UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2022-00825

November 9, 2023

Todd Tillinger
Chief, Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, Bldg. 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Olympic Pipe Line Company LLC's MP 28.35 Colony Creek Pipeline Relocation Project, Skagit County, Washington (USACE No. NWS-2019-825, HUC: 171100020301 – Oyster Creek-Frontal Samish Bay)

Dear Mr. Tillinger:

Thank you for the U.S Army Corps of Engineers' (USACE's) letter of April 7, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the USACE's authorization of Olympic Pipe Line Company LLC's MP 28.35 Colony Creek Pipeline Relocation Project. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [16 U.S.C. 1855(b)] for this action.

The enclosed document contains the biological opinion (opinion) prepared by the NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, the NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) steelhead. This opinion also documents our conclusion that the proposed action is not likely to adversely affect PS Chinook salmon and designated critical habitat for PS Chinook salmon and PS steelhead.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) the NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the USACE must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated freshwater EFH for Pacific Coast Salmon. However, as described in Section 3, the NMFS knows of no practical measures, beyond those already proposed by the applicant, that would reduce the action's expected effects. Therefore, the NMFS offers no conservation recommendations pursuant to MSA (§305(b)(4)(A)).

Section 305(b)(4)(B) of the MSA requires that an action agency provide a detailed response in writing to the NMFS within 30 days after receiving an EFH Conservation Recommendation. However, because the NMFS has offered no EFH Conservation Recommendations, no EFH response is required from the COE for this action.

Please contact Donald Hubner in the North Puget Sound Branch of the Oregon/Washington Coastal Office at (206) 526-4359, or by electronic mail at Donald.Hubner@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Danette Guy, USACE

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the

Olympic Pipe Line Company LLC's MP 28.35 Colony Creek Pipeline Relocation Project, Skagit County, Washington
(USACE No. NWS-2019-825, HUC: 171100020301)

NMFS Consultation Number: WCRO-2022-00825

Action Agencies: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound (PS)	Threatened	No	No	No	No
Steelhead (*O. mykiss*) PS	Threatened	Yes	No	No	No

Affected Essential Fish Habitat (EFH) and NMFS' Determinations:

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No
Pacific Coast Groundfish	No	No
Coastal Pelagic Species	No	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: November 9, 2023

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LIST OF ABBREIVIATIONS

BA – Biological Assessment
BMP – Best Management Practices
CFR – Code of Federal Regulations
dB – Decibel (common unit of measure for sound intensity)
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EFH – Essential Fish Habitat
ESA – Endangered Species Act
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
mg/L – Milligrams per Liter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NTU – Nephlometric Turbidity Units
OHWM – Ordinary High-Water Mark
PAH – Polycyclic Aromatic Hydrocarbon
PBF – Physical or Biological Feature
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RL – Received Level
ROW – Right-of-Way
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
TSS – Total Suspended Solids
USACE – U.S. Army Corps of Engineers
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology
WQMPP – Water Quality Monitoring and Protection Plan

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

On April 7, 2022, the NMFS received a letter from the U.S. Army Corps of Engineers (USACE) that requested consultation for their authorization of Olympic Pipe Line Company LLC's MP 28.35 Colony Creek Pipeline Relocation Project, in Skagit County, Washington (USACE 2022). The request included Olympic Pipe Line Company LLC's Biological Assessment (BA), Basis of Design Report, Fish Exclusion and Construction Dewatering Plan, Water Quality Monitoring and Protection Plan (WQMPP), and Wetland Mitigation Plan and Bank Use Plan (GeoEngineers 2022a - e). It also included the Hydraulic Project Approval (HPA) for the project (WDFW 2022).

On April 19, 2023, an electronic meeting has conducted between representatives of the applicant, the USACE, and to discuss the importance and various details of the project. The NMFS submitted an electronic mail (email) to request additional information the same day. On May 16, 2023, the NMFS and the USACE received an email with 1 attachment from the applicant's agent to provide requested information (GeoEngineers 2023a; 2023b). On September 8, 2023, the NMFS received 2 emails from the applicant's agent, sent in response to additional information requests from the NMFS (GeoEngineers 2023c; 2023d).

For administrative purposes, the NMFS considers that consultation was initiated on April 7, 2022, when we received the request for formal consultation.

This opinion is based on the information in the documents identified above; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under the MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910).

The USACE proposes to authorize Olympic Pipe Line Company LLC (applicant) to remove and relocate an exposed section of its 16-inch diameter gas pipeline at mile post 28.35, where it crosses Colony Creek, about 1.9 miles northwest of Bow, Washington (Figure 1).

Figure 1. The project site on Colony Creek, about 1.9 miles northwest of Bow, Washington. The pipeline section to be replaced is shown in the rightmost image (The left image is from Google Earth. The center and right images are adapted, respectively, from Figure 2, and Appendix D Figure D-1 in GeoEngineers 2022).

<u>Project Overview</u>

The applicant proposes to install a new section of 16-inch diameter pipe about 15 feet to the west of its current location. The new pipe section would connect to the existing pipeline about 50 feet outside of the channel, on both sides, and be buried a minimum of 6 feet below the streambed where it crosses the channel. The replaced section of existing pipe would be removed, the cut streambank would be stabilized, and about 150 feet of the creek's bed and banks would be restored to conditions believed to be similar to the creek's conditions prior to pipeline installation in the mid-1960s (GeoEngineers 2023b). The disturbed upland areas would be replanted with appropriate native vegetation.

Project work is expected to be done in 2024, would require about 3.5 months to complete. Work would include the use of standard heavy equipment such as a hydraulic excavator and or backhoe, loaders, various trucks and trailers, and dewatering pump and hoses. Work would begin mid- to late-June and end early- to mid-October of the same year. Work below the ordinary high-water mark (OHWM) would require about 8 weeks to complete, and per approval from the Washington State Department of Fish and Wildlife (WDFW), would be limited to July 1 through September 30, when water levels in the channel are typically at their lowest (GeoEngineers 2023b). To further reduce environmental impacts, all work would be done in compliance with the best management practices (BMPs), conservation measures, and provisions detailed in the project's BA, HPA, WQMPP, Fish Exclusion and Construction Dewatering Plan, and the Wetland Mitigation and Bank Use Plans.

<u>Construction Sequence</u>

Prior to the in-water work period, equipment would be mobilized to the construction site. BMPs would be installed and or constructed as necessary, such as sediment barriers along the toes of slopes and around staging and stockpile areas, and runoff interception and diversion ditches and check dams. Some upland heavy equipment work would occur on the southwest side of the stream prior to the in-water work window. This would include the removal of about 4 evergreen trees, 28 deciduous trees, and numerous shrubs to provide access to the project area (Figure 2), and upland excavation to expose the existing pipeline as well as create trenches along the upland portions of the existing and replacement pipelines' routes.

At the start of the in-water work window, but prior to in-water construction, fish exclusion and salvage, and installation of temporary dewatering and stream bypass systems (work area isolation) would be done by qualified personnel and monitored by an experienced fisheries biologist. The work area isolation plan is based on the guidance in the 2016 Washington State Department of Transportation Fish Exclusion Protocols and Standards (WDOT 2016), Appendix A of the USACE 2008 Washington State Restoration Programmatic Specific Project Information Form (USACE 2008), and the 2000 NMFS Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (NMFS 2000). The length of bypassed stream would be about 140 feet (GeoEngineers 2023b), and the duration of dewatering would be about 8 weeks.

The first phase of work area isolation would be the installation of exclusion netting across the channel, upstream of the bypass cofferdam location, with enough space to avoid fish impacts from the intake pump. After net installation, the existing large wood structure at the upstream end of the project reach would be removed, and the in-stream work area would be swept multiple times by qualified personnel using seine and dip nets to remove fish. If necessary, partial water

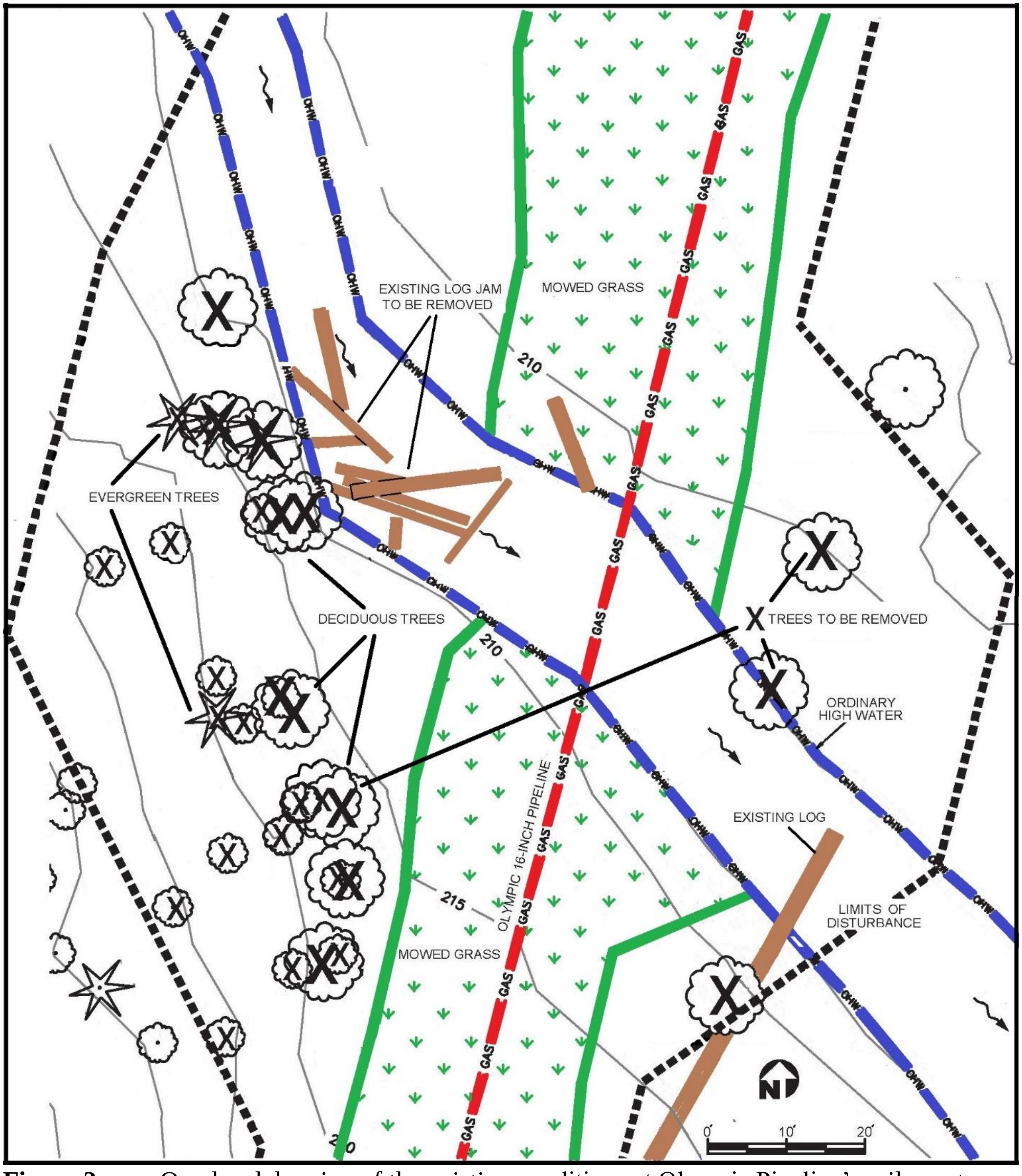

Figure 2. Overhead drawing of the existing conditions at Olympic Pipeline's mile post 28.35 crossing of Colony Creek, Skagit County, Washington. The dashed red line indicates the existing pipeline, the green line delineates the pipeline's mowed right of way, and the dashed blue line indicates ordinary high water. The black Xs indicate trees that would be removed to provide access to the project site (Adapted from Appendix B's Sheet 4 of 10 in GeoEngineers 2022).

draw-down and or electrofishing may be utilized to remove fish, particularly in the pool that is collocated with the existing large wood structure that would be removed. Captured fish would be placed in dark-colored buckets equipped with bubblers and kept out of the sun. Fish would be monitored for stress and released as quickly as feasible outside the exclusion zone. The applicant estimates that up to 25 juvenile steelhead may be handled as part of this work (GeoEngineers 2023b). The temporary dewatering and stream bypass systems would include temporary cofferdams up- and downstream of the work area, a screened pump system sized to convey predicted flows around the site (less than 5 cubic feet per second), and erosion control structures at the outfall end of the bypass pipe.

After completion of work area isolation, heavy equipment would ford the stream northeast of the pipeline crossing, but within the isolated work area. If wet or muddy conditions exist, equipment would be used to reduce ground pressure (HPA condition 14). Driving mats or quarry spall rock may be temporarily placed on graded banks or overbank areas at the ford location to reduce ground disturbance and erosion during construction.

The construction crew would then perform upland and instream excavation to expose the existing pipeline on the northeast side of the stream and to create the trenches along the existing and replacement pipelines' routes. The new route would be about 15 feet west of the existing pipeline where it crosses the stream. They would weld together and hydrotest the replacement pipe section (handlebar), prepare the trench, then install the handlebar. They would then cut the existing pipeline, weld the handlebar section to the existing pipeline, and hydrotest the replacement. They would then remove the decommissioned pipeline section.

They would then backfill the trenches, grade the bank slopes to recreate a more natural form, install about 20-foot wide sections of rock armoring centered over the new pipeline where it crosses the banks, and install 4 embedded large wood structures with root wads along the stream banks, 1 upstream and 1 downstream of the crossing on each bank. They would also install new streambed cobble and gravel mix over about 150 feet of stream channel (Figures 3 and 4).

To complete the project, they would remove the temporary BMPs, and restore conditions at the fording location, and remove the dewatering and stream bypass systems from the creek bed. Topsoil scarification and or amendments would be applied as required prior to revegetation if compaction or other construction impacts appear likely to limit successful plant establishment. To replace the cut trees and shrubs, and to help stabilize the upland disturbed areas, they would plant 67 evergreen trees (hemlock, cedar and fir), 25 deciduous trees (maple and alder), replace cut shrubs using native shrubs at a 1 to 1 ratio, and also seed the disturbed areas with native grasses (GeoEngineers 2023b). If the vegetation clearing is less than expected, the tree replacement ratio would be about 3:1. As final steps, they would remove erosion control features and demobilize from the site.

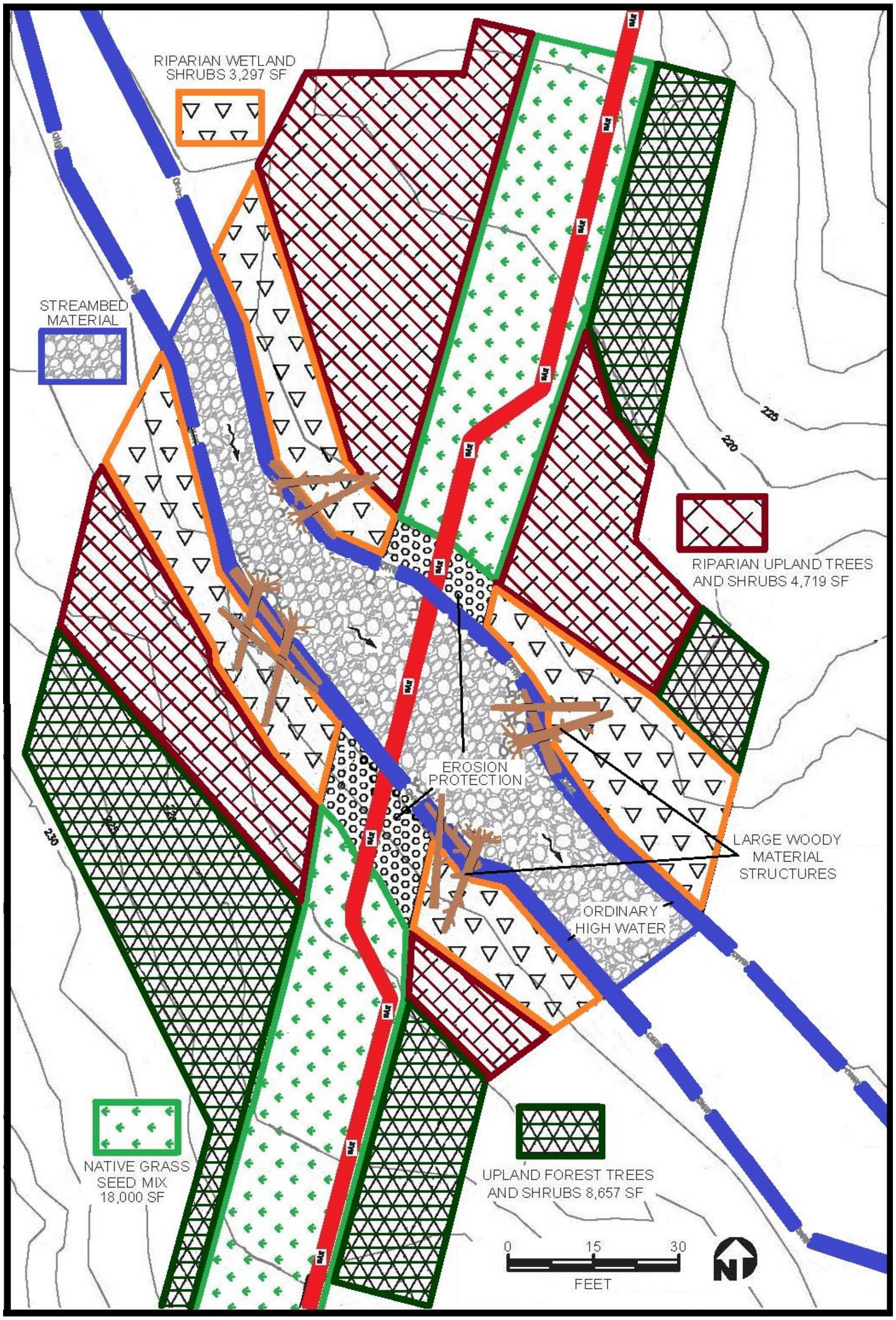

Figure 3. Overhead drawing of the proposed conditions at Olympic Pipeline's mile post 28.35 crossing of Colony Creek, Skagit County, Washington. The red line indicates the proposed pipeline alignment, the dashed blue line indicates ordinary high water, the brown logs indicate the large-wood structures, the outlined areas indicate bank protection and various planting plan areas (Adapted from Appendix B's Sheets 5 & 9 of 10 in GeoEngineers 2022).

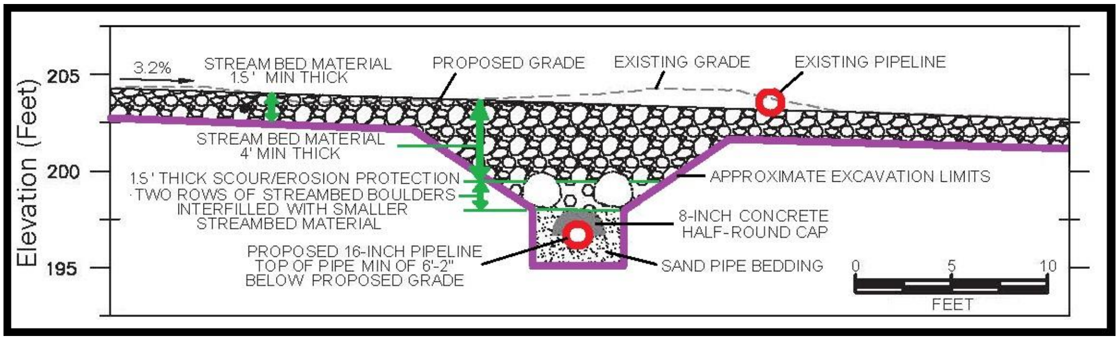

Figure 4. Cross-section drawing of the existing and proposed conditions at Olympic Pipeline's mile post 28.35 crossing of Colony Creek, Skagit County, Washington. The red circles indicate the existing and proposed pipelines relative to the streambed. The purple line indicates the extent of proposed excavation, with the various layers of fill shown above that line (Adapted from Appendix B's Sheet 6 of 10 in GeoEngineers 2022).

Other activities that could be caused by the proposed action

The NMFS also considered, under the ESA, whether or not the proposed action would cause any other activities that could affect our trust resources, and concur with the determination of the applicant and the USACE that the project would cause no other activities, and it may reduce the necessity for future work at the site to protect the bank and the pipeline from erosion.

2. ENDANGERED SPECIES ACT BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with the NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, the NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires the NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The USACE determined that the proposed action is likely to adversely affect PS steelhead. They further determined that the proposed action would have no effect on PS steelhead critical habitat, but addressed no other species or critical habitats. The NMFS proceeded with formal consultation because we concluded that the proposed action is likely to adversely affect PS steelhead. Additionally, because PS Chinook salmon and designated critical habitat for both PS Chinook salmon and PS steelhead occur downstream of the project site, we analyzed the action's potential effects on those species and critical habitats in the "Not Likely to Adversely Affect" Determinations section 2.12 of this opinion (Table 1).

Table 1. ESA-listed species and critical habitats that may be affected by the proposed action.

ESA-listed species and or critical habitat likely to be adversely affected (LAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
steelhead (*O. mykiss*) Puget Sound	Threatened	LAA	NLAA	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound	Threatened	NLAA	NLAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)

LAA = likely to adversely affect NLAA = not likely to adversely affect

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion, we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce

appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Range-wide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the physical or biological feature (PBFs) that are essential for the conservation of the species.

Listed Species

Viable Salmonid Population (VSP) Criteria: For Pacific salmonids, we commonly use four VSP criteria (McElhany et al. 2000) to assess the viability of the populations that constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits.

"Abundance" generally refers to the number of naturally-produced adults that return to their natal spawning grounds.

"Productivity" refers to the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is in decline.

For species with multiple populations, we assess the status of the entire species based on the biological status of the constituent populations, using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams.

Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the action area and are considered in this opinion. More detailed information on the biology, habitat, and conservation status and trend of these listed resources can be found in the listing regulations and critical habitat designations published in the Federal Register and in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

Puget Sound (PS) steelhead

The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based MPGs; Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 2). Critical habitat for Puget Sound steelhead DPS was designated by NMFS in 2016 (81 FR 9251, February 24, 2016). NMFS adopted the steelhead recovery plan for the Puget Sound DPS in December, 2019.

In 2015, the PSSTRT concluded that the DPS is at "very low" viability; with most of the 32 DIPs and all three MPGs at "low" viability based on widespread diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence (Hard et al. 2015). Based on the PSSTRT viability criteria, the DPS would be considered viable when all three component MPG are considered viable. A given MPG would be considered viable when: 1) 40 percent or more of its component DIPs are viable; 2) mean DIP viability within the MPG exceeds the threshold for viability; and 3) 40 percent or more of the historic life history strategies (i.e., summer runs and winter runs) within the MPG are viable. For a given DIP to be considered viable, its probability of persistence must exceed 85 percent, as calculated by Hard et al. (2015), based on abundance, productivity, diversity, and spatial structure within the DIP.

General Life History: PS steelhead exhibit two major life history strategies. Ocean-maturing, or winter-run fish typically enter freshwater from November to April at an advanced stage of maturation, and then spawn from February through June. Stream-maturing, or summer-run fish typically enter freshwater from May to October at an early stage of maturation, migrate to headwater areas, and hold for several months prior to spawning in the following spring. After hatching, juveniles rear in freshwater from one to three years prior to migrating to marine habitats (two years is typical). Smoltification and seaward migration typically occurs from April to mid-May. Smolt lengths vary between watersheds, but typically range from 4.3 to 9.2 inches (109 to 235 mm) (Myers et al. 2015). Juvenile steelhead are generally independent of shallow nearshore areas soon after entering marine water (Bax et al. 1978, Brennan et al. 2004, Schreiner et al. 1977), and are not commonly caught in beach seine surveys. Recent acoustic tagging studies (Moore et al. 2010) have shown that smolts migrate from rivers to the Strait of Juan de Fuca from one to three weeks. PS steelhead feed in the ocean waters for one to three years (two years is again typical), before returning to their natal streams to spawn. Unlike Chinook salmon, most female steelhead, and some males, return to marine waters following spawning (Myers et al. 2015).

Table 2. PS steelhead Major Population Groups (MPGs), Demographically Independent Populations (DIPs), and DIP Viability Estimates (Modified from Figure 58 in Hard *et al.* 2015).

Geographic Region (MPG)	Demographically Independent Population (DIP)	Viability
Northern Cascades	Drayton Harbor Tributaries Winter Run	Moderate
	Nooksack River Winter Run	Moderate
	South Fork Nooksack River Summer Run	Moderate
	Samish River/Bellingham Bay Tributaries Winter Run	Moderate
	Skagit River Summer Run and Winter Run	Moderate
	Nookachamps River Winter Run	Moderate
	Baker River Summer Run and Winter Run	Moderate
	Sauk River Summer Run and Winter Run	Moderate
	Stillaguamish River Winter Run	Low
	Deer Creek Summer Run	Moderate
	Canyon Creek Summer Run	Moderate
	Snohomish/Skykomish Rivers Winter Run	Moderate
	Pilchuck River Winter Run	Low
	North Fork Skykomish River Summer Run	Moderate
	Snoqualmie River Winter Run	Moderate
	Tolt River Summer Run	Moderate
Central and South Puget Sound	Cedar River Summer Run and Winter Run	Low
	North Lake Washington and Lake Sammamish Winter Run	Moderate
	Green River Winter Run	Low
	Puyallup River Winter Run	Low
	White River Winter Run	Low
	Nisqually River Winter Run	Low
	South Sound Tributaries Winter Run	Moderate
	East Kitsap Peninsula Tributaries Winter Run	Moderate
Hood Canal and Strait de Fuca	East Hood Canal Winter Run	Low
	South Hood Canal Tributaries Winter Run	Low
	Skokomish River Winter Run	Low
	West Hood Canal Tributaries Winter Run	Moderate
	Sequim/Discovery Bay Tributaries Winter Run	Low
	Dungeness River Summer Run and Winter Run	Moderate
	Strait of Juan de Fuca Tributaries Winter Run	Low
	Elwha River Summer Run and Winter Run	Low

<u>Spatial Structure and Diversity:</u> The PS steelhead DPS includes all naturally spawned anadromous steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts (USDC 2014). PS steelhead are the anadromous form of *O. mykiss*

that occur below natural barriers to migration in northwestern Washington State (Ford 2022). Non-anadromous ''resident'' *O. mykiss* (a.k.a. rainbow trout) occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2015). As stated above, the DPS consists of 32 DIPs that are distributed among three geographically-based MPG. An individual DIP may consist of winter-run only, summer-run only, or a combination of both life history types. Winter-run is the predominant life history type in the DPS (Hard et al. 2015).

Abundance and Productivity: Available data on total abundance since the late 1970s and early 1980s indicate that abundance trends have fluctuated between positive and negative for individual DIPs. The long-term abundance of adult steelhead returning to many rivers in Puget Sound has fallen substantially since estimates began for many populations in the late 1970s and early 1980s. Despite relative improvements in abundance and productivity for some DIPs between 2015 and 2019, particularly in the Central and South Puget Sound MPG, low productivity persists throughout the 32 DIPs, with most showing long term downward trends (Ford 2022). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIPs but remain predominantly negative, well below replacement for most DIPs, and most DIPs remain small (Ford 2022). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (Ford 2022). The PSSTRT concluded that the PS steelhead DPS is currently not viable (Hard et al. 2015). The most recent 5-year status review reported an increasing viability trend for the Puget Sound steelhead DPS, but also reported that the extinction risk remains moderate for the DPS, and that the DPS should remain listed as threatened (Ford 2022).

Limiting Factors: Factors limiting recovery for PS steelhead include:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania)
- Declining diversity in the DPS, including the uncertain but weak status of summer run fish
- A reduction in spatial structure
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition
- Dikes, hardening of banks with rip rap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

PS Steelhead within the Action Area: The PS steelhead in Colony Creek are winter-run fish from the Samish River and Bellingham Bay Tributaries DIP (Ford 2022; WDFW 2023a). The WDFW considers the Samish River stock to be native with wild production (WDFW 2023b). The abundance trend for the MPG is positive. Based on its last two 15-year spawner trends (1990-2005 and 2004-2019), the DIP's population growth rate was between 4 and 5%. The DIP's most recent 5-year geometric mean of raw natural spawner abundance (2015-2019) exhibited a 74% increase, with an average of 1,305 natural-origin spawners, which is an underestimate because the data doesn't include the tributaries to Bellingham Bay (Ford 2022). No specific abundance and trend data are available for steelhead in Colony Creek, but abundance is assumed to be very low due the very small size of the creek.

Spawning-suitable habitat has been documented both up- and downstream of the project site, but not within it (BA). Therefore, it is likely that both adult and juvenile steelhead salmon utilize the project site for freshwater migration, with juveniles also likely rearing there.

Based on the life history characteristics of other PS steelhead DIPs, returning winter-run adult steelhead typically enter their natal rivers from early November to the end of April or early May. Spawning can occur anytime between December and June. Although steelhead smolt typically migrate to marine waters between April and mid-May (Myers et al. 2015), juvenile steelhead rear in freshwater for 1 to 3 years. Therefore, juveniles are likely to be present in the action area year-round.

Critical Habitat

No critical habitat under NMFS jurisdiction has been designated within the expected range of effects from the proposed action.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The project site is located on Colony Creek, about 1.9 miles northwest of Bow, Washington (Figure 1). As described in the "Effects of the Action" section (2.5) in this opinion, work-related water quality impacts within about 300 feet downstream of in-water project activities would be the stressor with the greatest range of detectable effect, and post-work hydrological impacts may extend to about 80 feet upstream and 175 feet downstream of the in-water work area, based on the nearest bends in the creek that are about 30 degrees or more (GeoEngineers 2023e). Therefore, the action area is defined as the reach of Colony Creek that is within 80 feet upstream to 300 feet downstream of the in-water work area.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Climate Change: Climate change is a factor affecting the environmental baseline, aquatic habitats in general, and the status of the ESA-listed species considered in this opinion. Although its effects are unlikely to be spatially homogeneous across the region, climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species and the conservation value of designated critical habitats in the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC WGII 2022). Long-term trends in warming have continued at global, national, and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 °C (IPCC WGI 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI 2021). Globally, 2014 through 2018 were the 5 warmest years on record both on land and in the ocean (NOAA NCEI 2022). Events such as the 2013 through 2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming. Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature), and improving growth opportunity in both freshwater and marine environments are strongly advocated for in the recent literature (Siegel and Crozier 2020).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015; 2016; 2017; Crozier and Siegel 2018; Siegel and Crozier 2019; 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Below, we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will continue to impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreaks (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

<u>Freshwater Environments</u>

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

The magnitude of low river flows in the western U.S., which generally occur in September or October, and are driven largely by summer conditions and the prior winter’s precipitation. Although, low flows are more sensitive to summer evaporative demand than to winter precipitation, interannual variability is greater for winter precipitation. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation, which suggests that summer flows are likely to become lower, more variable, and less predictable over time.

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon O. nerka and the availability of suitable habitat for brown trout Salmo trutta and rainbow trout O. mykiss. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020; Myers et al. 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (Ou et al. 2015; Williams et al. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower stream flows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Ward et al. 2015; Williams et al. 2016). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

<u>Climate change effects on salmon and steelhead</u>

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact inter-gravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress. Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of in-route or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Barnett et al. 2020; Keefer et al. 2018).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Burke et al. 2013; Holsman et al. 2012). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon O. nerka from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018; Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Gosselin et al. 2021; Healey 2011; Wainwright and Weitkamp 2013). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010; Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples.

Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019; Munsch et al. 2022).

Environmental conditions at the project site and the surrounding area: The project site is located on Colony Creek, which is a small stream that originates in the southeastern area of the Chuckanut Mountains and drains into Samish Bay. The creek flows through a small basin with sparse rural residential development, scattered livestock pastures, and light agriculture. Per the applicant's BA, undeveloped areas consist predominantly of mixed coniferous and deciduous forests of western redcedar, Douglas fir, and red alder, with understories of blackberry, red elderberry, salmonberry, snowberry, and moderately sparse sword fern. The stream is perennial at the project location with typical summertime flows as low as 1 to 2 cubic feet per second.

The project area includes about 150 feet of Colony Creek stream channel and banks, roughly centered on the maintained (mowed) right-of-way (ROW) for the Olympic pipeline that transects the adjacent forested areas (Figure 1). Although there are no riparian trees or shrubs along the banks of the creek within the ROW, some wetland with emergent vegetation is reported within the ROW area at the project site.

The channel within the ROW is confined by 5-foot tall vertical soil banks. High bank confinement that alternates from one side of the channel to another occurs occasionally upstream and downstream of the project area. Gravels dominate the substrate throughout the reach, with scattered boulders and patches of cobbles and sand also present. Patches of consolidated clay on the banks and within the channel were also observed. Large woody material, including an artificial logjam is present within the immediate vicinity of the project area as well as upstream and downstream areas. Also, the existing 16-inch diameter gas pipeline lays exposed across the streambed at the project site. Downstream of the project area, culverts at the Blanchard Road and Colony Mountain Drive crossings are identified by WDFW as 33 percent passable partial barriers to fish migration.

The Washington State Department of Ecology (WDOE) identifies no water or sediment quality issues within the project area. However, about 2,000 feet downstream of the project area, the stream is identified on the State's 303d list as a Category 5 waterbody for bacteria, and Category 2 for dissolved oxygen and temperature (WDOE 2023).

Steelhead, coho salmon, and resident coastal cutthroat trout are documented in the project area, and critical habitat for PS steelhead has been designated in the creek about 2,000 feet downstream of the project area. No salmonid spawning has been documented within the project area, but it has been documented both up-and downstream of it. Therefore, the project area supports freshwater migration for adult and juvenile PS steelhead, and also likely supports juvenile rearing.

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

As described in Section 1.3, the USACE would authorize the applicant to perform about 8 weeks of work below the OHWM of Colony Creek between July 1 and September 30. Project work would include work area isolation with fish salvage, removal of some riparian trees and shrubs, and removal of an existing artificial logjam. It would also include excavation above and below the OHWM, installing a new pipeline about 6 feet below the stream bed, removal of the existing pipe crossing, streambed and bank restoration, installation of 4 large wood structures, and replanting disturbed upland areas.

The best available information about the proposed work supports the understanding that the demolition and construction would cause direct effects on fish and habitat resources at the project site through exposure to fish salvage, and work-related noise and pollutants. The proposed work would also cause indirect effects on fish and habitat resources through exposure to work-related habitat impacts such as forage and shelter diminishment, reduced riparian vegetation, and altered hydrological, biological, and chemical and processes.

The action's in-water work window avoids the normal migration and spawning seasons for returning adult PS steelhead, as well as the presence of eggs, interstitial, and newly emerged juveniles, and it occurs after that year's smolts would have departed the creek. However, because juvenile PS steelhead remain in freshwater for multiple years, low numbers of rearing juvenile steelhead are expected to remain in Colony Creek year-round.

2.5.1 Effects on Listed Species

Effects on species are a function of exposure and response. The duration, intensity, and frequency of exposure, and the life stage at exposure all influence the degree of response.

Fish Salvage

Exposure to fish salvage is likely to adversely affect juvenile PS steelhead. Fish that are within the isolated work area would be exposed to removal by nets and to electrofishing.

Handling and transfer processes can cause physical trauma and physiological stress responses in exposed fish (Moberg 2000; Shreck 2000). Contact with nets can cause scale and skin damage, and overcrowding of small fish in traps can cause stress and injury. The primary factors that contribute to stress and mortality from handling are: (1) Difference in water temperatures between the creek and the holding buckets; (2) dissolved oxygen levels; (3) the amount of time that fish are held out of the water; and (4) physical trauma. Stress from handling increases rapidly if water temperature exceeds 18ºC (64ºF), or if dissolved oxygen is below saturation.

Electrofishing and capture can cause stress, physical trauma, and mortality in exposed fish. Dalbey et al. (1996), Emery (1984), and Snyder (2003) describe responses that range from muscular contractions to mortality from exposure to electrofishing. Depending on the pulse train used, and the intensity and duration of exposure, muscular contractions may cause a lactic acid load and oxygen debt in muscle tissues (Emery 1984), it can cause internal hemorrhage and spinal fractures in 12 to 54% of the exposed fish, and acute mortality in about 2% (Dalbey et al. 1996). Severe interruption of motor function can stop respiration, and combinations of lactic acid load and oxygen debt may be irreversible, causing delayed mortality in apparently healthy fish. Obvious physical injuries often reduce long-term growth and survival, whereas uninjured to slightly injured fish showed long-term growth and survival rates similar to unexposed fish of similar age (Dalbey et al. 1996).

Based on the timing and location of the work, the applicant estimates that a maximum of 25 juvenile steelhead may be handled as part of this work (GeoEngineers 2023b). Based on the best available information for the region, the 2013 biological opinion completed for restoration activities in the Pacific Northwest Region (NMFS 2013) estimated that up to 5% of the salvaged fish are seriously injured or killed by that activity, which equals 1.25 for 25 fish. To avoid underestimating the take, and because there is no such thing as a fraction of a fish, we have rounded up to 2 fish. Therefore, no more than 2 juvenile steelhead are likely to be seriously injured or killed by fish salvage activities. The remaining fish would likely experience sub-lethal effects that are unlikely to affect their fitness or survival. Because the fish that may be injured or killed by this stressor would comprise such a tiny subset of their cohort, their potential loss would cause no detectable population-level effects.

Work-related Noise

Exposure to work-related noise is likely to adversely affect juvenile PS steelhead, but adults are extremely unlikely to be exposed. Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by up to 8 weeks of project-related work, particularly the use of heavy equipment to excavate and refill trenches, to reshape the creek bed and banks, and to install large wood structures, boulders, and streambed cobbles and gravels.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin et al. 2009), startle responses and altered swimming (Neo et al. 2014), abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin et al. 2010; Sebastianutto et al. 2011; Xie et al. 2008), and increased vulnerability to predators (Simpson et al. 2016). At higher intensities and or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift (TTS), Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift (PTS)) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin et al. 2010; Scholik and Yan 2002; Xie et al. 2008).

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds (Stadler and Woodbury 2009). The metrics are based on exposure to peak sound level and sound exposure level (SEL). Both are expressed in decibels (dB). The metrics are: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or 183 dB SEL_{cum} for fish under 2 grams. Further, any received level (RL) below 150 dB_{SEL} is considered "Effective Quiet". The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can potentially experience TTS or PTS from the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). When the range to the 150 dB_{SEL} isopleth exceeds the range to the applicable SEL_{CUM} isopleth, the distance to the 150 dB_{SEL} isopleth is typically considered the range at which detectable behavioral effects would begin, with the applicable SEL_{CUM} isopleth identifying the distance within which sound energy accumulation would intensify effects. However, when the range to the 150 dB_{SEL} isopleth is less than the range to the applicable SEL_{CUM} isopleth, only the 150 dB_{SEL} isopleth would apply because no accumulation of effects are expected for noise levels below 150 dB_{SEL}.

The discussion in Stadler and Woodbury (2009) indicate that these thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, Stadler and Woodbury's assessment did not consider non-impulsive sound, which is believed to be less injurious to fish than impulsive sound. Therefore, application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, these criteria represent the best available information. Therefore, to avoid underestimating potential effects, this assessment applies these criteria to the impulsive and non-impulsive sounds that are expected from the proposed work to gain a conservative idea of the potential effects that fish may experience due to exposure to that noise.

To further avoid underestimating potential impacts, this assessment considers work done both above and below the OHWM of the creek because sound that originates from outside of the water often radiates into the water via the substrate with little to no difference in attenuation than if it had originated in the water, and that the noise could be present anytime during the 8 weeks of project work. Also, is impossible to estimate the number of impulsive events that may occur from a workday's worth of excavation, backfilling, and rock installation, other than to expect that the number is likely to be enormous, and the range to the SEL_{cum} threshold would likely exceed that of effective quiet. Therefore, this assessment considers the range to the 150 dB_{SEL} isopleth as the maximum ranges for detectable acoustic effects from exposure to work-related noise.

The best available information to describe the in-water noise levels from excavation and installation of rocks is presented is a recent study that measured the in-water noise from excavator dredging of rocks (Reine *et al*. 2012). They report that the source level (sound level at 1 meter from the source) for the excavator bucket scooping rocks was about 179 dB_{RMS}. Based on the relationship between dB_{RMS}, dB_{peak}, and dB_{SEL} for impulsive sources, dB_{peak} is often about 16 dB higher than dB_{RMS}, while dB_{SEL} is typically about 10 dB lower. Based on this, NMFS estimates that excavation, backfilling, and rock installation could cause in-water sound levels of up to 194 dB_{peak} and 169 dB_{SEL} (Table 3). The expected peak source level is well below the 206 dB_{peak} threshold.

Table 3. Estimated in-water source levels for the loudest expected project-related sources with the estimated ranges to the source-specific effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
Excavator Bucket Strike	< 370 Hz Impulsive	194 dB_{peak}	206 @ N/A
		169 dB_{SEL}	150 @ 19 m

In the absence of location-specific transmission loss data, the NMFS typically uses some variation of the equation RL = SL – #Log(R) to estimate the received sound level at a given range from a source (RL = received level (dB); SL = source level (dB, 1 m from the source); # = spreading loss coefficient; and R = range in meters (m). Numerous acoustic measurements in shallow water environments support the use of a spreading loss coefficient of about 15 for projects like this one (CalTrans 2015; 2020). This value is considered the practical spreading loss coefficient, and was used for all sound attenuation calculations in this assessment. Application of the practical spreading loss equation to the expected SEL SL suggests that noise levels above the 150 dB_{SEL} threshold could extend to about 62 feet (19 m) around excavation, backfilling, and rock installation.

Any juvenile steelhead that are within about 62 feet of project-related excavation, backfilling, and rock installation are likely to experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Further, the intensity of these effects would increase with increased proximity to the source and or duration of exposure. Response to this exposure would be non-lethal, but some individuals may experience stress and fitness effects that could reduce their long-term survival, and individuals that are eaten by predators would be killed.

The number of juvenile PS steelhead that would be impacted by this stressor, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, the best available information about the numbers of juveniles that could be present at the site during the work, the planned work area isolation, and the small size of the affected area supports the expectation that the number of the juvenile steelhead that might be meaningfully affected by exposure to work-related noise would be too low to cause detectable population-level effects.

Work-related Pollutants

Exposure to work-related pollutants would cause minor effects in juvenile PS steelhead. Water quality in the creek would be temporarily affected by increased turbidity that may also reduce dissolved oxygen (DO) levels. It may also be affected by the introduction of toxic materials.

Turbidity: Installation and removal of the stream bypass would briefly mobilize small amounts of streambed sediments. Excavation, backfilling, and other streambed work would loosen a large amount of streambank and streambed sediments, and runoff from the upland work could also transport sediments to the creek.

The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU) that describe the opacity caused by the suspended sediments, or by the concentration of TSS as measured in milligrams per liter (mg/L). A strong positive correlation exists between NTU values and TSS concentrations. Depending on the particle sizes, NTU values roughly equal the same number of mg/L for TSS (i.e. 10 NTU = ~ 10 mg/L TSS, and 1,000 NTU = ~ 1,000 mg/L TSS) (Campbell Scientific Inc. 2008; Ellison et al. 2010). Therefore, the two units of measure are relatively comparable.

The effects on fish exposed to suspended sediments are somewhat species and size dependent (Bjornn and Reiser 1991). In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. At concentration levels of about 700 to 1,100 mg/l, minor physiological stress is reported in juvenile salmon only after about three hours of continuous exposure (Newcombe and Jensen 1996). Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU for a period of 4 hours or more (Berg and Northcote 1985; Robertson et al. 2006).

During construction, the work area would be dewatered by the stream bypass and pumps as needed to prevent its exposure to flowing water, and most upland erosion-mobilized sediments would be contained within upland sediment barriers. Upon completion of work, the disturbed streambank and streambed fine sediments would be covered by large wood structures and a layer of appropriately sized, clean streambed rocks, cobbles, and gravel that would greatly diminish the exposure of fine sediments to moving water after the bypass is removed.

Based on the available information, project-related turbidity in the creek would consist of TSS concentrations well below those described by Berg and Northcote (1985) and Robertson et al. (2006), and would be largely undetectable beyond 300 feet downstream of the project site, and last no more than one or two hours after work stops each day (Bloch 2010). If any PS steelhead are exposed to project-related turbidity, the duration of their exposure would likely be measured in minutes, and the plume concentrations would most likely be too low to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume and mild gill flaring. None of the potential responses, individually, or in combination would affect the fitness of exposed fish nor meaningfully affect their normal behaviors. Further, the timing of the work would prevent exposure of eggs and interstitial juveniles to the effects of sedimentation, and the TSS concentrations would be too low to measurably increase substrate embeddedness that could affect future spawning.

Dissolved Oxygen: Mobilization of anaerobic sediments can decrease dissolved oxygen levels (Hicks et al. 1991; Morton 1976). Sediment's impact on dissolved oxygen is a function of the oxygen demand of the sediment, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz et al. 1988). Reduced dissolved oxygen can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low dissolved oxygen levels (Hicks 1999). However, as described above, very little sediment would be mobilized in the creek. Further, it is very unlikely that the mobilized sediments would be anaerobic, and the well-oxygenated water in the stream flow beyond the project sites would quickly oxygenate the small volumes of affected water. This supports the expectation that any dissolved oxygen reductions would be too small and short-lived to cause detectable effects on the fitness or normal behaviors of any fish that may be exposed to the affected water.

Toxic Materials: Work-related spills and discharges may introduce toxic materials to the water. PS steelhead and other fish can uptake contaminants directly through their gills, and through dietary exposure (Karrow *et al*. 1999; Lee and Dobbs 1972; McCain *et al*. 1990; Meador *et al*. 2006; Neff 1982; Varanasi *et al*. 1993).

Some of the petroleum-based fuels, lubricants, and other fluids used by work-related equipment contain Polycyclic Aromatic Hydrocarbons (PAHs). Depending on the pollutant, its concentration, and or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Brette *et al*. 2014; Feist *et al*. 2011; Gobel *et al*. 2007; Incardona *et al*. 2004, 2005, and 2006; McIntyre *et al*. 2012; Meadore *et al*. 2006; Sandahl *et al*. 2007; Spromberg *et al*. 2015).

However, the project includes a comprehensive suite of BMPs intended to reduce the risk and intensity of work-related discharges. In the unlikely event of a spill or discharge, the amount of material released would likely be very small, and it would be quickly contained and cleaned up. Also, non-toxic and or biodegradable lubricants and fluids are strongly encouraged by the State, and are commonly used by many of the local contractors. Therefore, any in-water work-related contaminants would be very infrequent, very short-lived, and at concentrations too low to cause detectable effects on the fitness or normal behaviors of exposed fish.

Work-related Habitat Impacts

The proposed action's work-related habitat impacts would adversely affect PS steelhead. Project work would include temporary dewatering of about 150 linear feet of the stream, as well as removal of riparian vegetation, excavation and backfilling of trenches, minor reshaping of the creek bed and banks, installation of about 30 feet of rip rap along each bank, installation of stream-appropriate sediments along 150 feet of streambed, and installation of 4 large wood structures, 1 adjacent to each end of rip rapped bank (Figures 2 and 3). Those activities would immediately diminish forage and shelter availability, reduce riparian vegetation within the work area, and alter the hydrological, biological, chemical processes within the affected stream reach.

Forage and Shelter Diminishment: The proposed in-water work would temporarily diminish forage and shelter availability. Juvenile salmonids primarily prey on water-dependent aquatic organisms such as copepods, euphausiids, and larvae of many benthic species and fish, and on terrestrial-origin insects that fall into the water (NMFS 1997; NMFS 2006). They also utilize submerged aquatic vegetation (SAV), leaf litter, small branches, and large wood as shelter from predators.

Dewatering the in-water work area would kill many of the aquatic infaunal and epifaunal invertebrate organisms and SAV within the work area through desiccation and or asphyxiation, especially those that are on or near the surface of the substrate. The planned excavation and other earth work within the creek would move and rearrange stream substrates in ways that would kill both surface and deeper aquatic invertebrates and SAV by some combination of mechanical injury, desiccation, asphyxiation, and or burial.

The available information about ecosystem responses to excavation and dredging indicates that little recovery would occur during the first seven months after the work is complete, with early successional fauna increasing in abundance over the next six months (Jones and Stokes 1998). Full recovery of a site could take years. Therefore, the in-stream work would reduce forage and shelter availability within the affected stream reach for a year or more, which would be exacerbated by work-related removal of riparian vegetation (discussed below). Due to the small size of the affected area and the close proximity of unaffected habitat in the stream immediately upstream of the affected area that would help repopulate the affected area, the greatest impacts are not expected last much beyond a year or two. However small reductions in forage and shelter availability would persist for several years to decades, until the replacement riparian vegetation recovers to pre-construction levels of organic material input to the creek.

This work-related reduced forage and shelter availability within the affected areas is likely to cause some juvenile steelhead to avoid or abandon the affected area in favor of less disturbed and or more productive habitat, whereas others may remain within the affected area. The displaced individuals would increase inter- and intraspecific competition in the areas that they move to, while the individuals that remain within the degraded areas are likely to experience reduced forage and cover availability. The displacement and the reduced availability of shelter resources may also increase the risk of predation for some individuals. The intensity of effects that any individual may experience due to these exposures is uncertain and likely to be quite variable. However, to be protective, this assessment assumes that some small subset of the exposed juvenile steelhead is likely to experience reduced fitness and reduced long term survival due reduced forage and cover availability that would be attributable the proposed project's in-water work.

Riparian Vegetation Removal: The project would require the removal of 4 evergreen trees, 28 deciduous trees, and numerous shrubs to provide access to the project area and to perform the proposed work (Figure 2). After construction is complete, the applicant would replace the removed tress at about a 3 to 1 ratio, but also maintain their mowed ROW over the pipeline (Figure 3). They would plant 67 evergreen trees (hemlock, cedar and fir), 25 deciduous trees (maple and alder), replace cut shrubs using native shrubs at a 1 to 1 ratio, and also seed the disturbed areas with native grasses (GeoEngineers 2023b). However, the replacement vegetation would take several years to decades before it would provide ecological functions equitable to pre-construction levels.

Reduced riparian vegetation can alter in-stream chemical and biological functions. Chemical processes involve inputs of thermal energy and organic matter, as well as linkages to terrestrial food webs, the retention and export of nutrients and nutrient cycling in the aquatic food web, and gas exchange (Beechie et al. 2010). Biological processes include aquatic and riparian plant and animal growth, and community development and succession, which establish the biodiversity and influence the life histories of aquatic and riparian organisms (Harman et al. 2012).

Removal of riparian vegetation from the project area would slightly increase summer-time input of solar energy (insolation) to the creek. However, the relatively small size of the affected area compared to the large amount of existing riparian vegetation both up and downstream from the project area, combined with the continuous water flows from the upstream reaches of the creek's watershed that are largely shaded by riparian forest canopy supports the expectation that any action-related temperature increases would be very small, and unlikely to meaningfully increase water temperatures in the creek. Additionally, project-related increased insolation would diminish over time as the replacement vegetation matures. However, until the riparian vegetation has fully recovered, the increased insolation is likely to cause some juvenile steelhead to avoid the affected area, which could increase inter- and intraspecific competition in the adjacent areas.

Removal of streambank vegetation from the project area would reduce the input of terrestrial-origin organic matter, such as insects, leaf litter, small branches and large wood to the creek. Terrestrial insects that fall into streams are a forage resource for salmonids, and the decay of dead insects and leaf litter add to the in-stream nutrient cycle that supports the growth of aquatic algae and invertebrates that provide important shelter and forage resources for juvenile salmonids. Large wood that falls into streams provides shelter and also drives stream forming processes that are important to salmonids. The planned installation of large wood structures may partially offset some to effects of reduced large wood input to the affected stream reaches. However, it would not offset the reduction in terrestrial-origin insect and leaf litter input. Therefore, the reduced input of terrestrial-origin insects and leaf litter would exacerbate work-related forage and shelter diminishment within the affected stream reach (discussed immediately above).

Over the years-long vegetation recovery period, reduced riparian vegetation would slightly reduce forage and shelter availability in and slightly downstream of the areas with reduced input of terrestrial-origin organic matter, and increased in-water illumination would cause some avoidance or abandonment of unshaded areas. These impacts would be similar and additive to, but would last longer than those that would be caused by work-related forage and shelter diminishment discussed above. Due to the expected long recovery period for the replacement vegetation, this assessment assumes that a very small subset of the PS steelhead that pass through the affected area is likely to experience reduced fitness and long-term survival that would be attributable the proposed removal of riparian vegetation.

Altered Hydrological, Biological, and Chemical and Processes: As stated at the start of Work-related Habitat Impacts, this project would include minor reshaping of the creek bed and banks, installation of about 30 feet of rip rap along each bank, installation of stream-appropriate sediments along 150 feet of streambed, and installation of a large wood structure adjacent to each end of rip rapped bank (Figures 2 and 3).

Riverine habitats are the product of physical, chemical, and biological processes that interact together to form and maintain the streams (Fischenich 2003). Physical processes involve the interaction of hydrological forces with the substrate and objects in the streambed that drive geomorphic adjustments in the channel, floodplain, and riparian habitats. Chemical processes involve inputs of organic matter, retention and export of nutrients and thermal energy, nutrient cycling in the aquatic food web, linkages to terrestrial food webs, and gas exchange (Beechie *et al*. 2010). Biological processes include aquatic and riparian plant and animal growth, and community development and succession, which establish the biodiversity and influence the life histories of aquatic and riparian organisms (Harman *et al*. 2012).

Hydrological Processes

Under natural conditions, the physical shape and structure of a channel is ever-evolving in response to the interaction between the substrate type and sediment loads, the volume and velocity of water flow, and the presence of large wood. Changes in any of these features can alter erosion and deposition rates that drive geomorphic adjustments that can change the channel alignment and depth, as well as drive side channel formation or abandonment. It can also alter the exposed substrate (rock, gravel, sand, or mud bottoms), and cause changes in the presence of large wood.

Additionally, by design, bank stabilization structures, such as rip rap, replace naturally dynamic processes with a set of semi-permanent conditions that prevent natural channel migration past the structure, and alter fundamental channel and aquatic habitat formation processes (Cramer 2012). Many bank stabilization structures, especially older-style rip rap revetments and vertical bulkheads, redirect water flows and often cause unexpected changes in the stream-forming processes upstream and downstream from the stabilization structure, such as increased erosion, altered sediment recruitment and transport, and reduced formation of complex off-channel and edge habitat features such as undercut banks and alcove habitats (Fischenich 2003; Pracheil 2010). Also, most bank stabilization structures require periodic maintenance and repair to prevent their failure. The process often leads to ever-steepening banks, with reduced velocity diversity, depth diversity, substrate diversity, large wood recruitment and retention, and stream bank roughness along its length, which can exacerbate the effects identified above.

Bank stabilization structures often reduce or eliminate the input of large woody material along the protected banks because the structures are designed to prevent bank failure and large trees are typically prevented from growing along rip rapped banks. Typically, reduced input of large woody material negatively affects natural streambed and bank formation processes. However, the very short lengths of the proposed rip rap installations support the expectation they are unlikely to measurably reduce the future availability of large woody material in the creek.

The best available information indicates that the proposed work would alter water flows, which could impede natural stream-forming processes at the site and in adjacent parts of the creek, which, in turn, could reduce the affected area's ability to support salmonid spawning and rearing. Due to the complex relationships between the processes that are involved, it is virtually impossible to predict and quantify the exact effects the proposed work would have on stream hydrology, geomorphology, and habitat forming processes. However, the small size of the area and the short lengths of rip rapped bank, combined with installation of large wood structures adjacent to each end of rip rapped bank suggest that the impacts would be small. Further, the large wood structures may act to help soften the hydrological impacts of the rip rap, including providing some velocity diversity and stream bank roughness that could encourage some natural processes to occur at the site, such as large wood and sediment recruitment and distribution, which, over time, may increase depth and substrate diversity within the affected stream reach. The best available information supports the expectation that the proposed work would slightly reduce the affected area's ability to support salmonid spawning and rearing through slightly altered habitat forming processes. However, these effects are expected to be very small, and the structures' influence on those processes would likely decrease with time, distance from the structure, and with increasing size of flood events. Because the potential impacts related to bank stabilization structures are typically limited to the stream reach within the nearest bends in the stream, the area of affect is estimated to be between about 80 feet upstream to about 175 feet downstream from the ends of the project area (GeoEngineers 2023d).

Biological and Chemical and Processes

In addition to the impacts of work-related forage and shelter diminishment and loss of riparian vegetation discussed earlier, the proposed rip rap is likely to reduce juvenile salmonid use the affected banks.

Juvenile salmonids tend to aggregate more densely in edge habitats than in the center of streams and rivers where adult salmonids occur in greater numbers (Washington Trout 2006). Also, studies of Juvenile Chinook salmon also show that juvenile salmonids tend to select natural banks over hardened ones, and that the habitat provided by armored banks is typically degraded as compared to natural banks. Although not specifically discussed, it is assumed that juvenile steelhead are likely to react similarly to artificial banks. Juvenile salmonids are consistently more abundant along natural banks with wood, cobble, boulder, aquatic plants, and or undercut bank cover than they are along rip rap banks (Beamer and Henderson 1998; Peters et al. 1998). In a study of 667 bank stabilization structures of various designs in Washington State, fish densities were generally positively correlated with increased amounts of large woody debris and overhead vegetation within 30 cm of the water surface. Fish densities under those conditions were also consistently higher than those at the control sites. Conversely, fish densities at sites that were stabilized by rip rap alone were consistently lower than at control sites (Peters et al. 1998).

Based on the available information, the inclusion of large wood structures adjacent to the ends of the rip rapped banks would provide some of the features preferred by juvenile Chinook salmon.

However, it would do little to improve the acceptability of the rip rapped banks unless and until, over time, the large wood structures enhance the accumulation of natural sediments and woody debris along the rip rapped banks.

Therefore, it is likely that some rearing and migrating juvenile steelhead will selectively avoid the rip rapped banks in favor of more suitable habitat. As described earlier, displaced individuals may experience decreased fitness from increased competition, which may reduce their likelihood of survival. They may also experience increased exposure to predators. To be protective, the NMFS assumes that for the first 10 years after construction, very low numbers of juvenile PS steelhead would annually experience behavioral effects that would be attributable to avoidance of the proposed rip rap, and that those effects would reduce the fitness and long-term survival for some of the exposed individuals.

Conversely, the project's habitat improvement features are unlikely to cause any detectable negative impacts on the biological processes in the creek, and over time, they are likely to improve habitat-forming processes that would enhance the growth of native aquatic organisms and SAV, such that the availability of forage and shelter resources for PS steelhead would be improved over existing conditions. They may also act to improve the availability and quality of spawning habitat within the affected reach.

<u>In Summary:</u> The proposed project is likely to annually expose very low numbers of PS steelhead to some combination of diminished forage and shelter availability, and altered physical stream conditions at and slightly downstream of the Condos location. The exact duration of these impacts is uncertain, but forage and shelter availability are expected to return to very close to existing levels in 1 to 2 years, whereas the effects from the loss of riparian vegetation and installation of rip rap may persist for several years to a low number of decades.

The responses that these exposures would cause in juvenile steelhead would be highly variable, but are likely to include some combination of areal avoidance, reduced forage efficiency, increased inter- and intra-specific completion, and increased exposure to predators. The intensity of the effects that any exposed individuals would be likely to experience would also be highly variable, such that some individuals would experience no meaningful fitness or behavioral effects, while others would experience reduced fitness and reduced long-term survival, including low levels of mortality related to increased exposure to predators.

The number of individuals that would be annually exposed to these stressors is unquantifiable with any degree of certainty. However, based on the very small affected area, the low levels of utilization of this creek by PS steelhead, and the expectation that only a subset of the exposed individuals would be meaningfully affected, the annual numbers of individuals that would be meaningfully affected by these stressors would be too small to cause detectable population-level effects.

2.5.2 Effects on Critical Habitat

No critical habitat under NMFS jurisdiction has been designated within the expected range of effects from the proposed action.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02 and 402.17(a)]. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the discussion of the environmental baseline (Section 2.4).

The current conditions of ESA-listed species and designated critical habitat within the action area are described in the Range-wide Status of the Species and Critical Habitat and Environmental Baseline sections above. The non-federal activities in and upstream of the action area that have contributed to those conditions include past and on-going bankside development, vessel activities, and upland urbanization, as well as upstream forest management, agriculture, road construction, water development, subsistence and recreational fishing, and restoration activities. Those actions were, and continue to be, driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

The NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, the NMFS is reasonably certain that future non-federal actions such as the previously mentioned activities are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic input from point- and non-point pollutant sources will likely continue and increase into the future. Recreational and commercial use of the waters within the action area are also likely to increase as the human population grows.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS steelhead. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the opinion. It is also likely to increasingly affect the PBFs of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced dissolved oxygen, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but is likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation.

The proposed action will cause direct and indirect effects on the ESA-listed species and critical habitats considered in this opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA Listed Species

PS steelhead are listed as threatened based on declines from historic levels of abundance and productivity, loss of spatial structure and diversity, and an array of limiting factors as a baseline habitat condition. This species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, the effects on viability parameters of PS steelhead are also likely to be negative. In this context we consider how the proposed action's impacts on individuals would affect PS steelhead at the population and DPS scales.

The long-term abundance trend of the PS steelhead DPS is negative, especially for natural spawners. Abundance information is unavailable for about 1/3 of the DIPs. In most cases where no information is available, abundances are assumed to be very low. Although most DIPs for which data are available experienced improved abundance over the last five years, 95% of those

DIPs are at less than half of their lower abundance target for recovery. The extinction risk for the Puget Sound steelhead DPS is considered moderate. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species Ford 2022.

The project site is located about midway upstream on Colony Creek, about 1.9 miles northwest of Bow, Washington (Figure 1). The creek serves as a freshwater migration route to and from marine waters for adult and juvenile PS steelhead, with spawning-suitable habitat documented both up- and downstream of the project site. Therefore, it is likely that juveniles utilize the project area as rearing habitat as well.

The environmental baseline within the creek has been degraded by the effects of past and ongoing logging and agricultural practices, residential development, and relatively light road building and maintenance. Currently, the basin supports sparse rural residences, scattered livestock pastures and agriculture, and large forested areas. Additionally, the applicant's gas pipeline and its mowed ROW cross the creek at the project site, with the pipe currently laying exposed across the creek bed.

The PS steelhead most likely to occur in the action area would be winter-run fish from the Samish River and Bellingham Bay Tributaries DIP. The DIP is small to medium in size. The DIP's growth rate is positive, with an average of 1,305 natural-origin spawners estimated based on the 2015-2019 5-year geometric mean of raw natural spawner abundance (Ford 2022).

Up to 25 juvenile steelhead may be captured during fish salvage operations, with up to 2 resulting mortalities. Direct and indirect impacts from the work and from slightly altered habitat conditions are likely to cause a range of effects that both individually and collectively would cause altered behaviors and possible mortality in extremely low numbers of juveniles annually for several years following the completion of the project. However, the annual numbers of individuals that would be detectably affected by action-related stressors would be too low to cause any population-level effects.

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS steelhead DIP. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

No critical habitat under NMFS jurisdiction has been designated within the expected range of effects from the proposed action.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is the NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS steelhead, and it would have no effect on designated critical habitat for PS steelhead.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

2.9.1 Amount or Extent of Take

In the biological opinion, the NMFS determined that incidental take is reasonably certain to occur as follows:

Harm of PS steelhead from exposure to:

- Fish Salvage
- Work-related Noise
- Work-related Habitat Impacts

The applicant predicts that a maximum of 25 juvenile steelhead may be captured during fish salvage activities. Up to 2 of those fish are expected to be seriously injured or killed.

The NMFS cannot predict with meaningful accuracy the number of PS steelhead that are reasonably certain to be injured or killed annually by exposure to work-related noise and habitat impacts. The distribution and abundance of the PS steelhead that occur within the action area are affected by numerous biotic and environmental processes, such as timing in relation to the life stage and typical behaviors of the species under consideration, intra- and inter-specific interactions such as competition and predation, habitat quality, and the interaction of processes that influence genetic, population, and environmental characteristics. These processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Therefore, the distribution and abundance of listed fish in any given area are likely to vary greatly, and somewhat randomly, over time. Further, with the exception of the planned fish salvage, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may be injured or killed annually by exposure to the proposed action's impacts. In such circumstances, the NMFS uses the causal link established between an activity and the likely extent and duration of changes in habitat conditions as surrogates to describe the extent of take as a numerical level of habitat disturbance.

The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take. The timing of in-water work is applicable for all work-related noise because the proposed July 1 through September 30 in-water work window targets the period of time when juvenile steelhead would be least numerous, and adults would be absent. Therefore, working outside of the proposed work window could increase the number of juvenile PS steelhead that would be exposed to work-related stressors.

The size of the construction area; the amount and location of lost riparian vegetation; the location and amount of affected streambed and bank; the size of the proposed rip rapped banks; and the number, size, and location of the proposed large wood structures are the best available surrogates for the extent of take of juvenile PS steelhead from exposure to work-related habitat impacts. These surrogates are appropriate because the resulting fitness impacts would be positively correlated with the amount of degraded aquatic habitat and with the intensity of the degradation. As the size of impacted habitat increases, the number of fish that are likely to be exposed would increase. As the post-project in-stream features diverge from similarity to natural streambank and streambed conditions, the intensity of those installations' impacts on the fitness of exposed fish would increase.

In summary, the extent of PS steelhead take for this action is defined as:

- A maximum of 25 juvenile PS steelhead captured during fish salvage, with a up to 2 individuals being seriously injured or killed;
- In-water work to be completed between July 1 and September 30; and
- The size of the construction area; the amount and location of lost riparian vegetation; the location and amount of affected streambed and bank; the size of the rip rapped banks; and the number, size, and location of the proposed large wood structures as described in the proposed action section of this biological opinion.

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that could trigger the need to reinitiate consultation.

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective re-initiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger re-initiation because the

USACE has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

2.9.2 Effect of the Take

In the biological opinion, the NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species, and would have no effect on designated critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

The USACE shall require the applicant to:

1. Ensure the implementation of monitoring and reporting to confirm that the take exemption for the proposed action is not exceeded.

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE, and the applicant have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

    a. The USACE shall require the applicant to develop and implement plans to collect and report details about the take of listed fish. That plan shall:
        i. Require the applicant and or their contractor to maintain and submit records to verify that all take indicators are monitored and reported. Minimally, the records should include:
            1. Documentation of fish salvage activities. The applicant or their contractor shall maintain and submit fish salvage logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
                a. The identity (name, title, organization), qualification, and contact information of the persons conducting fish salvage, and the person completing the report;
                b. The date, time, and air and water temperatures during salvage work;
                c. The method(s) of capture and handling procedures that were used; and

    d. The species and quantities of captured fish, and their disposition at release (i.e. alive with no apparent injuries, alive with apparent minor/serious injuries, dead with/without apparent injuries).
  2. Documentation of the timing of in-water work to ensure that all in-water work is accomplished between July 1 and September 30; and
  3. Documentation of construction details to verify that they are consistent with the description of the proposed action in this opinion.

ii. Require the applicant to establish procedures for the submission of the construction records and other materials to the appropriate USACE office, and to submit an electronic post-construction report to the NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov, with "Attn: WCRO-2022-00825" included in the subject line.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

The proposed project includes design characteristics that would limit the impacts of the planned in-stream features on listed fish and on the quantity and quality of aquatic habitat features. It also includes a comprehensive set of BMPs to minimize work-related effects. The NMFS knows of no other reasonable measures that the applicant could include to further reduce the project's effects on PS steelhead, and consequently offers no conservation recommendations.

2.11 Re-initiation of Consultation

This concludes formal consultation for the USACE's authorization of Olympic Pipe Line Company LLC's MP 28.35 Colony Creek Pipeline Relocation project in Skagit County, Washington.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.12 "Not Likely to Adversely Affect" Determinations

This assessment was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence.

As described in Section 2 and below, the NMFS has concluded that the proposed action is not likely to adversely affect PS Chinook salmon and designated critical habitat for PS Chinook salmon and PS steelhead. Detailed information about the biology, habitat, and conservation status and trends of PS Chinook salmon can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, which are incorporated here by reference.

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.

2.12.1 Effects on Listed Species

The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the analyses of effects presented in Section 2.5. As described in Section 2.5, the range of detectable action-related stressors would be limited to the waters and substrates of Colony Creek that are within 80 feet upstream to 300 feet downstream of the in-water work area.

Documentation of PS Chinook salmon within Colony Creek is limited the lower reaches of the creek, stopping about 9,000 feet downstream from the project site (GeoEngineers. 2022a; WDFW 2023a). Therefore, it is extremely unlikely that any PS Chinook salmon would be exposed to any detectable effects from the proposed action.

2.12.2 Effects on Critical Habitat

As stated immediately above, and as described in Section 2.5, the range of detectable action-related stressors would be limited to the waters and substrates of Colony Creek that are within 80 feet upstream to 300 feet downstream of the in-water work area.

The closest PS Steelhead critical habitat in Colony Creek is about 2,000 feet downstream from the project site, and PS Chinook salmon critical habitat is limited to the estuarine portion of creek at its mouth to Samish Bay (NMFS 2023). Therefore, it is extremely that the proposed action would cause any detectable effects on the PBFs of designated critical habitat for either species.

For the reasons expressed immediately above, the NMFS has concluded that the proposed action is not likely to adversely affect ESA-listed PS Chinook salmon and designated critical habitat for PS Chinook salmon and PS steelhead.

3. MAGNUSON–STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with the NMFS on all actions or proposed actions that may adversely affect Essential Fish Habitat (EFH). Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces 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). Section 305(b) of the MSA also requires the NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the USACE and the descriptions of EFH contained in the fishery management plan for Pacific Coast salmon developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce (PFMC 2014).

3.1 Essential Fish Habitat Affected By the Project

The project site is located on Colony Creek, about 1.9 miles northwest of Bow, Washington (Figure 1). The waters and substrate of Colony Creek are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the Colony Creek watershed include Chinook and coho salmon.

Freshwater EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan, and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., large woody debris, pools, aquatic and terrestrial vegetation, etc.); (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition.

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The project area provides no known HAPC habitat features.

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the proposed action and its adverse effects on ESA-listed species and critical habitats, and is relevant to the effects on EFH for Pacific Coast Salmon. Based on the analysis of effects presented in Section 2.5 the proposed action will cause minor short- and long-term adverse effects on freshwater EFH for Pacific Coast Salmon as summarized below.

<u>Freshwater EFH for Pacific Coast Salmon</u>

1. <u>Water quality:</u> The proposed action would cause minor short-term adverse effects on this attribute. In-water excavation and other work would cause elevated turbidity, and very small pollutant discharges from construction equipment are also possible. The impacts on water quality are unlikely to be detectable beyond about 300 feet downstream of the project site, and they would persist no more than a low number of hours after work stops. The action would cause no measurable changes in water temperature or salinity.

2. <u>Water quantity, depth, and velocity:</u> The proposed action would likely cause a mix of minor long-term adverse and beneficial effects on the water depth and velocity attributes. The project's in-stream and bank features are intended to return the project site to conditions that would be more similar to the creek's conditions prior to the original installation of the pipe. However, the 2 30-foot long rip rapped bank sections and the 4 proposed large wood structures are likely to slightly alter water velocities and other stream forming factors at the site, which may slightly alter hydraulically driven habitat forming processes within the creek between about 80 feet upstream to about 175 feet downstream from the ends of the project area. The effects are likely to be minor and to reduce in intensity over time. No impacts on water quantity are expected.

3. <u>Riparian-stream-marine energy exchanges:</u> The proposed action would cause minor long-term adverse effects on this attribute. The proposed action would include the removal and replacement of riparian vegetation. Some parts of the creek may experience increased input of solar radiation and very slightly increased water temperatures due to the reduced canopy cover. Additionally, the removal of the vegetation would reduce the input of organic material of terrestrial origin to the stream, which is important to the in-stream nutrient cycle. The removal of the vegetation may also delay the input of large wood debris, which can affect water flows and velocities that drive stream forming processes. However, the delayed input of large wood would likely be offset by the planned installation of 4 large wood structures.

Impacts on riparian-stream energy exchange are unlikely to be detectable beyond about 300 feet downstream of the project area, but they may persist at diminishing intensity as the replacement vegetation grows to fully replace the existing functionality (likely several years after the end of the project).

4. Channel gradient and stability: The proposed action would likely cause a mix of minor long-term adverse and beneficial effects on this attribute. The project's in-stream and bank features are intended to return the project site to conditions that would be more similar to the creek's conditions prior to the original installation of the pipe. However, the 2 30-foot long rip rapped bank sections and the proposed large wood structures are likely to slightly alter water velocities and other stream forming factors at the site, which may slightly alter hydraulically driven habitat forming processes within the creek between about 80 feet upstream to about 175 feet downstream from the ends of the project area. The effects are likely to be minor and to reduce in intensity over time.

5. Prey availability: The proposed action would cause long-term minor adverse effects on this attribute. The project would remove or kill SAV and benthic invertebrates within the footprint of the in-water work area. Additionally, the removal of riparian vegetation would result in reduced input of organic material of terrestrial origin, all of which would negatively impact the in-stream nutrient cycle and reduce prey availability for juvenile salmonids in the creek. However, the impacts are expected to be very minor, and with the exception of riparian vegetation, prey availability is expected to return to preconstruction levels within one of two seasons after the end of the project.

6. Cover and habitat complexity: The proposed action would cause minor long-term adverse effects on this attribute. The proposed in-water work would remove or kill SAV along 150 feet of creek bed, and the removal of riparian vegetation would also reduce the input of leaf litter and branches. However, the planned installation of 4 large wood structures would provide cover that would help offset the loss, and SAV availability is expected to return to preconstruction levels within one of two seasons after the end of the project.

7. Space: No changes expected.

8. Habitat connectivity from headwaters to the ocean: No changes expected.

9. Groundwater-stream interactions: No changes expected.

10. Substrate composition: The proposed action would likely cause a mix of minor long-term adverse and beneficial effects on this attribute. The project's in-stream and bank features are intended to return the project site to conditions that would be more similar to the creek's conditions prior to the original installation of the pipe. However, the 2 30-foot long rip rapped bank sections and the proposed large wood structures may slightly increase erosion and gravel sedimentation at other locations within the creek between about 80 feet upstream to about 175 feet downstream from the ends of the project area. However, the intensity of the transposed erosion is likely to be very minor due to the design of the in-water features, and it is likely to reduce over time as the features mature. Additionally, the planned deep burial of

the currently exposed pipe is likely to reduce or eliminate ongoing inputs of fine sediments due to bank erosion at the ends of the pipe.res alter hydraulically driven habitat forming processes.

<u>Habitat Areas of Particular Concern (HAPCs)</u>

The project area provides no known HAPC habitat features.

3.3 Essential Fish Habitat Conservation Recommendations

The proposed project includes design characteristics that would limit the impacts of the planned in-stream features on the attributes of freshwater EFH for Pacific Coast Salmon. It also includes a comprehensive set of BMPs to minimize work-related effects. The NMFS knows of no other reasonable measures that the applicant could include to further reduce the project's effects on EFH for Pacific Coast Salmon, and consequently offers no conservation recommendations.

3.4 Supplemental Consultation

The USACE must reinitiate EFH consultation with the NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USACE. Other interested users could include the applicant, the WDFW, the governments and citizens of Skagit County, and Native American tribes. Individual copies of this opinion were provided to the USACE. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by the NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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