section 106 of the NHPA and its implementing regulations (36CFR800).

The following sections describe the cultural resources assessment for the Project.

3.10.2.1 Records and Literature Review

A records search of the proposed Project area was conducted using the Washington Information System for Architectural and Archaeological Records Database (WISAARD). WISAARD contains all cultural resources documents submitted to DAHP since 1995. Additional sources of background research and information included: historical maps and General Land Office (GLO) records, NRHP-listed properties, historic U.S. Geological Survey (USGS) topographic maps, and modern aerial photographs and topographic maps.

The records search completed on October 29, 2024, did not identify any previously recorded cultural resources or historic properties within the proposed Project area. The nearest archaeological site is approximately 0.6 km (0.4 mile) from the proposed Project area. No prior cultural resources assessments have been undertaken within 1.6 km (1 mile) of the proposed Project area (DAHP 2024). There are no recorded ethnographic place names within 8 km (5 miles) of the proposed Project area, although there are several throughout the San Juan Islands (Suttles and Lane 1990). WISAARD does not contain all ethnographic information and is limited to what has been researched, identified, and shared by researchers and Tribal Nations. Unrecorded resources could be present and may not be widely shared because of the confidentiality of that information.

The shoreline in the vicinity of the proposed Project area is classified as "Very High Risk" in DAHP's Statewide Predictive Model for containing precontact-era archaeological sites (DAHP 2010). The Statewide Predictive Model is a tool used by archaeologists and planners to evaluate potential archaeological risks on a broad scale and to inform methods for determining if historic properties are present. The model was developed to statistically evaluate multiple environmental factors (e.g., elevation, slope percent, aspect, distance to water, soils, and landforms) to predict where archaeological resources might be found (Kauhi 2013).

The proposed Project area has not been previously surveyed. Two archaeological sites have been recorded in the vicinity (less than 1.6 km [1 mile] away); both of these are associated with shoreline locations.

Archaeological sites along the coast and nearshore environment in the San Juan Islands typically include shell midden deposits. These include shellfish processing locations that are associated with littoral environments where shellfish can be harvested nearby. Accumulations of shell and shell middens provide an ideal environment for the preservation of bone, and often contain the bones of vertebrate faunal prey, lithics, and even human remains from burials. Middens are often directly associated with long-term habitation sites, but this is not always the case. Features associated with shellfish processing, other than shell middens, include, but are not limited to, hearths and pole- or post-holes for drying racks.

Shell middens can be associated with occupation sites including villages and seasonal camp sites. Occupation sites are located on stable landforms that are not periodically inundated. These sites represent collection points for resources on the landscape. When resources are extracted and processed elsewhere, they are generally moved to an occupation site where they are stored, consumed, and used. These sites may either be short-term (e.g., base camp) or long-term occupation (e.g., winter village) sites. Artifacts at these sites are indicative of the activities that occurred during resource extraction and processing of the surrounding landscape. Features at these sites include, but are not limited to, temporary shelters, permanent shelters, storage pits, hearths, ritual features, burials, and tool production areas.

3.10.2.2 Previously Recorded Archaeological Sites within 1.6 km (1 Mile)

There are no previously recorded archaeological sites in the proposed Project area; however, there are two previously recorded archaeological site within 1.6 km (1 mile) including Site 45SJ00154 and Site 45SJ00160.

Site 45SJ00154 is in the southwestern portion of Blakely Island, approximately 0.6 km (0.4 mile) north of the proposed Project area. Site 45SJ00154 was first recorded in 1954 and was described as a midden deposit measuring 59 m (195 ft) in length, 31.8 m (125 ft) in width, and with depths of deposits ranging from 0.2 to 0.6 m (0.5 to 2 ft). In 1985, the archaeological site was revisited by archaeologist Gary Wessen who described the site as a “continuous mass of shell midden deposits” (Wessen 1986a). No other features were noted.

Site 45SJ00160 is located on the northern portion of Decatur Island approximately 1.3 km (0.8 mile) south of the proposed Project area. Site 45SJ00160 was first recorded in 1947 by R. Lane with the University of Washington (UW 2024). The site was described as a rock cairn and no artifacts or other cultural deposits were noted. In 1985, the archaeological site was revisited by archaeologist Gary Wessen; however, the rock cairn could not be relocated (Wessen 1986b).

3.10.2.3 Historic Buildings or Structures

No historic buildings or structures (i.e., historic built environment resources) have been recorded and mapped in WISAARD within the proposed Project area (DAHP 2024).

3.10.2.4 Traditional Cultural Places

There are no previously recorded TCPs identified within the proposed Project area or a 1.6-km (1-mile) radius. The Tribal Nations are being engaged to determine if TCPs are present.

3.10.2.5 Cemeteries

No cemeteries have been recorded and mapped in WISAARD within the proposed Project area or a 1-mile radius (DAHP 2024).

3.10.2.6 Potential for Cultural Resources

The entire proposed Project area is located underwater and has been submerged for an extended period. Archaeological sites in the vicinity of the proposed Project area are primarily located along the shoreline on beaches and terraces in the nearshore environment outside the proposed boundaries of the Project. An assessment of the potential for submerged archaeological sites was conducted using a desktop review of published data as well as a review of the side-scan sonar results conducted as part of the site characterization studies to inform the mapping of the seafloor in the vicinity of the proposed Project area.

3.10.2.7 Potential for Submerged Archaeological Sites

The post-glacial creation of the Salish Sea Islands, including Blakely Island and the other San Juan Islands, occurred approximately 15,500 years ago with the recession of the Cordilleran ice sheet and flooding of what is now the Juan De Fuca Strait, Straits of Georgia, and Puget Sound. Relative sea level has fluctuated throughout that time, both above and below current shorelines. Relative sea level changes occurred most widely in the period from 15,000 to 5,000 years ago because of post-glacial isostatic rebound and continued Holocene era glacial melting, large -scale tectonic plate movement, several large magnitude earthquakes in the region occurring between 3,100 and 300 years ago, and both local and global eustatic sea level changes. In summary, relative sea levels were up to approximately 50 m (150 ft) below modern levels in the period from 13,000 to 10,000 years ago and generally rose in the period from 10,000 to 5,000 years ago, with contemporary shorelines established about 5,000 years ago. Relative sea level has continued to rise much more slowly since that time (Beale 1990; Fedje et al. 2018; Hutchings and Williams 2020; Shugar et al. 2014; James et al. 2005). At current sea levels, the subsurface elements of the Project (i.e., anchors and cable) would lie at depths of approximately 101 m (330 ft) to 14 fathoms (84 ft), except for a small shelf at the south end of Blakely Island that lies at 11 m (36 ft) (Office of Coast Survey 2024).

The U.S. Bureau of Ocean Energy Management developed a predictive model for potential locations of underwater archaeological sites by identifying potential relict submerged landforms that would have survived marine transgressive processes associated with sea level rise across the Pacific Coast of the North America (ICF International et al. 2013). According to the map dataset, the seafloor on the east and south side of Blakely Island has a low to low-moderate potential for relic landforms, with only a very small area of potentially higher probability near the proposed location of the Orbital O2-X (Data Basin 2024).

If present, submerged archaeological resources would likely be of three primary types within the Salish Sea: historical shipwrecks and other historical objects, subtidal middens and occupation sites, and subtidal resource harvesting sites or features. Shipwrecks would typically be expected to have left large and distinct materials on the seafloor, such as hull, cargo, and ballast. The type and extent of materials would vary based upon the ship type and size, material construction, and amount of ballast and cargo. In addition, shipping could leave isolated materials from lost or jettisoned cargo and deck-gear (Arcas Consulting Archaeologists Ltd. 2000). There are no known shipwrecks within the proposed Project area, and a recent sonar side scan conducted for this Project by Tetra Tech, Inc. in October of 2024 indicates that the seafloor is uniform and bare other than a pocket of large boulders; it is otherwise free of evident features or objects (Appendix C1).

Precontact archaeological sites such as subtidal middens, occupations sites including villages and temporary camps could occur with the proposed Project area in areas less than 46 m (150 ft). Seasonal temporary camps and occupation sites could consist of small features, stone and bone artifacts, and fire-modified rock. Larger more intensively used locations may contain archaeological middens housing similar materials, as well as large shellfish deposits and anthropogenic soils. These site types are unlikely to have remained intact (if once present) from inundation, wave action, and tidal and current impacts in the steeply sloping terrain of the proposed Project area, particularly along the east side of Blakely Island. The small shelf at the southern end of Blakely Island would hold the greatest potential for subtidal middens and terrestrial occupation sites such as seasonal camps and villages. The ADCP results indicate increased wave action in the fall and winter months with a significant storm in December 2025 with wave heights of 1.8 m (5.9 ft) creating significant erosional forces on the shoreline (Appendix C2).

Subtidal resource harvesting sites, such as those related to reef net fishing could be present at the southern end of Blakely Island since the landform in that location is a headland. Reef net sites are recognized by distinct piles of stones once used to anchor the nets, refreshed annually. Reef net sites typically occur in shallow waters usually at depths less than 25 feet (8 meters). Landform components of an intertidal beach include the beach face and low-tide terrace and can be found on beaches primarily shaped by wave action. Such landform components are extremely unstable and are constantly reworked by wave action, creating seaward-dipping or cross-bedded sedimentary laminations (Waters 1992). Intertidal beach landform components are composed of sediments eroded and deposited by wave action (Waters 1992).

Based on this cultural resources assessment, there is limited potential for the Project to encounter cultural resources. There are no previously recorded resources and site types associated with submerged resources in this environment would no longer remain intact (if previously present). With the depth of the existing conduit and the wave/tidal forces at this location, it is unlikely that subtidal harvesting or resource gathering sites would still be present. Based on this analysis, there is limited potential for intact cultural resources or historic properties to be present within the proposed Project area.

4. Natural Resources Environmental Analysis

4.1 Potential Project Effects on Natural Resources

The potential effects (stressors) to natural resources due to Project activities are described in the following subsections. Project activities include the installation, operation and maintenance, and decommissioning and removal of the Orbital O2-X device and supporting infrastructure. The analysis of effects is organized and presented for the following categories of stressors:

- Entanglement
- Collision
- Entrainment
- Noise disturbance
- Displacement
- Habitat alteration
- Electromagnetic field (EMF) exposure
- Artificial light
- Changes in oceanographic systems.

These identified stressors are parts of the Orbital O2-X, maintenance operations, or a result of Orbital O2-X's functioning, that may have potential to harm or stress a receptor (i.e., a marine animal, habitat, or ecosystem).

Where possible, each stressor has been considered during different Project phases (i.e., installation, operation and maintenance, and removal) for different receptors (e.g., marine mammals, fish, avian species, and invertebrates) in the proposed Project area. Key terms used in the analysis of effects are defined below.

"*Likelihood*" is the probability of an interaction occurring, described qualitatively as "Low," "Medium," or "High."

"*Impact*" (as defined in Minerals Management Service [MMS] 2007) is the estimated degree of effect from the stressor, and is described as negligible, minor, moderate, or major. "Negligible" means the stressor will have no measurable impact on the receptor. "Minor" impact means that most impacts on the affected receptor could be avoided with proper mitigation; if impacts occur, the affected receptor will likely recover without any mitigation once the impacting agent is eliminated. "Moderate" impact means the viability of the affected receptor is not likely to be threatened, although some impacts may be irreversible, or the affected receptor is likely to recover completely if proper mitigation is applied during the life of the Project or proper remedial action is taken once the impacting agent is eliminated. "Major" impacts on the affected receptor are unavoidable, the viability of the affected receptor may be threatened, and the affected receptor is not likely to fully recover even if proper mitigation is applied during the life of the Project or remedial action is taken once the impacting agent is eliminated.

"*Risk*" considers both the likelihood of occurrence and level of impact from the stressor described above, qualitatively rated as "Low," "Medium," or "High."

For the purposes of this effects analysis, these stressors and impacts have been evaluated without applying any mitigation measures, to better understand their greatest potential effect. The anticipated effects of the proposed Project, based on scientific literature and modeling, are also discussed in this section. In consultation with Tribal Nations, regulatory agencies, and stakeholders, appropriate best management practices (BMPs) and mitigation measures would be administered to reduce the risk and potential impacts of the proposed Project.

4.1.1 Entanglement

Entanglement, which occurs when an animal becomes intertwined with mooring lines or cables, is a concern for marine mammals, large pelagic elasmobranchs (e.g., sharks, rays, skates), and other marine animals such as seabirds, sea turtles, and large fish. Concern over entanglement has been voiced about possibly occurring during the following Project operations:

- Primary entanglement during the installation, operation, decommissioning, and removal of Project components.
- Primary entanglement with Project vessel moorings.
- Secondary entanglement with derelict gear caught in mooring lines or the umbilical portion of the new subsea cable (i.e., the portion that is vertical in the water column).

4.1.1.1 Primary Entanglement

The risk of primary entanglement, or direct entanglement with Project components, is considered low for this Project. To date, no entanglements of marine animals with marine renewable energy (MRE) systems have been observed, and no evidence demonstrates that such an event has occurred (ORJIP Ocean Energy 2022a). The Project's new subsea cable and mooring lines are heavy, under tension, and do not have loose ends nor sufficient slack to create an entangling loop (Benjamins et al. 2014) (**Figure 72**). Overall, the probability of interaction between a marine mammal or other species of concern and the mooring lines of a single Orbital O2-X device is low, as the mooring lines occupy only a small portion of the water column, allowing mobile species to easily navigate around them (Copping and Hemery 2020).

Due to the lack of studies concerning species interactions with mooring lines for MRE devices, additional studies and modeling efforts would help to better understand any risks. As such, drop camera footage of the Project's mooring lines would be reviewed for evidence of entanglement events, and a reporting protocol would be established for the operator to follow in the event of an entanglement.

Figure 72. Typical Orbital O2-X Subsea Cable Slack

Temporary vessel mooring lines would be used to keep vessels in place during installation and removal of the Orbital O2-X, as well as during any manual device maintenance. In general, vessel presence on-site would be minimal. There has been limited study on the entanglement risk posed by vessel moorings during MRE deployment and other offshore construction projects, primarily due to their temporary nature and widespread use across various marine sectors. Given their temporary nature, the vessel moorings for this Project are unlikely to cause primary entanglement.

4.1.1.2 Secondary Entanglement

Secondary entanglement, or the entanglement of marine species in human-made waste materials, is a concern. Derelict (i.e., lost or discarded) fishing gear and other marine debris are known to pose an entanglement risk for a range of species (Garavelli et al. 2024). Once entangled, small marine animals are typically unable to free themselves, and most die without human intervention (Duncan et al. 2017; Schrey and Vauk 1987). Although no part of the Project would be abandoned or discarded, secondary entanglement is possible for MRE devices, if waste attaches to the mooring lines or umbilical of the new subsea cable (Taormina et al. 2018). Since no instances of secondary entanglement have been reported on MRE devices, the likelihood of fishing gear becoming snagged on components of the Project mooring is considered very low. However, this risk ultimately depends on the types and density of gear in the surrounding waters (Macfadyen et al. 2009; Richardson et al. 2019).

In the U.S. portion of the Salish Sea, the predominant derelict gear types are drift and set gillnets from salmon fisheries and shellfish pots from the Dungeness crab and shrimp fisheries (Drinkwin et al. 2023). Gillnets are considered high-risk for secondary entanglement due to their mobility, multispecies impacts, durability, and ability to entangle with other debris and create larger masses (Gilman et al. 2021). While crab pots are typically designed to stay anchored to the seafloor, storm surges or strong tides can dislodge and transport them, potentially creating secondary entanglement scenarios. The frequency of derelict gillnets and shellfish pots in the Salish Sea has been relatively well-documented since 2002, when the Northwest Straits Foundation launched the Northwest Straits Marine Conservation Initiative (NWSI) Derelict Fishing Gear Program. This program has removed thousands of derelict nets and pots from the Salish Sea via diver-led retrieval methods, as well as recorded data (e.g., location, depth, area, habitat type) on each recovered gear item (Drinkwin et al. 2023). Also in 2002, the Washington State legislature passed legislation to develop safe, effective methods to remove derelict fishing gear and discourage future gear losses.

While the Washington State Derelict Gear Database is not publicly available, published maps indicate that at least 10 nets were recovered from Rosario Strait between 2002 and 2012, although not necessarily from within the proposed Project area (Drinkwin et al. 2023). While location and habitat information about recovered pots is less available than for gillnets, potential hotspots are outside of the proposed Project area (e.g., Port Townsend Bay, Dungeness Bay, and Port Gardner) (NSF 2016).

Secondary entanglement is known to impact elasmobranchs and smaller marine animals such as sea turtles, fur seals, and sea lions (Garavelli 2020). NWSI has documented more than 270 unique species trapped in derelict fishing gear in the Salish Sea, including porpoise, sea lions, scoters, grebes, cormorants, canary rockfish, Chinook salmon, and Dungeness crab (NSF 2016). Because of the types and density of derelict fishing gear in the Salish Sea and the documented impacts on marine mammals, fish, diving seabirds, and other species found in or near the proposed Project area, Orbital O2-X deployment poses a medium risk for secondary entanglement, even with a low likelihood of occurrence, primarily due to the impact on a marine animal if it were to occur. There would be cameras and hydrophones mounted on the Orbital O2-X to enable monitoring of the mooring lines and umbilical cable for evidence of entanglement events. A reporting protocol would be established for the operator to follow in the event of an entanglement.

4.1.2 Collision

Collision is the direct contact between an animal and a vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade), but does not always imply injury (Amaral et al. 2015; Garavelli et al. 2024). Marine mammals may also interact with the mooring lines and subsea cable umbilical in the water column, although little is known about resulting consequences of this type of encounter (Copping and Hemery 2020). The potential for collision exists during the following Project operations:

- Vessel operations required for installation, maintenance, and removal of the Orbital O2-X.
- Operation of Orbital O2-X's two turbine blades during energy generation in the tidal currents.
- Orbital O2-X movement within its watch circle between peak tide periods.

For the proposed Project, there are varying degrees of collision risk based on the vessel, Orbital O2-X device or component (e.g., turbine blade), species type (e.g., marine mammals, fish, and birds), and likelihood of impact occurrence. Given the technical and logistical complications involved in observing and/or recording marine species in proximity to tidal energy systems, current knowledge about collision risk comes from both empirical and modeling studies examining animal behavior in proximity to a turbine (Garavelli et al. 2024), as well as studies using passive acoustic monitoring and/or multibeam sonar (Viehman and Zydlewski 2015; Copping et al. 2017; Palmer et al. 2021; Gillespie et al. 2023).

4.1.2.1 Vessel

Vessel collision has the potential to occur during all Project actions using vessel support: installation, maintenance, and removal of the Orbital O2-X device and supporting infrastructure. A large barge with a maximum size of 83 m x 23 m (275 ft x 75 ft) would be used to install the Orbital O2-X near Blakely Island; for routine maintenance visits, the largest vessel to visit the Project area would be approximately 25 m (82 ft) in length. Examples of the types of boats and vessels used for installation and maintenance of another Orbital tidal device (which is very similar in type and size to the O2-X) are shown in **Figure 73**, **Figure 74**, and **Figure 75.**

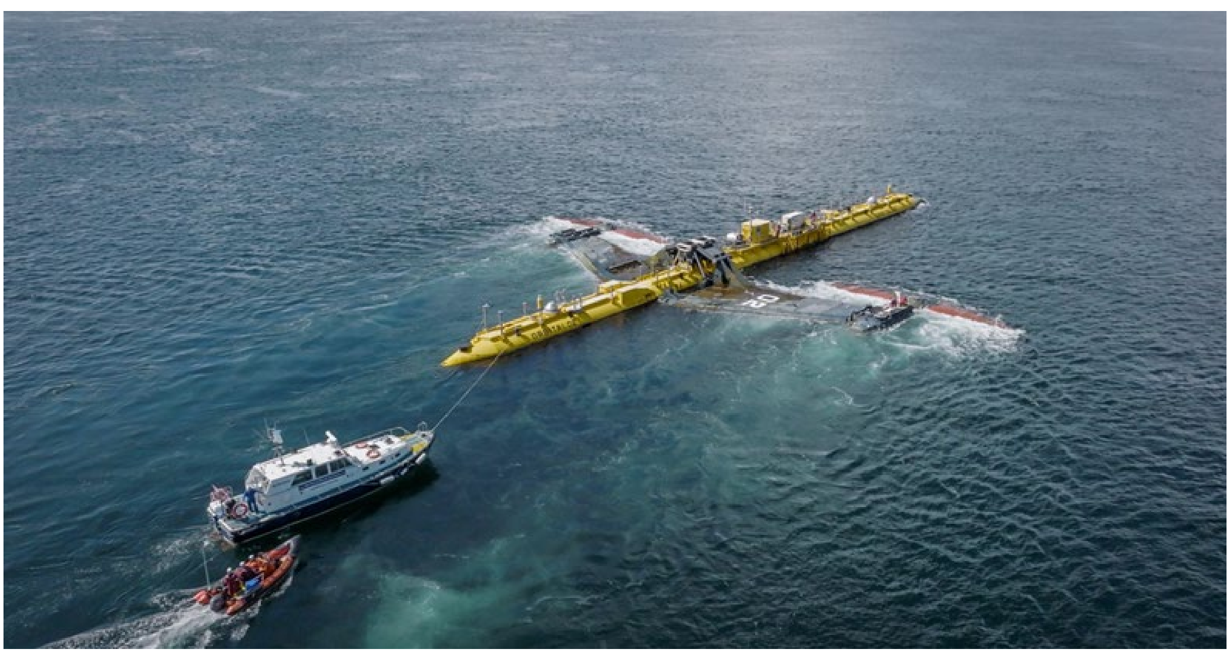

Figure 73. Example of Vessel and Boat Installing Orbital Tidal Device

Figure 74. Example of Maintenance Personnel and Boat for Orbital Tidal Device

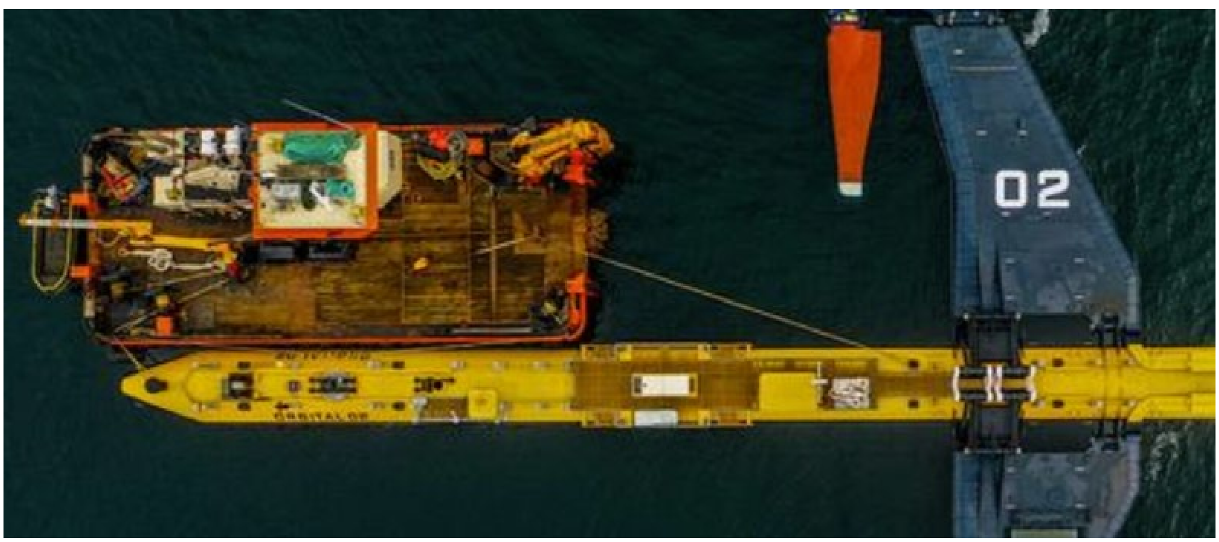

Figure 75. Example of Maintenance Boat for Orbital Tidal Device

While some risk of collision between Project vessel(s) and marine animals exists, these mobile marine animals would likely avoid the vessel or otherwise alter their behavior to avoid a collision. Individuals may deflect around vessels and continue along their path, but these behaviors would not likely result in significant disruption of normal behavioral patterns. Cetaceans (whales and dolphins) are known to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok et al. 1989, Richardson et al. 1995, Heide-Jørgensen et al. 2003).

Evidence indicates that the probability of lethal injury to cetaceans and other marine animals increases with vessel speed, while there is a substantial decrease in lethality as a vessel's speed falls below 15 knots (Vanderlaan and Taggart 2007; Hazel et al. 2007; Rudebusch et al. 2020). Vessels would follow BMPs to mitigate vessel collision risk to marine mammals when traveling to and from the Project area, which includes traveling at a speed limited to 9 knots or less during transit, and 3 knots or less while installing the new subsea power cable on the seafloor. The vessel(s) would follow standardized procedures, which are outlined below, for navigating the presence of ESA-listed species (e.g., SRKWs). Vessel personnel would also be instructed to monitor for ESA-listed species to reduce the likelihood of impact and severity of a collision with a marine animal.

After installation of the Orbital O2-X and supporting components, vessel presence for on-site maintenance would be limited to one or two times per year for inspections and periodic mooring surveys, unless unexpected challenges arise (see **Table 8**). Additionally, vessels would be present for an Orbital O2-X overhaul at approximately 5 years into operations, and major inspection between 5 to 8 years (see **Table 8**). Based on existing evidence, vessel collision is not expected to occur due to the proposed Project, including subsea power cable installation (Taormina et al. 2018). In order to reduce collision risk during maintenance and surveys, vessel(s) and staff would be compliant with any required standard operating procedures (SOPs) and BMPs. With mitigation measures in place to minimize the potential collision risk, including using industry-wide SOPs, BMPs, and vessel regulations related to marine mammals, vessel traffic associated with the proposed Project is not expected to increase the likelihood of a vessel collision with marine mammals or other marine species. Without the implementation of protection measures (e.g., SOPs and BMPs), there would be a moderate likelihood of a vessel collision, which, if it occurred, could have a moderate impact and pose a potentially high risk to marine mammals.

During project activities requiring vessels, trained personnel would visually monitor for wildlife. If marine mammals are sighted:

- Vessels should maintain a minimum distance of 91 m (300 ft; 100 yards) from the marine mammal sighting, when feasible. BMPs by sighting type are provided below:
    - <u>SRKWs</u>: Vessels would stay 914 m (3,000 ft; 1,000 yards) (approximately 0.5 NM) away from SRKWs in all directions whenever possible. If a SRKW approaches within 366 m (1,200 ft; 400 yards) of the vessel, it would disengage the transmission until the SRKW moves away. If a vessel operator believes it may be closer than 914 m (3000 ft; 1,000 yards) to SRKW(s), but not within 366 m (1,200 ft; 400 yards), the vessel operator could attempt to navigate out of the path of the SRKW(s) at a speed of 7 knots or less (RCW 77.15.740).
        - Project vessels should not leapfrog SRKW but would stay out of the forward path of whales, at any point within 366 m (1,200 ft; 400 yards).
    - <u>Other ESA-listed marine mammals</u>: If an ESA-listed marine mammal comes within approximately 91 m (300 ft; 100 yards) of the vessel, onboard personnel may modify vessel operations until the animal moves safely out of the area and remains unobserved for 30 minutes.
    - <u>Bigg's/Transient killer whales</u>: Vessels would stay 183 m (600 ft; 200 yards) away from Bigg's/Transient killer whales and would not park in their path within 366 m (1,200 ft; 400 yards).
    - <u>All other marine mammals</u>: Vessels would stay 91 m (300 ft; 100 yards) from all other marine mammals (e.g., humpback whales, gray whales, sea lions, seals) and 183 m (600 ft; 200 yards) from baleen whales resting or with a calf.
- Vessels would not be permitted to cross directly in front of or intersect the path of any sighted marine mammals.
- If a large marine mammal (e.g., whale) passes along the ship, the vessel operator would maintain a steady heading and constant speed that is not faster than the sighted individual's speed.
- Vessels should not position themselves in the path of a whale or cut in front of a whale in a way or at a distance that causes the whale to change direction of travel or behavior (including breathing/surfacing pattern), whenever possible.

- If sighted marine mammals demonstrate defensive or disturbed actions, the vessel would slow or be taken out of gear until the animal calms and/or moves a safe distance away from the vessel.
- Vessels would take reasonable steps to alert other vessels in the vicinity of whale(s).

In the highly unlikely event of a vessel collision with a marine mammal during installation activities or vessel transit, the vessel operator must document the conditions at the time of the incident, including the following:

- Latitude and longitude of the vessel at the incident location.
- Date and time of the incident.
- Speed and bearing of the vessel at the time of the incident.
- Approximate size of the animal (length) and take a photo if possible.
- Condition of the animal (e.g., alive, dead, wounded, bleeding).
- Environmental conditions at the time of the incident, including wind speed and direction, swell height, visibility in miles, percent cloud cover, and presence or absence of precipitation or fog.
- The names of the vessel, vessel operator, vessel owner, and captain or officer in charge of the vessel at the time of the incident.

If a collision occurs, the vessel must stop if it is safe to do so and attempt to evaluate the condition of the animal for reporting purposes. Any vessel strike would be reported immediately by telephone communications to NOAA's West Coast Region Marine Mammal Stranding Network:

- West Coast Region Marine Mammal Stranding Hotline: 1 (866) 767-6114.

Vessel operators are not permitted to aid injured marine mammals or recover a carcass unless specifically instructed to do so by the Stranding Coordinator from the hotline.

4.1.2.2 Turbine Blade and Device Collision

During Orbital O2-X operation, there is the risk of potential collision with the device's turbine blades. These events are difficult to predict or measure (Sparling et al. 2020). However, ongoing monitoring, mitigation strategies, and adaptive management throughout the Project's lifespan would help minimize the likelihood of these events occurring.

The Orbital O2-X's turbine rotors operate at a relatively slow speed, with a rated rotation of 9.2 rotations per minute (rpm) and a maximum of 11.2 rpm. This slow rotation significantly reduces the risk of serious injury or death to marine animals in the extremely unlikely event of an interaction with a turbine blade. There is also a risk of marine mammals colliding with the Orbital O2-X device itself during operation while it pivots with the changes of the tide. An individual may experience a sublethal collision, which has the potential to disrupt life history in the future (Onoufriou et al. 2019). However, because the device moves slowly due to its tidal-driven operation, this risk is considered low, with a low likelihood and minor impact if it were to occur.

Marine Mammals

For the proposed Project, the likelihood of a collision with a turbine blade is low. To date, there have been no detected or recorded instances of direct collision of marine mammals with the Orbital O2 device deployed in Scotland (Onoufriou et al. 2021; Garavelli et al. 2024). If one were to occur, it would have a moderate impact, resulting in a medium risk level for marine mammals. Although the likelihood of a collision between SRKWs and a turbine blade is low, the small population size makes each individual more valuable, increasing the potential for a major impact. The sensory capabilities of marine mammals (e.g., sight, hearing, and echolocation) suggest that a collision with a turbine blade would be a rare event, as they can detect objects in the water and avoid them.

A case study was recently conducted at MeyGen (Pentland Firth, Scotland), a site with an array of four horizontal axis 1.5 MW tidal turbines (Gillespie et al. 2021). Using video cameras, active and passive acoustic monitoring, and tagging, results showed that no collision or other detectable impacts were caused by the presence of tidal turbines, and that harbor seals avoided the area when turbines were operational (Sparling et al. 2020; Gillespie et al. 2021; Coles et al. 2021). Additional MeyGen studies showed that harbor seals foraged in the area of tidal turbines but spent very little time within 100 m (328 ft) of them (Coles et al. 2021). Porpoises frequently swam within 150 m (492 ft) of operational turbines, but their presence dropped between 33 and 78 percent during turbine operation (Coles et al. 2021). After 451 days of monitoring, there was no evidence of detectable species tracks going through the rotor swept area while the turbine was operating (Gillespie et al. 2021).

Fish

For the proposed Project, the likelihood of a collision would be low, but the impact would be moderate, resulting in a medium risk level for fish species. Several recent risk monitoring studies for fish collision have focused on detecting direct contact with turbine blades using various technologies (Garavelli et al. 2024). In Alaska, interaction between sockeye salmon smolts and the ORPC RivGen® river turbine in the Kvichak River was assessed using video cameras (Courtney et al. 2022). Of the 2,374 fish identified in the images, 382 fish (16 percent) were observed to swim in a disoriented manner (related to turbulence and flow) and 36 fish (1.5 percent) in direct contact with the turbine at production speed (Garavelli et al. 2024). Collision outcomes were unobservable and unknown.

Tidal turbines may also act as a fish aggregating device, increasing their numbers and potential for collision (Fraser et al. 2018; Williamson et al. 2019). Studies have shown that fish begin to occupy deeper areas at night in areas of tidal turbines, which may increase the risk of collision due to poor visual detection at low light conditions (Williamson et al. 2019; da Silva et al. 2022). MeyGen site studies also showed that fish schools were at a much higher abundance during neap tides compared to spring tides (Couto et al. 2022). Laboratory studies using fish released upstream and downstream of an axial flow turbine have shown significant avoidance behavior by the fish, which increased as blade tip speed increased (Zhang et al. 2017). Yoshida et al. (2020) observed that most fish pass outside an operating turbine blade, with a one percent chance of blade collision; two collisions were observed and neither resulted in fish injury.

Avian Species

For the proposed Project, the likelihood of a collision is low, but the impact would be moderate, resulting in a medium risk level for avian species. Collision risk is a concern for seabirds in locations where tidal turbines overlap with diving and foraging areas; however, much less is known about the risk concerning diving seabirds compared to other types of marine species (Couto et al. 2022).

There is a lack of information regarding the threat of collisions between avian species and tidal turbines, with no studies available for the species that may be present within or near the proposed Project area. In other studies, the black guillemot (*Cepphus grille*) and European shag (*Phalacrocorax aristotelis*) (neither of which occur in the San Juan Islands) were investigated due to diving behavior (Sparling et al. 2020), and their risk could be extrapolated and applied to other diving seabird species. A 5-year study focused on the Nova Innovation turbine array (Bluemull Sound, Shetland, Scotland) indicated that black guillemot and European shag actively pursued fish prey in the vicinity of tidal turbines but did not interact with them (Coles et al. 2021). Of the 12 individual European shags and five individual black guillemots observed at the same site, no physical contact with the turbine blade was observed (Garavelli et al. 2024). Other land- and boat-based studies observing seabirds in tidal areas suggest that highly energetic tidal channels may provide predictable foraging sites for a range of seabirds, but that collision risk is site-specific and can even vary within a single site (Waggitt and Scott 2014; Wade 2015).

Invertebrates

Since marine invertebrates are primarily sessile or mobile benthic species, and if present would be out of range from any vessels or the Orbital O2-X device, it is expected that there is no collision risk posed to these types of species.

Summary

The 2024 State of the Science report (Garavelli et al. 2024), as well as the most recent literature (Matzner et al. 2017; Sparling et al. 2020; Copping and Hemery 2020; Copping et al. 2023; da Silva et al. 2022), indicate that there have been no recorded instances of marine mammals, diving seabirds, or other marine animals colliding with an operational tidal or river turbine. Potential exceptions involve fish species, as river turbine technology has been shown to result in a low direct collision rate (approximately 1.5 percent) at production speed (Courtney et al. 2022; Garavelli et al. 2024). Worst-case scenario collision modeling also suggests small collision risk rates for fish (Shen et al. 2016; Grippo et al. 2017; da Silva et al. 2022). Since sessile and mobile marine invertebrates are primarily benthic organisms, no collision risk is expected for these species.

The available observations cannot definitively confirm that fish and other marine animals would always avoid a rotating turbine. However, the majority of evidence suggests that the sensory capabilities of marine animals would alert them to the presence of a hazard, allowing for high survivability rates (Jacobson et al. 2012; Schweizer et al. 2011; Bevelhimer et al. 2016; Copping et al. 2023). It is highly likely that marine animals would avoid the Orbital O2-X device, turbine blades, or other moving components of the proposed Project (Fraser et al. 2018; Gillespie et al. 2021; Onoufriou et al. 2021). Therefore, a collision between marine animals and vessels or the Orbital O2-X is expected to be a rare event (Copping and Hemery 2020; Copping 2023).

Based on existing evidence, there is a low likelihood of collision events occurring, but the potential impact on marine animals (e.g., injury or death) remains uncertain, and could range from moderate to major (Garavelli et al. 2024). A low likelihood of collision is predicted with the Orbital O2-X device and/or turbine blades; however, the collision impact varies depending on the nature of the collision and type of species (**Table 20**). Without any mitigation measures in place, the overall risk of vessel collision with a marine mammal would be considered high; the risk of turbine blade collision for marine mammals, fish, and avian species would be medium; and the risk of marine mammal collision with the device itself would be low. In consultation with Tribal Nations, regulatory agencies, and stakeholders, appropriate BMPs and mitigation measures will be implemented to reduce the risks and potential impacts of the proposed Project.

Ultimately, collision risk with Project components is influenced by factors such as the device's location, water depth at the deployment site (approximately 60 m [197 ft] depth; 27 m [89 ft] from the bottom of the rotor blade tip), tidal velocity, and blade tip speed, as well as the behavioral patterns of nearby marine species, including their vertical distribution within the water column and swimming behavior in tidal currents and nearby foraging areas (da Silva et al. 2022). Mitigation measures, such as SOPs, BMPs, and reduced vessel operating speeds, along with post-installation monitoring, will be implemented to minimize collision risk and impact from project activities.

4.1.2.3 Mooring Line Collision

Very little is known about marine mammal interactions with MRE device mooring lines, making it an emerging area of research (Copping and Hemery 2020). The primary concern with marine mammals encountering mooring lines is not collision injury, but entanglement risk (discussed in **Section 4.1.1**). The likely consequences of marine mammal encounters with MRE mooring lines (e.g., injury or death) remain largely unknown, although impacts are expected to be negligible.

4.1.3 Entrainment

In the context of this proposed Project, “entrainment” refers to the transport of marine animals through the water due to flow, which can be affected by turbine sweep, i.e., being drawn toward/into the tidal turbine(s). Entrainment is a concern during the following Project activities:

- Project operation during peak tidal current flow when turbines are in motion.

Entrainment into a tidal turbine is a primary concern for marine mammals, fish, and seabirds (USFWS 2024e), as it could potentially lead to collision with turbine blades resulting in injury and/or mortality. In conventional hydrokinetic turbines, fish may suffer injuries or mortality due to rapid pressure changes, cavitations (bubbles forming and popping), and shear stress (layers of water moving at different speeds) (Dadswell and Rulifson 1994; Čada et al. 2006). For a single Orbital O2-X tidal turbine device, there is no “engine” involved or fast rotating propellers. Therefore, these types of effects are not expected.

Very few studies have focused on the susceptibility of species to entrainment by tidal turbine devices. Most available entrainment studies have focused on fish species and analogous MRE systems (e.g., vertically oriented turbines, devices deployed in river systems, or conventional hydropower). A discussion is provided below:

Marine Mammals

Very few studies have investigated the entrainment risk posed by tidal turbines to different types of marine mammals (e.g., pinnipeds and cetaceans). No studies exist on the entrainment of cetaceans by any type of turbine, so little is known about their entrainment risk with a single tidal turbine device. The few existing studies primarily focus on altered behavior and collision risk with turbine blades (Section 4.1.2), particularly in harbor porpoises and smaller mammals. None have reported marine mammals becoming entrained or suffering injury or death (Gillespie et al. 2021)

At the 1.5 MW horizontal-axis turbine array at the MeyGen site (Pentland Firth, Scotland), harbor porpoises have been observed swimming in close proximity to a rotating tidal turbine (9 m [29.5 ft] rotor sweep area), but they generally avoid the area close to the rotors whether or not the turbine was operating (Gillespie et al. 2021). Of the 344 occasions when harbor porpoises swam close to the operating turbine (“events”) (10 m [33 ft] up/downstream), 111 (32 percent) occurred when the turbine was rotating (greater than 1 rpm) and 233 (68 percent) when it was stationary (less than/equal to one rpm) (Gillespie et al. 2021). None of the harbor porpoises clearly passed through the rotor sweep area, but of the 111 events when the turbine was rotating, 11 passed the turbine with a clear swim direction (one above and slightly to the side, 10 below or to the side), while a further 19 were either passing or milling; the behavior of the remaining 90 unknown (Gillespie et al. 2021). Approximately 75 percent of the observed porpoises passed the turbine at distances greater than 35 m (115 ft) (Gillespie et al. 2021). This study suggests that porpoises (and possibly other similar-sized marine mammals) that do swim close to tidal turbines would likely evade or avoid them, swimming below or around the rotor swept area, and would not get entrained into the operating turbine.

Fish

Studies have investigated the entrainment risk to fish, but many knowledge gaps remain concerning single tidal turbine devices. At the Fall of Warness tidal test site (Orkney, Scotland), consistent aggregations of fish schools have been observed around the tidal turbine during reduced flood velocities in its wake, while fish have displayed avoidance behavior during peak flow velocities (Fraser et al. 2018). It is inconclusive whether increased fish presence around the tidal turbine increased entrainment risk and/or occurrence.

Other studies indicate that fish species have low susceptibility to entrainment and high survival rates if they do pass through an operating turbine: Amaral et al. (2014) tested fish species passing through turbines operating at 1.5 m/s and 2.0 m/s (4.9 ft/s and 6.6 ft/s), observing survival rates of 94 to 100 percent for turbine-passed fish, while avoidance rates were between 86 and 100 percent (32 to 65 percent for white sturgeon [*Acipenser transmontanus*]) (Amaral et al. 2014).

Acoustic cameras have observed the effects of fish size, tidal turbine motion, and diel cycle (i.e., daytime or nighttime) on fish behavior at a commercial-scale tidal turbine energy site in Cobscook Bay, Maine (Viehman and Zydlewski 2015). While the turbine was rotating, the probability of fish entering the turbine decreased by over 35 percent and avoidance behavior increased by 120 percent, but the probability of passing increased by 97 percent compared to a non-operating turbine (Viehman and Zydlewski 2015). Schools had a 56 percent lower probability of entering the turbine than individual fish and reacted at greater distances from the turbine: median 2.5 m (8.2 ft) for schools and 1.7 m (5.6 ft) for individuals (Viehman and Zydlewski 2015). Fish behavior in response to tidal turbines would likely be similar to their response to other obstacles (e.g., trawls), and does not indicate an increased risk of entrainment. This suggests that fish are more likely to avoid a tidal turbine than to get entrained.

Avian Species

No studies have been conducted on the entrainment risk from tidal turbines to seabirds. Given the relatively low blade speed of the Orbital O2-X's turbines and the low likelihood that birds (including diving seabirds) would be present near the device, no entrainment risk to avian species is expected.

Invertebrate

Since the marine invertebrates are sessile or mobile benthic species and would not be in close proximity to the Orbital O2-X, no entrainment risk is posed to these species.

Summary

The mechanics of crossflow turbine design create essentially no suction or entrainment force during operations. Although few studies have evaluated entrainment risk to marine mammals, it is not expected to result from the proposed Project, as evidenced by entrainment not occurring at other deployed tidal turbine sites (Gillespie et al. 2021; Garavelli et al. 2024). The turbine is designed to operate at a rated rotation speed of 9.2 rpm (11.2 rpm maximum). Water is decelerated as it approaches the rotors, and in lab-scale experiments, this effect is apparent at 1 to 2 diameters upstream, such that deceleration would begin 30 to 60 m (98 to 197 ft) upstream of the rotors. Therefore, it is very unlikely that a suction force strong enough to entrain marine mammals would occur due to the Orbital O2-X's operating turbines.

If entrainment were to occur, it would likely be on a small scale and unlikely to pose an overall serious danger to nearby mammals, fish, and seabirds. Of all the species in the area, schooling fish may have some entrainment risk. The most relevant studies that have been conducted concerning marine species (e.g., porpoises) colliding with tidal turbines (see **Section 4.1.2.2**) indicate that species actively avoid nearby areas while turbines are in operation compared to non-operation (Coles et al. 2021; Onoufriou et al. 2021). There is a very low risk of entrainment due to the proposed Project.

4.1.4 Noise Disturbance

Ocean noise can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean. Noise intensity is measured by its sound pressure (amplitude, in dB), while hearing ranges are measured by the speed of sound waves (frequency, in Hz or kHz). Additionally, because water is denser than air, sound travels faster and farther in the ocean (approximately 1,500 m/s [4,921 ft/s]) compared to the atmosphere (340 m/s [1,115 ft/s]) (Solé et al. 2023). Both underwater and aerial noise disturbance is expected during the following Project actions:

- Vessel presence during Project installation, operation, maintenance, and removal.
- Rock-drilled anchor installation and removal (if they are used, as opposed to gravity anchors).

- Powertrain energy conversion during operation and maintenance.

The risk of noise disturbance to marine animals is expected but would vary during different actions of the proposed Project. Vessel operations for Project activities would also be an occasional noise source throughout all stages (**Table 20**).

Table 20. Noise Disturbance Risk Due to Project Activities

Device	Receptor	Likelihood	Impact	Risk
All Stages				
Vessel	**Marine Mammals**	Medium	Minor	Medium
	Fish	Medium	Minor	Medium
Installation				
Rock-drilled Anchor Drill (if used)	**Marine Mammals**	Medium	Minor	Medium
	Fish	Medium	Minor	Medium
Operation and Maintenance				
Orbital O2-X Powertrain	**Marine Mammals**	Low	Minor	Low
	Fish	Low	Minor	Low

Noise levels would be elevated during installation and removal activities. To install rock-drilled anchors, if used, a submersible and remotely operated drill rig would be deployed from a multi-cat vessel, or equivalent, operated by a hydraulic power unit on deck. The drilling operation to install the anchors would be completed in a short timescale (e.g., 12 hours of drilling per anchor; 48 hours total for four). Mooring lines would take 4 days to install (one per day), and the new subsea cable would take up to 1 week to install. Once installed and operating, broadband noise (e.g., the hum of machinery) from the Orbital O2-X would be created by the rotation of the turbines and their powertrains. Noise generated by the flow of water around the Orbital O2-X device or in the turbine wake is not expected to significantly contribute to ambient noise levels because the source is an inefficient radiator of sound.

While operating, the Orbital O2-X turbines would generate relatively low-frequency noise, evidenced by other tidal turbine devices. Two 1.5 MW tidal turbines at the MeyGen site (Pentland Firth, Scotland) (Atlantis AR1500 and Andritz AHH1500) were shown to produce noise levels between 50 Hz and 1 kHz (Risch et al. 2023). The operating Atlantis AR1500 turbine, a three-bladed horizontal axis tidal-stream turbine, was shown to emit elevated noise levels by approximately 30–40 dB at 100 m (328 ft), equivalent to a 30–40 percent increase based on ambient noise measurements of 100 dB (Risch et al. 2020). At a distance of 2.3 km (1.4 miles) from the turbine, elevated noise was reduced to 5 dB (Risch et al. 2020).

4.1.4.1 Scope of Impact

Increased noise levels due to Project activities would be temporary, from sources including vessel(s) for Project activities, installation of rock-drilled anchors (if used), and the Orbital O2-X device powertrain (operation and maintenance). The likelihood of noise disturbance occurring varies depending on the source, ranging from low (Orbital O2-X powertrain only) to medium, with expected minor impacts. The risk to marine animals is also low (Orbital O2-X powertrain only) to medium (**Table 20**). Unlike commercial vessels, the Orbital O2-X has no engine or fast-rotating propellers that generate the noise commonly associated with shipping, nor does it produce propeller cavitation that could potentially injure or disturb marine animals.

Post-installation acoustic monitoring of other tidal turbines gives insight into the scope of impact expected from the Orbital O2-X. The Orbital O2 device installed at the EMEC Fall of Warness tidal test site in the Orkney Islands, Scotland was studied in July–August 2021. Under low wind conditions and a drifting speed of 2.6–3.5 m/s (8.5–11.5 ft/s), the Orbital O2 operating at 25 percent capacity was clearly detectable at frequencies between 1 Hz and 1 kHz, with a difference in median SPL of 40 dB above ambient noise and 10–15 dB compared to when the device was not generating power (PNNL 2024). Similar noise ranges can be expected from the operating Orbital O2-X in Rosario Strait.

4.1.4.2 Species Impacts

Noise disturbance can have various effects on marine animals, including attraction, avoidance, harm, or injury. However, the impact on different species would depend on the noise source. Increased noise levels from vessel operations, rock-drilling anchor installation (if needed), and the Orbital O2-X powertrain are expected to affect marine animals to varying degrees. The risks to marine animals depend on several factors: the amplitude (dB), frequency (Hz-kHz), and directionality of the noise source, as well as prevailing ambient noise, the attenuation of noise with distance, and a species' hearing thresholds and potential behavioral responses (Rose et al. 2024). Impacts are primarily a concern for marine mammals and fish species due to their sensitivity to underwater noise and existing scientific evidence. While noise impacts on avian and invertebrate species are briefly discussed, there is insufficient evidence to assess the likelihood, impact, and risk to these groups with the same certainty as for marine mammals and fish.

Noise from the Orbital O2-X turbine operation would be a continuous, non-impulsive source. Non-impulsive sounds can vary in frequency (broadband, narrowband, or tonal), duration (brief or prolonged), and pattern (continuous or intermittent). Unlike impulsive sounds, they do not have high peak sound pressures with quick rises or falls in volume (NMFS 2018, 2024r) (**Table 21**).

Auditory injury occurs when the inner ear is damaged, particularly the nerves that transmit sound signals to the brain. This damage can impair hearing and may disrupt the connections between nerves, potentially leading to permanent threshold shift (PTS), also known as permanent hearing loss (NMFS 2018, 2024r) (**Table 22**). Temporary threshold shift (TTS) is temporary, reversible hearing damage at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018, 2024r; Engel et al. 2024) (**Table 23**). Project activities, including installation, Orbital O2-X operation and maintenance, and removal, are expected to produce noise levels within the hearing ranges of the marine mammal groups shown in **Table 21**, but outside the ranges indicated in **Table 22** and **Table 23**. As a result, no auditory injuries or temporary threshold shifts (TTS) to marine mammals are anticipated.

Table 21. Marine Mammal Hearing Group Ranges

Hearing Group	Species	Generalized Hearing Range[1] (2024[2])
Underwater		
Low-frequency (LF) cetaceans	Baleen whales, including gray whales	7 Hz – 36 kHz

Hearing Group	Species	Generalized Hearing Range[1] (2024[2])
High-frequency (HF) cetaceans[3]	Killer whales, pilot whales, and some dolphin species	150 Hz – 160 kHz
Very High-frequency (VHF) cetaceans[4]	Dolphins and porpoises	200 Hz – 165 kHz
Phocid pinnipeds (PW)	True seals	40 Hz – 90 kHz
Otariid pinnipeds (OW)	Sea lions and fur seals	60 Hz – 68 kHz
In-Air		
Phocid pinnipeds (PA)	True seals	42 Hz – 52 kHz
Otariid pinnipeds (OA)	Sea lions and fur seals	90 Hz – 40 kHz

Notes: dB = decibel; HF = high-frequency; Hz = hertz; LF = low frequency; kHz = kilohertz; MF = mid-frequency; NMFS = National Marine Fisheries Service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); VHF = very high-frequency

1. Generalized hearing range represents the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing ranges are based on ~65 dB threshold from normalized composite audiogram (NMFS 2018, 2024r).
2. Generalized Hearing Ranges (2024) are the updated ranges from the NMFS Draft 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0) (NMFS 2024r).
3. HF cetaceans are listed as "MF cetaceans" in NMFS' 2018 Technical Guidance (Version 2.0), for the Generalized Hearing Range listed in this table (NMFS 2018, 2024r).
4. VHF cetaceans are listed as "HF cetaceans" in NMFS' 2018 Technical Guidance (Version 2.0), for the Generalized Hearing Range listed in this table (NMFS 2018, 2024r).

Source: NMFS 2018, NMFS 2024r

Table 22. Summary of Auditory Injury Onset Criteria for Impulsive and Non-Impulsive Noise Sources (sound intensity; dB)

	Auditory Injury Onset Criteria[1]	
Hearing Group	**Impulsive**	**Non-impulsive**
Underwater		
LF Cetaceans	Peak Sound Pressure[2], flat: **222 dB** Weighted cumulative sound pressure[3], 24 hours: **183 dB**	Weighted cumulative sound pressure, 24 hours: **197 dB**
HF Cetaceans	Peak Sound Pressure, flat: **230 dB** Weighted cumulative sound pressure, 24 hours: **193 dB**	Weighted cumulative sound pressure, 24 hours: **201 dB**
VHF Cetaceans	Peak Sound Pressure, flat: **202 dB** Weighted cumulative sound pressure, 24 hours: **159 dB**	Weighted cumulative sound pressure, 24 hours: **181 dB**

	Auditory Injury Onset Criteria[1]	
Hearing Group	**Impulsive**	**Non-impulsive**
Phocid pinnipeds (PW)	Peak Sound Pressure, flat: **223 dB** Weighted cumulative sound pressure, 24 hours: **183 dB**	Weighted cumulative sound pressure, 24 hours: **195 dB**
Otariid pinnipeds (OW)	Peak Sound Pressure, flat: **230 dB** Weighted cumulative sound pressure, 24 hours: **185 dB**	Weighted cumulative sound pressure, 24 hours: **199 dB**
In-Air		
Phocid pinnipeds (PA)	Peak Sound Pressure, flat: **162 dB** Weighted cumulative sound pressure, 24 hours: **140 dB**	Weighted cumulative sound pressure, 24 hours: **154 dB**
Otariid pinnipeds (OA)	Peak Sound Pressure, flat: **177 dB** Weighted cumulative sound pressure, 24 hours: **163 dB**	Weighted cumulative sound pressure, 24 hours: **177 dB**

Notes: dB = decibels; HF = high-frequency; Hz = hertz; LF = low frequency; NMFS = National Marine Fisheries Service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); VHF = very high-frequency

1. The Auditory Injury Onset Criteria are those that appear in the NMFS Draft 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0) (NMFS 2024r).
2. Peak Sound Pressure ($L_{p,0\text{-}pk}$) has a reference value of 1 μPa, and weighted cumulative sound exposure level ($L_{E1p,\,PW}$) has a reference value of 1 μPa^{2}s.
3. "Flat" indicates peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 Hz), and "24 hours" refers to the recommended accumulation period of 24 hours.

Table 23. TTS Onset Criteria for Non-Impulsive Sounds

Hearing Group	Weighted TTS Onset Acoustic Criteria[1]
Underwater	
LF Cetaceans	177 dB
HF Cetaceans	181 dB
VHF Cetaceans	161 dB
Phocid pinnipeds (PW)	175 dB
Otariid pinnipeds (OW)	179 dB
In-Air	
Phocid pinnipeds (PA)	134 dB
Otariid pinnipeds (OA)	157 dB

Hearing Group	Weighted TTS Onset Acoustic Criteria[1]
Notes: HF = high-frequency; Hz = hertz; LF = low frequency; kHz = kilohertz; NMFS = National Marine Fisheries service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); TTS = temporary threshold shift; VHF = very high-frequency 1. Determined from minimum value of auditory exposure function and weighting function at its peak.	

Marine Mammals

Marine mammals, especially cetaceans, are highly vocal and depend on sound for many aspects of their life history including reproduction, feeding, predator and hazard avoidance, communication, and navigation, thus making them particularly vulnerable to increased underwater noise (Weilgart 2007; Rose et al. 2024). This has been a focus of research in recent years (Polagye et al. 2011; Thomsen et al. 2015; Harding et al. 2019, 2023; Risch et al. 2023).

Noise effects on marine mammals can range from no obvious response, behavioral responses, to masking other important sounds used for social interaction, mating, navigation, foraging, and predation avoidance (Popper and Hawkins 2018; Popper et al. 2023; Rose et al. 2024). On a small scale, harbor seals avoid simulated tidal turbine sounds (Hastie et al. 2018) and harbor porpoise click activity decreases within a few hundred meters of an active device compared to baseline levels (Tollit et al. 2019; Coles et al. 2021). Severe potential effects of increased underwater noise (e.g., threshold shift, physiological changes, physical injury, and death) have not been observed for MREs (Popper and Hawkins 2018; Popper et al. 2023).

Increased noise disturbance due to vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure is expected to have a medium likelihood of occurrence, with minor impacts on marine mammals, resulting in an overall medium risk. Increased noise disturbance due to the Orbital O2-X powertrain is expected to have a low likelihood of occurrence, with minor impacts, resulting in an overall low risk.

Fish

Vessel activity, installation, and removal of Orbital O2-X and supporting infrastructure are expected to have a medium likelihood of causing minor impact on fish species, resulting in an overall medium risk. Increased noise disturbance due to the Orbital O2-X powertrain is expected to have a low likelihood of occurrence, with minor impacts, leading to an overall low risk.

Fishes' ability to detect sounds differs between species and depends on their physiology and morphology (Zang et al. 2023). All fish hear through their inner ears by sensing particle motion, while species with specialized structures can also hear sound through pressure (Popper and Hawkins 2018; Popper et al. 2019). Demersal fish (i.e., groundfish) may be sensitive to particle motion during the Project's construction and installation activities, while diadromous and pelagic fish may be sensitive to the sound frequencies of the Orbital O2-X's continuous operational noise (ORJIP Ocean Energy 2022b).

Studies have shown that fish do not experience adverse effects from elevated noise levels up to approximately 160 dB re 1 μPa. However, at higher noise levels, fish may exhibit avoidance behavior, stress, temporary or permanent hearing loss, auditory and non-auditory tissue damage, egg damage, reduced growth rates, or mortality (Hastings and Popper 2005; Popper et al. 2014). While mortality and physical injuries are rare, they can occur when fish are exposed to high-magnitude impulsive sounds, such as pile driving or explosions at close range. In comparison, physiological and behavioral changes, along with impaired hearing, are more likely. This hearing impairment can reduce fishes' ability to detect biological sounds from predators, prey, and acoustic cues for navigation. (Zang et al. 2023). However, the noise levels produced by these activities are beyond the range anticipated for the proposed Project and will not occur.

Avian Species

There is uncertainty regarding the potential impacts of underwater noise on seabirds, and the significance of underwater hearing and hearing thresholds for these species remains largely unknown (ORJIP Ocean Energy 2022b). However, it is important to note that for a single tidal turbine device, the potential noise impacts on seabirds are considered low, and the available evidence is limited (ORJIP Ocean Energy 2022b). A summary of the relevant information on avian hearing is provided below.

For example, Atlantic puffins (*Fratercula arctica*) had the lowest measured hearing thresholds between 1 and 2 kHz, but measurable responses to noise began between 0.5 and 6 kHz (Mooney et al. 2019). Common murres (*Uria aalge*) exposed to underwater noise react to sound intensities between 110 and 137 dB re 1 μPa, with a clearly graded response to higher received levels (Hansen et al. 2020). Other aquatic bird species, such as the lesser scaup (*Aythya affinis*) and the great cormorant (*Phalacrocorax carbo*), exhibit hearing thresholds very similar to odontocetes (toothed whale species) and pinnipeds at low frequencies (Crowell et al. 2016; Hansen et al. 2017).

Evidence suggests that effects on some avian species' breeding behavior begin at noise levels of 38 dB (Reijnen et al. 1995; Engel et al. 2024). TTS has been observed in avian species exposed to noises between 93 and 110 dB for budgerigars (budgies, *Melopsittacus undulatus*) and small mammals (Dooling and Popper 2007), and vocalization masking has been reported from noise sources producing amplitudes between 85 and 125 dB (Engel et al. 2024). Physiological responses have been observed between 85 and 140 dB, and behavioral responses between 38 and 140 dB (Engel et al. 2024). Noise has also resulted in American oystercatchers (*Haematopus palliates*) and Brandt's cormorants spending less time on their nests (Borneman et al. 2016; Buxton et al. 2017).

Invertebrates

Particle motion, a component of underwater sound, is detectable by invertebrates; however, scientific understanding of the significance of sound perception in marine invertebrates is limited (Popper and Hawkins 2018; Solé et al. 2023). Due to the lack of focused studies on this subject, it is difficult to assess how noise from the Orbital O2-X and Project activities might affect marine invertebrate species. While there is potential for acoustic cues to attract both sessile (e.g., larvae) and mobile invertebrates (Garavelli et al. 2024), the likelihood of this occurring is considered very low, and any resulting impacts are expected to be negligible.

4.1.4.3 Summary

Overall, the scientific community generally agrees that underwater noise from operating devices in small-scale MRE projects, such as the proposed Project, does not significantly impact marine animals (Copping et al. 2019; Copping and Hemery 2020; ORJIP Ocean Energy 2022b; Polagye and Bassett 2020).

Due to the temporary nature of increased vessel presence during the installation and removal of the Orbital O2-X and supporting infrastructure, only minor impacts would be expected on marine mammals, fish, avian species, and invertebrates. Once installed, operational noise from the Orbital O2-X is unlikely to cause acoustic injury to marine mammals, fish, seabirds, or other species (e.g., sunflower sea star). The likelihood of noise disturbance is low, with minor impacts and an overall low risk to marine animals. However, marine mammals and fish may exhibit behavioral responses, such as avoidance or reduced activity near the tidal turbine (Hastie et al. 2018; Tollit et al. 2019; Polagye and Bassett 2020). These behavioral changes could potentially provide benefits, such as a reduced risk of collision with the Orbital O2-X or its components. Any impacts are expected to be small and limited to areas in close proximity to the device.

Impacts from vessel noise can be mitigated by following SOPs and BMPs, complying with marine mammal regulations, and implementing specific mitigation measures as determined in consultations with experts. Post-installation monitoring of the Orbital O2-X device would include monitoring for any noise events from the system that could exceed known biological thresholds.

4.1.5 Displacement

Project activities could potentially displace life history activities of marine mammals, fish, and seabirds. Displacement may occur due to:

- Vessel presence, including the noise generated during the installation, operation, maintenance, and removal of the Orbital O2-X.
- Noise from the installation and removal of anchors and mooring lines.
- The marine areas that Project components would spatially occupy and transverse.

Displacement of marine animals due to the presence and/or operation of vessels and devices can include attraction, avoidance, and exclusion behaviors that cause animals to interact unusually with their preferred or critical habitats, or to move into areas that are unfamiliar to them (Hasselman et al. 2023; Hemery et al. 2024; Garavelli et al. 2024). Displacement varies; it can be over a range of spatial scales, short- or long-term, temporary (e.g., effects change over time as species adjust), or permanent (e.g., a species never returns to habitat area).

“Attraction” is the intentional movement of animals toward an area within or immediately adjacent to an MRE. “Avoidance” is the intentional bypassing of an area with an MRE to travel in the same general direction. Regarding displacement, "exclusion" refers to an animal leaving the area and moving away from the device, creating a "barrier effect" (Hemery et al. 2024; Garavelli et al. 2024). Reasons for displacement can include underwater noise, exposure to electromagnetic fields (EMF), habitat changes, physical presence and movement of the Orbital O2-X device, and hydrodynamic changes (Hemery et al. 2024).

4.1.5.1 Species Impacts

Vessels will be needed for several activities in the proposed Project, which is expected to have a medium likelihood of causing displacement, with minor impacts. This results in an overall medium risk level for marine mammals, fish, and avian species. Vessel operations are not expected to affect or pose any risk to invertebrate species.

Orbital O2-X operations and maintenance, including the device’s spatial sweep while rotating between tides, would have a low likelihood of causing displacement or avoidance, with negligible impacts, resulting in a low overall risk for marine mammals, fish, avian, and invertebrate species. Additionally, there would be a medium likelihood of attraction to the Orbital O2-X device by marine mammals, fish, and avian species, with negligible impacts and low risk. Fish and avian species may be drawn to the water column components of the device; for example, birds attracted to prey aggregation around them. Invertebrate attraction to the device components on the seafloor is anticipated to have a low likelihood, with negligible impacts and low overall risk.

Various marine animals are vulnerable to displacement due to their life history and biological traits (e.g., mobility around the device), including large whales, small cetaceans, pinnipeds, seabirds, and both pelagic and demersal fish. Potential effects of displacement could involve changes in energy use, disruptions in predation, competition, and connectivity, alterations to essential functions such as breeding, rearing, and migration, and in severe cases, population decline (Hemery et al. 2024). The extent of displacement would depend on the significance of the habitat for a species' life history and the availability of alternative suitable habitats. However, for a small-scale or single MRE device, these effects are expected to be minimal.

Marine Mammals

Limited research exists on the impacts of a single MRE device on whale species. Large cetaceans, such as humpback whales, may be displaced during the installation and operation of a tidal turbine due to underwater noise (e.g., vessel traffic) and the physical presence of the Orbital O2-X (Kraus et al. 2019; Hemery et al. 2024). Previous studies suggest that cetaceans may experience local-scale spatial changes of tens to a few hundred meters around an MRE device (Tollit et al. 2019; Coles et al. 2021).

Small cetaceans are less at risk of displacement due to their maneuverability compared to larger cetaceans (Hemery et al. 2024). However, small cetaceans may be displaced due to increased underwater noise (e.g., from vessels and installation activities) as has been shown in harbor porpoises and bottlenose dolphins (*Tursiops truncatus*) (Graham et al. 2017; Brandt et al. 2018). Studies have shown that species such as harbor porpoises appear to adjust over time to disturbance and are only temporarily displaced (Thompson et al. 2013; Robertson et al. 2018). In some cases, local cetacean activity has been shown to resume shortly after a disturbance, once the activity stops (Tollit et al. 2019).

Evidence also suggests that habitat displacement caused by single MRE devices occurs at a relatively small scale for pinnipeds. Harbor seals may exhibit altered behavior up to 100 m (328 ft) away from a tidal turbine due to underwater noise (Robertson et al. 2018) and have previously demonstrated displacement between 200 m and 2 km (656 ft and 1.2 miles) (Joy et al. 2018; Hastie et al. 2018; Onoufriou 2020; Coles et al. 2021).

Fish

Critical habitat exists within the proposed Project area for bocaccio and yelloweye rockfish (Puget Sound Georgia Basin DPS), and Chinook salmon (Puget Sound ESU). Potential effects of displacement within critical habitat for these species are described further in **Section 4.3.2.2.** Additionally, EFH exists for Pacific Coast Groundfish, Coastal Pelagic Species, and salmon within the proposed Project area where the Orbital O2-X would be deployed. Displacement effects on EFH for these fishes are described further in **Section 4.3.4**.

Displacement of large pelagic fish is possible due to underwater noise and EMF emitted from cables, which may attract or repel species depending on their sensitivities (Garavelli et al. 2024). Forage fish schools may avoid the Orbital O2-X area during installation activities or operation due to underwater noise, visual changes, and changes in flow patterns, while other fish species may be attracted to new habitats and foraging areas (Williamson et al. 2019; Garavelli et al. 2024). However, little is known about these effects.

For demersal fish, as with other fish species, the effects of displacement may be species-specific, with some being attracted to the area as it provides new habitat. Larvae may be more attracted to the device than adults, as they may respond differently to visual and acoustic cues; however, hydrodynamic changes may displace some larvae from suitable habitats (Anderson et al. 2021).

Avian Species

Very little information is available to describe the extent of potential displacement of avian species due to a single tidal turbine device. Most existing knowledge comes from studies focused on seabird interactions with offshore wind energy infrastructure (Dierschke et al. 2016; Kelsey et al. 2018). Site-specific displacement could potentially occur if there is a decrease in habitat quality or food availability, or even attraction to any lighting on the above-water portions of the tidal turbine (Dierschke et al. 2016). These factors have only been explored for offshore wind farms and not tidal turbines and therefore may not be directly applicable to a single MRE device such as the Orbital O2-X (Garavelli et al. 2024). Displacement of diving seabirds is most likely to be species-specific (e.g., marbled murrelet compared to a tufted puffin) and site-specific (Washington State's inland waters compared to its Pacific coast), depending on the time of year, activity of the seabird, and a species' vulnerability to collision risk, as well as food availability or attraction to new roosting habitats (Dierschke et al. 2016; Kelsey et al. 2018; Garavelli et al. 2024).

Invertebrates

Both sessile (e.g., larvae) and mobile invertebrates may be displaced due to habitat alteration (**Section 4.1.6**), such as seafloor footprint impacts and the creation of artificial habitat, or may be attracted to the Orbital O2-X device through acoustic cues or EMF (Langhamer 2016; Anderson et al. 2021; Garavelli et al. 2024). Orbital O2-X operations and maintenance are expected to present a low likelihood of displacement, attraction, and/or avoidance with a negligible impact, resulting in a low overall risk for invertebrate species. Vessel operations are not expected to affect or pose any risk to invertebrate species.

If they are present in the area, sessile benthic invertebrates would likely be displaced only in areas from anchoring devices and the new subsea cable infrastructure. Mobile invertebrates, such as the sunflower sea star, are expected to move around these devices, similar to how they would move around a rock. Given the small seafloor footprint of the proposed Project relative to Rosario Strait—anchoring devices and cable diameter (17.8 cm [7 in.]) and length (5.3 km [3.3 miles])—it is unlikely that benthic invertebrates would be displaced from any significant portion of their habitat in the area. Artificial habitat around and near the anchoring points and cable for the Orbital O2-X may attract mobile and sessile invertebrates to the area. Larvae (e.g., oysters, mollusks, and mussels) may settle on the artificial habitat before reaching nearby natural habitats, particularly if they are attracted by the soundscape or other cues from the tidal turbine (Lillis et al. 2015; Morello and Yund 2016; Williams et al. 2022).

Summary

Vessel activity presents a medium likelihood of displacement, with minor impact, resulting in an overall medium risk level for marine mammals, fish, and avian species. Based on existing studies, the risk of permanent habitat displacement from the proposed Project is low; however, temporary displacement may occur for nearby marine mammals, fish, avian species, and invertebrates due to the presence and operation of vessels, the Orbital O2-X device, and associated infrastructure.

Mitigation strategies would be implemented to reduce the effects of displacement, avoidance, and/or attraction to vessels, the Orbital O2-X device, and its supporting infrastructure. Mitigation of displacement effects due to vessels would be achieved by using SOPs and BMPs, and implementing specific strategies as determined in consultations with experts. Monitoring data could also be collected using multibeam sonars focused on the nearfield behavior of fish, marine mammals, and diving birds in the vicinity of the device to understand potential displacement effects.

4.1.6 Habitat Alteration

Habitat alteration refers to the temporary or permanent change of benthic or pelagic habitats. Habitat alteration may occur during the following Project operations:

- Installation, operation, and removal of Project components including the Orbital O2-X tidal energy device, anchors, mooring lines and umbilical cable, and new subsea power cable

4.1.6.1 Benthic Habitat Alteration

Project activities may alter benthic habitats by increasing turbidity during installation and removal, seafloor scour, and the sweeping of sediment by mooring chains.

Installation and Removal of Device Infrastructure

Changes in turbidity (the amount of sediment suspended in the water column) may occur during the installation and removal of anchors for the Orbital O2-X. Installing and removing anchors from the seafloor would create local turbulence that resuspends nearby sediments. It is expected that the turbulence would create a plume of suspended sediments with a radius of a few meters.

Increases in turbidity would depend on location, active currents, sediment type, and other variables. Given the strength of currents and tides in Rosario Strait, suspended sediment is expected to disperse, be diluted, and resettle relatively quickly. Coarse sediments (sand or larger) would likely resettle to the seafloor within seconds within the immediate area, whereas fine sediments (silt to clay) tend to drift and remain in suspension for minutes to hours (Hitchcock et al. 1999). Once installed, the moorings would not result in alterations in suspended sediments or turbidity levels until their removal, which would likely create a similar degree of temporary sediment suspension.

The installation and removal of the new subsea cable on the seafloor could also create localized, short-term, small-scale increases in turbidity, to the extent sediment may be disturbed when the cable touches down onto the seabed. Although no study has focused on the impact of sediment resuspension induced by cable installation on marine communities, it is expected to have negligible impacts on marine ecosystems, particularly for a cable that is surface laid and not buried (Taormina et al. 2018). Increases in turbidity due to cable installation would depend on location, active currents, sediment type, elapsed time, and other variables. However, due to the small size of the new subsea cable (maximum diameter of 17.8 cm [7 in.]), the minimally disruptive installation technique of laying the cable on the seafloor, and the short-term timeframe of one-time installation operations, there would be no permanent or long-term impacts on marine water quality due to suspended sediments.

The seafloor below the Orbital O2-X device—where the anchors, mooring lines, and subsea power cable would be installed—largely consists of hard substrate with a thin sediment layer (see **Section 3.2.3**). Direct effects from sediment suspension and increased turbidity on fish populations may include reduced visibility, changes in feeding rates, reduction in predator-avoidance ability, or smothering of feeding and respiratory organs (Wilber and Clarke 2001; Utne-Palm 2002; Au et al. 2004). To avoid these effects, fishes respond by relocating nearby until water clarity returns to levels similar to pre-disturbance conditions. The activities of the proposed Project would generate only minimal and short-term impacts on benthic habitat and cause a negligible increase in suspended materials over a very short timeframe, which is expected to be largely undetectable by fishes.

Seabed Sweeping

Mooring chains sweeping over the seabed throughout the 10-year Project duration also have the potential to disturb sediment on the seafloor. These chains include necessary slack to accommodate tidal fluctuations and naturally curve under their own weight (forming a catenary), which helps absorb lift and shock from wave action (Morrisey et al. 2018). As a result, mooring chains may be dragged across the seabed, which can disturb or destroy benthic habitat or organisms in that zone, as well as prevent recolonization until the mooring lines are removed. Each mooring line would have two areas in contact with the seabed: (1) where the mooring chain is lifted up and placed back down (i.e., no “sweep”); and (2) where the chain is dragged over the seabed (i.e., “sweep”).

The mooring chain would be lifted up off the seabed over a length of 246 m (807 ft) and placed back down in the same location. Remotely operated vehicle footage from other MRE sites has shown a very narrow area of disturbance to the seabed; the width is less than 1 m (3.3 ft), giving an affected area of less than 246 m^2 (2,648 ft^2) per mooring line and 984 m^2 (10,592 ft^2) in total area. The black circles in **Figure 76** denote an area where the chain is dragged over the seabed, rather than lifted up and placed back down (an area of approximately 10 m^2 [108 ft^2] per mooring line, or 40 m^2 [431 ft^2] in total area. Slack tide (minimal tension on the chains) and at rated power (peak tension) would affect contact with the seabed differently, as denoted by the white dots in **Figure 77** and **Figure 78**, respectively.

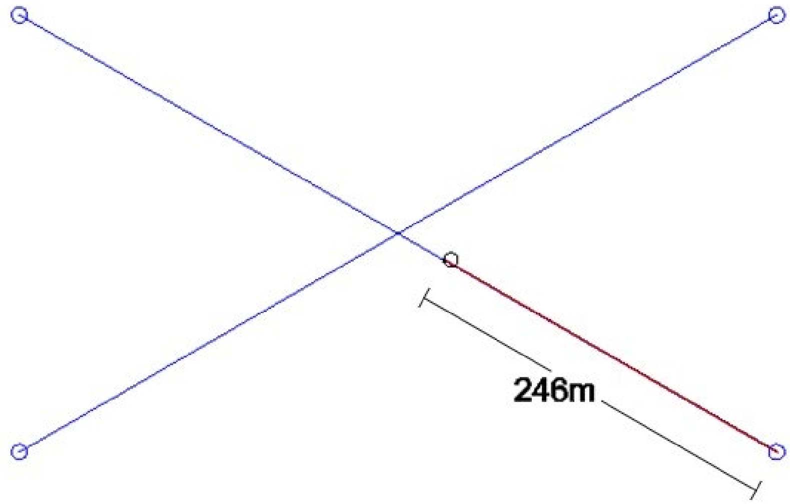

Figure 76. Extent of Mooring Line Contact with Seabed

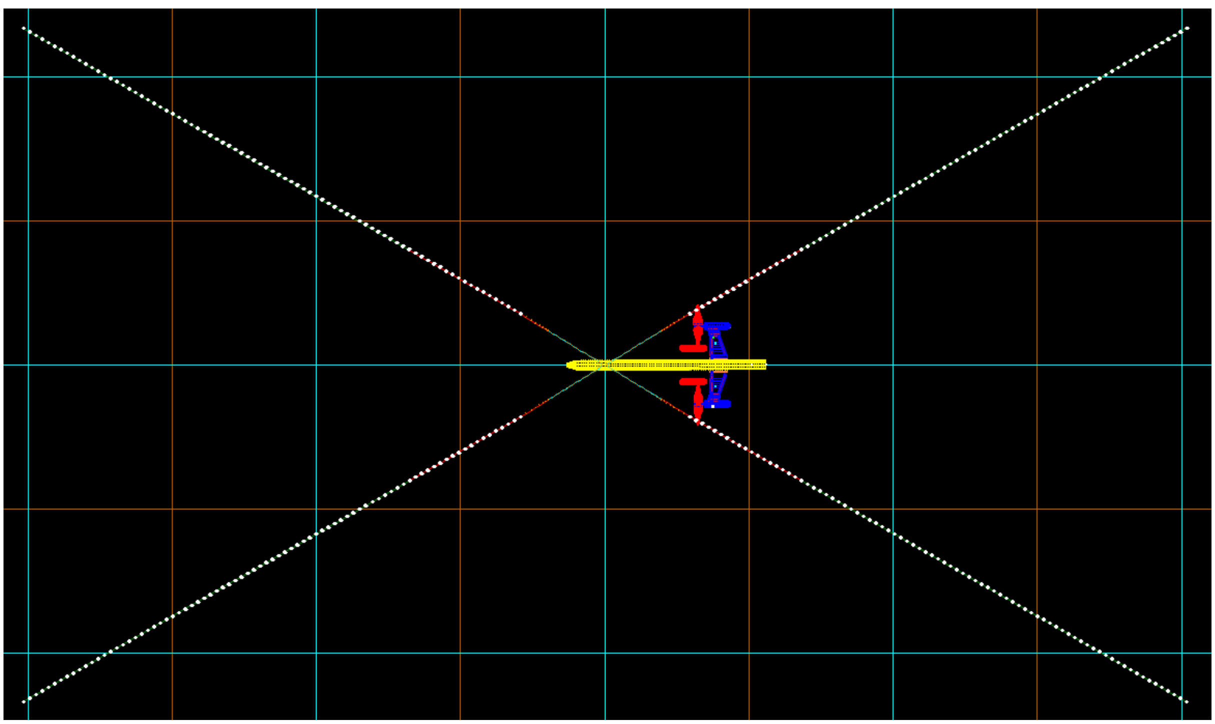

Figure 77. Slack Tide (Minimal Tension in Mooring Lines)

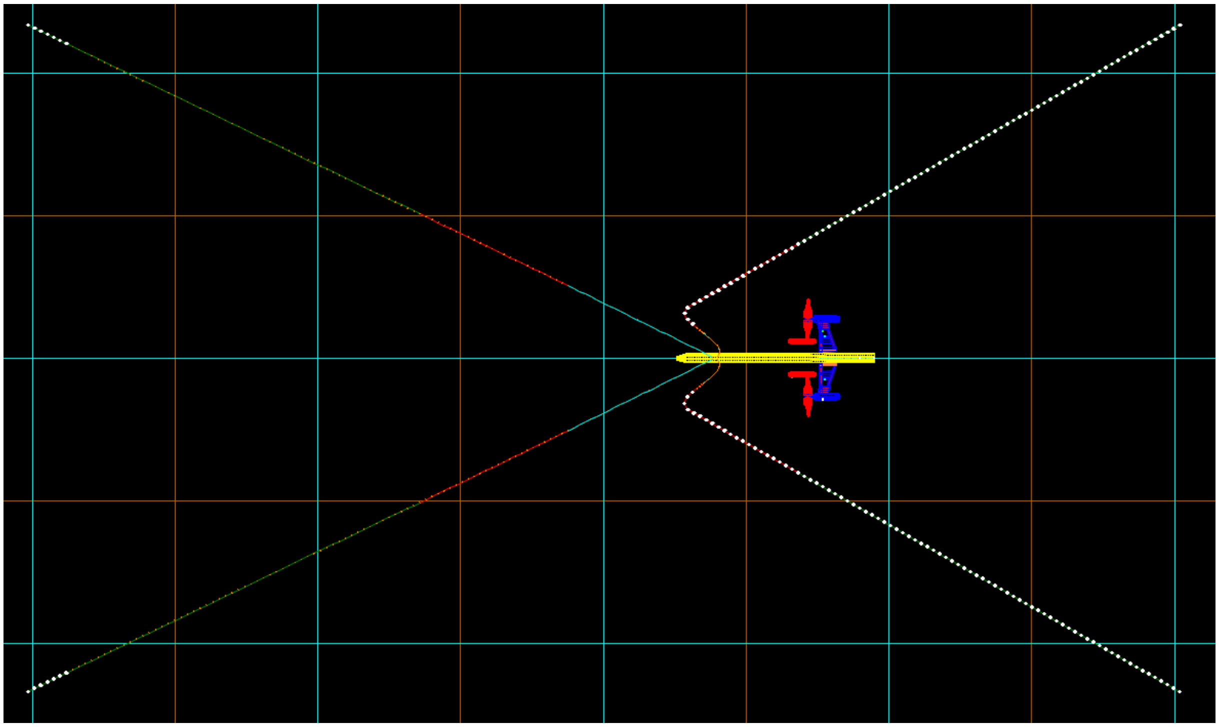

Figure 78. Rated Power (Peak Tension in Line)

The seabed substrate exposed to mooring chain contact and sweep is primarily smooth with some ridges, with a likely very thin sediment layer (according to the Tetra Tech, Inc. survey from October, 2024) and is not considered to be sensitive habitat (Appendix C1). Due to the strength of the currents and tides of Rosario Strait, thin sediment layers may continue to cover the mooring line sweep area and produce small, localized turbidity plumes. These sediment disturbances are expected to be short-lived and of very low intensity. Turbidity would be dispersed, with sediments carried away by the currents and tides of Rosario Strait and settled back to the seafloor and diluted to background levels, likely within minutes after disturbance. As such, turbidity increases due to mooring chain contact with the seafloor is not expected to meaningfully affect the water quality of the surrounding aquatic environment.

Scouring

Increased turbulence and flow velocity changes could lead to scour of fine sediment (i.e., footprint effect) around the Orbital O2-X's bottom structures (e.g., anchors and subsea cable) (Copping and Hemery 2020; Lancaster et al. 2022; Garavelli et al. 2024). If scour were to occur, the resulting footprint would be extremely small relative to Rosario Strait, due to the size of the four rock bolt anchors (58.4 cm [23 in.] diameter, each) and the surface-laid subsea cable (up to 20 cm [8 in.] in diameter).

In previous studies, abundances of invertebrates such as polychaetes and oligochaetes (e.g., worms), bivalves (e.g., clams), and small crustaceans (e.g., crabs) were shown to be higher closer to artificially installed benthic structures compared to areas without structures (Mendoza and Henkel 2017). However, no meaningful effects on species' diversity or richness were measured in relation to distance from the structures, nor were meaningful population changes, compared to areas without artificial structures (Mendoza and Henkel 2017). Another study assessing potential changes to sediment characteristics and macrofaunal communities (i.e., species large enough to see with the naked eye) around anchors deployed at Oregon State University's PacWave-North test site off Newport, Oregon, showed that median sediment grain size and the macrofaunal organism communities were not meaningfully different compared to reference locations of similar depths (Henkel 2016). Any seafloor changes that did occur were localized and did not appear to result in ecological changes (i.e., there were few changes to species abundance and no change to species compositions [Henkel 2016]).

While scour could potentially affect benthic habitat and less resilient benthic organisms, which may include prey species for ESA-listed and EFH species in the proposed Project area, any effects would likely be limited to the seafloor area directly adjacent to the Orbital O2-X device and infrastructure, such as has been shown in other tidal turbine locations (e.g., SeaGen in Strangford Lough, Northern Ireland) (Kregting et al. 2016; O'Carroll et al. 2017; Copping and Hemery 2020). It is not expected that any scour effects to sediment and benthic organisms would scale up to a point that would adversely affect the quality and quantity of the surrounding aquatic habitat in any meaningful way; therefore, scour is expected to have minimal impacts.

4.1.6.2 Benthic and Pelagic Habitat Alteration

Impacts on benthic and pelagic habitat include habitat alteration, biofouling (e.g., algae growth, barnacles) on Project components, and artificial reef effects.

Habitat Alteration

Areas of benthic and pelagic habitat would be temporarily occupied by Project components. The benthic footprint of the Orbital O2-X includes the four mooring anchors and new subsea cable. Rock bolt anchors are 60 cm (23.6 in.) in diameter, resulting in a relatively small footprint. Notably, the subsea cable route would be surface laid, and unburied cables are much less likely to result in habitat alteration than buried cables because no trenching is required. Disturbance of surface-laid cable is limited to the cable width itself, or to the dimensions of the materials used to stabilize and protect (Wilhelmsson et al. 2010). This Project would utilize cable that is up to 17.8 cm (7 in.) in diameter along the 5.3 km (3.3 miles) route, resulting in a very small footprint. Furthermore, the subsea cable route design is based on marine survey results and avoids macroalgae, eelgrass, and critical habitats wherever possible. Based on Tetra Tech's marine survey from October 2024 (Appendix C1), the seabed in the turbine area (i.e., below the device and the mooring anchor sites) is composed of textured hard bottom where sediment has been scoured away or with a thin layer of sediment. The new subsea cable would lay atop exposed hard bottom area until inshore of Black Rock, where the seabed then transitions to a smooth, sedimented bottom.

Tidal energy projects require high tidal velocities that usually result in a seafloor dominated by coarse sediments, boulders, or rocky outcrops. Benthic communities associated with these habitats are typically stress-tolerant, highly resilient, and mainly composed of mosaics of opportunistic species adapted to great physical disturbance (Copping and Hemery 2020). While the cable route does not necessarily experience the same tidal velocities as the turbine area, and thus may host a different benthic community, impacts from cable installation are still expected to be minimal. One study found that the biological impacts of an unburied subsea cable on organisms living on and within the seafloor were "minor at most" (Kogan et al. 2006). The placement of the cable on the seafloor may result in the cover, disturbance, injury, or death of sessile or slow-moving benthic organisms. However, any affected benthic organisms are expected to quickly recolonize the affected area. Notably, mobile organisms such as fish could easily relocate to avoid Project installation activities. Bottom-dwelling fish and other mobile organisms would likely avoid the area during installation activities. Seabed contact and sweeping by mooring lines may also limit access to habitat during the Project duration. In areas of rocky seafloor or cobble, sessile organisms present in this sweep zone are unlikely to recolonize the immediate area until the mooring is removed, while throughout the Project duration mobile species could occupy areas of the sweep zone that are temporarily unobstructed by the mooring chain (Morrisey et al. 2018).

The Orbital O2-X would be installed in pelagic habitat (i.e., the water column). Its presence and operation may cause localized effects such as shading, changes in water flow and turbulence, and fish aggregation. However, because the device rotates with the tides, any one area would only be affected for a short duration before the device repositions. With the implementation of BMPs and other mitigation measures, along with the temporary nature of the proposed Project, there would be no permanent reduction in the quantity or quality of pelagic habitat, and any effects would remain minimal.

During installation of the Orbital O2-X device, mooring lines, and umbilical, pelagic-dwelling fish and other highly mobile organisms would likely avoid the area and return upon completion of activities. Once installed, the Orbital O2-X device, operating turbines, mooring lines, and umbilical would occupy the immediate area of pelagic habitat in the water column. While the mooring spread of the four line consists of a much larger area than the mooring chains themselves, mobile organisms would easily maneuver around the lines and/or relocate to avoid them (Hasselman et al. 2023; Hemery et al. 2024; Garavelli et al. 2024).

Any spatial effects that may result from the Orbital O2-X device and Project infrastructure would be temporary (up to 10 years maximum, the allowable lifespan of a pilot project), and habitat within the water column would return to pre-installation conditions after Orbital O2-X decommissioning and removal. No permanent displacement would occur. The presence of the Orbital O2-X, including its two turbines, four mooring lines, and subsea umbilical in the proposed Project area, is not expected to result in significant effects to pelagic habitat or the pelagic community, nor is it expected to meaningfully reduce available habitat.

Biofouling and Artificial Reef Effects

Over time, the seafloor infrastructure and Orbital O2-X hull bottom below the water surface may be colonized by marine life, including biofouling organisms and non-native organisms, which may impact local biodiversity and attract foraging fish species (Garavelli et al. 2024). Biofouling starts with a biofilm of marine bacteria and fungi followed over time by successions of initial colonizers (e.g., barnacles, hydroids, and tubeworms), then secondary colonizers (e.g., anemones and mussels) (Causon and Gill 2018; Dannheim et al. 2019), which can occur relatively rapidly (e.g., within 2 months in some cases) (Viola et al. 2018). Other device sites have shown an increase in green algae, snails, barnacles, and sponges on the devices themselves, but had sediment free from megafauna and macroalgae (Marine Solutions 2023). At tidal device sites in the Orkney Islands, Scotland, biofouling has been reported, but no non-native species were detected in previous studies (Nall et al. 2022; Want et al. 2023).

While biofouling would likely occur to some extent on Project infrastructure, it is not expected that it would affect the water quality. Additionally, to reduce the accumulation and potential impacts due to biofouling, antifouling paints that comply with the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships would be used, as well as inspections of coatings during regular maintenance intervals to ensure that they remain intact.

MRE device installations may also become artificial reefs, providing ecological benefits such as providing foraging opportunity to marine animals and attracting demersal and pelagic fish species (Langhamer et al. 2009; Broadhurst and Orme 2014; Langhamer 2016; Causon and Gill 2018; Dannheim et al. 2019). By increasing the complexity of the seafloor and surrounding water, the Orbital O2-X device and supporting infrastructure could provide shelter or flow refuge for aggregating species, leading to changes in the local organismal community diversity, abundance, and size (Copping and Hemery 2020). Negative reef effects could also occur, such as non-native species or causing shifts in local community composition (Dannheim et al. 2019; Loxton et al. 2017; Copping and Hemery 2020). However, studies have indicated that artificial structures on the seafloor and in surrounding areas do not significantly differ in non-native species attraction and composition (Nall et al. 2022; Want et al. 2023).

Related to artificial reef effects, nutrient enrichment around the Orbital O2-X device and seafloor infrastructure may also occur due to the accumulation of organic matter and decaying shells from increased litterfalls from biofouling and marine organisms attracted to the device (Wilding 2014; Garavelli et al. 2024). An increase in benthic biomass could in turn benefit higher trophic levels, up to apex predators, thereby potentially intensifying the artificial reef effect (Raoux et al. 2017). However, this effect is less likely to occur near tidal turbines due to the hydrodynamic forces preventing the local accumulation of organic matter (Garavelli et al. 2024).

The magnitude and extent to which the Orbital O2-X could create an artificial reef effect would ultimately depend on the existing local ecosystem, natural habitats, and nearby species composition (Loxton et al. 2017). Over time, artificial reefs may be created near the anchors, mooring lines, subsea cable, and potentially on the underside of the Orbital O2-X hull; however, the effects would be limited to small area of the single Orbital O2-X device. It is not expected that artificial reef effects would lead to significant regional changes (e.g., a shift from soft-sediment to hard-substrate communities) (Causon and Gill 2018).

Benthic and pelagic habitat would not be significantly impacted by artificial reef effects. Based on past studies, artificial reefs may attract mobile marine species while foraging for food and/or shelter, as well as increase local species diversity, richness, and abundance, and colonization by sessile and mobile invertebrates and fish (Langhamer 2012; Taormina et al. 2018; Bender et al. 2020; Garavelli et al. 2024). Therefore, species may be attracted to the proposed Project area for foraging and sheltering opportunities created by the presence of the Orbital O2-X and supporting infrastructure. Since some of these artificial reef effects have only been hypothesized and modeled and could take up to decades to develop (i.e., much longer than the proposed Project timeline), it is unlikely that significant habitat-altering artificial reef effects would occur (Raoux et al. 2017; Copping and Hemery 2020).

4.1.7 Electromagnetic Field (EMF) Exposure

Electromagnetic fields (EMF) are naturally present throughout the world's oceans from the background magnetic field of the Earth and from atmospheric and solar influences. All marine animals are exposed to these natural fields, and some have evolved the ability to sense and respond to them. Subsea power cables emit anthropogenic EMF that can interact with natural geomagnetic EMF, potentially affecting the behavior of electromagnetic sensitive species by disrupting cues. EMF are generated by current flow passing through power cables during operation and can be divided into electric fields (E-fields, measured in volts per meter) and magnetic fields (B-fields, measured in micro-Tesla [μT]) (Taormina et al. 2018). B-fields have a second induced component, a weak electric field, or an induced electric (iE) field. Both E- and B-fields rapidly diminish in strength with increasing horizontal and vertical distance from the source.

The proposed Project would install a new 5.3-km (3.3-mile) double-armor subsea cable with an operating voltage of approximately 12.47 kV to export power from the Orbital O2-X. The cable's operational frequency would be approximately 60 Hz to match the local grid with current levels of 111 Amps per phase of the electrical system at normal operating power. As an example of a much higher capacity cable, the magnetic fields generated from a high voltage direct current (150 kV) subsea power transmission cable at the sediment surface ranged from 50 μT at the cable surface, dropping off rapidly to approximately 35 μT at 1 m (~3 ft) from the cable (Copping et al. 2016). The Earth's background magnetic field ranges from 30 to 60 μT (Copping et al. 2016).

A common concern regarding MRE projects is the potential sensitivity of elasmobranchs and other fishes, marine mammals, sea turtles, and invertebrates to anthropogenic EMF (Normandeau et al. 2011; Snyder et al. 2019). Anthropogenic EMF from subsea power cables can affect exploratory/foraging behavior in some benthic and demersal marine species (Hutchison et al. 2020) or affect animal physiology, development, and growth (Woodruff et al. 2012) and biochemical processes (Kuz'mina et al. 2015). Although elevated EMF may be detectable by benthic species at the power cable location, impacts fall off within a short distance from the cable, as magnetic field levels decrease with the inverse of distance from the cable and are proportional to the current carried by the cable.

Field measurements of subsea power cable EMF are scarce. Some show a close match between measurements and models (e.g., Kavet et al. 2016), others have shown the EMF recorded are not always consistent with the models, especially for the alternating current case (Hutchison et al. 2020). In-situ measurements suggest that EMF from cables can be present over tens of meters, but the overall EMF environment is complex and influenced by the power system, ambient magnetic fields (e.g., geomagnetic field) and water movements (Hutchison et al. 2020, 2021). Modeling suggests that EMF from cables decreases with distance from the cable core (Chainho and Bald 2021; Hutchison et al. 2021) but does not provide insight about potential effects on marine animals. Nonetheless, there is consensus amongst researchers, developers, and regulators that EMF traveling through cables from single or small numbers of devices would be of relatively low intensity and of very localized extent, thereby posing minimal risk to sensitive marine species (Gill et al. 2014; Copping and Hemery 2020).

EMF are thought to cause changes in the behavior and movement of susceptible animals, and potentially long-term changes in growth or reproductive success. The evidence to date suggests that the ecological impacts of EMF emitted from power cables from single devices or small arrays are likely to be limited, and marine animals living in the vicinity of devices and export cables are not likely to be harmed (Copping and Hemery 2020). Data are limited, but only minor responses (such as lingering near or being attracted to cables) have been noted in electrosensitive species (e.g., elasmobranchs, benthic species). No interactions with anthropogenic EMF from subsea cables have been recorded for marine mammals or sea turtles.

Not all marine animals are able to detect EMF; only a few species have the sensory capabilities to sense and react to them. The animals most likely to encounter and be affected by EMF from MRE systems are those that spend time close to a power cable over extended periods, most commonly sedentary benthic organisms. Among fishes, demersal species, including sensitive life history stages (embryos, larvae) with lengthy incubation periods, are thought to have the greatest likelihood for exposure to EMF from cables (Nyqvist et al. 2020). It is uncertain whether EMF-sensitive fishes are routinely found in the proposed Project area, in the immediate vicinity of cables where exposure may occur, or along the subsea cable corridor that leads to shore-based infrastructure.

Given the limited scale of the proposed Project (i.e., a single 2.4 MW device), EMF are anticipated to be minimal and localized to the immediate vicinity of the cable and to have negligible effects on any sensitive species that may be present. At this scale of development, EMF are not expected to result in the death of marine species or the harmful alteration, disruption, or destruction of habitat. This is consistent with the current global state of knowledge about the effects of EMF from MRE devices on marine animals, including fish (Copping and Hemery 2020; Copping et al. 2021; Gill and Desender 2020). Overall, EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020).

4.1.8 Artificial Light

Artificial light could impact natural resources during the following Project activities:

- Project operation when artificial light would be used for both internal and external lighting on the Orbital O2-X.
- All Project activities with vessel navigation lights during Project area visits.

The Orbital O2-X would have lighting systems that are situated in each compartment within the device. These internal lights are fed from battery-backed power supplies and include fixtures such as fire exit and escape route bulkhead lighting, navigational lighting, and surface deck walkway lighting for use during maintenance. Additionally, the Orbital O2-X device would have a marking and lighting schedule to make its location highly visible to vessels that may transit the region 24 hours a day. The device would be yellow in color above the water line and lit by two amber lights that display synchronized flashing once every 3 s. These flashing lights have a nominal visible range of 3 NM and would be mounted a minimum of 3 m (10 ft) above the waterline. The device would also be fitted with a radar reflector at a similar elevation and a navigation aid AIS (Automated Identification System) transmitter.

Underwater lighting may sometimes be used to conduct monitoring studies and to track the frequency of interactions that marine mammals, fish, diving birds, and invertebrates have with Project components. A final decision on monitoring equipment would be determined after consultation with relevant agencies.

In Washington State, vessels are required to have the appropriate navigation lights (Island County 2015). For all vessels that measure 5 to 12 m (16 to 40 ft) in length, navigation lights with a visibility range of 1 NM are required while the vessel is in motion. For all vessels 14 to 20 m (45 ft to 65 ft) in length, navigation lights must be visible at 3 NM for masthead lights and at 2 NM for all other navigation lights (Island County 2015). See **Table 24** for more information about lighting requirements per vessel size and operation.

Table 24. Washington State Vessel Navigation Light Requirements

Equipment & Action	Requirement
Power Driven Vessel (underway)	• Sidelights, masthead, stern light. • Vessels less than 12 m (39 ft) may exhibit an all-round white light in lieu of separate masthead and stern lights.
Sailing Vessel (underway)	• Sidelights, stern light. • If less than 20 m (66 ft) these lights can be combined into one lantern to be carried at or near the top of the mast. • A sailing vessel under 7 m (23 ft) may substitute a white lantern or flashlight, which shall be exhibited in sufficient time to prevent a collision – this does not include sailing vessels under mechanical power.
Rowing Vessel (underway)	• Sidelights, stern light, or have at ready a white lantern or flashlight that shall be exhibited in sufficient time to prevent a collision.
Any Vessel (at anchor)	• All around white light visible for 2 NM at night unless in a chart-designated anchorage.

Notes: ft = feet; m = meters; NM = nautical miles

Source: Island County 2015; WAC 352-60-060

4.1.8.1 Potential Impacts on Species

Around the world, artificial light is being used more frequently, and its spatial extent is expanding (Cinzano et al. 2001; Hölker et al. 2010). While increasingly more research is taking place about the impact of artificial light on terrestrial species, there is less research about impacts on marine life (Depledge et al. 2010). Most species have evolved under the natural cycles of exposure to moonlight, sunlight, and starlight, and these cycles cue species activity times, offer navigation aid, help regulate and coordinate maturation and reproductive events, provide constant regulation of physiology, and inform visually guided behavior such as predation and communication (Gaston et al. 2013; Davies et al. 2014).

Research results about the impact of artificial light on terrestrial species include findings that artificial light triggers the advancement of sexual maturation of birds (Dominoni et al. 2013), the intensifying of foraging efforts of birds (Titulaer et al. 2012), and the extension of dawn song time by birds into the night (Nordt and Klenke 2013). Some species become attracted to or avoid areas where artificial light is present and thus are either displaced from or occupy new habitat (Rydell 1992; Stone et al. 2012; Davies et al. 2014). The same types of cues are changed in marine species as well, and those potential behavior changes can be sorted into four categories: orientation, reproduction and recruitment, predation, and communication (Davies et al. 2014).

Orientation

Birds and sea turtles, among other species, use natural light to navigate, and it is common for vessel strikes with birds to occur at night when they become disoriented by artificial lights on vessels (Tuxbury and Salmon 2005; Merkel 2010). One of the marine species that is most studied when it comes to light exposure impacts are sea turtles who prioritize laying eggs in dark locations and whose hatchlings can be led astray toward inland lights instead of toward the water (FFWCC 2022). New artificial lights like light-emitting diodes (LEDs) have shorter wavelengths that penetrate deeper into the water thus impacting more ecosystems, but solutions such as using red light that does not penetrate water as deeply or using shields to block coastal areas from artificial light exposure are being studied (Miller and Rice 2023).

Orientation to moonlight is also researched in sandhopper invertebrates, dung beetles, and fish, and the introduction of new artificial lights can introduce confusion in behaviors that need intentional orientation (Ugolini et al. 2005; Dacke et al. 2003; Marchesan et al. 2005). Coastal lighting around estuaries is found to aggregate fish in artificially lit habitats, and the behavior of some species gravitating toward artificial lights is used to catch squid (Becker et al. 2012). The impacts of artificial lights on marine ecosystems can be so profound that artificial lights captured by satellites can be used to quantify fishing pressure, spawning grounds, and migration routes (Kiyofuji and Saitoh 2004).

Reproduction and Recruitment

In marine environments, many species use light regimes to regulate times of reproduction, maturation, and synchronized spawning events (Davies et al. 2014). Patterns of reproduction can be changed by the introduction of artificial lights, and due to this, techniques of artificial light use are common in aquaculture to control the sexual maturation of fish (Oppedal et al. 2011). One example of this is the spawning of the palolo worm (*Eunice virids*), which releases gametes only during a few days of the third quarter moon in October (Naylor 1999). Other species that use the moon for spawning cues include polychaetes, coral, and echinoderms (Bentley et al. 1999; Harrison 2011; Lessios 1991). While the extent to which additional factors such as day length, temperature, and tidal conditions could play a role in these spawning events is unknown, it seems that lunar light intensity provides the final trigger for spawning (Harrison 2011). Some scientists are researching whether moonlight could be masked in the sky by artificial lights (Davies et al. 2013), and as a result interfere with the synchronization of spawning events and could result in decrease in cross fertilization and thus decline among a species (Davies et al. 2014).

Predation

Artificial light can impact predation by changing the lighting in a habitat and thus changing the ability of predators and prey to camouflage or use nocturnal adaptations to hunt or hide (Davies et al. 2014). The ability to locate prey or avoid predation relies on a predator's ability to see its prey among habitats with various shapes, colors, and patterns, and the ability of the prey to disguise itself to avoid detection (Troscianko et al. 2009). The introduction of more light means that there is a greater likelihood that predators will see their prey; in the marine environment, artificial light often attracts both predators and prey to the lit area, thus increasing predation opportunities (Becker et al. 2012). Fish larvae or fry exposed to artificial light pollution exhibit habitat avoidance, a disruption in the endocrine and metabolic systems during metamorphosis, and an increase in susceptibility to predation (O'Connor et al. 2019; Tabor et al. 2021). Additionally, some species use bioluminescence to either deter or attract prey by confusing predators, sacrificing light-emitting parts of their body, attracting the predators or predators, or mimicking ambient light (Haddock et al. 2010). The introduction of artificial light can change possibilities for these adaptive behaviors to occur.

In one project, the lights on bridges that passed over the Puntledge River in British Columbia, Canada were turned off, and it was found that there was reduced predation by harbor seals (on migrating juvenile Pacific salmon (Yurk and Trites 2000). Artificial lights have potentially drastic impacts on species' populations and food chains.

Communication

Several marine species have developed complex eyes including fish, cephalopods, and arthropods, and this adaptation assists with inter- and intra-species communication (Davies et al. 2014). Cephalopods for example use adaptive displays of color-changing cells to communicate (Mathger et al. 2009). Visually guided behaviors of species such as mate selection could be influenced by artificial light introduction since physical features that are used to communicate fitness will be more recognizable under whiter light (Davies et al. 2013). Additionally, if brighter artificial lights enter an ecosystem, then sexual communication via bioluminescence could also be disrupted (Haddock et al. 2010).

Summary

The proposed Project area currently has little exposure to artificial light since there are no residential or commercial buildings along the shoreline, and the current presence of artificial light is primarily due to vessel traffic from ferry routes, recreational or commercial vessel use, or buoys.

Due to proposed Project activities, an increase in artificial light use would occur to mark the Orbital O2-X device with two amber lights that display synchronized flashing once every 3 s. Since these lights would be situated at least 3 m (10 ft) above the waterline, be amber in color, and have inconsistent intensity due to the flashing, impacts are expected to be minimal.

Finally, additional vessel presence during all Project phases could increase artificial light presence in the proposed Project area, but due to the preference for the majority of Project work to occur during daytime hours, increased use of artificial light via vessel presence in the proposed Project area would be minimal and temporary.

4.1.9 Changes in Oceanographic Systems

The proposed Project could impact oceanographic systems during the following Project activities:

- Operation when the Orbital O2-X is deployed in Rosario Strait.

When deploying a device like the Orbital O2-X, there are concerns about the ways in which the device would alter oceanographic systems and processes, such as the transportation of sediments and planktonic organisms, the distribution of the concentrations of dissolved gases and nutrients, tidal circulation and basin flushing, wave action, ocean currents, temperature and salinity gradients, the exchange of heat, and maintenance of habitats and water quality (OESE 2022). Drastic changes to these systems could have negative implications for healthy ecosystems.

The tidal and wave regimes are governed by much larger, regional-scale oceanographic processes, which would not be disrupted by the presence of the Project infrastructure. Wang and Yang (2017) explored tidal power extraction scenarios from tidal inlets in Puget Sound and indicated that system-wide environmental effects were unlikely to be a concern for small-scale projects.

Alterations to water circulation patterns due to the presence of an MRE can affect sedimentation rates, reducing rates both upstream and downstream, which could lead to modification of sediment depositional patterns (Roberts et al. 2016; Kadiri et al. 2012). Small-scale deployments (less than four MRE's), like that of the Orbital O2-X, do not result in changes that are measurable within the natural variability of the ecosystem, so the proposed Project would not impact sedimentation rates (Copping and Hemery 2020).

The spinning of turbines makes the water move faster downstream and creates swirling currents, which can increase shear stress (Sun et al. 2018; Chen et al. 2017; Hill et al. 2014). Sediment bed-shear stress is linked to changes in the strength of tidal currents, meaning that extracting tidal energy could significantly impact sediment movement. This could lead to a temporary decline in water quality due to increased turbidity from disturbed sediment (Neill et al. 2017; Kadiri et al. 2012). Given the existing effect of strong tides on the currents, sediment deposition, and suspended sediments in Rosario Strait, this Project is not expected to cause substantive change over the natural variation in Rosario Strait. Also, computer models consistently show that groups of fewer than 10 tidal energy devices would have very little effect on wave heights, water flow, and the movement of sediment (Baring-Gould et al. 2016).

Hydrokinetic tidal energy conversion takes energy from the water, which changes the local water conditions. Even though energy removal may not cause noticeable changes at a small pilot project scale, factors like temperature, salinity, oxygen levels, and the concentrations of metals and nutrients in the water could be affected, since they depend on the water's movement.

Kadiri et al. (2012) investigated the hydro-environmental impacts associated with tidal renewable energy systems, with a focus on water quality impacts. They found that local tidal power extraction may reduce tidal flushing, leading to a decrease in salinity levels within the water column. The extent of this salinity change depends on the water volume within the area where energy is extracted. A reduction in salinity could increase the residence time of nutrients in the sediment because there would be less competition between nutrients and seawater ions for binding sites on sediment particle surfaces. Additionally, reducing the magnitude of tidal currents could lead to a decrease in suspended sediment concentrations and turbidity levels (Kadiri et al. 2012).

Because the Orbital O2-X is a floating tidal stream generator rather than a tidal barrage, it would not significantly obstruct tidal flushing, and no noticeable changes in salinity or dissolved oxygen levels in the water column are expected. The reduction in suspended sediment levels following the introduction of a single Orbital O2-X could lead to lower metal concentrations in the downstream water column. However, accelerated flow around the turbine could cause localized sediment resuspension, potentially increasing metal concentrations near the device (Kadiri et al. 2012). Operation of a floating tidal turbine may increase nutrient availability due to reduced tidal flushing and longer residence time, but nutrient concentrations are not expected to increase substantially, and eutrophication (i.e., excess nutrients) is unlikely to occur (Kadiri et al. 2012).

Despite these concerns, evidence suggests that small arrays of MRE generation devices (one to four devices with less than 10 MW generation potential total), such as that of a single Orbital O2-X device, would not result in changes that are measurable relative to the natural variability of the oceanographic system (Copping and Hemery 2020; OESE 2022). Overall, the scientific community has reached consensus that potential changes to oceanographic systems from small-scale deployments of marine energy devices are below the natural variability of oceanographic systems and the risk can be considered discountable (Copping and Hemery 2020; OESE 2022; De Dominicis et al. 2017; Robins et al. 2014).

The operation of the Orbital O2-X would have a low likelihood of impacting oceanographic systems such as ocean dynamic processes and sediment transport, and any impacts would be negligible and would not rise above the natural variation of those systems.

4.2 Geology and Soils

Localized impacts on the seabed geology and geomorphology could occur during the following proposed Project activities:

- Project anchoring in benthic habitat.
- Project operation activities due to mooring line and umbilical sweep areas.

Project activities could result in changes in: (1) seabed level/morphology due to placement of infrastructure (e.g., anchors, cable protection, scour protection); (2) changes in seabed level/morphology due to changes in sediment deposition; and (3) changes in suspended sediment concentrations due to installation activities and movement of mooring lines and the subsea cable umbilical during operation.

The placement of infrastructure on the seabed could alter seabed levels locally, depending on the anchor foundation used. This may have a localized effect on seabed morphology, with the potential for effects during the operation stage of the Project. The accelerated flows in the immediate region around the tidal turbine could scour the seabed around the device (Kadiri et al. 2012). The rotor's effect, the increased wake effect under the turbine, and the tip clearance (i.e., the distance between the tip of a rotating blade to a stationary part, point, or object) are the main considerations for scour induced by tidal turbines (Chambel et al. 2024; Chen and Lam 2014). The hard substrate of the seabed would limit the potential to generate scour from the anchoring operations.

Prior to installation, a scour assessment would be completed to determine the need for protection, and if required, the protection would be installed to eliminate the potential scouring. These mitigation measures would prevent scour developing around the four anchors and mooring lines.

Installation of anchors, particularly through drilling, may result in a small and localized increase in suspended sediment concentrations (SSC). Additionally, the mooring sweep areas (40 m^2 [430 ft^2] total for four mooring lines), the mooring line lift and lower areas (246 m^2 [2,648 ft^2] per mooring line or 984 m^2 [10,592 ft^2] total), and the subsea cable umbilical sweep area (314 m^2 [3,380 ft^2]) may cause small, local, temporary sediment plumes when the Orbital O2-X changes orientation in the water due to the changes of the tide. For more information about local turbidity and suspension of sediments, see Section 4.1.6.

The Orbital O2-X would be in an area with fast flows, where outcropping bedrock is more likely. The rise and fall of the mooring lines with the tides would be slow and progressive, and the associated sedimentation would be highly localized and rapidly dispersed in a tidally active area. In the context of the potential for mooring lines and subsea cable umbilical to be moved on the seabed within the sweep area, seabed sediment disturbance is expected to be minimal. Therefore, increases in SSC associated with the movement of mooring lines would be minimal and would be in line with general SSC within the western portion of Rosario Strait.

4.3 Species and Habitats Effects Analysis

The potential effects due to the Project on fish and wildlife species and habitats are analyzed within this section, including federally listed species and critical habitats, marine mammals, EFH, avian species, Washington's PHS, and aquatic invasive species. The Fish and Wilding Monitoring Plan (Appendix B1) and Adaptive Management Plan (Appendix B3) outline the monitoring efforts and their response to data that is collected during the proposed Project.

4.3.1 Federally Listed Species Effects Analysis

The potential effects on ESA-listed species that may be present in the proposed project area are analyzed separately in this sub-section, due to their federal protection. The following is not intended as an ESA-listed species effects determination, as consultation with NMFS and USFWS has not yet occurred. The Project is anticipated to potentially affect the ESA-listed species in ways described below; however, it is not expected that any potential effects would rise to the level of being significant.

4.3.1.1 Marine Mammals

Killer Whale (Southern Resident DPS) and Humpback Whale (Central America and Mexico DPSs)

Southern Resident Killer Whales (SRKWs) are well-documented in Rosario Strait but occur in lower abundance there compared to other areas of the Salish Sea, such as Haro Strait, Boundary Passage, the southern Gulf Islands, and the eastern end of the Strait of Juan de Fuca (Olson et al. 2018). Humpback whale presence is still considered rare within the Salish Sea in general, and when sightings do happen, they tend to be within the Strait of Juan de Fuca, Haro Strait, Moresby Passage, and Southern Puget Sound (Calambokidis et al. 2017); i.e., outside of the proposed Project area. The Project is anticipated to potentially have the effects described below on SRKWs and Central America and Mexico DPSs of humpback whales.

Entanglement: The existing scientific literature supports the conclusion that whales would not get entangled in either catenary or tensioned mooring lines. The Project's new subsea power cable and four mooring lines would not have loose ends or sufficient slack to create an entangling loop. Therefore, the risk of entanglement in mooring lines for this Project is considered to be discountable for SRKWs and humpback whales.

Derelict gear could present a secondary entanglement concern, if it were to become snagged in Orbital O2-X infrastructure and whales were foraging within the proposed Project area. However, there have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019). Therefore, there is a low likelihood of SRKWs and humpback whales in the proposed Project area getting entangled in derelict fishing gear snagged on the Orbital O2-X or its mooring lines, but it is considered a medium risk given the impacts on either species if entanglement were to occur.

Collision and Entrainment: A collision with O2-X turbine blades would be a rare event (Onoufriou et al. 2021; Garavelli et al. 2024). There have been no instances of marine mammals, including whales, colliding with an operational tidal or river turbine (Sparling et al. 2020; Copping and Hemery 2020; Garavelli et al. 2024). Entrainment due to underwater tidal turbines remains a primary environmental concern. The potential for injury or mortality of a whale due to blade strike, from either collision and/or entrainment, is uncertain but expected to be low according due to industry SOPs, BMPs, and mitigation measures that would be employed at the proposed Project (Copping and Hemery 2020; Copping et al. 2023; Garavelli et al. 2024).

Noise Disturbance: Exposure to increased noise levels is expected due to vessel presence for the installation, operation, maintenance, and removal of the Orbital O2-X and supporting infrastructure. Noise emitted from Project activities is not expected to rise to the level of being injurious or harassing; however, it is possible that SRKWs and humpback whales, if present within close proximity of Project construction activities (e.g., anchor and mooring line installation and removal), may exhibit altered behavior such as avoidance of the proposed Project area. Evidence suggests that underwater noise emitted from operational MRE devices is unlikely to significantly alter behavior or cause physical harm to marine animals (Copping and Hemery 2020).

Displacement: Whales have been known to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok et al. 1989; Richardson et al. 1995; Heide-Jørgensen et al. 2003). In the presence of a slow-moving vessel, neither humpback whales nor SRKWs are anticipated to be meaningfully displaced. Feeding and traveling humpback whales are likely to maintain their behavioral state regardless, and surface active whales may have short-term and minor changes in movement and behavior (Schuler 2019). Similar responses are expected from SRKWs, and it is anticipated that their behavior would not change, or that they would temporarily relocate to a suitable location and resume previous activities.

Overall, the proposed Project area is on the periphery of SRKW passageways through Rosario Strait (Olson et al. 2018) and is not expected to result in significant displacement of SRKWs. Humpback whales are also not expected to be meaningfully displaced from their habitat, since they are already considered rare in the Salish Sea. When humpbacks are spotted within the Salish Sea, it is primarily in the Strait of Juan de Fuca and Strait of Georgia (Falcone et al. 2005) and outside of the proposed Project area.

<u>Habitat Alteration (including turbidity)</u>: Benthic and pelagic habitat effects, such as a temporary increase in suspended sediment (i.e., turbidity), biofouling, and artificial reef effects, are expected to have minimal impacts on SRKWs and humpbacks. While SRKWs and humpbacks may avoid the immediate location where the Orbital O2-X would be deployed, they are highly mobile and would not be temporarily or permanently displaced by Project activities. There is a potential for benthic artificial reef effects to lead to localized increased prey abundance. However, given the relatively small size of the Project (i.e., one device, not an array), the artificial reef effect is unlikely to meaningfully impact SRKW or humpback habitat or prey availability and is considered discountable.

<u>EMF Exposure</u>: EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the subsea power cable, which would be located on the seafloor. Therefore, EMF effects on SRKWs and humpback whales would be discountable because neither species is expected to be within a few meters of the subsea cable for any appreciable amount of time.

<u>Artificial Light</u>: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Marine mammals with sensitive eyes, including cetaceans, may be temporarily and minimally affected by artificial light due to the proposed Project (Miller and Rice 2023). Marine mammal presence may increase to predate on aggregated fish species (McConnell et al. 2010; Nguyen and Winger 2019); however, the light intensity from the Orbital O2-X device is not anticipated to result in significant behavioral changes from, or adverse effects to, either SRKWs or humpback whales.

<u>Changes in Oceanographic Systems</u>: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on SRKWs and humpback whales (Central America and Mexico DPSs) would be negligible.

4.3.1.2 Fish Species

Bocaccio (Puget Sound-Georgia Basin DPS), Yelloweye Rockfish (Puget Sound-Georgia Basin DPS), Chinook Salmon (Puget Sound ESU), Steelhead (Puget Sound DPS), Eulachon, Green Sturgeon (Southern DPS), and Bull Trout (Coterminous U.S. Population [Coastal Recovery Unit])

Bocaccio and yelloweye rockfish (Puget Sound-Georgia Basin DPS) and Chinook salmon (Puget Sound ESU) each has designated critical habitat that overlaps with the proposed Project area and therefore have the potential to be present. Steelhead (Puget Sound DPS), eulachon, green sturgeon (Southern DPS), and bull trout (Coterminous U.S. Population [Coastal Recovery Unit]) do not have critical habitat that overlaps with the proposed Project area but may be present during Project activities. The Project is anticipated to potentially have the effects described below on the aforementioned ESA-listed fish species:

Entanglement: Given the cross section of the mooring lines and subsea cable umbilical, it is not considered possible for listed fish species to become entangled in one of them. There have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019) due to derelict fishing gear, which has been increasingly removed from the Salish Sea due to concerted efforts (Drinkwin et al. 2023). While the likelihood of ESA-listed fish species getting entangled in derelict fishing gear caught on the Orbital O2-X or its mooring lines is low, the risk is considered medium because of the potential harm entanglement could cause to these species.

Collision and Entrainment: As of 2024, no collisions between marine fish and tidal turbines have been observed (Garavelli et al. 2024). Unlike fish passing through a conventional hydroelectric dam, those in the vicinity of the Orbital O2-X can swim around and avoid the turbine. While ESA-listed fish near the turbine may face a potential risk of collision (e.g., blade strike), the likelihood is low. If a collision were to occur, it could result in injury, leading to a moderate classification of risk.

Due to limited studies, the effects of entrainment on fish cannot be definitively determined. However, given the Orbital O2-X turbine's design and slow-moving rotors, entrainment is expected to be highly unlikely. In the rare event that it does occur, it is unlikely to be lethal to fish.

Noise Disturbance: Knowledge on the effects of noise exposure on fishes is sparse, particularly regarding behavioral disturbances (Popper et al. 2014). Noise associated with the Orbital O2-X during installation, operation, maintenance, and removal is expected; however, the elevated noise would not reach levels that cause adverse or injurious effects to nearby ESA-listed fish species. Avoidance of the proposed Project area due to increased noise may occur during installation and removal of the Orbital O2-X and infrastructure; however, these activities would be temporary (e.g., 12 hours for anchoring devices). Noise levels during tidal turbine operations are expected to be low enough that there would not be adverse effects on listed fish species. If any listed fish are near noise-emitting activities and/or vessels during installation, operation, maintenance, and removal of the Orbital O2-X, they would likely relocate to another suitable location and resume their previous activities.

Displacement: When reacting to a vessel, fish usually exhibit an avoidance response such as diving, horizontal movements, or altered tilt angle distributions (Mitson 1995; De Robertis and Handegard 2013). Fish well ahead of an approaching vessel have been documented to move toward the vessel path, although this tends to be attributed to vessel noise more than physical presence (Misund et al. 1996; Handegard and Tjøstheim 2005). The effects on ESA-listed fish species from a temporary increase in Project-related vessel presence (and noise) would be minimal, and it is not anticipated to result in any meaningful displacement. Any listed fish species in the area would most likely temporarily relocate to another suitable location and resume their previous activities.

Fish may be displaced from the Orbital O2-X area due to underwater noise emitted from construction activities, visual stimuli, and minor changes in flow patterns, while other fish may be attracted to new artificial habitats and foraging areas (Williamson et al. 2019; Hemery et al. 2024; Garavelli et al. 2024). Displacement effects are expected to be species-specific, and it is currently unknown how each of the listed fish species would behave. Fish would likely relocate to another suitable location and resume their previous activities during any construction activities emitting noise. Displacement effects would be temporary, with affected fish returning to the area once the Orbital O2-X is operational. Long-term consequences of such displacement, if any, are still unknown (Hemery et al. 2024).

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), components occupying a footprint area, scouring, and seabed sweep from moorings, as well as habitat creation (e.g., biofouling and/or artificial reef effects) may affect listed fish species within the proposed Project area.

Given the strength of the currents and tides of Rosario Strait and temporary nature of the turbidity-increasing activities, suspended sediment is expected to dissipate and quickly resettle (in minutes to hours), which would not degrade long-term water quality or significantly alter fish habitat conditions of the surrounding marine environment. Fish may find new habitats on and around the anchoring and mooring components, while smaller life stages (e.g., larvae and small juveniles) may benefit from food and protection provided by components on the seafloor and in the water column (Garavelli et al. 2024). Given the relatively small area of the one Orbital O2-X device (single, as opposed to an array) and its moorings and anchorings, biofouling and artificial effects are expected to be small and localized. There may be an increase in the presence of prey species for listed fish, thereby attracting them to the proposed Project area. It is not expected that any significant adverse effects to listed fish species would occur from habitat alteration.

EMF Exposure: The amount of cable lying on the seabed, relative to the vast scale of Rosario Strait, represents an exceedingly small area over which listed fish species could pass and be influenced by the EMF from the new subsea cable. Salmon occasionally come into close proximity with subsea cable(s) at marine energy sites, causing some displacement concerns due to EMF (Wyman et al. 2018); however, these effects would be minimal, causing little-to-no response (Snyder et al. 2019). The likelihood of listed fish species being negatively affected by magnetic fields associated with the Project is discountable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Artificial light pollution has the potential to attract and aggregate listed fish species (and potentially their predators) to the proposed Project area (McConnell et al. 2010; Nguyen and Winger 2019), but the light intensity from the Orbital O2-X device is not expected to result in significant behavioral changes from, or adverse effects to, any of the listed fish species. Light intensity from operating vessels present during installation, maintenance, and removal of the Orbital O2-X and supporting infrastructure may have the potential to alter listed fish species' behavior (e.g., migration and foraging). However, these effects would be temporary and primarily occur during daytime hours, thereby reducing their potential impact.

Changes in Oceanographic Systems: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts on ESA-listed fish species would be negligible.

4.3.1.3 Avian Species

Marbled Murrelet

Although they appear in relatively small numbers, marbled murrelets are documented throughout Washington State's inland waters, particularly in shallow nearshore areas while foraging and diving for small fish (Sealy 1974; McIver et al. 2021; Pearson et al. 2022). There are no known murrelet nesting sites on Blakely Island; the nearest is on the Olympic Peninsula of Washington State. They do forage within nearshore areas of the San Juan Islands; therefore, they may be present in low numbers within the proposed Project area. The Project is anticipated to potentially have the following effects on the marbled murrelet:

Entanglement: Given the cross section of the mooring lines and subsea cable umbilical and their place within the water column, it would not be possible for a marbled murrelet to become entangled in one. Derelict gear could present a secondary entanglement concern, if it were to become snagged in Orbital O2-X infrastructure and marbled murrelets were foraging and diving within the proposed Project area. However, there are no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019) due to derelict fishing gear, which has been increasingly removed from the Salish Sea due to concerted efforts (Drinkwin et al. 2023). The likelihood of marbled murrelets becoming entangled in derelict fishing gear caught on the Orbital O2-

X or its mooring lines is low. However, the risk is considered medium due to the potential impact on murrelets if entanglement were to occur.

Collision and Entrainment: Very few studies focusing on seabird collision with turbine blades exist in the scientific literature, and practically none exist concerning entrained seabirds. While collision risk between the marbled murrelet and turbine blades is a concern, the current scientific literature is insufficient to accurately determine the level of risk. Based on the information available about other species, it is unlikely for collision or entrainment to occur nor result in injury or mortality.

Noise Disturbance: Any above-water acoustic noise due to Project activities, including increased vessel noise, is not expected to reach or exceed the thresholds for harassment or harm of any marbled murrelet that may fly over the proposed Project area or occupy the nearby waters. Installation and removal activities would be temporary, and the continuous operation of the Orbital O2-X would generate low-level non-impulsive noise that does not significantly contribute to ambient noise levels. If marbled murrelets are present during Project activities, they would likely relocate to a more suitable location and resume previous activities.

Displacement: If any marbled murrelet is flying overhead, foraging, or otherwise occupying nearby waters while vessels are installing or removing Project infrastructure (e.g., anchors, mooring lines, cable, Orbital O2-X), the effect would not be demonstrably different than the presence of any other small watercraft or vessels that would also be in Rosario Strait or surrounding area. Murrelets would likely relocate to a more suitable location and resume previous activities. Therefore, temporary vessel presence is not expected to result in displacement of marbled murrelets.

Site-specific displacement could occur if there is a decrease in habitat quality or food availability, or even attraction to any lighting on the above-water portions of the Orbital O2-X (Dierschke et al. 2016). No studies are currently available that have investigated the displacement of diving seabirds or avian species due to tidal turbine devices. Because marbled murrelets forage in the nearshore marine environment, they could potentially be displaced from the immediate proposed Project area if they were present. If displaced, murrelets would likely relocate to a more suitable location and resume previous activities.

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), footprint effect, scouring, and seabed sweeping, as well as habitat creation (e.g., biofouling, or marine reserve and artificial reef effects) are not expected to have a significant impact on marbled murrelets. Any increase in suspended sediment, or turbidity, would be temporary and local to the benthic zone where the four anchors, four mooring lines, and the new subsea cable would be located. There may be the potential for increased marbled murrelet diving and foraging activity if the Orbital O2-X and supporting infrastructure act as a fish-aggregating device (e.g., through artificial reef effects) for prey species; however, any habitat alteration effects would not meaningfully affect marbled murrelets within the proposed Project area.

EMF Exposure: No EMF effects on marbled murrelets are expected, given that they would not be present near any benthic EMF emitted by the subsea power cable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Amber and red light have been shown to have a diminished effect on nearby seabirds, as opposed to green or blue (Syposz et al. 2021). Altered behavior of marbled murrelets is possible due to artificial light during the installation, maintenance, and removal activities; however, these activities would primarily occur during daylight hours when light disturbance would not occur. There is the potential for marbled murrelets to be attracted to, or repelled by, the amber lights based on the documented behavior of other bird species (Syposz et al. 2021). This would be expected to primarily occur during night hours due to a lack of other artificial light in the area. Any change in murrelet behavior due to artificial light would not likely adversely affect the individual or population.

Changes in Oceanographic Systems: The Orbital O2-X single device operation is expected to have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on marbled murrelets would be negligible.

4.3.1.4 Echinoderms

Sunflower Sea Star

While historically abundant, the number of sunflower sea stars in the Salish Sea has drastically declined and is now considered rare in nearshore Washington State marine areas (88 FR 16212). Even with their population decline in the Salish Sea due to sea star wasting syndrome (SSWS), they are still more abundant than in the southern end of their range (e.g., in California). Therefore, there is the potential for sunflower sea star presence within the proposed Project area, even if it is unlikely due to the estimated low population numbers.

The Project is not expected to imperil the continued existence of the proposed sunflower sea star because impacts would not rise to a level that would prevent either their survival or population recovery. Baseline conditions of the sunflower sea star habitat and connectivity would be maintained, as no significant or permanent alterations from Project activities are anticipated to occur. The Project is anticipated to potentially have the following effects on the sunflower sea star:

Entanglement: It is expected that there would be no entanglement risk with mooring lines or subsea cable for sunflower sea stars given their cross section area and presence within the water column. There is the potential for secondary entanglement due to derelict gear if it were to get snagged on the Orbital O2-X and/or mooring lines and impact the seafloor habitat of sunflower sea stars; however, there have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019). It is very unlikely that derelict gear would get snagged on the Orbital O2-X or its infrastructure to present an entanglement concern for the benthic sunflower sea star. Therefore, entanglement impacts on the species are considered discountable.

Collision and Entrainment: Given that the Orbital O2-X would rest on the water's surface and the sunflower sea star inhabits the seafloor (the benthic zone), it is not anticipated that a collision or entrainment could occur. There would be no collision or entrainment risk for sunflower sea stars that may be present within the proposed Project area.

Noise Disturbance: Studies have examined the potential impacts of anthropogenic noise on marine invertebrates (Solé et al. 2023); however, few are insightful (Morley et al. 2014). It is expected that increased noise due to Project-related activities (e.g., Orbital O2-X installation and anchoring and vessel presence) would have a discountable impact on sunflower sea stars that may be present within the proposed Project area.

Displacement: A temporary increase in vessel traffic on the water surface, as necessary for Project-related activities, is not anticipated to have any displacement effect on sunflower sea stars if they are present within the proposed Project area. The sunflower sea star, if present, may be displaced due to the seafloor footprint from anchoring and new subsea cable installation. However, the footprint is expected to be relatively small within Rosario Strait. Since the sunflower sea star is mobile, if any are present within the proposed Project area, they would likely move around these components, as they would a rock. Any displacement effects that occur to the sunflower sea star are not likely to be significant.

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), seafloor footprint, scouring, and seabed sweeping from moorings, as well as habitat creation (e.g., biofouling and/or artificial reef effects) would locally alter the benthic habitat of sunflower sea stars that may occur within the proposed Project area. Benthic effects would be limited to four anchors and the diameter of the power cable between the Orbital O2-X and existing cable landing station on the southern end of Blakely Island.

If any sunflower sea stars in the proposed Project area were to be disturbed by suspended sediment due to Project-related activities, they may not be able to relocate to a more suitable location and resume previous activities with enough time. However, sunflower sea stars are adaptable, can tolerate a range of environmental conditions, and would not be significantly impacted by the minor increase in turbidity that is expected to dissipate quickly due to the strength of the currents and tides of Rosario Strait. Because sunflower sea stars are mobile, they would likely maneuver around the devices installed on the seafloor. Sunflower sea stars may become attracted to the devices due to any artificial reef effects that may occur, particularly if local diversity, prey availability, and biomass and nutrients increase (Garavelli et al. 2024). Habitat disturbance would also occur when all anchoring devices and the subsea cable are removed, particularly if any artificial reefs are established. However, effects are expected to be temporary, and the habitat would recover quickly after the disturbance.

EMF Exposure: EMF emitted from the Project would be low intensity and approach background levels within a few meters from the subsea power cable. While no study has investigated EMF effects on the sunflower sea star, others studying 24-hour exposure of the common starfish (*Asterias rubens*) and other invertebrates to high levels of EMF found no significant differences in physiological stress or behavioral responses (Chapman et al. 2023). It is expected that similar (lack of) responses would occur if any sunflower sea stars were exposed to EMF emitted from the subsea power cable; therefore, EMF effects on sunflower sea stars are discountable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. While artificial light pollution has the potential to alter the behavior of aquatic invertebrate species (e.g., movement, habitat choice, and foraging), the light intensity from the Orbital O2-X device would not significantly alter sunflower sea star behavior in their seafloor habitat. Light intensity from operating vessels present during installation, maintenance, and removal of Orbital O2-X and supporting infrastructure may have the potential to alter sunflower sea star behavior; however, these effects would only be temporary during these types of Project activities and primarily occur during daylight hours. Therefore, it is expected that artificial light would not meaningfully affect the sunflower sea star.

Changes in Oceanographic Systems: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on the sunflower sea star would be negligible.

4.3.2 Critical Habitat Effects Analysis

The potential effects on designated critical habitat for ESA-listed species by project activities are described within this sub-section. The following is not intended as an ESA-listed designated critical habitat effects determination, as consultation with NMFS and USFWS has not yet occurred. The Project is anticipated to potentially affect ESA-listed critical habitats that overlap with the project area in ways described below; however, it is not expected that any potential effects would rise to the level of being significant.

4.3.2.1 Marine Mammals

Killer Whale, Southern Resident DPS

The Project is anticipated to potentially have effects on SRKW designated critical habitat, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for SRKWs.
- Any impacts on water quality (e.g., increased turbidity) would be temporary in nature and localized, and are expected to have insignificant effects on the overall water quality of SRKW critical habitat.

- SRKW presence is very closely correlated to salmon migration patterns throughout the Salish Sea, and these migration patterns are not expected to be significantly altered by Project activities and the Orbital O2-X presence in its proposed location, which is outside of dense SRKW migration areas through the San Juan Islands (Olson et al. 2018).
- The Project is located in an area of less SRKW abundance compared to other areas of the San Juan Islands and is not expected to significantly alter their passage conditions through Rosario Strait.

The following discussion addresses the essential PBFs for SRKW critical habitat and the associated assessment for each element.

1. *“Water quality to support growth and development”*

   Proposed Project area: The proposed Project would create very temporary and localized turbidity plumes that extend into the water column, mainly due to installation of an anchoring system into the seafloor. In the proposed Project area, the seafloor is mainly hard substrate covered by a thin layer of sediment. Given the strength of the currents and tides of Rosario Strait, that resulting turbidity would be temporary, localized, dispersed quickly, and have insignificant impacts on the surrounding aquatic environment. Project activities are not expected to affect the water quality within the proposed Project area with any measurable impact that would adversely affect the growth and development of SRKWs.

2. *“Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth”*

   Proposed Project area: Short-lived increases in turbidity have the potential to affect SRKW’s prey species, which is primarily Chinook salmon, during the short time in which there is an increase in suspended sediment. However, if prey species are in the vicinity of the proposed Project area during installation and removal activities that increase turbidity (e.g., anchoring system), they would most likely relocate to a suitable location and resume their previous activities. SRKW’s presence in Washington State’s inland waters is strongly correlated with Chinook salmon migration, and the proposed Project activities are not expected to alter or affect salmon populations’ migration capabilities, which is already less common in Rosario Strait than other areas of the Salish Sea (Ford et al. 2011; Hauser et al. 2007; Bubac et al. 2021). Vessel and Orbital O2-X device noise, presence on the water surface, or other potential effects are not expected to affect the sufficient quantity, quality, and availability of prey species (such as Chinook salmon) for SRKWs. Therefore, it is anticipated that this PBF may be affected but would not be adversely affected.

3. *“Passage conditions to allow for migration, resting, and foraging”*

   Proposed Project area: The Project would contribute vessel traffic in the proposed Project area offshore Blakely Island on the edge of Rosario Strait during installation, maintenance, and removal activities. Once the Orbital O2-X device is installed, the space taken up by the device and its sweep area have the potential to displace SRKWs; however, this is unlikely to occur and would have negligible impact on SRKWs. Additionally, SRKWs can likely hear noise associated with the installation, maintenance, or removal of the device, and/or device operations, although effects are expected to be minor and not significantly contribute to altering conditions required for their migration, resting, or foraging. Given the low likelihood of displacement and relatively lower abundance of SRKWs in the proposed Project area compared to the rest of the Salish Sea and Rosario Strait (Olson et al. 2018), it is not expected that the passage conditions to allow for SRKW migration, resting, and foraging would be adversely affected. Therefore, it is anticipated that this PBF may be temporarily affected but would not be adversely affected.

4.3.2.2 Fishes

Bocaccio, Puget Sound-Georgia Basin DPS

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound-Georgia Basin DPS of bocaccio, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for bocaccio.
- Pelagic juvenile bocaccio are opportunistic feeders, and their prey species are not expected to be impacted in such a way that their quantity, quality, or availability would meaningfully be affected, or reduce the feeding opportunities for bocaccio.
- Project activities would result in an increase in turbidity; however, any increases are expected to be temporary, localized, disperse and resettle quickly (hours), and have insignificant effects on the water quality of the surrounding marine environment. Dissolved oxygen levels would not be altered.
- A majority of the seafloor under the Orbital O2-X device (where anchoring would be installed) and the cable laying route is comprised of hard substrate with areas covered by a thin layer of sediment, but the location and route have been selected and designed in such a way as to avoid the textured hard substrate where bocaccio may be more likely to be present.

The following discussion addresses the essential PBFs for bocaccio critical habitat and the associated assessment for each element.

1. *"Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities (adults and juveniles)"*

   Proposed Project area: Potential impacts on the benthic marine environment associated with this Project are a temporary increase in localized turbidity due to anchor installation and removal, and laying the 17.8 cm (7 in.) diameter subsea power cable on the seafloor between the Orbital O2-X device and existing landing station (5.3 km [3.3 miles]) on the southern tip of Blakely Island. The temporary turbidity increase is not expected to impact fish species, including bocaccio prey (e.g., fish larvae, copepods, krill, other rockfish, and hake). Therefore, the proposed Project is not expected to meaningfully impact the quantity, quality, and availability of prey species to support the individual growth, survival, reproduction, and feeding opportunities of juvenile and adult bocaccio (Puget Sound-Georgia Basin DPS).

2. *"Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities (adults and juveniles)"*

   Proposed Project area: Potential increases in turbidity associated with the proposed Project would be temporary, localized, and have *an* insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Project activities are not expected to have any impact on the levels of dissolved oxygen in the area. Therefore, the proposed Project is not expected to produce any meaningful adverse effects to the surrounding water quality that would adversely affect the growth, survival, reproduction, and feeding opportunities of juvenile and adult bocaccio.

3. *"The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance (adult life stage only)"*

   Proposed Project area: The proposed Project activities would not adversely impact the types and amount of structure and rugosity, such as rocky bottoms and outcrops, that support feeding opportunities and predator avoidance for adult bocaccio. While the majority of the seafloor where the Orbital O2-X anchoring and subsea power cable would be installed is hard substrate (with some areas having a thin layer of sediment above it), the seafloor has been mapped and shown to be relatively smooth (north end of the Project area). There are areas of textured hard substrate in the south end of the proposed Project area, around outcrops of Black Rock, but the inshore area of Black Rock is smooth and sedimented. The subsea cable laying route would avoid those outcrop and textured hard substrate areas to the maximum extent possible, primarily being laid on relatively smooth substrate. Therefore, it is expected that there would be no effect on this PBF.

Yelloweye Rockfish, Puget Sound-Georgia Basin DPS

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for yelloweye rockfish.
- Larger juvenile and adult yelloweye rockfish are opportunistic feeders and their prey species are not expected to be impacted in such a way that their quantity, quality, or availability would meaningfully reduce the feeding opportunities for yelloweye rockfish.
- Project activities would result in an increase in turbidity; however, any increases are expected to be temporary, localized, disperse and resettle quickly (in minutes to hours), and have an insignificant impact on the water quality of the surrounding marine environment. Dissolved oxygen levels would not be altered.
- A majority of the seafloor under the Orbital O2-X device (where anchoring would be installed) and the cable laying route is comprised of hard substrate with areas covered by a thin layer of sediment, but the location and route have been chosen and designed in such a way as to avoid rugose or textured hard substrate where yelloweye rockfish may be more likely to be present.

The following discussion addresses the essential PBFs for yelloweye rockfish critical habitat and the associated assessment for each element.

1. "*Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities (adults and juveniles)*"

   Proposed Project area: Potential impacts on the benthic marine environment associated with the Project are limited to a temporary increase in localized turbidity due to rock bolt anchor installation and removal at the end of Project life, and laying the 17.8 cm (7 in.) diameter subsea power cable on the seafloor between the Orbital O2-X device and existing landing station (5.3 km [3.3 miles]) on the southern tip of Blakely Island. The temporary turbidity increase is not likely to impact invertebrate and fish species, including yelloweye rockfish prey (e.g., sand lance, gadids, flatfishes, shrimps, crabs, gastropods, and other similar species). Therefore, the proposed Project is not expected to meaningfully impact the quantity, quality, and availability of prey species to support the individual growth, survival, reproduction, and feeding opportunities of juvenile and adult yelloweye rockfish (Puget Sound-Georgia Basin DPS).

2. "*Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities (adults and juveniles)*"

   Proposed Project area: Potential increases in turbidity associated with the proposed Project would be temporary, localized, and have an insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Project activities are not expected to have any impact on the levels of dissolved oxygen in the area. Therefore, the proposed Project is not expected to produce any meaningful effects to the surrounding water quality that would adversely affect supporting the growth, survival, reproduction, and feeding opportunities of juvenile and adult yelloweye rockfish (Puget Sound-Georgia Basin DPS).

3. *"The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance (adults and juveniles)"*

   Proposed Project area: The proposed Project activities would not adversely impact the types and amount of structure and rugosity that support feeding opportunities and predator avoidance, such as high relief and complex rocky habitats, for juvenile and adult yelloweye rockfish. The majority of the seafloor where the Orbital O2-X anchoring and subsea power cable would be installed is hard substrate (with some areas having a thin layer of sediment above it) and has been mapped and shown to be relatively smooth (north end of the proposed Project area). There are areas of textured hard substrate in the south end of the proposed Project area, around outcrops of Black Rock, but the inshore area of Black Rock is smooth and sedimented. The cable laying route would avoid outcrops and textured hard substrate areas to the maximum extent possible, primarily being laid on relatively smooth substrate. Therefore, it is expected that there would be no effect on the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance for adult bocaccio (Puget Sound-Georgia Basin DPS).

Chinook Salmon, Puget Sound ESU

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound ESU of Chinook salmon, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for Puget Sound ESU Chinook salmon.
- Project activities would not occur within any freshwater spawning or rearing sites, migration corridors, or any offshore marine areas for Chinook salmon.
- Project activities would occur within an estuarine (Salish Sea) and nearshore marine area. Turbidity increases would be temporary, localized, and have an insignificant impact on the overall water quality of the surrounding aquatic environment, i.e., salinity conditions, natural cover, and foraging opportunities would not be affected.
- The Orbital O2-X would create a spatial obstruction in areas below the water surface (e.g., the operating turbines, moorings); however, Chinook salmon would be able to avoid these obstructions, and their presence would not impact nearby submerged wood, large rocks and boulders, or foraging opportunities.
- Project activities would not result in any increase in predation of Chinook salmon.

The following discussion addresses specific critical habitat PBFs, cited in the 2005 FR as primary constituent elements (PCEs; *replaced* by the term PBF) essential for conservation of the Chinook salmon Puget Sound ESU, and the associated assessment for each element.

1. *"Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development"*

   Proposed Project area: The proposed Project would not go through any freshwater spawning sites for Chinook salmon; therefore, this PBF would not be affected by the proposed Project activities.

2. *"Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks"*

Proposed Project area: The proposed Project would not go through any freshwater rearing sites for Chinook salmon; therefore, this PBF would not be affected by proposed Project activities.

3. "*Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival*"

Proposed Project area: The proposed Project would not go through any freshwater migration corridors for Chinook salmon; therefore, this PBF would not be affected by proposed Project activities.

4. "*Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation*"

Proposed Project area: The Project is within the Salish Sea, a large estuarine system. Potential increases in turbidity associated with Project activities would be temporary, localized, and have an insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Therefore, temporary turbidity increases are not expected to meaningfully affect water quality, quantity, or salinity conditions in such a way as to adversely impact juvenile and adult physiological transitions of Chinook in the area. Project activities would not affect natural cover, such as submerged and overhanging large wood, large rocks and boulders, or side channels. Survey mapping of the area has confirmed that no aquatic vegetation (e.g., eelgrass or kelp) is present within the proposed Project area. Installation of the Orbital O2-X device, anchoring system, moorings, and subsea power cable on the seafloor is not expected to meaningfully affect the foraging capabilities of juvenile and adult Chinook salmon in support of their growth and maturation.

5. "*Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels*"

Proposed Project area: Increases in localized turbidity due to anchor installation and subsea power cable laying in the nearshore marine areas would be temporary, disperse, and resettle quickly (minutes to hours) due to the strength of Rosario Strait's current and tides, resulting in insignificant impacts on the surrounding marine environment. Therefore, water quality and quantity conditions are not expected to be impacted to such a degree that conditions would be impaired for Chinook salmon to forage in support of their growth and maturation. Project activities would not create conditions of excessive predation of Chinook salmon. Natural cover, such as submerged and overhanging large wood, large rocks and boulders, or side channels, would not be affected by Project activities or the presence of the Orbital O2-X device and supporting infrastructure. Survey mapping of the area has confirmed that no aquatic vegetation (e.g., eelgrass or kelp) is present within the Orbital O2-X area.

6. "*Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation*"

Proposed Project area: No Project activities or components would occur in offshore marine areas; therefore, this PBF would not be affected by proposed Project activities.

4.3.3 Marine Mammal Species Effects Analysis

A summary of the potential Project effects on marine mammal species protected under the MMPA, and their expected responses to each effect, are listed below in **Table 25.** Potential Project effects on marine mammal species protected under the ESA (SRKWs and humpback whales [Central America and Mexico DPSs]) are described in **Section 4.3.1.1.**

Table 25. Summary of Potential Project Effects on MMPA Species

Potential Effect to Marine Mammal Species	Response
Entanglement When a marine animal becomes intertwined with mooring lines or cables (primary), or derelict fishing gear snagged in Project infrastructure (secondary)	• The Project's new subsea cable and mooring lines do not have loose ends or sufficient slack to create an entangling loop that could pose an entanglement risk to mammals. • To date, no entanglements of marine mammals with MRE systems have been observed, and no evidence indicates that such event has occurred (ORJIP Ocean Energy 2022a). • Derelict gear may snag on the Orbital O2-X or its supporting infrastructure and pose an entanglement risk; however, due to the unlikelihood of this occurring within the proposed Project area, effects are considered negligible. • The risk of entanglement due to mooring lines, the new subsea cable, and (potential) derelict gear is considered to be very low to negligible for all marine species, including mammals (Copping and Hemery 2020).
Collision Direct contact between an animal and vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade)	• While there exists a risk of collision between Project vessel(s) and nearby marine mammals, species are expected to avoid or otherwise alter their behavior to avoid collision. • Studies show that the probability of a lethal injury to whales increases with vessel speed, while there is a substantial decrease in lethality as a vessel speed falls below 15 knots (Vanderlaan and Taggart 2007); however, vessel SOPs and BMPs would reduce this risk by operating at much slower speeds (e.g., 1–3 knots). • Maintenance requiring vessel would primarily occur one to two times per year, with the exception of periodic mooring surveys and infrequent (e.g., every five or eight years) major maintenance. During maintenance, vessel(s) would follow BMPs when in proximity of marine mammals. • Substantive evidence suggests that when marine animals can detect operational tidal turbines, they exhibit evasion or avoidance behaviors (Wilson et al. 2007; Pearson et al. 2010; Garavelli et al. 2024) and take measures to prevent being struck by turbine blades (Fraser et al. 2018; Gillespie et al. 2021; Onoufriou et al. 2021). • Past evidence and the sensory capabilities of marine mammals suggest that a collision with a turbine blade would be an extremely rare event, as to date, there have been no detected or recorded instances of direct collision (Copping and Hemery 2020; Copping et al. 2023; Onoufriou et al. 2021; Garavelli et al. 2024). • There would be a low likelihood but moderate impact of collision (if one were to occur), leading to a medium risk level for marine mammals.
Entrainment The unwanted forced passage of marine animals through a water intake or	• No studies that focused on smaller mammals (e.g., harbor porpoises) have shown or indicated marine mammals becoming entrained and suffering injury or death.

Potential Effect to Marine Mammal Species	Response
turbine sweep; i.e., getting sucked into the tidal turbine(s)	• The mechanics of crossflow turbine design means that essentially no suction or entrainment force is created during operations; therefore, although very few studies exist on entrainment risk to marine mammals, it is not expected to occur.
Noise Disturbance Sounds made by human activities that can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean due to vessel operations, installation, operation and maintenance of Orbital O2-X device, and removal	• Vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure (e.g., rock-drilled anchoring), is anticipated have a medium likelihood of generating noise levels causing disturbance with a minor impact on marine mammals; therefore, it is considered to be an overall medium risk. • Increased noise due to the Orbital O2-X powertrain is expected to have a low likelihood of resulting in disturbance effects to nearby marine mammals, with expected minor impacts; therefore, it is considered an overall low risk. • Harbor seals avoid simulated tidal turbine sounds (Hastie et al. 2018), and harbor porpoise click activity has been shown to be reduced compared with baseline levels within a few hundred meters of an active device (Tollit et al. 2019; Coles et al. 2021). • Overall, increased noise levels due to installation, maintenance, and removal of the Orbital O2-X would be temporary and not likely to cause harassment and/or injury of nearby marine mammals. There is the potential for altered behavior (e.g., avoidance); however, this is not expected to cause significant adverse effects to marine mammal species. • Severe potential effects of increased underwater noise (e.g., threshold shift, physiological changes, physical injury, and death) have not been observed for MRE devices (Popper and Hawkins 2018; Popper et al. 2023). • Overall, there is consensus that underwater noise from operational devices within the small-scale MRE developments (one to six devices) does not pose a significant risk to marine mammals (Copping et al. 2019, 2020; ORJIP Ocean Energy 2022b; Polagye and Bassett 2020).
Displacement Mechanisms (including attraction, avoidance, and exclusion) that cause animals to depart from, or not enter into, their preferred or critical habitats, or to move into areas that are new to them	• Large cetaceans may be temporarily displaced during installation, maintenance, and removal activities due to underwater noise (e.g., increased vessel traffic) and physical presence of the Orbital O2-X (including sweep area), as well as have limited maneuverability around the device (Kraus et al. 2019; Hemery et al. 2024). • Small cetaceans are at less risk of displacement due to their maneuverability and improved swimming capabilities (Hemery et al. 2024). In some cases, local cetacean activity has been shown to resume shortly after disturbance due to the cessation of construction or maintenance (Tollit et al. 2019). • Evidence also suggests that habitat displacement caused by single MRE devices occurs at a relatively small scale for pinnipeds (e.g., harbor seals). • The risk of permanent habitat displacement from the Orbital O2-X device is low overall; however, temporary displacement (including avoidance and attraction) is anticipated for nearby marine mammals with a minor (vessel) to negligible (Orbital O2-X device) impact.

Potential Effect to Marine Mammal Species	Response
Habitat Alteration Temporary or permanent physical transformation of benthic or pelagic habitats (e.g., footprint effect, scour, sweep, biofouling, and artificial reef effect)	• An increase in temporary suspended sediment in the water column may cause whales and other mammals to alter their normal movements, but these minor movements would be too small to be meaningfully measured or detected. Mammals would be able to easily swim away from the minor turbidity plume and would not be adversely affected by passing through it. • Alteration of the benthic habitat (e.g., footprint effect, scour, and sweep) is not expected to significantly affect marine mammals within the proposed Project area. There is the potential for an artificial reef effect to cause fish prey to aggregate and attract predator mammals, but the small-scale extent to which this may occur due to the four moorings and anchors for a single MRE device is not expected to meaningfully affect nearby marine mammals. • Effects of habitat alteration of the pelagic environment (e.g., presence of mooring lines) are expected to be the same as those due to displacement: temporary displacement with a negligible impact. Marine mammals are highly mobile and could maneuver around mooring lines in the water column.
EMF Force generated by current flow passing through power cables during operation and can be divided into electric fields and magnetic fields	• EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020). • No interactions with anthropogenic EMF from subsea cables have been recorded for marine mammals, and it is anticipated EMF from the subsea power cable would have no effect on nearby marine mammals.
Artificial Light Anthropogenic sources of light needed for the Project's installation, operation and maintenance, and removal	There is a lack of scientific evidence to determine the level of impact that artificial light may have on nearby marine mammals; therefore, a fully informed impact assessment or risk determination cannot be accurately made.
Changes in Oceanographic Systems Changes in water circulation, wave heights, and current speeds, which in turn can affect sediment transport and water quality, within both nearfield and farfield environments around MRE devices	The scientific literature indicates that changes in oceanographic systems from properly sited small tidal and wave deployments (one to six devices) would be lower than those within the natural variability of the system (Garavelli et al. 2024). Therefore, any changes in oceanographic systems would be not significant enough to cause adverse, or beneficial, effects on nearby marine mammal species.
Notes: BMP = best management practice(s); EMF = electromagnetic field; MMPA = Marine Mammal Protection Act; MRE = marine renewable energy; ORJIP = Offshore Renewables Joint Industry Programme	

4.3.4 Essential Fish Habitat Effects Analysis

"Adverse effect" refers to any impact that reduces the quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR § 600.810).

The effects of the proposed Project are described below. BMPs and mitigation measures would be implemented to reduce or otherwise mitigate potential impacts. The potential Project-related impact stressors on EFH include:

- Habitat Alteration: Benthic and Pelagic
- EMF Exposure

In Washington State, "areas of interest" are HAPC, which encompass all waters and sea bottom in state waters from the 3 NM boundary of the territorial sea shoreward to the MHHW. Therefore, it would be impossible to avoid this type of HAPC. BMPs and mitigation measures would be employed throughout the Project's lifespan to minimize adverse effects to this HAPC.

Other types of HAPC are not present within the proposed Project area. Patchy eelgrass presence has been documented at the new subsea cable landing site (DNR 2025); however, surveys conducted by Tetra Tech, Inc. in October 2024 detected no eelgrass in their MBE data, nor was any observed (**Figure 50**; Appendix C1). Patchy and continuous kelp beds are also present along the Blakely Island coastline (DNR 2025), but survey results indicate that they are not near the new subsea cable landing station or other proposed Project areas (**Figure 50** and **Figure 51**). Because HAPC are not present nor affected by Project activities, they are not further addressed in this DLA.

4.3.4.1 Habitat Alteration

Both benthic and pelagic EFH alteration is expected to occur due to the installation, operation, and removal of the Orbital O2-X device and supporting infrastructure. As described in **Section 4.1.6**, the two main changes for benthic and pelagic EFH would include adverse effects (e.g., increased turbidity, habitat alteration) due to seafloor infrastructure installation and removal, and habitat creation over time (e.g., biofouling and artificial reefs), which could have both positive and negative consequences (Copping and Hemery 2020; Garavelli et al. 2024). As such, the installation, presence, operation, and removal of the Orbital O2-X device and supporting infrastructure would result in some changes to EFH that may differ from natural variability (Garavelli et al. 2024). Relative to the size of the surrounding waters of Rosario Strait and the greater Salish Sea, effects on EFH attributable to the proposed Project activities would occur on a small spatial scale and be minimized by implementing BMPs, mitigation measures, and avoidance of HAPC. These actions would help ensure that effects on EFH for Pacific Coast groundfish, CPS, and Pacific salmon are temporary and minimized.

Benthic EFH Effects

Impacts on benthic EFH include an increase in turbidity due to the installation and removal of Project infrastructure, mooring line and subsea cable sweep, and scour.

Turbidity: Sediment disturbance is expected due to the following: (1) the installation and removal of anchors and subsea power cable on the seafloor; (2) areas of mooring chain and subsea cable contact and sweep along the seafloor; and (3) scouring of sediment around benthic structures. Although a variety of EFH species are found in the marine waters of Rosario Strait where the proposed Project would occur, the likelihood of any species being present during the installation, operation, movement of the Orbital O2-X, mooring chains, subsea cable, and removal phases depends largely on the habitat needs of those species.

1. Installation and Removal of Device Infrastructure

Increases in sediment disturbance within EFH would primarily occur during the installation and removal of anchors and subsea power cable along its proposed length of 5.3 km (3.3 miles) and would be limited to the size of the anchors (58.4 cm [23 in.] diameter) and width of the cable (up to 20 cm [8 in.]). During installation and removal, the elevated turbidity levels are expected to be temporary and localized to the seafloor and nearby water column, and due to the strength of currents and tides within Rosario Strait, suspended sediment is expected to disperse and resettle quickly (minutes to hours) (Hitchcock et al. 1999) and have an insignificant impact on the surrounding EFH and aquatic environment (Taormina et al. 2018). Once installed, and until removal, the rock bolt anchors and subsea power cable would not cause any additional localized turbidity.

The seafloor below the proposed Orbital O2-X device—where the anchors, mooring lines, and subsea power cable would be installed and removed—largely consists of hard substrate with a thin sediment layer (see Section 3.2.3, Bathymetry). The seabed on the northern end of the proposed Project area is relatively smooth with some undulation and a very thin sediment layer. To the south, the overlying sediment layer has been scoured away, and inshore of Black Rock (along the proposed subsea cable route), the seabed is smooth and sedimented. The proposed Project area, including the subsea power cable route, was chosen in part to avoid areas of complex seafloor structure that would otherwise provide essential habitat for EFH species in the area (Pacific Coast groundfish, CPS, and Pacific salmon), which likely reduces the concentration and frequency of species present.

2. Mooring Line Sweep

Throughout the duration of the proposed Project, there is the possibility of mooring chain contact with, and sweep along, the seabed, which is likely to disturb sediment along the seafloor. The mooring chains would have necessary slack to allow for tidal rise and fall, and to form a catenary against lift and shock from wave action (Morrisey et al. 2018). As such, mooring chains for the Orbital O2-X may be dragged repeatedly across the seabed, which can disturb benthic habitat around the mooring anchor, as well as prevent recolonization until the mooring lines are removed. Each mooring line would have two areas in contact with the seabed: (1) where the mooring chain is lifted up and placed back down (i.e., no "sweep"); and (2) where the chain is dragged over the seabed (i.e., "sweep").

The mooring chain would be lifted up off the seabed over a length of 246 m (807 ft) and placed back down in the same location. Remotely operated vehicle footage from other MRE sites has shown a very narrow area of disturbance to the seabed; the width is less than 1 m (3.3 ft), giving an area of less than 246 m^2 (2,648 ft^2). Areas where the mooring chain is dragged over the seabed, rather than lifted up and placed back down would impact an area of approximately 10 m^2 [108 ft^2]), and contact with the seabed would change from slack tide (minimal tension) to rated power (peak tension) (see Section 4.1.6.1, *Seabed Sweeping*).

The seabed substrate exposed to mooring chain contact and sweep is primarily smooth with some undulation, with a likely very thin sediment layer (according to Tetra Tech, Inc. survey) and is not considered to be sensitive habitat even though it is located within EFH for Pacific Coast groundfish, CPS, and Pacific salmon (Appendix C1). Due to the strength of the currents and tides of Rosario Strait, thin sediment layers may continue to cover the sweep area and produce small, localized turbidity plumes. These sediment disturbances would be short-lived and of very low intensity. Turbidity would likely be dispersed, carried away by the currents and tides of Rosario Strait, and settle back to the seafloor and dilute to background levels within minutes to hours of mooring chain movement. As such, turbidity increases due to mooring chain contact with the seafloor is not expected to meaningfully affect the water quality of the surrounding aquatic environment but instead have minimal impacts on EFH and Pacific Coast groundfish, CPS, and Pacific salmon (Taormina et al. 2018).

3. Scour

There is the possibility of increased turbulence and flow velocity changes leading to scour around the Orbital O2-X's bottom structures (e.g., anchors and subsea cable) (Copping and Hemery 2020; Lancaster et al. 2022; Garavelli et al. 2024). If scour were to occur, the resulting footprint would be extremely small relative to Rosario Strait, due to the size of the four rock bolt anchors (58.4 cm [23 in.] diameter, each) and the surface-laid subsea cable (up to 20 cm [8 in.] in diameter).

In previous studies, abundances of invertebrates such as polychaetes, oligochaetes, bivalves, small crustaceans (which can serve as prey for Pacific Coast groundfish, CPS, and Pacific salmon) were shown to be higher closer to artificially installed benthic structures compared to areas without structures (Mendoza and Henkel 2017). However, no meaningful effects on diversity or richness were measured in relation to distance from the structures, nor were meaningful changes in infaunal communities measured, compared to areas without artificial structures (Mendoza and Henkel 2017). Another study around anchors deployed at Oregon State University's PacWave-North test site off Newport, Oregon, showed that median sediment grain size and the macrofaunal organism communities were not meaningfully different than areas outside the test site (Henkel 2016). Any seafloor changes that occurred were very localized and did not appear to result in ecological changes, i.e., there were few changes in species abundance and no change in species composition (Henkel 2016).

While scour could potentially affect benthic EFH, including prey species for EFH species in the proposed Project area, any effects would likely be minor and limited to the seafloor area directly adjacent to the Orbital O2-X device and infrastructure, such as has been shown in other tidal turbine locations (e.g., SeaGen in Strangford Lough, Northern Ireland) (Kregting et al. 2016; O'Carroll et al. 2017; Copping and Hemery 2020). It is anticipated that any scour effects to sediment and benthic organisms would not scale up to a point that would meaningfully affect the quality and quantity of EFH or the nearby surrounding benthic environment; therefore, scour is not expected to meaningfully negatively affect EFH for Pacific Coast groundfish, CPS, or Pacific salmon.

Benthic and Pelagic EFH Effects

Impacts on benthic and pelagic EFH include habitat alteration, biofouling, and artificial reef effects.

Habitat Alteration

A temporary reduction in available EFH would occur due to the inaccessibility of portions of seafloor habitat directly underneath the Orbital O2-X device and infrastructure while installed on/in the substrate (Hemery 2020). Resulting impacts would be limited to the footprint of the four anchors, area of mooring chain contact and sweep on the seafloor, the subsea power cable on the seafloor, and any benthic areas subject to turbulence from the proposed Project. Once installed, benthic organisms and Pacific Coast groundfish, and likely other EFH species, would be unable to use these immediate areas of their benthic habitat until the end of the Project's life (up to 10 years). Upon device removal, any artificial reef habitat created by colonization on the structures would be lost (Miller et al. 2013).

The temporary exclusion from some benthic habitat due to anchors and subsea power cables in the MRE industry is widely acknowledged by decision-makers (Hemery 2020) and has been factored into the proposed Project's design and siting to avoid or minimize any adverse effects to seafloor habitat. Mooring chain contact with the seafloor has the potential to affect a much larger benthic area than the four anchors and subsea power cable (see *'2. Mooring Line Sweep'* within the *Turbidity* subsection above). While the surface area of contact between the mooring line chains and seafloor would cover a relatively large area (246 m^2 [2,648 ft^2] per mooring line or 984 m^2 [10,592 ft^2] total), similar to the subsea power cable, much of the affected area would be narrow (a width of approximately 1 m [3.3 ft] or less). The total area susceptible to mooring chain drag, which would also result in a loss of benthic habitat, is estimated to be approximately 10 m^2 (108 ft^2) per mooring chain, or 40 m^2 (430 ft^2) total.

Surveys conducted by Tetra Tech, Inc. in October 2024 confirmed that no sensitive habitats or HAPC (e.g., eelgrass, canopy kelp, or rocky reefs) are present in areas where the Orbital O2-X, anchoring, mooring line, and subsea cable installation would occur (Appendix C1). Additionally, the anchoring and cable route avoids areas of complex hard rocky substrate, which could otherwise provide sensitive habitat for sheltering and foraging opportunities for different EFH species. While installation of the proposed Project infrastructure would affect the benthic habitat for EFH species, these effects would be temporary and minimized as a result of the design choices made to avoid sensitive habitats and HAPC, as well as BMPs and mitigation measures that would be implemented.

The maximum depth of the Orbital O2-X platform below the water would be 2.4 m (7.9 ft) for the length of its hull (85 m [279 ft]), spatially displacing an area of approximately 204 m^2 (2,196 ft^2). Each rotor would have two turbine blades for a total diameter of 30 m (98 ft); i.e., 60 m (196.7 ft) total for two rotors. From the water surface, the uppermost part of the rotor tip would be 3 m (9.8 ft) deep and the bottom tip (deepest part while rotors extended) 33 m (108 ft) deep. The maximum rotor sweep area for each rotor would be 706 m^2 (7,600 ft^2) (i.e., 1,412 m^2 [15,199 ft^2] total). The mooring line system would consist of four approximately 95 mm (3.7 in.) and 115 mm (4.5 in.) diameter studlink mooring chains, with synthetic or steel rope potentially limited to the upper section (approximately 170 mm [6.7 in.] in diameter). The four mooring lines and anchoring components would cover a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft) or 134,400 m^2 (~1,446,700 ft^2).

Pelagic-dwelling fish (e.g., CPS) and other highly mobile organisms would likely avoid the proposed Project area if disturbed, and return upon completion of installation, removal, and maintenance activities. While the mooring spread of the four lines consists of a much larger area than the mooring chains themselves, mobile organisms, such as most Pacific Coast groundfish, CPS, and Pacific salmon species, are anticipated to easily maneuver around the lines and/or relocate to avoid their presence in the water column (Hasselman et al. 2023; Hemery et al. 2024; Garavelli et al. 2024). However, tidal turbines may also act as a fish aggregating device (Fraser et al. 2018), with studies showing that fish begin to occupy deeper areas at night in areas of tidal turbines (Williamson et al. 2019; da Silva et al. 2022).

Any spatial effects that do result from the Orbital O2-X device and Project infrastructure would be temporary (up to 10 years maximum, the allowable pilot project lifespan), and the water column would be fully unobstructed again after Orbital O2-X decommissioning and removal, i.e., no Pacific Coast groundfish, CPS, or Pacific salmon species would be permanently displaced from their EFH. The presence of the Orbital O2-X, including its two turbines and raising/lowering legs for maintenance, and four narrow mooring lines and subsea cable in the proposed Project area is not expected to result in significant direct effects to pelagic EFH or the pelagic community, nor is it expected to meaningfully remove available habitat from Pacific Coast groundfish, CPS, or Pacific salmon. With the implementation of BMPs and other mitigation measures, and the temporary nature of the proposed Project, there would be no permanent reduction in the quality and/or quantity of pelagic EFH for Pacific Coast groundfish, CPS, or Pacific salmon.

Biofouling and Artificial Reef Effects

Over time, the seafloor infrastructure and Orbital O2-X hull may be colonized by benthic marine life including biofouling organisms and non-native organisms, which may impact local biodiversity and attract foraging Pacific Coast groundfish, CPS, and Pacific salmon (Garavelli et al. 2024). Biofouling has been reported at tidal device sites in the Orkney Islands, Scotland; however, no non-native species were detected (Nall et al. 2022; Want et al. 2023). Biofouling would likely occur to some extent on Project infrastructure within EFH, although it is not likely to significantly affect the water quality of EFH as the Project anchoring, mooring connections, and cable have a relatively small footprint. To minimize potential biofouling impacts, antifouling paints would be used, as well as regular inspections of coatings during regular maintenance intervals to ensure that they remain intact.

Artificial reefs have also been created around MRE devices, providing beneficial effects for the surrounding marine environment and species (Langhamer et al. 2009; Broadhurst and Orme 2014; Langhamer 2016). By increasing the complexity of the seafloor and surrounding water, the Orbital O2-X device and supporting infrastructure could provide shelter or flow refuge for fish species, increase the local organismal community diversity, abundance, and size (Copping and Hemery 2020), and aggregate EFH fish species that may not occur without device introduction (Causon and Gill 2018; Dannheim et al. 2019). Negative artificial reef effects on EFH are also possible, such as facilitating the introduction of non-native species or causing significant shifts in local communities (Dannheim et al. 2019; Loxton et al. 2017; Copping and Hemery 2020); however, studies have indicated that near artificial structures there has not been a significant increase in non-native species attraction and composition (Nall et al. 2022; Want et al. 2023).

Artificial reefs may also result in nutrient enrichment around the Orbital O2-X device and seafloor infrastructure, due to the accumulation of organic matter and decaying shells from increased litterfalls from biofouling and marine organisms attracted to the device (Wilding 2014; Garavelli et al. 2024). Increased benthic biomass could benefit higher trophic levels, up to apex predators, thereby potentially intensifying the artificial reef effect (Raoux et al. 2017); however, this is less likely to occur near tidal turbines due to the strength of hydrodynamic forces preventing the local accumulation of organic matter (Garavelli et al. 2024).

EFH for Pacific Coast groundfish, CPS, and Pacific salmon is not expected to be impacted by artificial reef effects. There may, however, be positive outcomes, e.g., EFH species may be attracted to the proposed Project area if increased foraging opportunities are created. Based on past studies, artificial reefs can attract mobile marine species while foraging for food and/or shelter, as well as increase local species diversity, richness, and abundance, and colonization by sessile and mobile invertebrates and fish (Langhamer 2012; Taormina et al. 2018; Bender et al. 2020; Garavelli et al. 2024). Species including Pacific Coast groundfish, CPS, and Pacific salmon may be attracted to the proposed Project area for foraging and sheltering opportunities created by the presence of the Orbital O2-X and supporting infrastructure. Some of these artificial reef effects have only been hypothesized and modeled and could take up to decades to develop (the proposed Project would be temporary, up to 10 years). It is unlikely that any significant EFH-altering artificial reef effects would occur (Raoux et al. 2017; Copping and Hemery 2020).

4.3.4.2 EMF Exposure

EMF from the proposed new subsea power cable is a general concern for potentially sensitive species such as elasmobranchs, fishes, marine mammals, sea turtles, and invertebrates (Normandeau et al. 2011; Snyder et al. 2019). Although elevated EMF may be detectable by benthic species, such as Pacific Coast groundfish near the power cable location, the impacts decrease quickly with distance from the cable. Magnetic field levels diminish with the inverse of the distance from the cable and are proportional to the current carried by the cable. For example, the magnetic fields generated from a high voltage (150 kV direct current [DC]) submarine power transmission cable at the sediment surface ranged from 50 μT at the cable surface, dropping off rapidly to approximately 35 μT at 1 m (3.3 ft) from the cable (Copping et al. 2016). For context, the Earth's background magnetic field ranges from 30 to 60 μT (Copping et al. 2016). The proposed new subsea power cable would have an operating voltage of 12.47 kV (dependent on local infrastructure, but considerably lower than 150 kV DC), 60 Hz to match the local grid.

Pacific CPS finfish—generally occurring and harvested from above the thermocline in the upper mixed layer of the ocean—are not associated with the seafloor where the power cable would be located. While other studies have considered potential impacts on pelagic species, such as impairment of navigation or homing, changes in feeding success, mate finding, and predator evasion, these effects are generally considered negligible (Snyder et al. 2019). CPS are not expected to be exposed to EMF emitted from the Project's subsea power cable and, if so, would only be for fleeting periods of time as they swim by. EFH for krill species (*Euphausia pacifica* and *Thysanoessa spinifera*) extends from the shoreline to the 1,830 m (6,000 ft) isobath to a depth of 400 m (1,312 ft); however, there is currently no evidence to suggest that EMF would affect krill species. Given that EMF is expected to drop off dramatically within a short distance from the subsea power cable (less than 1 m [3.3 ft]), it is not likely that CPS EFH would be meaningfully altered due to EMF.

Pacific Coast groundfish species, which include over 90 commercially important species such as rockfish, flatfish, roundfish, sharks, and skates inhabiting coastal seafloor habitats, are most likely to encounter EMF produced by subsea power cables (Snyder et al. 2019). Although groundfish species would be closer to undersea power cables and potentially be exposed for longer periods of time, the rapid environmental decay of EMF minimizes potential impacts (Synder et al. 2019). Other species, such as Atlantic cod (*Gadus morhua*) larvae, have been shown to have reduced swimming activity, but no change in spatial distribution, when exposed short-term to artificially intense DC B-fields (22–156 μT) (Cresci et al. 2023). MRE arrays may attract benthic sharks, skates, and rays because of EMF generated by multiple subsea power cables (Maxwell et al. 2022; Synder et al. 2019), but a single device with a subsea power cable, such as the Orbital O2-X, is not expected to emit EMF strong enough to attract these types of groundfish. EMF emitted from the subsea power cable would have negligible consequences for Pacific Coast groundfish and EFH, even if they are more likely to be exposed than pelagic species.

Modeling results suggest that magnetic fields emitted by alternating current cables might be detectable by spawning and migrating salmon, but the fish would need to be within several meters of the cable. Additionally, their pelagic behavior keeps them away from the strongest fields (Normandeau et al. 2011). There is evidence that salmon species rely on multiple senses, including sight and smell, during migration; therefore, they may be able to compensate for a localized disturbance in the geomagnetic signal (Normandeau et al. 2011). Other studies have shown that the migration success of Chinook salmon was largely unchanged after installing a 200 kV high-voltage DC subsea cable (much stronger than the 12.47 kV cable for the proposed Project), although transit times through the cable area were slightly reduced (Wyman et al. 2018). As such, it is very unlikely that any potential EMF effects would meaningfully affect the quality or quantity of Pacific salmon EFH, including their prey and other required ecosystem components.

The current evidence suggests that the ecological impacts of EMF emitted from power cables of single MRE devices are likely limited, and marine animals living in the vicinity of devices and export cables are not likely to be harmed (Copping and Hemery 2020). Given the relatively small scale of the proposed Project, EMF would be minimal and localized to the immediate vicinity of the 5.3 km (3.3 miles) long cable, with negligible effects on any Pacific Coast groundfish, CPS, or Pacific salmon that may be present within the proposed Project area. These EMF are not likely to result in the harmful alteration, disruption, or destruction of EFH. While there may be measurable effects from EMF on a small number of individuals (e.g., behavior, physiology, and development), these effects are not evident at EMF intensities associated with current small-scale MREs, such as the Orbital O2-X (e.g., most bony fishes have not evolved to detect EMF at 60 Hz) (Snyder et al. 2019; Copping and Hemery 2020; Copping et al. 2021; Gill and Desender 2020; Garavelli et al. 2024). EMF emitted by the proposed Project subsea power cable would likely be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020). Therefore, they are not expected to have significant adverse effects on EFH for Pacific Coast groundfish, CPS, or Pacific salmon, or their prey species.

4.3.4.3 Effects Not Considered

Hazardous material contamination was assessed but is not considered a Project-related stressor because it is not reasonably likely to occur and/or adversely affect EFH, EFH species, or prey. As with any motorized vessel at sea, there is a potential for accidental oil or fuel releases to occur during operations, which could introduce pollutants into marine water that may affect fish species. Sources of hazardous materials include petroleum-based fuel and oil used in vessel operations for installation, maintenance, and removal of the Orbital O2-X device and supporting infrastructure, and anti-fouling coating, oils, chemicals, and lubricants from the Orbital O2-X device during operations.

To mitigate for potential contamination effects due to hazardous materials, vessels would abide by SOPs and have proper spill response materials and follow protocols for fuel spills or leaks, e.g., should a fuel or oil spill occur from a vessel, it would be cleaned immediately using onboard spill kits. To mitigate potential effects from hazardous materials associated with the Orbital O2-X device, only industry-accepted anti-fouling coatings and biodegradable materials, or other acceptable options, would be used. An Emergency Response and Recovery Plan would be developed with spill prevention, response actions, and control protocols, as well as provisions for recording types and amounts of hazardous fluids contained in Project components.

4.3.5 Avian Species Effects Analysis

A summary of the potential Project effects to avian species, and their expected responses to each effect, are summarized in **Table 26**.

Table 26. Summary of Potential Project Effects to Avian Species

Potential Effect to Avian Species	Response
Entanglement When a marine animal becomes intertwined with mooring lines or cables (primary), or derelict fishing gear snagged in Project infrastructure (secondary)	• No entanglement is expected to occur between avian species (including diving seabirds) and mooring lines and subsea power cable. • Derelict fishing gear has the potential to snag on turbine structures and pose a secondary entanglement risk for foraging diving seabirds; however, the effects are expected to be negligible. If derelict fishing gear is found to be snagged on the Orbital O2-X device and/or supporting infrastructure (e.g., mooring lines), it would be promptly removed.
Collision Direct contact between an animal and vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade)	• No physical contact between a tidal turbine blade and seabird has been observed in previous studies (Garavelli et al. 2024). • It is expected that there would be a low likelihood but would be a moderate impact of collision with Orbital O2-X turbine blade(s), leading to a medium risk level for avian species. Collision risk is a concern for seabirds in locations where tidal turbines overlap with diving and foraging areas; however, much less is known about the risk concerning diving seabirds compared to other types of marine species (Couto et al. 2022). • No other studies have indicated that collisions between avian species and single tidal turbine devices and/or parts have occurred, and it is not expected that the Orbital O2-X would present a significant risk to seabirds
Entrainment The unwanted forced passage of marine animals through a water intake or turbine sweep,	• Given the relatively low blade speed and expected high unlikelihood that birds (including diving seabirds) could get sucked into the Orbital O2-X turbine blades, no entrainment risk to avian species is expected.

Potential Effect to Avian Species	Response
i.e., getting sucked into the tidal turbine(s)	
Noise Disturbance Sounds made by human activities that can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean due to vessel operations, installation, operation and maintenance of Orbital O2-X device, and removal	• For a single MRE device such as the Orbital O2-X, the importance of noise on seabirds is considered low, and the available evidence base remains poor (ORJIP Ocean Energy 2022b). • Noise from installation and removal activities (e.g., rock bolt anchors) would be temporary and primarily occur underwater. • There is the potential for an increase in aerial noise due to Project construction activities (e.g., vessel presence); however, these noise levels are not expected to have a significant effect on avian species. While operating, the device is not expected to produce aerial noise levels that would affect avian species. • It is expected that noise created by the Orbital O2-X device turbine operations would be above ambient noise levels, but not at a level that would negatively affect avian species, including diving seabirds, present in the proposed Project area. Any avian species present during installation and removal activities would likely forage elsewhere nearby and return to resume their regular behavior once construction activities cease.
Displacement Mechanisms (including attraction, avoidance, and exclusion) that cause animals to depart from, or not enter into, their preferred or critical habitats, or to move into areas that are new to them	• Displacement of avian species due to vessel activity required during all Project phases (due to presence and noise) is expected to have minor, or insignificant, temporary effects on avian species near Project activities. • Any avian species present during installation, maintenance, and removal activities would likely forage elsewhere nearby, and return to resume their regular behavior once construction activities cease. • Once installed and operating, the Orbital O2-X has the potential to displace, attract, and result in avoidance of the proposed Project area; however, the likelihood is considered low and the potential effects negligible.
Habitat Alteration Temporary or permanent physical transformation of benthic or pelagic habitats (e.g., footprint effect, scour, sweep, biofouling, and artificial reef effect)	• Habitat alteration effects are expected to largely be confined to the benthic habitat, and to a lesser degree in the water column, neither of which are expected to significantly affect avian species. • MRE devices may potentially attract mobile organisms and act as artificial reefs or fish aggregating devices (Dannheim et al. 2019; Langhamer 2016), which would have the potential to increase seabird foraging in the area. The extent of this effect is unknown but is expected to not significantly negatively impact avian species near or in the proposed Project area.
EMF Force generated by current flow passing through power cables during operation and can be divided into electric fields and magnetic fields	• Given the location of the subsea power cable on the seafloor, no impacts on avian species due to EMF are expected.

Potential Effect to Avian Species	Response
Artificial Light Anthropogenic sources of light needed for the Project's installation, operation and maintenance, and removal	• Artificial light is expected to increase due to vessel lighting and lighting on the Orbital O2-X device. The majority of Project work would occur during daytime hours, thereby minimizing and making temporary the increased use of artificial light via vessel presence. • The Orbital O2-X device would have two amber lights that display synchronized flashing once every 3 s, situated at least 3 m (10 ft) above the waterline. • There is the potential for avian species to be attracted to, or become disoriented, due to the introduction of artificial light in the proposed Project area; however, the effects due to vessel lighting are expected to be discountable due to their temporary nature and minimization measures (e.g., work during daylight hours). Avian species may become attracted to the Orbital O2-X lighting, but this is not expected to result in significant adverse effects to avian species.
Changes in Oceanographic Systems Changes in water circulation, wave heights, and current speeds, which in turn can affect sediment transport and water quality, within both nearfield and farfield environments around MRE devices	• The scientific literature suggests that changes in oceanographic systems from properly sited tidal and wave developments will be lower than those within the natural variability within the system, allowing the risk posed to the marine environment to be retired for a small number of devices (e.g., one to six) (Garavelli et al. 2024). • No significant adverse effects are expected on avian species due to any changes in oceanographic systems that may occur due to the installation and operation of the Orbital O2-X device.
Notes: EMF = electromagnetic field; f = feet; m = meters; MRE = marine renewable energy	

4.3.6 Washington PHS Effects Analysis

Due to their habitat location on the seafloor, pandalid shrimp (family *Pandalidae*) and the Washington State (not federally ESA-listed) endangered pinto abalone (*Haliotis kamtschatkana*) could potentially be impacted by the new subsea cable, Orbital O2-X anchors, and mooring lines. Potential effects include the following:

- Secondary entanglement in derelict gear that may get caught in mooring lines (**Section 4.1.1.2**).
- Noise disturbance during all Project phases (**Section 4.1.4**).
- Displacement of habitat due to new subsea cable installation (**Section 4.1.5**).
- Temporary increase in turbidity due to the new subsea cable and anchors installation (**Section 4.1.6**).
- Habitat alteration due to mooring anchors, mooring lines footprints, and sweep (**Section 4.1.6**).
- EMF exposure due to new subsea cable installation (**Section 4.1.7**).

During Project activities, Townsend's big-eared bats (*Corynorhinus townsendii*) (Washington State candidate listing species) could potentially fly over the proposed Project area to forage for prey through their use of echolocation (WDFW 2024s). The following are potential effects to this species:

- Collision with the Orbital O2-X above-water components (**Section 4.1.2.2**).

- Noise disturbance during all Project phases (**Section 4.1.4**).
- Displacement due to the Orbital O2-X footprint (**Section 4.1.5**).
- Artificial light exposure during all Project phases (**Section 4.1.8**).

No potential effects to PHS estuarine and marine wetlands along the shore of Blakely Island are expected. The new subsea cable would be threaded through the existing conduit to connect to OPALCO's power grid.

4.3.7 Invasive Species Effects Analysis

The proposed Project would not have the potential to impact the transfer of invasive species in Washington State. All vessels proposed for use in Project activities would be property of OPALCO or local subcontracting companies, so no aquatic invasive species prevention permit from WDFW would be needed since vessels would be registered in Washington State (WDFW 2024o).

All vessels used for Project activities would also follow WDFW-recommended BMPs to "Clean/Drain/Dry" all vessels and gear (e.g., paddles, waders, shoes, life vests, nets, buckets, and trailers) (WDFW 2024o). If vessel and gear operators become aware of potential exposure, they would deploy decontamination methods to remove all aquatic invasive species from their vessel(s) and gear.

The Orbital O2-X device and all Project components would be delivered in new condition and not having been used in outdoor projects prior. Therefore, they pose no risk of delivering new invasive species into Washington State.

The Project team would adhere to law (RCW 77.135.040) and would not possess, transport, or traffic prohibited invasive species or release non-native species into state waters through intentional or unintentional means (WDFW 2024o).

4.4 Air Quality

The proposed Project could impact air quality during the following activities:

- Increased vessel traffic to and from the Project area.

A single multi-cat vessel would tow the Orbital O2-X to the proposed Project area, for anchor and mooring installations, and for any surveys or geotechnical investigations, as needed. Multi-cat vessels are relatively small but powerful workboat tugs that have a large deck area, high-capacity hydraulic cranes, and large winches. These vessels typically use diesel fuel, with the exhaust consisting of a mixture of gases and particulates (i.e., carbon, ash, metallic abrasion particles, sulfates, and silicates) produced from fuel oil combustion (OSHA 2013).

It is anticipated that all marine operations would be undertaken during periods of weakest tidal stream within neap tidal cycles, targeting daylight hours and favorable weather. It is expected to amount to a period of a maximum of 10 working days per month during construction and installation, notwithstanding weather limitation.

During certain operations, particularly during moored maintenance operations where vessels may not be able to respond to an incident in a timely manner, an additional vessel such as a rigid-hulled inflatable boat (RHIB) or similar class of vessel would be employed as a safety vessel and to transfer crew. These vessels are commonly 4 to 9 m (13 to 29 ft) long and typically use diesel fuel. Infrequent maintenance of the Orbital O2-X is expected on a once per month basis during the first year and likely less frequent over time.

As a renewable energy device powered by tidal energy, the Orbital O2-X would not produce any greenhouse gas (GHG) emissions or other air pollution (Shetty and Priyam 2022).

Overall, the impacts on air quality from increased vessel presence associated with the proposed Project would be low. Vessels used for installation and operational maintenance would emit typical particulate matter and gases such as carbon dioxide, sulfur oxides, and nitrogen oxides. These emissions would have a localized effect on the atmosphere but are not considered significant in comparison to usual vessel traffic in the region. In addition, there would be no long-term impact on air quality due to the limited number of working days per month that the multi-cat vessel would operate and the infrequent expected use of a RHIB.

4.5 Terrestrial Resources

The Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island. The only terrestrial portion of the Project would be an existing 46 cm (18 in.) conduit on southwest Blakely Island, which would be used as an interconnection between the new turbine and OPALCO's grid. This interconnection would connect to an existing substation on Blakely Island where the energy would then be transmitted, via OPALCO's 69 kV transmission system, to the surrounding islands along existing subsea power cables. No terrestrial resources (e.g., wetlands or species) would be directly impacted by Project activities.

5. Human Environmental Analysis

5.1 Recreation, Land Use, and Ocean Use

5.1.1 Recreation

Common recreational activities in the region, like SCUBA, freediving, kayaking, boating, and camping, would not be greatly impacted by the proposed Project due to its location on the Rosario Strait where currents are strong and less desirable for recreating. While hunting is permitted on Blakely Island at times, it would not be impacted by the proposed Project. No public camping is permitted on Blakely Island, and the more popular SCUBA spots are east across Rosario Strait near Strawberry Island. While kayakers and boaters may transit the region occasionally, their routes can be easily navigated around the proposed Project area as they travel to their desired destinations.

The Project is not expected to have any significant negative effects on recreation or land use.

5.1.2 Fisheries

Recreational, Tribal, and commercial fisheries would be impacted by the temporary presence of Project installation and removal equipment, as well as the presence of Project components. The location of the Orbital O2-X device would impede fishing in Marine Area 7 of the San Juan Islands due to its location in the water. Once the Project activities are finalized in coordination with relevant agencies, the complete impact on fishing can be determined.

One or two times per year, the OPALCO team would visit the proposed Project area and drop cameras to investigate mooring lines and remove derelict gear from the mooring system, if necessary.

Recreational shellfish harvest would also be limited in the proposed Project area. While the beaches on the east side of Blakely Island where shellfish harvest is permitted would be unaffected, off-beach areas where crabbing and shrimping areas could be impacted. Once the Project location is finalized in coordination with relevant agencies, the impacts on recreational shellfish harvest can be determined.

Six types of commercial fisheries in the San Juan Islands could be affected by the proposed Project: Dungeness crab, Puget Sound salmon, Puget Sound smelt, sea urchin, sea cucumber, scallop, and squid fisheries. Due to the small size of the area relative to Marine Area 7 and its strong currents, it is not expected that the ability of commercial fishing vessels to pass through the area would be significantly impacted, nor would it greatly impact their harvest quantities.

5.1.3 Vessel Traffic

The proposed Project area is outside of vessel traffic and shipping lanes. Shipping lanes are to the east of the proposed Project area, and scheduled WSDOT WSF pass to the south. In rough weather, WSDOT WSF may use an alternate route that passes through Rosario Strait; however, the ferries remain in the vessel traffic lanes east of the proposed Project area.

Due to its proximity to the shoreline, the proposed Project would not change or impact vessel transit lanes. The only impact of vessels on the proposed Project would be their wake.

5.1.4 Marine Protected Areas

Since the San Juan County/Cypress Island Marine Biological Preserve (SCBP) shares a border with San Juan County, the entire proposed Project area on the east side of Blakely Island is within the SCBP Marine Protected Area (MPA).

The SCBP protects ecological and cultural resources, and could be affected by the following Project activities: an increase in turbidity during installation of the four anchors, the new subsea cable, and mooring line and umbilical sweep (**Section 4.1.6**); an increase in artificial light due to navigation lights on the Orbital O2-X or associated vessels (**Section 4.1.8**); and acoustic disturbance due to increased vessel traffic to the area and the turbine operations (**Section 4.1.4**). Additionally, local species may be displaced from habitat due to the presence of the turbine (**Section 4.1.5**). No change is expected in oceanography, such as currents and sediment distribution, due to the small scale of the proposed Project (**Section 4.1.9**).

Due to the effects of these Project activities, the proposed Project could impact the species, habitats, and natural resources in the SCBP. Collaboration with local agencies and the University of Washington Friday Harbor Laboratories would occur to ensure that BMPs to reduce negative effects would be adhered to for the duration of the proposed Project.

See **Section 5.2** for more information on potential Project effects on the cultural resources of the SCBP.

5.2 Aesthetic Resources

5.2.1 Visual Aesthetic

The proposed Project would impact the aesthetic environment due to the:

- Footprint of the Orbital O2-X.
- Increase in vessel traffic to and from the Project area.

The Orbital O2-X would sit at the surface of the water, so there are potential impacts on the aesthetic viewshed. The body portion of the Orbital O2-X would remain 1.5 m (5 ft) above the waterline during operations and 2.3 m (7.5 ft) below the waterline, leaving the main component visible to those passing by (**Figure 79**). The legs of the Orbital O2-X would sit below the water surface up to 27.4 m (90 ft) maximum depth when the Project is operational and would only be visible from the surface when the legs are raised for maintenance. The subsea components, including the four mooring lines, four anchors, and the new subsea cable, would be out of sight.

Figure 79. Orbital O2 with Wings Up during Orkney Islands, Scotland Deployment

The closest road to the Project area on Blakely Island is an unnamed road that runs east from Spencer Road, although it does not reach the edge of the island, so it is unlikely that the Orbital O2-X would be frequently viewed by island residents. No roads on Blakely Island are expected to offer views of the deployed Project. Surrounding vegetation would not be affected during site preparation and installation activities.

Depending on the weather, WSF passengers may be able to see the body of the Orbital O2-X from the ferry vessel, and its amber flashing safety lights, as it passes to the south of Blakely Island throughout the day. Other visible components of the Project (e.g., OPALCO conduit) have previously been installed and would not be modified as part of the proposed Project.

The proposed installation of the Orbital O2-X to this area would slightly increase the presence of vessel traffic during the installation, monitoring, maintenance, and removal of the turbine, although it would not be frequent. After the installation and commissioning period, a singular vessel would visit the Project area one or two times per year for maintenance, inspections, and monitoring (Table 8). One multi-cat vessel and one barge would be present during the installation and removal periods. The Orbital O2-X would be installed using a barge, and subsequent routine visits would occur via a 25 m (82 ft) vessel.

5.2.2 Acoustic Aesthetic

The addition of the Orbital O2-X to the proposed Project area could add new noise to the acoustic environment such as humming from generators and from the spinning turbines. The dB and frequency of the noise coming from the turbine has yet to be quantified, but research from prior turbine deployments estimates the noise levels to be between 50 Hz and 100 Hz, or 30–40 dB at 100 m (328 ft) away (Risch et al. 2020, 2023). Since humans would remain generally far from the proposed Project area, they would less likely be impacted by the change in acoustic aesthetic.

For information about acoustic impacts on the natural environment, see Section 4.1.4.

5.2.3 Light Aesthetic

The installation of the Orbital O2-X would increase the amount of artificial light in the area due to the 24-hour safety lighting that would make the proposed Project area visible to oncoming marine vessels or for repairs. The Orbital O2-X would have two amber lights with synchronized flashing once every 3 s, mounted a minimum of 3 m (9.8 ft) above the waterline. The amber lights would have a nominal visible range of 3 NM. These lights, although visible at a distance, would have a minimal impact on the overall light emitted from the area since the Orbital O2-X turbine and proposed Project area are relatively small compared to the size of Rosario Strait and the greater San Juan Islands.

Additionally, vessel traffic during the installation, monitoring, maintenance, and removal of the Orbital O2-X may have lights. This addition of extra light would be temporary, especially as most installation procedures would take place during daylight hours. It is expected that there would be 1-2 vessel visits per year to the proposed Project area for routine maintenance (Table 8).

There are currently two additional marine lights near the proposed Project area. One is a warning float located 280 m (918.6 ft) southeast of the proposed Orbital O2-X location and flashes a green light every 2.5 s and is bright enough to be seen from 4 NM (NOAA 2024c). The other light is farther south, about 2,500 m (8,200 ft) away, and flashes a green light every 4 s, and can also be seen 4 NM away (NOAA 2024c). These lights mark a shallow water area and a group of small islands to warn vessel operators.

5.3 Tribal and Cultural Resources

5.3.1 Tribal Resources

The analysis of effects on Tribal resources, including Tribal treaty fishing rights, differs compared to the impact analysis for other natural and cultural resources. Natural resources are analyzed elsewhere in Volume 2 and associated reports to determine if the project would have significant adverse effects from a non-Tribal perspective, and whether or not those could be mitigated. Initial feedback received from many of the Tribal Nations demonstrate that natural and cultural resources are highly interconnected. The Tribal Nations would have an opportunity to comment and provide feedback on the monitoring plans proposed elsewhere in this application as part of avoidance, minimization, and mitigation for potential impacts to natural resources.

OPALCO would continue to collaborate with the Tribal Nations to better understand the potential effects, and seek avoidance, minimization, or mitigation (where/if possible). It is important to engage with Tribal Nations to understand these important areas, how they are used, and how the installation, operations, maintenance, and decommissioning activities of a project could affect the rights that are guaranteed under treaties and federal laws, as well as the requirements set forth by other federal laws and guidelines for identifying and assessing effects on Tribal resources and cultural resources.

Effects are possible if Tribal resources are permanently removed or altered, or if access to resources is temporarily or permanently limited during construction, operation, or maintenance. Potential sources of effects include installation, contamination, ground-disturbing effects; changes in setting; temporary and/or permanent exposure to noise or vibration, and general lack of access to U&A treaty areas for hunting, fishing, and/or gathering.

The analysis of effects on Tribal resources considered the following:

- Construction and operation impacts on plant and animal species used by Tribal members.
- Loss of, or modifications to, habitats of species used by Tribal members.
- Indirect effects on species and habitats used by Tribal members, including fragmentation of habitats and impediments to migration.
- Loss of access to a traditional hunting, fishing, or gathering area, or to an area where other traditional practices occur.
- Loss of revenue to Tribal members as a result of the project.
- Interruption of spiritual practices.
- Loss of medicinal and traditional plants and foods.

The presence of the O2-X device and moorings would reduce some of the area available for Tribal fishing. Entanglement of fishing gear could occur, especially trolling (i.e., salmon) and trapping (i.e., crab) fisheries. As previously discussed, Project anchors would likely act as artificial reefs and could attract rockfish and other groundfish (e.g., lingcod) to bottom structures, and potentially increase Tribal fishing opportunities for these species.

The potential effects of proposed Project installation, operations, and de-commissioning activities on Tribal resources are uncertain. Impacts from vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure (e.g., rock-drilled anchoring), could have an effect on Tribal fishing rights. Prior to Project deployment, government consultations between Tribal Nations and government agencies would occur regarding the size and extent of the boundaries of the Project area and any limitations (e.g., seasonal) to access or activities within it.

Project construction could result in short-term, temporary displacement of Tribal fishing vessels, for example, while the vessel or barge is laying the subsea transmission cable, when the anchors are being installed, and when the Orbital O2-X device is being deployed. Once the subsea cable is laid and the device installed, most of the proposed Project area would be accessible.

The Project could affect Tribal treaty rights. As previously discussed, Tribal treaty fishing rights include access to traditional areas and times for gathering resources associated with a Tribe's sovereignty since time immemorial. OPALCO is continuing Tribal engagement throughout the duration of the development of the DLA and Final License Application. Ultimately, government-to-government consultation with the Tribal Nations would occur between FERC and the Tribal Nations. Determinations of significant effects, and effects on Tribal treaty rights and Tribal Resources would be coordinated through government-to-government consultation between FERC and the Tribal Nations.

It is possible that effects from vessel presence and installation and removal of the Orbital O2-X and supporting devices (e.g., rock-drilled anchoring) could be mitigated using standard operating procedures (SOPs) and in consultation with the Tribal Nations. Access to most of the area would be maintained during installation, with limitations only in place adjacent to the active construction area. OPALCO would minimize potential effects by coordinating directly with Tribal Nations and Tribal co-managers to limit installation, maintenance, and de-commissioning activities during periods of active Tribal treaty fishing.

5.3.2 Cultural Resources

The effects on cultural resources was defined based on the criteria used to assess adverse effects for cultural resources listed or eligible for listing in the NRHP. Based on the existing information available, the Project would not affect any cultural resources because none have been identified. The Project is not expected to cause temporary (construction) or long-term (operational) effects on cultural resources or indirect effects on cultural resources because no cultural resources have been identified. If historic properties (i.e., cultural resources determined eligible for listing in the NRHP) are identified during future phases of the Project, OPALCO would avoid and minimize effects by avoiding all uplands work and focusing nearshore activities within existing facilities and previously disturbed areas to the extent possible.

While no effects on cultural resources requiring mitigation have been identified, there is the potential that yet-unknown resources may be encountered during Project construction. To account for this possibility, the Project would have a cultural resources Inadvertent Discovery Plan in place during installation. The plan would be developed between the consulting parties as part of compliance with Section 106 of the NHPA and would have procedures to follow in the event that potential cultural resources are identified during construction activities. Tribal Nations would continue to be consulted during the Section 106 compliance process, for which FERC is functioning as Lead Agency.

6. Developmental Economic Analysis

The proposed Project will install an Orbital O2-X device with two turbines, an anchoring system, and a new subsea cable to the east of Blakely Island in Washington State. Calculations of costs related to Project installation, operations, maintenance, and removal are preliminary and subject to change. Current estimated costs and energy generation are outlined in **Table 27**.

Table 27. Economic Analysis per 18 CFR 5.18(b)(5)(E)

Summary of Economic Analysis Statistics	
Construction Costs	$38 million
Annual Operation Costs (O&M plus Insurance)	$611,000
Average Annual Energy Generation	4,265,991 kWh
Anticipated Price per kWh	$0.093 per kWh
Annual Revenue	$396,737
PME Measures (**Appendices B1** & **B3**)	$650,000 to $950,000
Notes: kWh = kilowatt hour; PME = protection, mitigation, and enhancement	

7. Cumulative Impacts

This section: (1) defines cumulative impacts; (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts; (3) analyzes the incremental interaction the proposed Project may have with other projects; and (4) evaluates cumulative impacts potentially resulting from these interactions.

7.1 Definition

The Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA define cumulative impacts as: *"…the impact on the environment which 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 other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"* (40 CFR 1508.7). At the time of writing this document, CEQ has proposed to withdraw this regulatory definition of "cumulative impact" as part of a recission of certain NEPA regulations (see 90 Fed. Reg. 10610 [Feb. 25, 2025]).

Each resource, ecosystem, and human community may be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters. Therefore, cumulative effects analysis normally would encompass a Region of Influence (ROI) or geographic boundaries beyond the immediate area of the proposed Project, and a time frame including past projects and foreseeable future projects, to capture these additional effects.

For the proposed Project activities to have a cumulatively significant impact on an environmental resource, two conditions may be considered. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource—including the effects of the proposed Project—must be significant. Second, the proposed Project must make a substantial contribution to that significant cumulative impact. To analyze cumulative effects, a cumulative effects region must be identified where the effects of the proposed Project and other past, present, and reasonably foreseeable actions would occur.

The cumulative impacts analysis for the proposed Project activities considers known past, present, and reasonably foreseeable future actions located within an 8 km (5 mile) ROI, that is, sufficiently close to have interacting impacts. Direct and indirect impacts, as well as unavoidable and irreversible impacts, are considered in this analysis. The level of detail required for the cumulative effects analysis presented in this DLA Volume 2 is appropriate and consistent with the scope and magnitude of the proposed Project due to its limited extent.

This analysis also lists the past, present, and reasonably foreseeable future projects within the ROI that have had, continue to have, or are expected to have some impact on the natural and human environment. Past projects in this analysis are limited to those implemented in the last 5 years or those with ongoing contributions to environmental effects, and future projects considered include those occurring up to 30 years into the future.

All past, present, and reasonably foreseeable future Projects within 8 km (5 miles) of the proposed Project area are included in Table 28.

Table 28. Past, Present, and Reasonably Foreseeable Future Projects within 8 km (5 miles) of the Proposed Project

Organization	Project	Project Description	Project Timeframe		
			Past	Present	Future
DNR	Dredged Material Management Program (DMMP)	Rosario Strait is an *"aquatic lands disposal site on state-owned aquatic lands [that is used to deposit] materials dredged from rivers, harbors, and shipping lanes."* This site received regularly scheduled environmental monitoring events to verify that the program is protecting the environment against unacceptable adverse impacts (DNR 2009).	X	X	X
OPALCO	Submarine Power & Fiber-Optic Cable	OPALCO has existing fiber-optic and power cables deployed to bring power and internet capabilities to the San Juan Islands (see **Figure 80**).	X	X	X
OPALCO	Submarine Power & Fiber Optic Cable	Within OPALCO's 20-year workplan they will be seeking to install a redundant 69 kV submarine transmission cable in an existing route connecting the San Juan Islands to the mainland for power and fiber to meet current and future system capacity needs. The scope of the project would be to install a new dielectric armored cable from Anacortes to Decatur to Lopez.			X
Samish Indian Nation	Bull Kelp Restoration Project	The Samish Indian Nation has been collecting bull kelp data in the San Juan Islands and is using the information to determine where to begin restoration efforts (Mesa 2024).			X
Whidbey Telecom	Point Roberts Middle Mile Infrastructure Project (PRMMI)	Whidbey Telecom's project goal is to improve internet infrastructure between South Whidbey Island and Point Roberts, Washington, as well as underserved areas in between. This includes an estimated 77 km (48 miles) of terrestrial cable installation and 101 km (63 miles) of subsea cable installation (Whidbey Telecom 2024).			X
WSDOT	New Hybrid-Electric Ferries	State Ferries has started to outsource the building of its first five hybrid-electric vessels. The first two ferries are expected to launch by 2028, with the additional three by 2030 (WSDOT 2025a).			X

Organization	Project	Project Description	Project Timeframe		
			Past	Present	Future
Notes: DMMP = Dredged Material Management Program; DNR = Washington State Department of Natural Resources; km = kilometers; kV = kilovolt; OPALCO = Orcas Power and Light Cooperative; WSDOT = Washington State Department of Transportation					

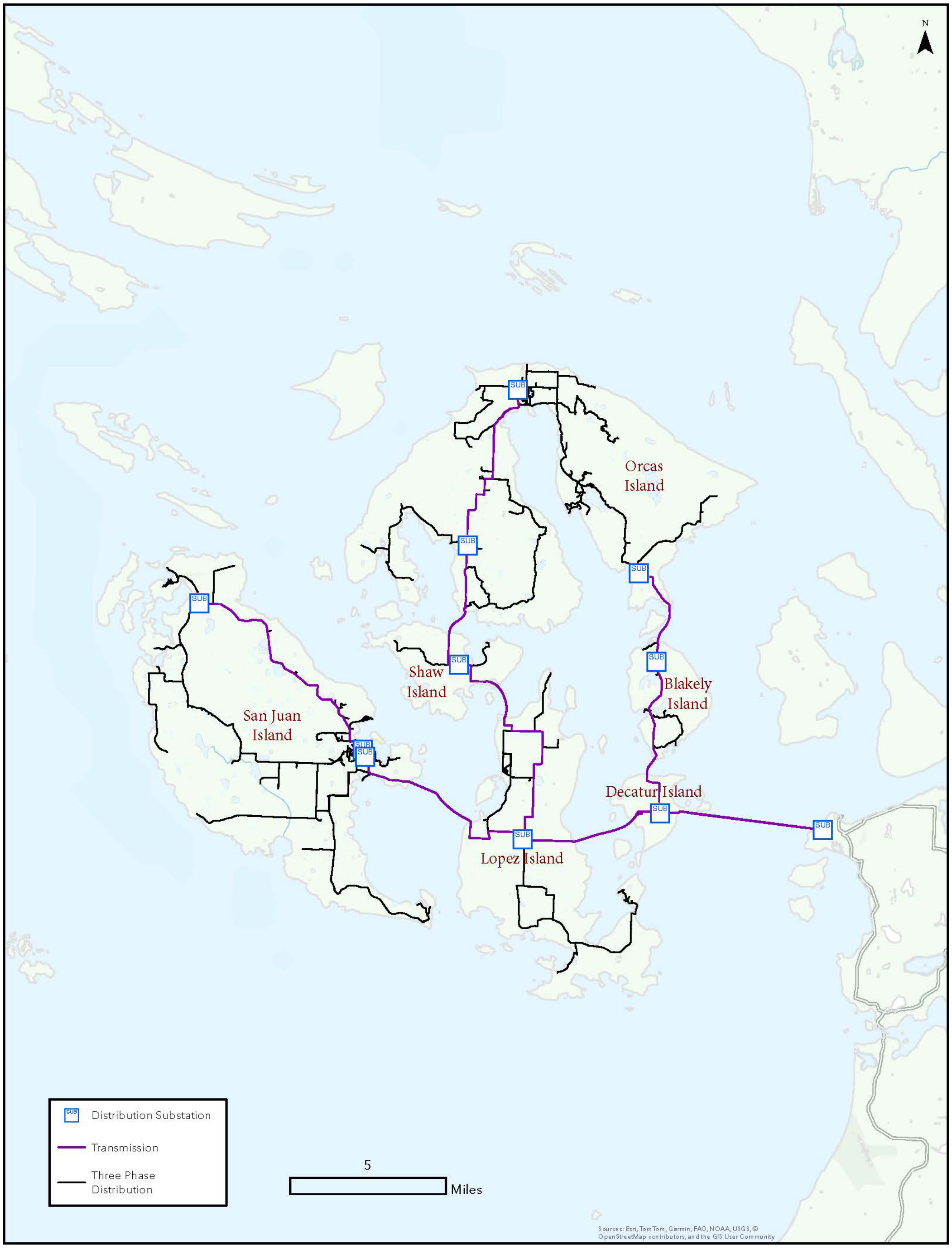

Figure 80. OPALCO Service Area

7.2 Assessment of Cumulative Impacts by Resource

OPALCO evaluated whether the following aspects could experience cumulative impacts because of the proposed Project and other projects in the ROI:

- Geology and Soils
- Water Resources
- Species and Habitats
- Air Quality
- Marine Protected Areas
- Terrestrial Resources
- Marine Activities
- Tribal and Cultural Resources
- Aesthetic Environment
- Economic Impact

7.2.1 Geology and Soils

7.2.1.1 Past and Present Project Impacts

Past and present projects have had temporary but minor impacts on geology and soils. The past OPALCO Submarine Power and Fiber Optic Cable project involved cable laying operations on the seafloor, with cable burial where feasible, which likely caused temporary sediment plumes. The suspension of sediment from this project was minor, temporary, and localized due to the small width of the subsea fiber cables and the relatively fast installation speed.

An increased sediment load was created when each Dredged Material Management Program (DMMP) approved Site Use Application for dredged material deposition in Rosario Strait was deployed (DNR 2009). The currents in Rosario Strait are strong; therefore, the dredged sediment disposed of in this area was likely redistributed by currents more quickly than at locations with weaker tidal currents and more environmentally stable habitats (Yang et al. 2021; Bolam and Rees 2003). This site receives regularly scheduled environmental monitoring to verify that the DMMP is protecting the environment from unacceptable adverse impacts (DNR 2009).

7.2.1.2 Proposed Project Impacts

The proposed Project has the potential to impact geology and soils during all activities. The installation of the new subsea cable and anchors, whether gravity anchors or rock bolt anchors are used, would create temporary sediment plumes. If rock bolt anchors are used, the drilling process would involve altering a portion of the seafloor to install the anchors, each of which is 60 cm (23.6 in.) in diameter. This installation would remove 11,309 cm^2 (1,753 $in.^2$) of surface area from the seafloor and replace it with the anchors. The anchors may remain in place at the end of the Project to reduce the likelihood of additional seafloor or habitat disturbance, to be determined in consultation with Tribes and regulatory agencies.

During Project operations, each of the four mooring lines would create sweep areas, covering an area of 10 m^2 (108 ft^2) per mooring line, or 40 m^2 (430 ft^2) in total. The subsea umbilical would also create a sweep area of 314 m^2 (3,380 ft^2). Additionally, an area of less than 246 m^2 (2,648 ft^2) per mooring line, or 984 m^2 (10,592 ft^2) total for all four, would be disturbed as mooring lines are raised and lowered onto the seafloor with the changing tide. These sweep and disturbance areas would impact sediment by creating small, localized sediment plumes that are expected to be short term and settle back to the seafloor within minutes. Localized scouring could occur, and mitigation would be installed around anchors as a preventative measure. Scouring that does occur is expected to be small and negligible and, therefore, would have a minimal negative impact on geology and soils.

7.2.1.3 Future Project Impacts

The OPALCO Submarine Power and Fiber Optic Cable project and the Whidbey Telecom Point Roberts Middle Mile Infrastructure project (PRMMI) would cause temporary, small-scale sediment plumes during cable laying operations that would quickly dissipate. The Samish Indian Nation Bull Kelp Restoration may also create small-scale sediment plumes, depending on kelp restoration methods, survey equipment, or planting methods deployed on the seafloor. As stated previously, the use of the DMMP disposal site in Rosario Strait would continue to cause changes in sediment composition at the disposal site, but sediment would be redistributed quickly due to strong local currents. The WSDOT New Hybrid-Electric Ferries Project would not impact geology and soils in the ROI.

7.2.1.4 Summary

In combination with other projects, the proposed Project would contribute to a cumulative impact of sediment plume creation within the ROI, although due to strong currents in Rosario Strait and the thin preexisting layer of sediment on the seafloor, these increases are expected to quickly become redeposited and indiscernible from adjacent seafloor sediment levels.

7.2.2 Water Resources

7.2.2.1 Past and Present Project Impacts

Past and present projects in the ROI, including the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project, have had no impact on water resources.

7.2.2.2 Proposed Project Impacts

The scientific community has reached consensus that the risk of potential oceanographic system changes due to small-scale marine energy projects (i.e., four or less devices with less than 10 MW total energy generation capacity) can be discounted (Hemery 2020; OESE 2022). The proposed Project would have no impact on water resources.

7.2.2.3 Future Project Impacts

The DMMP, OPALCO Submarine Power and Fiber Optic Cable project, the Whidbey Telecom PRMMI project, and the WSDOT New Hybrid-Electric Ferries project are expected to have no impacts on water resources.

Future proposed projects in the ROI are expected to have no negative or positive impacts on water resources.

The Samish Indian Nation Bull Kelp project could have positive effects on water resources. Oceanographic systems and processes are affected inside of kelp forests; current speeds are slower and can provide better refuge for fish, invertebrates, and marine mammals, and bull kelp can provide sun protection and lower temperatures for species in rocky areas where other aquatic plants struggle to survive (NOAA 2024b). Bull kelp forests are considered a foundational species and a HAPC on the west coast due to their positive role in marine ecosystems (NOAA 2024b).

7.2.2.4 Summary

Projects in the ROI are expected to have a neutral or positive cumulative impact on water resources. The majority of the projects in the ROI, including the proposed Project, have no impact on water resources, but the successful restoration of kelp beds would contribute to a positive cumulative effect on water resources in the ROI.

7.2.3 Species and Habitats

7.2.3.1 Past and Present Project Impacts

All past and present projects have had impacts on protected species and habitat. The OPALCO Submarine Power and Fiber Optic Cable project impacted species and habitats due to vessel noise during project activities, displacement of benthic communities due to the cable footprint on the seafloor, and habitat alteration due to temporary turbidity during installation and the cable footprint. Long-term impacts of cable projects are considered modest to species and habitats since the most significant impacts occur during installation due to increased vessel traffic and seafloor disturbance when the cable is laid (NOAA 2024d).

The DMMP disposal site impacted species and habitats due to turbidity generated during dredged material deposition, and the disruption of the natural quantity of sediment distribution. However, researchers have concluded that in areas such as Rosario Strait where there are strong currents, recovery rates of benthic communities are relatively rapid (several months) after dredged material disposal (Bolam and Rees 2003). DNR continues to ensure that this site receives regularly scheduled environmental monitoring events to verify that the program is protecting the environment against unacceptable adverse impacts (DNR 2009).

7.2.3.2 Proposed Project Impacts

The potential effects to protected species and habitats due to the proposed Project include the following (for more details, see **Section 4.1**): entanglement, collision, entrainment, noise disturbance, displacement, habitat alteration, EMF exposure, artificial light, and changes in oceanographic systems. Of these potential effects, the following are expected to occur to varying degrees, while the remainder, if they were to occur, would be isolated incidents: noise disturbance (due to vessel presence and the Orbital O2-X powertrain system), displacement (due to Project construction activities, vessel noise, and the area that the Project components occupy), habitat alteration (due to the installation, operations, and decommissioning of Orbital O2-X components), EMF exposure (due to the new subsea cable presence), and an increase in artificial light (due to the installation of amber lights on the device).

Before Project deployment, the proposed Project team would meet with Tribal, local, state, and federal agencies and regulators to ensure that Project components and activity methodologies are approved and in line with species and habitat protection regulations and initiatives in the proposed Project area, and that all relevant BMPs are implemented throughout the Project to minimize impacts on protected species and habitats. The proposed Project would also require review under NEPA to ensure that all potential impacts on species and habitats are considered before deployment.

7.2.3.3 Future Project Impacts

The impacts on protected species and habitats in the future due to the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project are the same as those listed in **Section 7.2.3.1** (*Past and Present Project Impacts*).

The Samish Indian Nation Bull Kelp project could include positive effects to protected species and habitats due to the increase in biodiversity and habitat that is associated with the restoration of bull kelp forests.

The potential impacts on protected species and habitats due to the Whidbey Telecom PRMMI Project are similar to those of the OPALCO Submarine Power and Fiber Optic Cable project and would likely include noise disturbance from vessel presence during project activities, displacement of benthic communities or habitats due to the cable in or on the seafloor, and habitat alteration due to temporary turbidity during installation and due to the addition of a cable on the seafloor.

The WSDOT New Hybrid-Electric Ferries project would likely only add new positive impacts on protected species and habitats since, when the new ferries are launched, they will continue to operate as usual along pre-established ferry routes but with a reduction in noise.

7.2.3.4 Summary

Most projects within the ROI have short-term impacts on protected species and habitats due to project activities. These impacts, such as displacement, habitat alteration, or noise disturbance, mostly cease at the conclusion of the installation of cable projects, or in the case of dredged material deposition, a few months after project activities occur.

The long-term cumulative impacts of projects, including those of the proposed Project, include habitat displacement due to the presence of project components. Positive effects to protected species and habitats could occur due to the Samish Indian Nation Bull Kelp project and WSDOT New Hybrid-Electric Ferries project.

7.2.4 Air Quality

7.2.4.1 Past and Present Project Impacts

The DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project created small impacts on air quality due to the increased vessel presence in the ROI. Overall, due to the low Air Quality Index (AQI) rating of less than 50 within the ROI, these impacts were low.

7.2.4.2 Proposed Project Impacts

The proposed Project would likely create a small impact on air quality in the ROI due to increased vessel traffic during the installation, maintenance, and removal activities. The frequency of visits to the proposed Project area is expected to be as often as once a month during the first year and likely less frequent during subsequent years of operation.

7.2.4.3 Future Project Impacts

The impact on air quality due to future projects would result from increased vessel traffic from the DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, the Samish Indian Nation Kelp Restoration project, and the Whidbey Telecom PRMMI project. These impacts are expected to be low since they are all temporary and infrequent. Positive effects are expected from the WSDOT Hybrid-Electric Ferries project, which has a goal of acquiring a completely emission-free ferry fleet by 2050 (WSDOT 2025a), although it is currently unknown precisely what stage of progress these goals would be at by the end of the next 10 years. Ferries are currently one of the most frequent and largest vessels that consistently pass through the ROI, with ferries departing from Anacortes to the San Juan Islands at least 16 times daily (WSDOT 2025b).

7.2.4.4 Summary

Most projects in the ROI are expected to have a small cumulative impact on air quality due to temporary increases in vessel traffic during project activities. In the long term, the cumulative impact of projects on air quality in the ROI could become neutral or positive due to the emissions that are expected to be removed due to the WSDOT Hybrid-Electric Ferries project.

7.2.5 Marine Protected Areas

All projects in the ROI have the potential to impact three Marine Protected Areas: (1) the San Juan County/Cypress Marine Biological Preserve (SCBP), which shares a border with San Juan County; (2) the Cypress Island Aquatic Reserve around Cypress Island; and (3) the San Juan Islands NWR.

7.2.5.1 Past and Present Project Impacts

Due to all projects taking place inside at least the SCBP, they have impacted the SCBP. The OPALCO Submarine Power and Fiber Optic Cable project impacted marine protected areas due to temporary increases in noise due to vessel operations, the displacement of habitat due to the small area which the fiber optic cable occupied on the seafloor, and small temporary turbidity plumes due to the cable being installed on the seafloor.

When the DNR DMMP approves a Site Use Application, the sediment deposited in Rosario Strait likely caused distress to benthic communities. However, due to the strong currents of Rosario Strait, recovery rates of benthic communities are likely relatively rapid (several months) after dredged material disposal (Bolam and Rees 2003).

7.2.5.2 Proposed Project Impacts

The proposed Project would impact the SCBP due to small temporary turbidity plumes during the installation of the new subsea cable and during operations due to mooring line and umbilical sweep. There would also be turbidity during the installation of anchors, an increase in artificial light during Project operation to mark the Orbital O2-X Project area, increased acoustic disturbance due to noise from vessels in the proposed Project area and the Orbital O2-X's powertrain system, the displacement of species and habitats due to the presence Project components, and potential EMF exposure within a close range of the new subsea power cable.

7.2.5.3 Future Project Impacts

The Whidbey Telecom PRMMI project and the OPALCO Submarine Power and Fiber Optic Cable project would have the same potential impacts as the OPALCO Submarine Power and Fiber Optic Cable project did in **Section 7.2.5.1** (*Past and Present*). The Samish Indian Nation Bull Kelp Project would continue to have potentially positive effects on bull kelp forests and species biodiversity, and the temporary impacts of the DNR DMMP would remain the same. The addition of the WSDOT New Hybrid-Electric Ferries project, depending on the timing of deploying new ferries to the San Juan Islands, could decrease the noise from ferry vessels that transverse the ROI.

7.2.5.4 Summary

While the impacts from the DNR DMMP would remain the same, and the Samish Indian Nation Bull Kelp project would continue to potentially improve biodiversity, the cumulative impacts of additional cable projects and the proposed Project would increase habitat displacement within the marine protected areas in the ROI, with the greatest impact coming from the proposed Project's anchor footprints, mooring line sweep, and umbilical sweep.

The total area of displaced habitat includes 10 m^2 (108 ft^2) per mooring line or 40 m^2 (430 ft^2) in total, 314 m^2 (3,380 ft^2) for the umbilical, and less than 246 m^2 (2,648 ft^2) per mooring line (or 984 m^2 [10,592 ft^2] total) by mooring lines being raised and lowered onto the seafloor during tidal current changes.

7.2.6 Terrestrial Resources

7.2.6.1 Past and Present Project Impacts

The only past and present project in the ROI that has impacted terrestrial resources is the OPALCO Submarine Power and Fiber Optic Cable project. Infrastructure such as beach manholes, powerlines, cables, and cable conduits were installed in the terrestrial environment. These additions could have had short-term negative impacts on natural resources due to noise disturbance, displacement, and habitat alternation during construction activities, but these impacts usually cease once the cable is installed and land is restored. Long-term impacts could include maintenance activities or continual habitat displacement due to clearings for transmission line corridors that are installed in remote or forested areas.

7.2.6.2 Proposed Project Impacts

The proposed Project would not impact terrestrial resources. The Project would use an existing cable conduit on the south shore of Blakely Island to connect to OPALCO's grid, so no construction within the terrestrial environment would occur.

7.2.6.3 Future Projects Impacts

The OPALCO Submarine Power and Fiber Optic Cable project and Whidbey Telecom PRMMI project could include terrestrial infrastructure such as beach manholes, powerlines, cables, and cable conduits. These activities would temporarily increase noise and cause displacement and habitat alteration, but impacts are expected to be low due to the relatively small area that cables and associated infrastructure occupy.

The WSDOT New Hybrid-Electric Ferries project would not impact terrestrial resources within the ROI.

7.2.6.4 Summary

While cumulative impacts of habitat alteration and displacement would continue in the ROI due to cable installation projects by OPALCO and Whidbey Telecom, the cumulative impacts of projects in the ROI on terrestrial resources are expected to be small due to the small size and relatively fast installation of project components.

7.2.7 Recreation, Land Use, and Ocean Use

7.2.7.1 Past and Present Project Impacts

The project activities associated with the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project have had a minimal impact on marine activities in the ROI. Dredged material deposition operations and cable laying operations created a temporary increase in turbidity that displaced marine species from the deposition site, but once project activities ended, marine species returned to the area.

All past and present projects have temporarily increased vessel traffic in their project areas, and therefore limited recreation and vessel access to project locations temporarily during project activities. The impacts of increased vessel traffic were short term.

7.2.7.2 Impacts of the Proposed Project

Recreation and fishing activities may be temporarily affected by the presence of Project installation and removal equipment, vessels, and Project components. The placement of the Orbital O2-X device would displace fishing in a small section of Marine Area 7 in the San Juan Islands due to its location in the water. A more precise assessment of the Project's impact on fishing will be determined through consultation with Tribal Nations and relevant agencies. The proposed Project area is located outside vessel traffic lanes, shipping areas, and WSDOT ferry routes, and vessels will be able to pass over the new subsea cable without disruption.

7.2.7.3 Future Project Impacts

Future activities in the ROI such as the DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, and the Whidbey Telecom PRMMI project would temporarily limit marine activities such as fishing or vessel traffic from their project areas and could temporarily displace marine species due to small, short-term increases in turbidity and noise during project activities. All impacts on marine activities would be temporary, and marine activities would return to normal following project installation.

The WSDOT New Hybrid-Electric Ferries project proposes no changes to usual WSDOT ferry routes in the San Juan Island region, so there it would not impact marine activities.

The Samish Indian Nation Bull Kelp restoration project could increase exclusionary areas due to restoration efforts, which would be off-limits for fishermen or recreational vessel to access. The long-term effects of bull kelp forest restoration could benefit marine species populations and benefit fisheries in the future.

7.2.7.4 Summary

The cumulative impact on marine activities of the projects in the ROI includes limits to project areas due to the temporary presence of vessels, project installation and removal equipment, and proposed Project components. Once the Project activities are finalized in coordination with regulatory agencies and Tribal Nations, the complete impact on fisheries can be determined.

Bull kelp restoration areas would likely be small, temporary, and if successful support marine species population growth and stability into the future, thus supporting and improving local fisheries activities.

7.2.8 Tribal and Cultural Resources

7.2.8.1 Past and Present Project Impacts

The project activities associated with the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project likely had a minimal impact on Tribal resources, specifically Tribal fishing and Tribal treaty fishing rights, in the ROI. Dredge material deposition operations and cable laying operations created a temporary increase in turbidity that displaced marine species from the deposition site, but once project activities ended, marine species returned to the area and the area was again accessible.

All past and present projects temporarily increased vessel traffic in their proposed Project areas and therefore limited Tribal treaty fishing access to project locations during project activities. The impacts of increased vessel traffic were short-term.

There are no known cultural resources so therefore, a cumulative effects discussion is not included.

7.2.8.2 Proposed Project Impacts

The proposed Project would impact Tribal treaty fishing rights and fishing activities, as they would have limited access to the proposed Project area due increased vessel presence during the installation and removal activities, and due to the presence of the Orbital O2-X and its anchoring components during operations. The proposed Project area is outside of vessel traffic lanes, shipping areas, and WSDOT ferry routes.

The proposed Project would not impact cultural resources. The Project would use an existing cable conduit on the south shore of Blakely Island to connect to OPALCO's grid, so no terrestrial construction would occur and there are no known cultural resources, including submerged cultural resources present.

7.2.8.3 Future Project Impacts

Future activities in the ROI such as the DNR DMMP, OPALCO Submarine Power and Fiber Optic Cable project, and the Whidbey Telecom PRMMI project would temporarily limit Tribal fishing activities such as fishing or vessel traffic from their proposed Project areas and could temporarily displace marine species due to small short-term increases in turbidity and noise during project activities. This would likely impact Tribal treating fishing rights. These impacts to Tribal resources would be temporary, and access would return to normal following project installation. There are no known cultural resources so therefore, a cumulative effects discussion is not included.

The WSDOT New Hybrid Electric Ferries project currently proposes no changes to usual WSDOT ferry routes in the San Juan Island region, so there it would not impact Tribal or cultural resources, including Tribal treaty fishing rights. The addition of the WSDOT New Hybrid-Electric Ferries project, depending on the timing of deploying new ferries to the San Juan Islands, could create a decrease in noise from ferry vessels that transverse the ROI and provide benefits to habitat and species; therefore, indirectly benefiting Tribal fishing.

The Samish Indian Nation Bull Kelp restoration project could temporarily limit access due to restoration efforts, which would restrict fisherpeople or vessel access. The long-term benefits of bull kelp forest restoration could benefit marine species populations and benefit fisheries in the future.

7.2.8.4 Summary

The cumulative impact to Tribal Resources of the projects in the ROI, specifically Tribal treaty fishing rights, includes an increase in in areas that may have temporary limited access due to the Orbital O2-X Project activities, temporary limitations to access during implementation of the bull kelp restoration projects, and temporary increases in vessel traffic due to project activities. Bull kelp restoration exclusion areas would likely be small, temporary, and if successful support marine species population growth and stability into the future, thus supporting and improving local fisheries activities.

7.2.9 Aesthetic Environment

7.2.9.1 Past and Present Project Impacts

The DNR DMMP and OPALCO Submarine Power and Fiber Optic Cable project impacted visual, acoustic, and light aesthetics. These impacts were due to the increased vessel traffic from project activities. The increased presence of vessels included an increase in noise, an increase in vessels in the visual landscape, and an increase in artificial light due to navigation lights.

7.2.9.2 Proposed Project Impacts

The proposed Project would impact the visual, acoustic, and light aesthetics of the ROI. The visual aesthetic would change due to the addition of the hull of the Orbital O2-X in the water and its flashing safety lights. There would also be an increase in vessel presence for installation, maintenance, and decommissioning of the proposed Project.

The acoustic aesthetic would be impacted by an increase in noise due to increased vessel traffic due to Project activities. Additional noise is expected due to the potential installation of rock bolt anchors, and all noise due to anchor installation would be temporary (48 hours maximum). The operation of the Orbital O2-X powertrain system would generate low frequency noise, although the exact level is unknown at this time.

The light aesthetic would include changes due to the addition of marking lights on the hull on the Orbital O2-X.

7.2.9.3 Future Project Impacts

The DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, the Samish Indian Nation Bull Kelp project, and Whidbey Telecom PRMMI project would all change the visual, acoustic, and light aesthetic of the ROI due to temporary increases in vessel presence. While the WSDOT New Hybrid-Electric Ferries project would not change the visual or light aesthetic of the ROI, it would decrease the noise from ferries due to the quieter engines on the new hybrid ferries.

7.2.9.4 Summary

The cumulative impact of projects in the ROI are expected to impact visual, acoustic, and light aesthetics. The visual aesthetics in the ROI would change due to temporary increases in vessel traffic and the addition of proposed Project components.

The acoustic environment would increase in noise due to temporary increases in vessel traffic during Project activities and during rock bolt anchor installation, as well as due to the Orbital O2-X powertrain system. The acoustic aesthetic could also see a reduction in noise when WSDOT transitions local ferries to hybrid-electric models that emit less noise.

The light aesthetic would see small changes due to temporary increases in vessel traffic due to Project activities and the installation light markings on the Orbital O2-X.

Overall, cumulative impacts of projects on the aesthetic environment are considered to be temporary (noise or artificial light from vessels), minor (Orbital O2-X amber lights and powertrain noise), or positive (decrease in noise due to hybrid-electric ferries).

7.2.10 Economic Impact

7.2.10.1 Past and Present Project Impacts

All projects in the ROI created primary and secondary economic impacts. The OPALCO Submarine Power Cable project created primary economic impacts when they hired local construction companies and vessel operators to install new cable and perform maintenance, in addition to when it generated money from cable operation and service to the San Juan Island community. Similar primary economic impacts were created for the DNR DMMP due to hiring contactors. Secondary economic impacts of the projects were created due to spending on goods or services in the proposed Project area during project activities.

7.2.10.2 Proposed Project Impacts

The proposed Project would create primary economic impacts due to spending during the initial construction phase, and due to annual spending on operations. Secondary economic impacts are likely to result from spending on goods and services during construction and operations activities. The current impact of the Project on customer rates is not known, but the addition of marine energy to OPALCO's grid could lead to changes in operational costs. For the long term, local power generation could increase the resilience of the energy grid of the San Juan Island community since it could be better able to withstand natural and man-made disasters that can impact their power retrieval from mainland Washington State.

7.2.10.3 Future Project Impacts

Economic impacts due to the DNR DMMP and the Samish Indian Nation Bull Kelp largely include hiring contractors and, if restoration effort are successful, benefits on kelp bed biodiversity could indirectly help local and Tribal fishing industries because the long-term benefits of bull kelp forest restoration could benefit marine species populations and ultimately benefit fisheries in the future. The addition of Whidbey Telecom PRMMI project and the OPALCO Submarine Power and Fiber Optic Cable project would have primary economic impacts due to spending on construction phases and annual operations. Fiber optic cable projects have the potential to increase job and education opportunities due to improved internet connectivity capacity. The WSDOT Hybrid-Electric Ferries project would see a change in operation costs for WSDOT as they transition from primarily relying on diesel to electricity for energy, although the exact cost differences are unknown. Secondary economic impacts from all future projects also include spending on goods and services during construction and operations, and for the ferries, more reliable service from new ferries could mean more reliable business from tourists and people visiting the region.

7.2.10.4 Summary

The cumulative economic effect of projects in the ROI is positive and would contribute to the amount of money spent on activities such as construction, maintenance, and operational activities, and well as on secondary activities such as goods and services.

8. Summary of Effects

8.1 Unavoidable Negative Effects

Based on the information reviewed, collected, and analyzed in support of this DLA, the following potential unavoidable adverse impacts have been identified:

- Underwater noise - underwater noise will be generated due to vessel presence during the installation, operation, maintenance, and removal activities. Additionally, underwater noise will be generated due to the Orbital O2-X device's power generating operations.
- Pelagic habitat - habitat alteration and spatial displacement of species in the water column during the installation, operation, maintenance, and removal activities of proposed Project components.
- Benthic habitat – habitat alteration and spatial displacement of species on the seafloor from the Project's anchor system and subsea cable during installation, operation, and removal activities.
- Aesthetics – effects on the viewshed from the Orbital O2-X and safety marking at the water's surface during installation, operation, maintenance, and removal activities.
- Turbidity - temporary turbidity caused by anchor and new subsea cable installation and removal. Additionally, temporary turbidity may occur in the mooring chain sweep area during operations.

Testing of the Orbital O2, an earlier model than the proposed Orbital O2-X, at Orkney Islands has indicated no observed significant negative impacts on the environment. Monitoring would contribute further to the understanding of potential cumulative effects.

8.2 Positive Effects

Based on the information reviewed, collected, and analyzed in support of this DLA, the following beneficial effects have been identified:

- Energy resilience - increased resiliency of the OPALCO energy grid during operation activities, leading to reduced dependence on mainland power, particularly during power outages.
- Socioeconomic benefits – generation of renewable energy and economic stimulation via regional services during Project installation, operation, maintenance, and removal activities.
- Environmental benefits – investments in energy efficiency and renewable tidal energy, contributing to the reduction of reliance on fossil fuels.

9. Conclusions and Recommendations

9.1 Fish and Wildlife Recommendations

If Section 10(j) recommendations are submitted, then pursuant to the Federal Power Act (FPA), FERC would be required to make a determination that the recommendations of the federal and state fish and wildlife agencies are consistent with the purpose and requirements of Part I of the FPA and applicable law. Section 10(j) of the FPA states that whenever FERC believes that a fish and wildlife agency recommendation may be inconsistent with the purposes and requirements of the FPA or other applicable law, FERC and the agency shall attempt to resolve any such inconsistency, giving due weight to recommendations, expertise, and statutory responsibilities of such agency.

9.2 Consistency and Comprehensive Plans

Section 10(a)(2)(A) of the FPA, 16 USC section 803(a)(2)(A), requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. The Project is consistent with the goals outlined in these documents.

9.2.1 Federal Plans

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