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-2021-02648

February 14, 2024

Susan Poulsom
Section Manager - NPDES Permitting Section
U.S. Environmental Protection Agency Region 10
1200 Sixth Avenue, Suite 155
Seattle, Washington 98101-3188

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the reissuance of National Pollutant Discharge Elimination System (NPDES) Permits for four tribally-owned wastewater treatment plants (WWTPs) that discharge to Puget Sound (WA0025666, HUC: 171100040700; WA0025658, HUC: 171100020500; WA0024805, HUC: 171100191100; WA0023256, HUC: 171100191000)

Dear Ms. Poulsom:

Thank you for your letter of October 13, 2021, 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 U.S. Environmental Protection Agency's (USEPA) reissuance of NPDES Permits for four tribally-owned WWTPs that discharge to Puget Sound. 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 (MSA)[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) Chinook salmon, PS steelhead, Puget sound/Georgia Basin (PS/GB) bocaccio, and PS/GB yelloweye rockfish. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon, PS/GB bocaccio, PS/GB yelloweye rockfish, and southern resident (SR) killer whales, but is not likely to result in the destruction or adverse modification of those designated critical habitats. This opinion also documents our conclusion that the proposed action may affect, but is not likely to adversely affect, southern eulachon, North American green sturgeon, humpback whales of the Central America and Mexico Distinct Population Segments (DPSs), SR killer whales, and leatherback sea turtles.

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 USEPA 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 Marine EFH for Pacific Coast Salmon, as well as EFH for Pacific Coast Groundfish and Coastal Pelagic Species. Therefore, we have provided 2 conservation recommendations that can be taken by the USEPA to avoid, minimize, or otherwise offset potential adverse effects on EFH.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to the NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the USEPA must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, the NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

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: Sally Goodman, USEPA
Erin Seyfried, USEPA

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

Reissuance of NPDES Permits for four tribally-owned WWTPs that discharge to Puget Sound, Washington (WA0025666; WA0025658; WA0024805; WA0023256)

NMFS Consultation Number: WCRO-2021-02648

Action Agencies: U.S. Environmental Protection Agency

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	Yes	No	Yes	No
Steelhead (*O. mykiss*) PS	Threatened	Yes	No	N/A	N/A
bocaccio (*Sebastes paucispinis*) Puget Sound /Georgia Basin (PS/GB)	Endangered	Yes	No	Yes	No
yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	Yes	No	Yes	No
eulachon (*Thaleichthys pacificus*) Southern	Threatened	No	No	N/A	N/A
North American green sturgeon (*Acipenser medirostris*) Southern	Threatened	No	No	N/A	N/A
humpback whales (*Megaptera novaeanglia*)					
Central America	Endangered	No	No	N/A	N/A
Mexico	Threatened	No	No	N/A	N/A
killer whales (*Orcinus orca*) Southern resident (SR)	Endangered	No	No	Yes	No
leatherback sea turtle	Endangered	No	No	N/A	N/A

N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

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	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	Yes	Yes

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: February 14, 2024

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ATC – Anthropogenic Trace Compounds
BE – Biological Evaluation
BMP – Best Management Practices
BOD_5 –Biochemical Oxygen Demand (5-day)
CFR – Code of Federal Regulations
CSO – Combined Sewer Overflow
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
GB – Georgia Basin
HAPC – Habitat Area of Particular Concern
HHCB – Hexahydrohexa methylcyclopentabenzopyran (synthetic musk used in cosmetics)
HUC – Hydrologic Unit Code
ITS – Incidental Take Statement
LTSWD - Lummi Tribal Sewer and Water District
MGD – Million Gallons per Day
µg/L – Microgram per Liter
mg/L – Milligram per Liter
MLLW – Mean Lower Low Water
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
ng/L – Nanogram per Liter
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
PAH – Polycyclic Aromatic Hydrocarbon
PBF – Physical or Biological Feature
PBDE – Polybrominated Diphenyl Ether
PBT – Persistent, Bioaccumulative and Toxic chemicals
PCB- Polychlorinated Biphenyl
PFMC – Pacific Fishery Management Council
POP – Persistent Organic Pollutant
PPCP – Pharmaceuticals and Personal Care Products
PS – Puget Sound
PSP – Paralytic Shellfish Poisoning
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RBC – Rotating Ciological Contactor
RPA – Reasonable and Prudent Alternative

RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SBR – Sequencing Batch Reactor
SR – Southern Resident (Killer Whales)
TRC – Total Residual Chlorine
TSS – Total Suspended Solids
USEPA – U.S. Environment al Protection Agency
USGS – U.S. Geological Survey
UV – Ultraviolet
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology
WWTP – Wastewater Treatment Plant

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 October 13, 2021, the NMFS received a letter from the U.S. Environmental Protection Agency's (USEPA) requesting informal consultation for their reissuance of National Pollutant Discharge Elimination System (NPDES) Permits for four tribally-owned wastewater treatment plants (WWTPs) that discharge to Puget Sound (USEPA 2021a). The request included the USEPA's Biological Evaluation (BE; USEPA 2021b). The NMFS considers that consultation was initiated on October 13, 2021.

On January 4, 2023, the NMFS requested copies of the current and proposed NPDES permits for the four WWTPs proposed for permit renewals. On January 6, 2023, the USEPA responded by email to provide links to the requested documents (USEPA 2023a). The USEPA provided more information via emails sent on a February 28, 2023 and December 14, 2023 (USEPA 2023b; 2023c).

This opinion is based on the information in the emails and documents identified above; in the recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/BG yelloweye rockfish, and SR killer whales; in the published and unpublished scientific information on the biology and ecology of those species; and in 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 (see 50 CFR 402.02). Under 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 USEPA proposes to reissue National Pollutant Discharge Elimination System (NPDES) permits for four minor wastewater treatment plants (WWTPs) that are on tribal lands, and which discharge to Puget Sound: Lummi Gooseberry Point WWTP (NPDES Permit No. WA0025666); Lummi Sandy Point WWTP (NPDES Permit No. WA0025658); Tulalip WWTP (NPDES Permit No. WA0024805); and Suquamish WWTP (NPDES Permit No. WA0023256) (Figure 1). All four WWTPs are considered minor facilities because their individual design flows are less than 1 million gallons per day (MGD). The permits would all have 5-Year terms.

Figure 1. Google Earth photograph of Northwest Washington State and Puget Sound showing the locations of the Lummi Gooseberry Point WWTP, the Lummi Sandy Point WWTP, the Tulalip WWTP and the Suquamish WWTP.

Due to the wide-spread and varied locations of the four WWTPs and their respective outfalls, the descriptions of the proposed actions for each WWTP are described separately.

The Lummi Gooseberry Point WWTP is located on the Lummi Reservation in Bellingham, Washington (Figure 1). The facility, as well as its permit history and conditions are described in the current NPDES permit, the BE, the Draft NPDES permit, and in the current Fact Sheet for the facility (USEPA 2011a; & 2021b; 2021c; 2021d). The facility is owned and operated by the Lummi Tribal Sewer and Water District (LTSWD), and serves a population of 2,771 residents. The collection system includes no input of stormwater, no combined sewer overflow (CSO) is permitted, and there are no industrial discharges to the facility. The WWTP currently discharges its effluent under the USEPA-issued NPDES Permit No. WA-002566-6, which was issued in 2011, and administratively extended in 2016 (USEPA 2021b).

The facility provides secondary treatment, using screens, an aerated grit chamber, a rotating biological contactor (RBC) system, and ultraviolet (UV) disinfection to remove suspended and dissolved solids from the influent and to disinfect the effluent (USEPA 2021b; 2021c; 2021d). The proposed permit retains a chlorine limit in the event of failure of the UV system. The outfall (001) is located in the estuarine waters of Hale Passage, about 925 feet from shore, at about 20 feet below the water surface (Figure 2). The outfall consists of a 2-port T-shaped diffuser with 4-inch diameter ports that are situated about 1.5 feet above the substrate.

Figure 2. Google Earth photograph showing the Lummi Gooseberry Point WWTP and the approximate location of its outfall.

The Lummi Gooseberry Point WWTP has a design flow of 0.375 million gallons per day (MGD), with reported actual flows of 0.08 to 0.48 MGD (USEPA 2021b; 2021c; 2021d). As detailed in Table 1 of the June 2021 draft NPDES Permit No. WA0025666 (USEPA 2021c), the proposed permit would limit the authorized discharge of Biochemical Oxygen Demand (5-day; BOD_5) and Total Suspended Solids (TSS) to weekly averages of 141 pounds per day each, Fecal Coliform Bacteria to a weekly geometric mean of 400 cfu/100ml, Total Residual Chlorine (TRC) to a daily maximum of 0.52 mg/L (520 µg/L), and pH to 6.0 to 9.0 at all times. The Fact Sheet for the permit renewal identifies chronic and acute mixing zones with respective radii of 218.8 and 21.9 feet (66.69 and 6.68 meters) that have been authorized for this facility by the Washington State Department of Ecology (WDOE-authorized).

The proposed NDPES permit also includes additional conditions such as required effluent monitoring, and the development and implementation of an operations and maintenance plan, a quality assurance plan for data collection, a facility response plan in case design criteria for flow, BOD loading, or TSS loading are exceeded, and an emergency response plan.

The Lummi Sandy Point WWTP is located on the Lummi Reservation in Ferndale, Washington (Figure 1). The facility, as well as its permit history and conditions are described in the current NPDES permit, the BE, the Draft NPDES permit, and in the current Fact Sheet for the facility (USEPA 2011b; 2021b; 2021e; 2021f). The facility is owned and operated by the LTSWD, and serves a population of 2,110 residents. The collection system includes no input of stormwater, no CSO is permitted, and there are no industrial discharges to the facility. The WWTP currently discharges its effluent under the USEPA-issued NPDES Permit No. WA-002565-8, which was issued in 2011, and administratively extended in 2016 (USEPA 2021b).

The facility provides secondary treatment, using screens, an aerated grit chamber, and an RBC system with UV disinfection to remove suspended and dissolved solids from the influent's and to disinfect the effluent. The permit retains a chlorine limit in the event of failure of the UV system. The outfall (001) is located in the estuarine waters of Georgia Strait, about 1,458 feet from shore, and about 19 feet below the water surface (Figure 3). The outfall consists of a 2-port T-shaped diffuser with 4-inch diameter ports that are situated about 1.5 feet above the substrate.

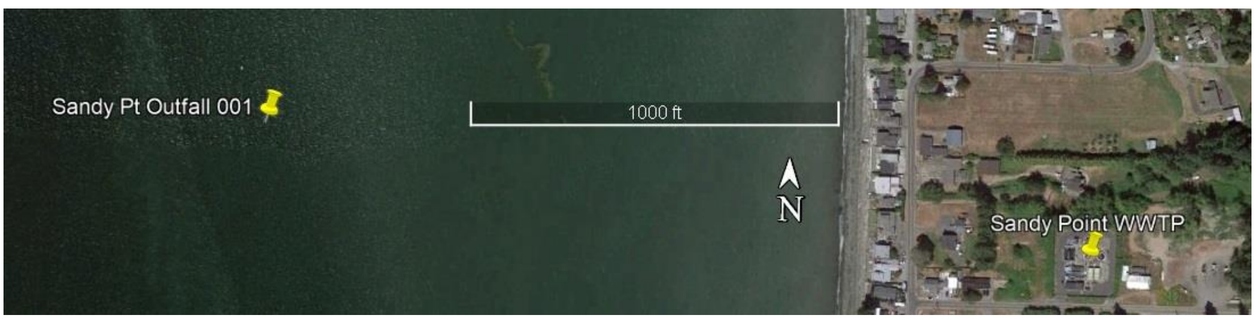

Figure 3. Google Earth photograph showing the Lummi Sandy Point WWTP and the approximate location of its outfall.

The Lummi Sandy Point WWTP has a design flow of 0.25 MGD, with reported actual flows of 0.024 to 0.55 MGD (USEPA 2021b; 2021e; 2021f). As detailed in Table 1 of the June 2021 draft NPDES Permit No. WA0025658 (USEPA 2021e), the proposed permit would limit the authorized discharge of BOD_5 and TSS to weekly averages of 94 pounds per day each, Fecal Coliform Bacteria to a weekly geometric mean of 400 cfu/100ml, TRC to a daily maximum of 0.65 mg/L, and pH to 6.0 to 9.0 at all times. The Fact Sheet for the permit renewal identifies WDOE-authorized chronic and acute mixing zones with respective radii of 218.5 and 21.9 feet (66.69 and 6.68 meters) for this facility's outfall.

The proposed NDPES permit also includes additional conditions such as required effluent monitoring, and the development and implementation of an operations and maintenance plan, a quality assurance plan for data collection, a facility response plan in case design criteria for flow, BOD loading, or TSS loading are exceeded, and an emergency response plan.

The Tulalip WWTP is located on the Tulalip Reservation in Tulalip, Washington (Figure 1). The facility, as well as its permit history and conditions, are described in the current NPDES permit, the BE, the Draft NPDES permit, and in the current Fact Sheet for the facility (USEPA 2009; & 2021b; 2021g, 2021h). The facility is owned and operated by the Tulalip Tribes of Washington, and serves a population of 3,200 residents. The collection system includes no input of stormwater, no CSO is permitted, and there are no industrial discharges to the facility. The WWTP currently discharges its effluent under the USEPA-issued NPDES Permit No. WA-002480-5, which was issued in 2009, and administratively extended in 2014 (USEPA 2021b).

The facility provides secondary treatment, using screens and an activated sludge system with UV disinfection to remove suspended and dissolved solids from the influent's and to disinfect the effluent (USEPA 2021a & d). The outfall (001) is located in the estuarine waters of Possession Sound, about 1,600 feet from shore, and about 51 feet below the water surface (Figure 4). The outfall consists of a 12-inch diameter pipe that is open on the end.

Figure 4. Google Earth photograph showing the Tulalip WWTP and the approximate location of its outfall.

The Tulalip WWTP has a design flow of 0.616 MGD, with reported actual flows of 0.168 to 0.372 MGD (USEPA 2021b; 2021g; 2021h). As detailed in Table 1 of the April 2021 draft NPDES Permit No. WA0024805 (USEPA 2021g), the proposed permit would limit the authorized discharge of BOD_5 and TSS to weekly averages of 231 pounds per day each, Fecal Coliform Bacteria to a weekly geometric mean of 400 cfu/100ml, and pH to 6.0 to 9.0 at all times. The Fact Sheet for the permit renewal identifies WDOE-authorized chronic and acute mixing zones with respective radii of 251 and 25.1 feet (76.5 and 7.65 meters) for this facility's outfall.

The proposed NDPES permit also includes additional conditions such as required effluent monitoring, and the development and implementation of an operations and maintenance plan, a quality assurance plan for data collection, a facility response plan in case design criteria for flow, BOD loading, or TSS loading are exceeded, and an emergency response plan.

The Suquamish WWTP is located on the Suquamish Reservation in Suquamish, Washington (Figure 1). The facility, as well as its permit history and conditions are described in the current NPDES permit, the BE, the Draft NPDES permit, and in the current Fact Sheet for the facility (USEPA 2008; 2019a & b; 2021b). The facility is owned and operated by Kitsap County, and serves a population of 2,770 residents, and receives an additional 81,500 gallons per day of domestic wastewater from the Suquamish Clearwater Casino Resort. The collection system includes no input of stormwater, no CSO is permitted, and there are no industrial discharges to the facility. The WWTP currently discharges its effluent under the USEPA-issued NPDES Permit No. WA-002325-6, which was administratively extended in 2013 (USEPA 2021b).

The facility provides secondary treatment, using screens, a grit chamber, a Sequencing Batch Reactor (SBR) system, and UV disinfection to remove suspended and dissolved solids from the influent's and to disinfect the effluent (USEPA 2019a & 2021b). The outfall (001) is located in the estuarine waters of Port Madison, about 2,285 feet from shore, and about 43 feet below the water surface (Figure 5). The outfall is equipped with a 4-port diffuser that consists of 12-inch diameter pipe with 2 horizontal 6-inch diameter ports, a vertical 4-inch diameter port on the top, and an opening of unspecified size on the end of the pipe.

Figure 5. Google Earth photograph showing the Suquamish WWTP and the approximate location of its outfall.

The Suquamish WWTP has a design flow of 0.40 MGD, with reported actual flows of 0.15 to 0.48 MGD (USEPA 2019a & b; 2021b). As detailed in Table 1 of the September 2019 draft NPDES Permit No. WA0023256 (USEPA 2019a), the proposed permit would limit the authorized discharge of BOD_5 and TSS to weekly averages of 150 pounds per day each, Fecal Coliform Bacteria to a weekly geometric mean of 400 cfu/100ml, and pH to 6.0 to 9.0 at all times. The Fact Sheet for the permit renewal identifies WDOE-authorized chronic and acute mixing zones with respective radii of 243 and 24.3 feet (74.1 and 7.41 meters) for this facility's outfall.

The proposed NDPES permit also includes additional conditions such as required effluent monitoring, and the development and implementation of an operations and maintenance plan, a quality assurance plan for data collection, a facility response plan in case design criteria for flow, BOD loading, or TSS loading are exceeded, and an emergency response plan.

<u>Compliance History and Expectations</u>

The facilities have varied histories of compliance with their permits. The Lummi Gooseberry Point and Sandy Point WWTPs have had several effluent limit violations in recent years. The Tulalip WWTP had many effluent limit violations prior to 2017, after which compliance has steadily improved, with two effluent limit violations occurring in 2022 and none in 2023. For all three facilities, effluent limit violations are typically small deviations from percent removal limits for BOD and TSS, versus effluent concentration or loading of those or other parameters. The Suquamish WWTP has had no effluent limit violations in recent years (USEPA 2023d).

Based on the compliance history for these facilities, occasional effluent limit exceedances may occur in the future. To address these occurrences, the Permittees are required to take steps (i.e. corrective action) to reduce, eliminate, and prevent the reoccurrence of effluent limit exceedances. Therefore, this consultation accounts for such variability and associated corrective action.

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. We determined that the proposed action would cause episodic maintenance work and or replacement of the four outfall pipes and their diffusers. However, that work is extremely likely to require permitting by the U.S. Army Corps of Engineers, which would trigger the need for consultation with the NMFS. Therefore, future maintenance and or replacement of the outfalls is not considered in this consultation.

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 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 USEPA determined that the proposed action would have no effect or is not likely to adversely affect the species and designated critical habitats identified in Table 1. However, the NMFS concluded that the proposed action may affect all of the species identified in Table 1.

Table 1. ESA-listed species and critical habitat that may be affected by the proposed action, with effects conclusions based on this biological opinion.

ESA-listed species and or critical habitat likely to be adversely affected (LAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound	Threatened	LAA	LAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)
steelhead (*O. mykiss*) Puget Sound	Threatened	LAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
bocaccio (*Sebastes paucispinis*) Puget Sound/Georgia Basin	Endangered	LAA	LAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	LAA	LAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
killer whales (*Orcinus orca*) southern resident	Endangered	NLAA	LAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
eulachon (Thaleichthys pacificus) southern	Threatened	NLAA	N/A	03/18/10 (75 FR 13012) / 10/20/11 (76 FR 65324)
North American green sturgeon (*Acipenser medirostris*) southern	Threatened	NLAA	N/A	04/07/06 (71 FR 17757) / 10/09/09 (74 FR 52300)
Humpback whales (Megaptera novaeangliae)				
Mexico	Threatened	NLAA	N/A	09/08/16 (81 FR 62260) / N/A
Central America	Endangered	NLAA	N/A	09/08/16 (81 FR 62260) / N/A
leatherback sea turtle	Endangered	NLAA	N/A	06/02/1970 (35 FR 8491) / 01/26/12 (77 FR 4170)

LAA = likely to adversely affect NLAA = not likely to adversely affect
N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

The NMFS proceeded with formal consultation because we also concluded that the proposed action is likely to adversely affect PS Chinook salmon and their critical habitat, PS steelhead, PS/GB bocaccio and PS/GB yelloweye rockfish and their critical habitats, and critical habitat for SR killer whales. Our conclusion that the proposed action is not likely to adversely affect southern eulachon, southern North American green sturgeon, humpback whales (Central America and Mexico DPSs), SR killer whales, and leatherback sea turtles is documented in the "Not Likely to Adversely Affect" Determinations section (2.12) of this opinion.

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 designations of critical habitat for the many species considered in this opinion use the terms primary constituent element or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced those terms with "physical or biological features" (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified primary constituent elements, essential features, or PBFs. In this biological opinion, we use the term PBF to mean primary constituent element or essential feature, as appropriate for the specific critical habitat.

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 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) Chinook Salmon

The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (SSPS 2007) and the final supplement to the Shared Strategy's Puget Sound salmon recovery plan (NMFS 2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002). The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet all the Viable Salmon Population (VSP) parameters are sustained to provide ecological functions and preserve options for ESU recovery.

General Life History: Chinook salmon are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C), but some tolerance to higher temperatures is documented with acclimation. Adult Chinook salmon spawn in freshwater streams, depositing fertilized eggs in gravel "nests" called redds. The eggs incubate for three to five months before juveniles hatch and emerge from the gravel. Juveniles spend from three months to two years in freshwater before migrating to the ocean to feed and mature. Chinook salmon spend from one to six years in the ocean before returning to their natal freshwater streams where they spawn and then die.

Chinook salmon are divided into two races, stream-types and ocean-types, based on the major juvenile development strategies. Stream-type Chinook salmon tend to rear in freshwater for a year or more before entering marine waters. Conversely, ocean-type juveniles tend to leave their natal streams early during their first year of life, and rear in estuarine waters as they transition into their marine life stage. Both stream- and ocean-type Chinook salmon are present, but ocean-type Chinook salmon predominate in Puget Sound populations. Chinook salmon are further grouped into "runs" that are based on the timing of adults that return to freshwater. Early- or spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Late- or fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks. Summer-run fish show intermediate characteristics of spring and fall runs, without the extensive delay in maturation exhibited by spring-run Chinook salmon. In Puget Sound, spring-run Chinook salmon tend to enter their natal rivers as early as March, but do not spawn until mid-August through September. Returning summer- and fall-run fish tend to enter the rivers early-June through early-September, with spawning occurring between early August and late-October.

Yearling stream-type fish tend to leave their natal rivers late winter through spring, and move relatively directly to nearshore marine areas and pocket estuaries. Out-migrating ocean-type fry tend to migrate out of their natal streams beginning in early-March. Those fish rear in the tidal delta estuaries of their natal stream for about two weeks to two months before migrating to marine nearshore areas and pocket estuaries in late May to June. Out-migrating young of the year parr tend to move relatively directly into marine nearshore areas and pocket estuaries after leaving their natal streams between late spring and the end of summer.

Spatial Structure and Diversity: The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015; Ford 2022). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPGs), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 2).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaus et al. 2002, NWFSC 2015).

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/SouthPuget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Hatchery-origin spawners are present in high fractions in most populations within the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawners. Between 1990 and 2019, the fraction of natural-origin spawners has declined in many of the populations outside of the Skagit watershed, and the ESU overall remains at a "moderate" risk of extinction (Ford 2022).

Abundance and Productivity: Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Further, across the ESU, 10 of 22 MPGs show natural productivity below replacement in nearly all years since the mid-1980s, and the available data indicate that there has been a general decline in natural-origin spawner abundance across all MPGs over the most-recent fifteen years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery (Ford 2022). Based on the current information on abundance, productivity, spatial structure and diversity, the most recent 5-year status review concluded that the PS Chinook salmon ESU remains at "moderate" risk of extinction, that viability is largely unchanged from the prior review, and that the ESU should remain listed as threatened (Ford 2022).

Limiting Factors: Factors limiting recovery for PS Chinook salmon include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Severely altered flow regime

PS Chinook Salmon within the Action Area: The PS Chinook salmon most likely to be exposed to the effluent discharges from the Lummi Gooseberry Point & Sandy Point WWTPs would be from the north fork and south fork Nooksack River populations, followed by fish from the Skagit River Basin populations (Ford 2022; WDFW 2023a). However, it is quite possible that over time, varied mixtures of fish from any of the populations within the Whidbey Basin MPG and the Central/South Sound MPG could pass through the area where they could be exposed to effluent from those WWTPs. The estuarine water and gently sloping substrates with eelgrass and macroalgae and or kelp in the areas adjacent to the Gooseberry Point and the Sandy Point WWTP outfall locations (USEPA 2021b) supports the expectation that juvenile Chinook salmon would utilize both areas for marine nearshore rearing and migration throughout the summer months. Returning adults are also likely to utilize the general areas as migration routes.

The PS Chinook salmon most likely to be exposed to the effluent discharges from the Tulalip WWTP would be fish from any of the populations within Whidbey Basin MPG, followed by varied mixtures of fish from any of the populations within the Central/South Sound MPG (Ford 2022; WDFW 2023a). However, over time, it is quite possible that varied mixtures of fish from any of the Puget Sound populations could pass through the area where they could be exposed to effluent from the Tulalip WWTP. The estuarine water and the presence of eelgrass in the area adjacent to the outfall (USEPA 2021b) supports the expectation that juvenile Chinook salmon would utilize the area for marine nearshore rearing and migration throughout the summer months. Returning adults are also likely to utilize the general area as a migration route.

The PS Chinook salmon most likely to be exposed to the effluent discharges from the Suquamish WWTP would be some mix of fish from any of the populations within Central/South Sound MPG, followed by varied mixtures of fish from any of the populations within the Whidbey Basin MPG (Ford 2022; WDFW 2023a). However, over time, it is quite possible that varied mixtures of fish from any of the Puget Sound populations could pass through the area where they could be exposed to effluent from the Suquamish WWTP. The Suquamish WWTP outfall is located offshore and well outside of areas with habitat features that are considered supportive of marine nearshore rearing for juvenile Chinook salmon (USEPA 2021b), which suggests that Chinook salmon presence near the outfall would be limited to emigrating juveniles and returning adults.

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 3). 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 3. 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

Spatial Structure and Diversity: 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).

<u>Abundance and Productivity:</u> 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).

<u>Limiting Factors:</u> 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 riprap, 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 most likely to be exposed to the effluent discharges from the Lummi Gooseberry Point & Sandy Point WWTPs would be from the Nooksack and the south fork Nooksack River DIPs, followed by fish from the other DIPs within the North Cascades MPG (Ford 2022; WDFW 2023a). However, over time, it is quite possible that varied mixtures of fish from any of the Puget Sound DIPs could pass through the area where they could be exposed to effluent from the Lummi WWTPs.

The PS steelhead most likely to be exposed to the effluent discharges from the Tulalip WWTP would be fish from any of the populations within North Cascades MPG, followed by varied mixtures of fish from any of the populations within the Central & South Puget Sound MPG (Ford 2022; WDFW 2023a). However, over time, it is quite possible that varied mixtures of fish from any of the Puget Sound DIPs could pass through the area where they could be exposed to effluent from the Tulalip WWTP.

The PS steelhead most likely to be exposed to the effluent discharges from the Suquamish WWTP would be some mix of fish from any of the DIPs within Central & South Puget Sound MPG, followed by varied mixtures of fish from any of the populations within the Whidbey Basin MPG (Ford 2022; WDFW 2023a). However, over time, it is quite possible that varied mixtures of fish from any of the Puget Sound DIPs could pass through the area where they could be exposed to effluent from the Suquamish WWTP.

At all four outfalls, emigrating juvenile steelhead and returning adults are likely to utilize the general areas as migration routes. However, the degree to which that occurs, and their typical proximity to the outfalls during migration past the area are unknown.

Puget Sound/Georgia Basin (PS/GB) Bocaccio and Yelloweye Rockfish

On April 28, 2010, the PS/GB bocaccio distinct population segment (DPS) was listed as endangered, and the PS/GB yelloweye rockfish DPS was listed as threatened (75 FR 22276). In April 2016, we completed a 5-year status review that recommended the DPSs retain their endangered and threatened classifications (Tonnes et al. 2016), and we released a recovery plan in October 2017 (NMFS 2017).

The waters of Puget Sound and Straits of Georgia can be divided into five interconnected basins that are largely hydrologically isolated from each other by relatively shallow sills (Burns 1985; Drake et al. 2010). The basins within US waters are: (1) San Juan, (2) Main, (4) South Sound, and (4) Hood Canal. The fifth basin consists of Canadian waters west and north of the San Juan Basin into the Straights of Georgia (Tonnes et al. 2016). Most individuals of the PS/GB bocaccio and PS/GB yelloweye rockfish DPSs are believed to remain within the basin of their origin, including larvae and pelagic juveniles. However, some movement between basins occurs, and both DPSs are currently considered single populations.

There are no estimates of historic or present-day DPS-wide abundance for either species across the full range of their respective DPSs. However, available data suggest that total rockfish abundance declined across the area at a rate of 3.1 to 3.8 percent per year from 1977 to 2014, representing a 69 to 76 percent total decline over that period, and the population growth rates for

PS/GB bocaccio and PS/GB yelloweye rockfish over that period are believed to have been more negative. Additionally, there is little to no evidence of any recovery in total rockfish abundance in response to recent protective measures. In 2013, the Washington State Department of Fish and Wildlife (WDFW) published abundance estimates for both species in the San Juan basin based on a remotely operated vehicle (ROV) survey conducted in 2008. The survey estimated abundances of about 47,000 yelloweye rockfish, and 4,600 bocaccio in the San Juan basin (Tonnes et al. 2016).

The VSP criteria described by McElhaney et al. (2000), and summarized at the beginning of Section 2.2, identified spatial structure, diversity, abundance, and productivity as criteria to assess the viability of salmonid species because these criteria encompass a species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. These viability criteria reflect concepts that are well founded in conservation biology and are generally applicable to a wide variety of species because they describe demographic factors that individually and collectively provide strong indicators of extinction risk for a given species (Drake et al. 2010), and are therefore applied here for PS/GB bocaccio and PS/GB yelloweye rockfish.

<u>General Rockfish Life History:</u> To reduce redundant common text for both species, common general life history information is discussed here, with important species-specific discussed for each species below.

Rockfish are long-lived species, with life histories that include a larval to pelagic juvenile stage that is followed by largely benthic juvenile, subadult, and adult stages. Rockfish eggs are fertilized internally, and the young are extruded as larvae that are about 4 to 5 mm in length. In general, embryo production increases with the age and or size of the female rockfish. For example, 20-cm long female copper rockfish produce about 5,000 eggs while 50-cm long females can produce about 700,000 eggs (Palsson et al. 2009). Based on observations of other rockfish species, mature female bocaccio and yelloweye rockfish are believed to produce from several thousand to over a million eggs annually, depending on their size and or maturity (Love et al. 2002).

Rockfish larvae tend to occur in two peaks in Puget Sound (early spring and late summer) that coincide with the main primary production peaks in Puget Sound, and they essentially disappear by the beginning of November. Additionally, larval densities tended to be lower in the more northerly basins (Whidbey and Rosario) than in the Central and South Sound basins (Greene and Godersky 2012).

Rockfish larvae are distributed by prevailing currents until they are large enough to actively swim toward preferred habitats, but they can pursue food within short distances immediately after birth (Tagal et al. 2002). Rockfish larvae are typically pelagic, distributed throughout the water column. They are often observed in the upper water layers, under detached floating algae, seagrass, and kelp (Love et al. 2002; Shaffer et al. 1995). The oceanographic conditions within Puget Sound likely result in most larvae staying within the basin where they are released rather than their being broadly dispersed (Drake et al. 2010). Natural mortality is believed to be quite high (up to about 70%) during early life stages (Green and Godersky 2012). At about 3 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile rockfish swim toward their preferred habitats (described in species-specific detail below).

<u>PS/GB Bocaccio</u>

<u>General Life History:</u> Bocaccio are a long-lived fish species with a maximum recorded age of 46 years in Alaskan waters, typically mature between 6 and 11 years old, and have a maximum size of about 36 inches (91 cm) (Palsson et al. 2009). They tend to school above the bottom or off of steep slopes, and some have large home ranges and move long distances (NMFS 2017).

The timing of larval parturition in PS/GB bocaccio is uncertain, but based on coastal bocaccio, parturition likely occurs between January and April (NMFS 2017). At about 5 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile bocaccio move to shallow nearshore habitats, most typically with rocky or cobble substrates with kelp, but they also utilize sandy areas with eelgrass (NMFS 2017).

Juvenile bocaccio may spend months or more in shallow nearshore rearing habitats before transitioning to deeper water habitats (Palsson et al. 2009). As they grow, their habitat preference shifts toward increasingly deep waters. Sub-adult to adult bocaccio are most commonly found between 131 to 820 feet (40 to 250 m) deep, typically in areas with high relief rocky substrates, but they also utilize sand, mud, and other unconsolidated sediment substrates (NMFS 2017).

<u>Spatial Structure and Diversity:</u> The PS/GB bocaccio DPS includes all bocaccio from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. As described above, within US waters, the PS/GB is subdivided into the San Juan, Main, South Sound, and Hood Canal basins with limited exchange of individuals occurring between the basins, and the DPS is currently considered a single population. The available data indicate that the historical distribution of PS/GB bocaccio was likely spatially limited, being most abundant in the Main and South Sound basins, but never a predominant segment of the total rockfish abundance within the region (Drake et al. 2010). There were no documented occurrences in the San Juan Basin until 2008 (Pacunski et al.2013).

<u>Abundance and Productivity:</u> Because bocaccio are long-lived, slow to mature, and their episodes of successful reproduction are sporadic, they are considered to have generally low levels of inherent productivity. Productivity may be further negatively impacted by the situation where the low density of reproductive aged adults reduces the likelihood of locating mates, which may further reduce population density. However, there is insufficient information to determine that this is currently occurring.

No reliable range-wide historical or current population estimates are available for the PS/GB bocaccio DPS. However, their abundance is very low, and observations of the species are relatively rare. Bocaccio were always infrequent in recreational fisheries, with low occurrences in localized areas of the Main and South Sound basins, and a few erratic occurrences in the North Sound. However, they have not appeared in recent research or recreational catches (Palsson et al. 2009).

The best available information indicates that total rockfish populations in the Puget Sound region have declined by about 70 percent, and that bocaccio have declined by an even greater extent (NMFS 2017). The apparent decrease in PS/GB bocaccio population size in the Main Basin and South Sound could result in further reduction in the historically limited distribution of PS/GB bocaccio, and add significant risk to long-term viability of the DPS.

Limiting Factors: Factors limiting recovery for PS/GB bocaccio include:

- Degraded Habitat (water quality, derelict fishing gear, climate change);
- Overutilization (commercial and recreational bycatch); and
- Inadequacy of existing regulatory mechanisms.

PS/GB Bocaccio within the Action Area: Very little specific information is available to describe PS/GB bocaccio in the action area, with the exception that they are likely to be uncommon to rare at all four WWTP outfall sites. The PS/GB Bocaccio most likely to be exposed to the effluent discharges from the Lummi Gooseberry Point & Sandy Point WWTPs would be larvae and or fish from the San Jun Basin (Burns 1985; Drake et al. 2010; Tonnes et al. 2016). However, over time, it is quite possible that varied mixtures of larvae and or fish from any of the five PS/GB basins could pass through the area where they could be exposed to effluent from the Lummi WWTPs.

The PS/GB bocaccio most likely to be exposed to the effluent discharges from the Tulalip and Suquamish WWTPs would be larvae and or fish from the Main Basin, followed by the South Sound Basin (Burns 1985; Drake et al. 2010; Tonnes et al. 2016). However, over time, it is possible that varied mixtures of larvae and or fish from any of the five PS/GB basins could pass through the areas where they could be exposed to effluent from those WWTPs.

Over time, some larval bocaccio are likely to be carried through the general areas adjacent to all four of the WWTP outfalls, and the presence of eelgrass, macroalgae, and kelp in the areas adjacent to the Goose Berry Point, Sandy Point, and Tulalip WWTP outfalls (USEPA 2021b) supports the expectation that some juvenile bocaccio may utilize those areas for settlement and early rearing before eventually migrating to the deep-water habitats of adults. The conditions at the Suquamish WWTP outfall are likely to be less supportive of settlement and early rearing, but may support migration of juveniles from shoreline areas to the deep-water habitats of adults.

PS/GB Yelloweye Rockfish

General Life History: Yelloweye rockfish are a long-lived fish species with a maximum recorded age of 118 years in Alaskan waters, 90 years in North Puget Sound, and 55 years in South Puget Sound. They typically mature between 19 and 22 years old, and can reach a maximum size of about 36 inches (91 cm) (Palsson et al. 2009). They tend to remain near the substrate at depths from 90 to 1,640 feet (30 to 500 m) deep, and to remain within relatively small home ranges (NMFS 2017).

The available information suggests that larval parturition in PS/GB yelloweye rockfish occurs from April to September, with the highest abundances in June and July. Juvenile and adult yelloweye rockfish typically occur in similar habitats, with juveniles tending to inhabit the shallower end of the shared deep-water range. At about 4 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile yelloweye rockfish typically settle in areas at depths greater than 98 feet (30 m) with complex rocky/boulder habitats with cloud sponges or with cobble substrates. They are not typically found in shallow nearshore waters (NMFS 2017). As they grow, their habitat preference shifts toward increasingly deep waters. Adult yelloweye rockfish prefer areas with moderate to extreme steepness, and substrates consisting of fractured bedrock, and or boulder-cobble complexes. They are most commonly found in highly rugose rocky areas and pinnacles that are between 164 and 1,640 feet (50 to 500 m) deep (NMFS 2017; Palsson et al. 2009).

Spatial Structure and Diversity: The PS/GB yelloweye rockfish DPS includes all yelloweye rockfish from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. As described above, within US waters, the PS/GB is subdivided into the San Juan, Main, South Sound, and Hood Canal basins with limited exchange of individuals occurring between the basins, and the DPS is currently considered a single population. However, recent research has found evidence that may support separating Hood Canal yelloweye rockfish from the rest of the PS/GB DPS. Within U.S. waters, PS/GB yelloweye rockfish are believed to be most abundant within the San Juan Basin. However, Hood Canal has the greatest frequency of yelloweye rockfish observations in both trawl and scuba surveys. Yelloweye rockfish are considered rare in Central and Southern Puget Sound.

Abundance and Productivity: Because yelloweye rockfish are long-lived, slow to mature, and their episodes of successful reproduction are sporadic, they are considered to have generally low levels of inherent productivity. Yelloweye rockfish productivity may be further negatively impacted by the situation where the low density of reproductive aged adults reduces the likelihood of locating mates, which may further reduce population density. However, there is insufficient information to determine that this is currently occurring.

No reliable range-wide historical or current population estimates are available for the PS/GB yelloweye rockfish DPS. However, their abundance is low. The best available information indicates that total rockfish populations in the Puget Sound region have declined by about 70 percent, and that yelloweye rockfish have declined by an even greater extent (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS/GB yelloweye rockfish include:

- Degraded Habitat (water quality, derelict fishing gear, climate change);
- Overutilization (commercial and recreational bycatch); and
- Inadequacy of existing regulatory mechanisms.

PS/GB Yelloweye Rockfish within the Action Area: Very little specific information is available to describe PS/GB yelloweye rockfish in the action area, with the exception that they are likely to be very uncommon at all four WWTP outfall sites. Further, no deep-water habitat that is likely to support juvenile and or adult yelloweye rockfish is present within the areas of expected effects around any of the four outfalls. However, over time, some larval yelloweye rockfish are likely to be carried through the general areas adjacent to all four of the WWTP outfalls.

The PS/GB yelloweye rockfish most likely to be exposed to the effluent discharges from the Lummi Gooseberry Point & Sandy Point WWTPs would be larvae from the San Jun Basin (Burns 1985; Drake et al. 2010; Tonnes et al. 2016). However, over time, it is quite possible that varied mixtures of larvae from any of the five PS/GB basins could pass through the area where they could be exposed to effluent from the Lummi WWTPs. Also, although very unlikely, some adult yelloweye rockfish in the deep-water pocket offshore from the Gooseberry Point outfall could be exposed to effluent affects.

The PS/GB yelloweye rockfish most likely to be exposed to the effluent discharges from the Tulalip and Suquamish WWTPs would be larvae from the Main Basin, followed by the South Sound Basin (Burns 1985; Drake et al. 2010; Tonnes et al. 2016). However, over time, it is possible that varied mixtures of larvae from any of the five PS/GB basins could pass through the areas where they could be exposed to effluent from the those WWTPs. Also, although very unlikely, some adult yelloweye rockfish in the deep-water areas offshore from the Tulalip and Suquamish outfalls could be exposed to effluent affects.

Critical Habitat

This section describes the status of designated critical habitat that would be affected by the proposed action by examining the condition and trends of physical or biological features (PBFs) that are essential to the conservation of the listed species throughout the designated areas. The PBFs are essential because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration, and foraging).

The project sites and surrounding areas have been designated nearshore marine critical habitat for PS Chinook salmon and PS/GB bocaccio, and Puget Sound inland water critical habitat for SR killer whales.

Puget Sound (PS) Chinook Salmon Critical Habitat

The NMFS designated critical habitat for PS Chinook salmon on September 2, 2005 (70 FR 52630). That critical habitat is located in 16 freshwater subbasins and watersheds between the Dungeness/Elwha Watershed and the Nooksack Subbasin, inclusively, as well as in nearshore marine waters of the Puget Sound that are south of the US-Canada border and east of the Elwha River, and out to a depth of 30 meters. Although offshore marine is an area type identified in the final rule, it was not designated as critical habitat for PS Chinook salmon.

The PBFs of salmonid critical habitat include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks; (3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival; (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PBF for PS Chinook salmon critical habitat are listed in Table 4.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon, and corresponding life history events. Although offshore marine areas were identified in the final rule, none was designated as critical habitat.

Physical or Biological Features		
Site Type	**Site Attribute**	**Life History Event**
Freshwater spawning	Water quantity Water quality Substrate	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Water quantity and Floodplain connectivity Water quality and Forage Natural cover	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	(Free of obstruction and excessive predation) Water quantity and quality Natural cover	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine	(Free of obstruction and excessive predation) Water quality, quantity, and salinity Natural cover Forage	Adult sexual maturation and “reverse smoltification” Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine	(Free of obstruction and excessive predation) Water quality, quantity, and forage Natural cover	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine	Water quality and forage	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek. Critical habitat throughout the Puget

Sound basin has been degraded by numerous activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood from the waterways, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors of critical habitat throughout the basin.

Land use practices have likely accelerated the frequency of landslides delivering sediment to streams. Fine sediment from unpaved roads also contributes to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and large wood recruitment (SSPS 2007).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish, and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Thousands of acres of lowland wetlands across the region have been drained and converted to agricultural and urban uses, and forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence et al. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of suspended sediment, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007).

Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist et al. 2011).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat, changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007). Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

The waters and substrates at all four outfall sites have been designated as estuarine and nearshore marine critical habitat for PS Chinook salmon (NOAA 2023). All four sites support adult and juvenile migration, as well as nearshore marine rearing for juveniles as they migrate and continue to adapt to the marine environment.

Puget Sound/Georgia Basin (PS/GB) Bocaccio and Yelloweye Rockfish Critical Habitat

The NMFS designated critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish on November 13, 2014 (79 FR 68042). That critical habitat includes marine waters and substrates of the US in Puget Sound east of Green Point in the Strait of Juan de Fuca. Nearshore critical habitat is defined as areas that are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 98 feet (30 m) relative to mean lower low water. The PBF of nearshore critical habitat includes settlement habitats with sand, rock, and/or cobble substrates that also support kelp. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities. The PBF of Deepwater critical habitat is defined as areas at depths greater than 98 feet (30 m) that possess or are adjacent to complex bathymetry consisting of rock and/or highly rugose habitat. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; (2) Water quality and sufficient levels of DO to support growth, survival, reproduction, and feeding opportunities; and (3) The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance. Both nearshore and deepwater critical habitat include the entire water column above those substrates. Table 5 lists the PBFs and corresponding life history events for PS/GB bocaccio critical habitat.

Table 5. Physical or biological features of designated critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish, and corresponding life history events.

Physical or Biological Features		
Site Type	**Site Attributes**	**Species Life History Event**
Nearshore habitats with substrate that supports kelp	Prey quantity, quality, and availability Water quality and sufficient dissolved oxygen	Juvenile bocaccio settlement, growth, and development
Deepwater habitats with Complex bathymetry	Prey quantity, quality, and availability Water quality and sufficient dissolved oxygen	Juvenile yelloweye rockfish settlement, growth, and development Adult bocaccio and yelloweye rockfish growth and reproduction

Designated critical habitat for PS/GB bocaccio and PS/GB yelloweye rockfish encompasses a total of about 1,083 square miles (1,743 sq. km) of marine habitat in Puget Sound, comprised of about 645 square miles (1,037 sq. km) of nearshore habitat, and about 438 square miles (706 sq. km) of deepwater habitat. Overall, nearshore critical habitat has been degraded in many areas by shoreline development. Both nearshore and deepwater critical habitat has been degraded by the presence of derelict fishing gear and reduced water quality that is widespread throughout Puget Sound.

Over 25 percent of the shoreline within Puget Sound has been impacted by development and armoring (Broadhurst 1998, WDOE 2010a). Shoreline armoring has been linked to reductions in invertebrate abundance and diversity, reduced forage fish reproduction, and reductions in eelgrass and kelp (Dethier et al. 2016; Heerhartz and Toft 2015; Rice 2006; Sobocinski et al. 2010).

Thousands of lost fishing nets and shrimp and crab pots (derelict fishing gear) have been documented within Puget Sound. Most derelict gear is found in waters less than 100 feet deep, but several hundred derelict nets have also been documented in waters deeper than 100 feet (NRC 2014). Derelict fishing gear degrades rocky habitat by altering bottom composition and killing encrusting organisms. It also kills rockfish, salmon, and marine mammals, as well as numerous species of fish and invertebrates that are rockfish prey resources (Good et al. 2010).

Over the last century, human activities have impacted the water quality in Puget Sound predominantly though the introduction of a variety of pollutants. Pollutants enter via direct and indirect pathways, including surface runoff; inflow from fresh and salt water, aerial deposition, discharges from wastewater treatment plants, oil spills, and migrating biota. In addition to shoreline activities, fourteen major river basins flow into Puget Sound and deliver contaminants that originated from upland activities such as industry, agriculture, and urbanization. Pollutants include oil and grease, heavy metals such as zinc, copper, and lead, organometallic compounds, chlorinated hydrocarbons, phenols, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and Polycyclic Aromatic Hydrocarbons (PAHs) (USACE 2015; WDOE 2010b). Some of these contaminants are considered persistent bioaccumulative toxics (PBTs) that persist in the environment and can accumulate in animal tissues or fat. The WDOE estimates that Puget Sound receives between 14 and 94 million pounds of toxic pollutants annually (WDOE 2010b).

The waters at all four outfall sites likely provide larval rockfish transport. Additionally, the waters and substrates at the two Lummi and the Suquamish outfall sites have been designated as nearshore critical habitat for PS/GB bocaccio, and designated deep-water rockfish critical habitat is present within 500 yards of the Tulalip and Suquamish outfalls. The critical habitat at the two Lummi and the Suquamish outfall sites likely supports juvenile bocaccio settlement, growth and development. The deep-water critical habitat adjacent to the Tulalip and Suquamish outfalls likely supports settlement, growth, and development for juvenile yelloweye rockfish, as well as adult bocaccio and yelloweye rockfish growth and reproduction.

Southern Resident (SR) Killer Whale Critical Habitat

The NMFS designated critical habitat for the SR killer whale DPS on November 29, 2006 (71 FR 69054), and then revised the designation on August 2, 2021 to expand the range of the designated critical habitat (86 FR 41668). SR killer whale critical habitat currently includes approximately 2,560 square miles of inland waters of Washington in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. It also includes 15,910 square miles of coastal marine waters from the U.S./Canada border with to Point Sur, California, with the exclusion of the Quinault Range Site off the coast of Washington.

Within the inland waters of Washington State, SR killer whale critical habitat includes all waters waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water. Along the coast, SR killer whale critical habitat includes all waters waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water out to the 656-ft (200-m) depth contour.

The NMFS identified the following physical or biological features that are essential to SR killer whale conservation: (1) Water quality to support growth and development; (2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) Passage conditions to allow for migration, resting, and foraging.

Water Quality: Waters that are free of contaminants or other agents at concentrations that would inhibit reproduction, impair immune function, result in mortalities, or otherwise impede the growth of SR killer whales is a habitat feature that is essential for the species' recovery. Good water quality is especially important in high-use areas where foraging behaviors occur and contaminants can enter the food chain.

As described in the Puget Sound Partnership's 2022-2026 Action Agenda for Puget Sound, the water quality in Puget Sound is degraded and continues to decline (Puget Sound Partnership 2022). Despite bans of some harmful substances in the 1970s, and subsequent cleanup efforts, several toxicants persist in Puget Sound and build up in marine organisms including SR killer whales and their prey resources. High levels of maritime activity discharge pollutants into the sound, and hundreds of outfalls continuously discharge stormwater and wastewater treatment plant effluents into Puget Sound. Water quality varies in the coastal waters from Washington to California. For example, high levels of DDTs have been found in SR killer whales, especially in K and L pods, which spend time during the winter in California where DDTs still persist in the marine ecosystem (Sericano et al. 2014).

Exposure to oil spills poses additional direct threats and long-term population level impacts. Oil spills can also have long-lasting impacts on other habitat features. Oil spill risk exists throughout the SR killer whales' coastal and inland range. For example, off the California coast, 463,848 gallons of crude oil was released in 2008, 141,680 gallons in 2015, and 44,755 gallons in 2016 (Stephens 2015 and 2017). Non-crude oil spills into the marine environment also occurred off California, Oregon, and Washington in 2015 and 2016 (Stephens 2015 and 2017).

Prey Quantity, Quality, and Availability: Access to adequate numbers of uncontaminated Chinook salmon and other fish species is essential to support individual SR killer whale growth and reproduction, and to support the recovery of the SR killer whale DPS. However, most wild salmon stocks throughout the geographic range of the SR killer whale DPS are at fractions of their historic levels. Beginning in the early 1990s, 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California were listed as threatened or endangered under the ESA, and many wild salmon stocks continue to decline. Some of these losses have been partially offset hatchery production.

Pollution also affects the quality and availability of SR killer whale prey across the range of the DPS. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment these substances migrate across the food web, and accumulate in in long-lived top predators like SR killer whales. Despite the increasing implementation of modern pollution controls in recent decades, those measures only reduce the presence of targeted contaminants in the environment. They don't completely eliminate them, and they often do little to reduce the presence of non-targeted substances, many of which becoming of increasing concern as new science comes to light. In addition to potentially accumulating in SR killer whale prey species, pollutants can directly and indirectly reduce the long-term survival of those prey species, which can reduce the amount of available prey resources for SR killer whales.

Passage: Southern Residents are highly mobile and use a variety of areas for foraging and other activities, as well as for traveling between these areas. Human activities and in-water structures can impede SR killer whale movement across their range. In particular, vessel operation and mod-frequency military sonars are believed to present obstacles to whale passage, often causing whales to change direction, and potentially having to swim further, which can increase energy expenditure and reduce foraging efficiency.

The waters at and adjacent to all four outfall sites have been designated as Puget Sound inland waters critical habitat for SR killer whales (NOAA 2023). Those waters support migration, feeding, and growth for juvenile and adult SR killer whales.

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 four outfall sites considered in this opinion are located at relatively distant locations across Puget Sound (Figure 1). The USEPA defined the action areas as the boundaries of the authorized chronic mixing zone for each outfall, the radii of which range between about 220 and 250 feet depending on the outfall. However, the chronic mixing zones do not define the distance from the outfall where the effluent's pollutants would be undetectable. Instead, the chronic mixing zones are based on meeting certain state and federal water quality standards, many of which are not sufficiently (?) protective of fish, and the standards do not address several common WWTP pollutants that are known to be harmful to fish and other aquatic organisms.

As described in section 2.5, the extent of detectable pollutants would almost certainly extend beyond the authorized chronic mixing zones. However, there is a high level of uncertainty about how far from the outfalls action-related pollutants would be detectable at each of the four sites. To avoid underestimating the impacts on our trust resources, this opinion defines the action area for this consultation as the waters and substrates of Puget Sound that are within 500 yards of any of the four WWTP outfalls.

The described areas overlap with the geographic ranges of the ESA-listed species and the boundaries of four of the designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

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.

Freshwater Environments

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 and the availability of suitable habitat for brown trout and rainbow trout. 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 and 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).

Climate change effects on salmon and steelhead

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 sites and the surrounding area: The four outfall sites considered in this opinion are located at relatively distant locations across Puget Sound (Figure 1), so we will assess the environmental conditions of the four locations individually.

The Lummi Gooseberry Point WWTP outfall is located in Hale Passage (Figures 2 and 6), which is an estuarine waterway that separates Lummi Island from the mainland near Bellingham. From the shoreline to about -30 feet relative to mean lower low water (MLLW), the substrate slopes gently, with the outfall located at about -19 re. MLLW. The intertidal substrate adjacent to the outfall consists of gravel and cobbles embedded in sand and mud. The subtidal substrate consists primarily of unconsolidated sand and silt. The primary vegetation in the tidal and shallow subtidal zones is native eelgrass (Zostera marina), which extends almost to the outfall. Several macroalgae and kelp have been documented in the area adjacent on the outfall, and patchy kelp has been documented along the shoreline southeast of the outfall. The eelgrass bed is documented herring spawning habitat (USEPA 2021b). The waters of surrounding the outfall are identified on the Washington State Department of Ecology (WDOE) Water Quality Assessment 303(d) list for impaired water or sediment quality as Category 2 (waters of concern) for fecal coliform (USEPA 2021b; WDOE 2023).

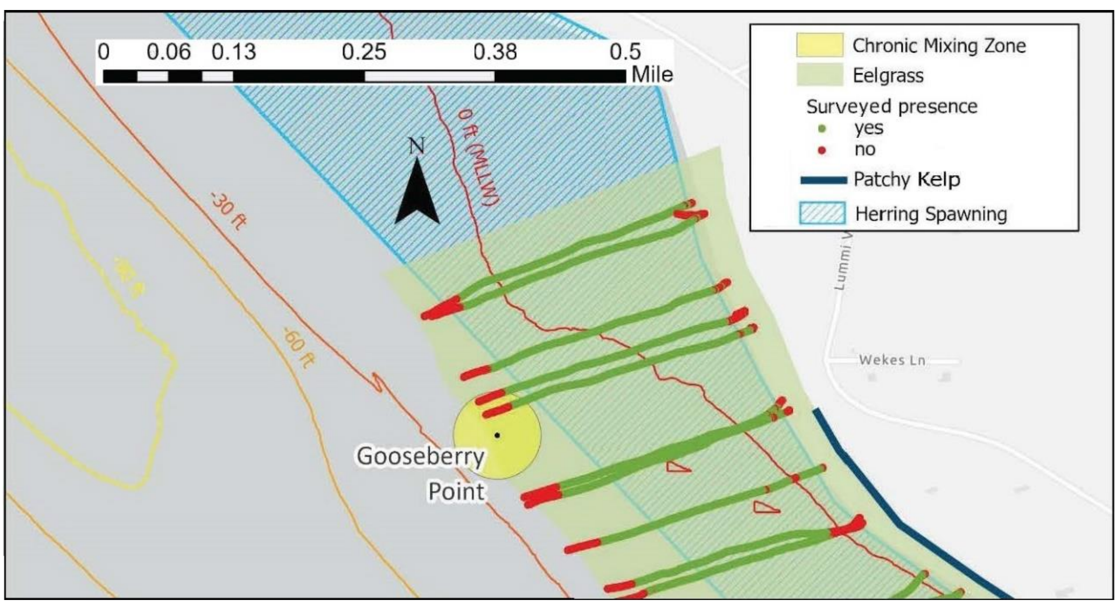

Figure 6. The Lummi Gooseberry Point WWTP outfall and its chronic mixing zone in Hale Passage, shown relative to documented eelgrass, kelp, and herring spawning habitat. The green lines with red ends indicate transects from a recent survey, with green indicating observed eelgrass and red indicating absence (Adapted from Figure 2-1 in USEPA 2021b).

The Lummi Sandy Point WWTP outfall is located in the Georgia Strait (Figures 3 and 7), which is classified as an estuarine waterway. Between the shoreline and about -45 feet re. MLLW, the substrate slopes relatively gently, with the outfall at about -19 feet re. MLLW (USEPA 2021b). The shoreline substrate at Sandy Point consists of fine gravel and sand. Dense kelp beds have been documented in the vicinity, and native eelgrass that is documented herring spawning habitat is present along the shore (Figure 7). Smelt spawning habitat extends along the shoreline (USEPA 2021b). The waters of the area are identified on the Washington State Department of Ecology (WDOE) Water Quality Assessment 303(d) list for impaired waters as Category 2 (waters of concern) for dissolved oxygen, and as Category 1 for temperature (WDOE 2023).

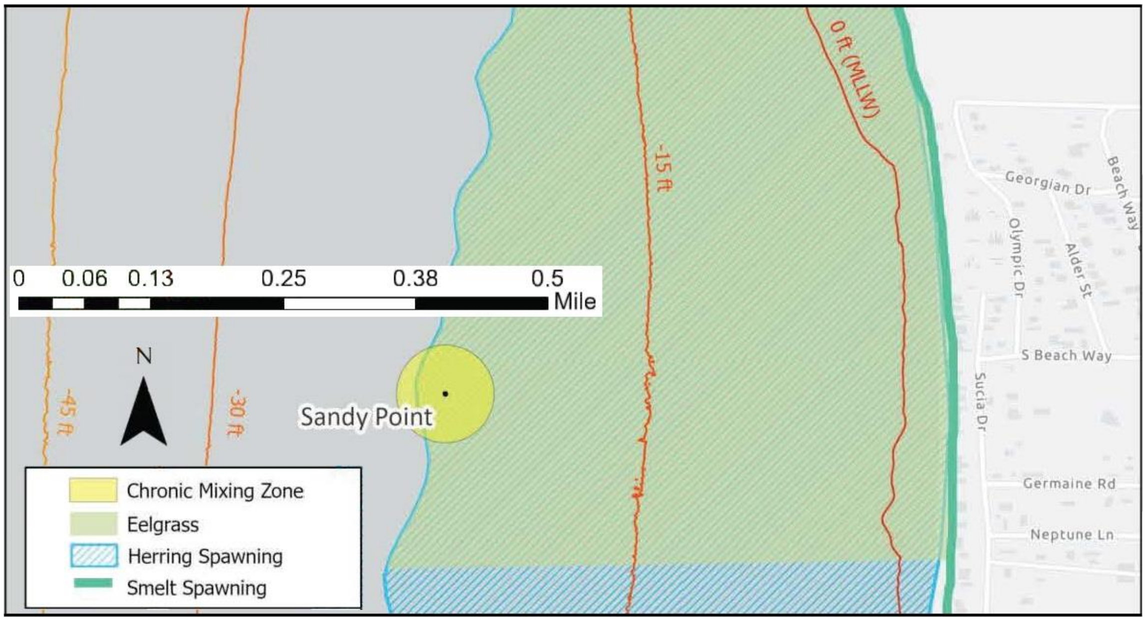

Figure 7. The Lummi Sandy Point WWTP outfall and its chronic mixing zone in the Georgia Strait, shown relative to documented eelgrass and herring and smelt spawning habitats. The green lines with red ends indicate transects from a recent survey, with green indicating observed eelgrass and red indicating absence (Adapted from Figure 2-2 in USEPA 2021b).

The waters at and adjacent to the two Lummi outfalls support migration for adult Chinook salmon and adult and juvenile steelhead, as well as larval rockfish transport. The nearshore waters and substrates at the outfall sites likely support marine nearshore rearing and migration for juvenile Chinook salmon and nearshore settlement, growth, and development for juvenile bocaccio. The waters and substrates at the sites have also been designated as nearshore marine critical habitat for PS Chinook salmon, as nearshore critical habitat for PS/GB bocaccio, and as Puget Sound inland waters critical habitat for SR killer whales.

The Tulalip WWTP outfall is located in Possession Sound (Figures 4 and 8), which is classified as an estuarine waterway. From the shoreline to about -30 feet re. MLLW, the substrate slopes gently, but the slope steepens beyond that.

The outfall is at about -51 feet re. MLLW (Figure 8). The substrate adjacent to the outfall is characterized as sandy, with eelgrass documented inshore of the outfall (USEPA 2021b). There are no 303(d) listings of any category in the area around the outfall. (USEPA 2021b; WDOE 2023). The waters at and adjacent to the Tulalip outfall support migration for adult Chinook salmon and adult and juvenile steelhead, as well as larval rockfish transport. The nearshore waters and substrates at the outfall site likely support marine nearshore rearing and migration for juvenile Chinook salmon and nearshore settlement, growth, and development for juvenile bocaccio. The deep-water waters and substrates within 500 yards of the outfall have been designated deep-water rockfish critical habitat, and likely support some level of settlement, growth, and development for juvenile yelloweye rockfish, as well as adult bocaccio and yelloweye rockfish growth and reproduction. The waters and substrates at the site have also been designated as nearshore marine critical habitat for PS Chinook salmon, and the waters have been designated as Puget Sound inland waters critical habitat for SR killer whales.

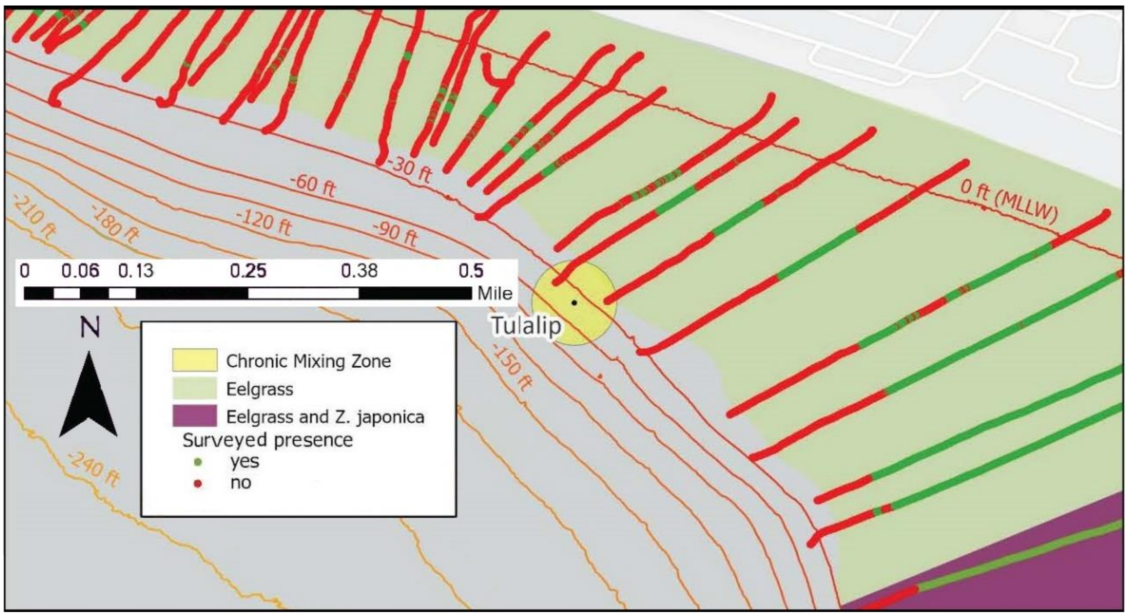

Figure 8. The Tulalip WWTP outfall and its chronic mixing zone in Possession Sound, shown relative to documented eelgrass (Adapted from Figure 2-3 in USEPA 2021b).

The Suquamish WWTP outfall is located in Port Madison (Figures 5 and 9), which is classified as an estuarine waterway. The substrate slopes relatively gently from the shoreline to beyond -120 feet re. MLLW, about 0.5 mile offshore. The outfall is located at about -43 feet re. MLLW.

Patchy kelp is documented along most of the shoreline in the area, Port Madison. Eelgrass has also been documented along all of the shoreline areas within Port Madison, at depths of -25 feet re. MLLW or less. The substrate around the outfall is relatively featureless, and consists of a mix of sand, cobble, and rocks (Figure 9). There is algal growth on the outfall, as well as starfish species and clusters of sedentary organisms such as white-plumed anemone and giant barnacles. Surf smelt spawning is documented along the shoreline areas northwest to southwest of the Suquamish outfall. Herring spawning is documented in the area’s eelgrass beds and the open water northeast to south east of the outfall is documented herring pre-spawning holding habitat (USEPA 2021b).

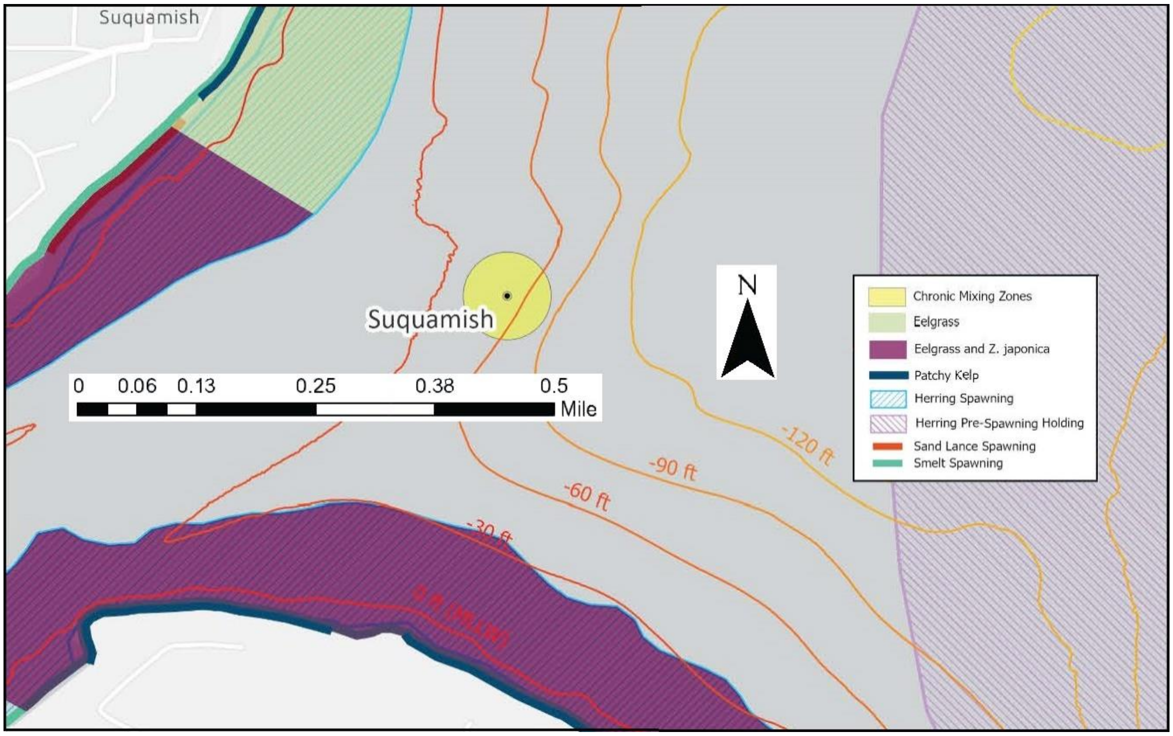

Figure 9. The Suquamish WWTP outfall and its chronic mixing zone in Port Madison, shown relative to documented eelgrass, and herring and smelt spawning habitats. (Adapted from Figure 2-4 in USEPA 2021b).

The waters at and adjacent to the Suquamish outfall support migration for adult Chinook salmon and adult and juvenile steelhead, as well as larval rockfish transport. The nearshore waters and substrates within 500 yards of the outfall site likely support marine nearshore rearing and migration for juvenile Chinook salmon and nearshore settlement, growth, and development for juvenile bocaccio. The deep-water waters and substrates within 500 yards of the outfall have been designated deep-water rockfish critical habitat, and likely support some level of settlement, growth, and development for juvenile yelloweye rockfish, as well as adult bocaccio and yelloweye rockfish growth and reproduction. The waters and substrates at the site have also been designated as nearshore marine critical habitat for PS Chinook salmon, as nearshore critical habitat for PS/GB bocaccio, and the waters have been designated as Puget Sound inland waters critical habitat for SR killer whales.

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 USEPA proposes to reissue NPDES Permits for four tribal WWTPs that would authorize the continued discharge of WWTP effluents to Puget Sound (Figure 1). As described in Section 2.2, adult and juvenile PS Chinook salmon and PS steelhead migrate annually through the affected areas at all four outfall sites, and juvenile PS Chinook salmon likely rear in the shallow-water eelgrass beds at or adjacent to all four outfalls. Also, larval, juvenile, and adult PS/GB bocaccio and PS/GB yelloweye rockfish could be episodically present in the affected areas. Additionally, the affected waters and substrates have been designated as critical habitat for PS Chinook salmon, PS/GB bocaccio and yelloweye rockfish, and SR killer whales. Therefore, the proposed action would expose those listed species and their critical habitats to effluent-related impacts.

2.5.1 Effects on Listed Species

Effluent-related Impacts

The proposed action would result in the decades-long continuation of WWTP effluent discharge at four locations across Puget Sound (Figures 1 – 9). Exposure to those discharges would adversely affect PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish.

Background: As described in Section 1.3, all four of the WWTPs are small facilities that service small populations of 2,110 to 3,200 residents each, having individual maximum flows that range from about 0.4 to 0.6 MGD. By comparison, the King County South WWTP has a maximum design flow of 144 MGD (WDOE 2015). Additionally, the collection systems of all four systems include no input of stormwater or industrial discharges.

Although small and treated to Level-II standards, the authorized discharges would still contain pollutants that are harmful to fish and other aquatic organisms. The authorized acute mixing zones for the individual outfalls would range between about 22 and 25 feet around the outfalls, with chronic mixing zones that range between about 220 and 250 feet around the outfalls. Based on the best available information, we have identified acute toxicity, chronic toxicity, and exposure to altered environmental conditions as potential effects associated with the discharge of wastewater from the all four of the WWTP outfalls under consideration in this opinion.

Acute Toxicity and Chronic Accumulation of Contaminants

Contaminants and Potential Effects: 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). Depending on the pollutant, its concentration, and or the duration of exposure, effects can range from avoidance of an affected area, to reduced growth, altered immune function, skeletal deformities, reproductive impacts, and mortality (Beitinger and Freeman 1983; Brette et al. 2014; da Silva et al. 2023; Fabbri and Franzellitti 2016; Feist et al. 2011; Gerbersdorf et al. 2015; 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; Srain et al. 2020). The intensity of effects depends largely on the pollutant, its concentration, the duration of exposure, and the life stage of the exposed individual. In addition to the pollutants identified in the proposed NPDES permits described in Section 1.3, WWTP effluent typically includes Anthropogenic Trace Compounds (ATCs), which are unregulated and of growing concern in aquatic habitats. ATCs include micropollutants, such as pharmaceuticals and personal care products (PPCPs), as well as surfactants, industrial chemicals, and pesticides that are discharged in municipal wastewater (Gerbersdorf et al. 2015; Meadore et al. 2016; USEPA 2013; WDOE and Herrera 2010). Microplastics and automotive-related pollutants are other pollutants of growing concern that are discharged in municipal wastewater (Chan et al. 2019; Du et al. 2017; Garcia et al. 2020; Gola et al. 2021; Mason et al. 2016; Masoner et al. 2019; NWFSC 2022a & b; Peter et al. 2018; Tian et al. 2020).

WWTP effluents are a major source of ATCs in aquatic habitats, including marine and coastal environments (Fabbri and Franzellitti 2016; Harding et al. 2016; Lubliner et al. 2010; Meadore et al. 2016; Mottaleb et al. 2015; Srain et al. 2020; Valder et al. 2014; WDOE and Herrera 2010). ATCs and microplastics are continuously discharged into all of the sanitary sewer systems of the world due to routine household and industrial use of source products. Automotive-related pollutants are sometimes improperly disposed of directly into sanitary sewer systems. They also enter sanitary sewer systems that are combined with local stormwater discharge systems.

Standard waste water treatment systems, including secondary treatment systems are not designed to remove ATCs, microplastics, and automotive-related pollutants, and consequently remove only a portion of those pollutants from the wastewater stream (Gerbersdorf et al. 2015; Lubliner et al. 2010; Mason et al. 2016; Meadore et al. 2016; Ramirez et al. 2009; USEPA 2013; WDOE and Herrera 2010), and t typically, tertiary treatment systems remove only select pollutants effectively (USEPA 2013).

Therefore, nearly all municipal WWTP effluents contain a complex mixture of ATCs that include antibiotics, analgesics, endocrine disruptors, microbial disinfecting substances, carcinogens, toxic chemicals, as well as microplastics that are discharged to receiving waters on a continuous basis (Gerbersdorf et al. 2015; Jobling et al. 1998; Kidd et al. 2007; Lubliner et al. 2010; Mason et al. 2016; Meadore et al. 2016; Ramirez et al. 2009; USEPA 2013). A recent survey of surface and groundwater sources that was done by the U.S. Geological Survey (USGS) found Hexahydrohexa methylcyclopentabenzopyran (HHCB; a synthetic musk used as a fragrance in cosmetics) was the most commonly detected PPCP, followed by chloroform and tri(2-utoxyethyl)phosphate (Valder et al. 2014). HHCB is considered very toxic to aquatic life with long lasting effects (NIH 2022). The USEPA's National Rivers and Streams Assessment found 7 pharmaceuticals and 2 personal care product chemicals in the fish tissue samples, with antihistamines, antidepressants, and musks being the most prevalent (USEPA 2013). Nearly all municipal WWTP effluents also continuously contain millions of microplastic particles (Mason et al. 2016). During rainstorms, the effluents from WWTPs with combined systems that include stormwater would also include automotive-related pollutants such as PAHs, 6-PPD and 6-PPD Quinone (6PPD-q), trace metals, and other pollutants that enter the wastewater stream from roadway stormwater drainage systems (NWFSC 2022a).

ATCs, microplastics, and automotive-related pollutants usually occur in aquatic habitats at low but consistent concentrations. However, many aquatic species, including salmonids, experience sub-lethal adverse effects from exposure to ATCs at environmentally relevant concentrations (low nanogram per liter ng/L range), particularly for pharmaceuticals and pesticides that are designed to cause physiological effects at very low concentrations (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Lubliner et al. 2010; Parrott and Blunt 2005; Srain et al. 2020; USEPA 2013). In freshwater environments, adult coho salmon are known to experience lethal effects from exposure to environmentally relevant concentrations of automotive-related pollutants (NWFSC 2022a)

ATCs are increasingly reported in a variety of biological matrices, including fish tissue (Meadore et al. 2016; Ramirez et al. 2009). Additionally, most PPCPs are persistent and tend to bioaccumulate in cell tissue (Meadore et al. 2016; Mottaleb et al. 2015; Muir et al. 2017; Srain et al. 2020). Therefore, for fish that remain in within an affected waterbody, or for those that migrate past numerous WWTP discharges, there is a high probability of cumulative effects from chronic exposure to the persistent and complex cocktail of ATCs in their environments (Gerbersdorf et al. 2015; Jobling et al. 1998; USEPA 2013)

Exposure to PPCPs at environmentally relevant concentrations has been shown to cause a wide range of sub-lethal metabolic effects and or tissue damage across a diverse list of aquatic species that included fish, arthropods, mollusks, echinoderms, planktonic invertebrates, plants, and bacteria, and some organisms experienced lethal effects at higher concentrations (Srain et al. 2020). PPCPs interfere with endocrine systems, disrupt homeostasis, and cause a host of abnormalities in aquatic organisms that are exposed to them (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Srain et al. 2020). Further, mixtures of PPCPs led to toxic effects, even when individual PPCP concentrations were below their threshold for effect (Srain et al. 2020).

Reproductive impacts are the most commonly reported effects in fish that are exposed to PPCPs environmentally relevant concentrations. Environmental exposure to PPCPs during the sexual differentiation phase of embryonic development has been shown to induce sex reversal and or intersexuality, while exposure during sexual maturation has been shown to inhibit gonadal development in both males and females. It also causes feminization in juvenile males (intersexuality), and reduced fecundity (Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015; Harding et al. 2016; Jobling et al. 1998; Kidd et al. 2007; Lubliner et al. 2010; Parrott and Blunt 2005; Srain et al. 2020). Lubliner et al. (2010) also report that the female to male ratio in white sucker fish that were downstream of a WWTP discharge was 90% female to 10% male, and that there was also an increased incidence of intersex fish. Kidd et al. (2007) report that exposure to environmentally relevant concentrations of a synthetic estrogen quickly led to the near extirpation of fathead minnows in a test lake.

Microplastics are widely detected in U.S. municipal WWTP effluent, and it is estimated that over 4 million microplastic particles are discharged per facility per day. Plastic fragments, pellets, and fibers are the most common type of microplastic particles within the effluent. Many of the plastic fragments and pellets found in the effluent are thought to come from the 'microbeads' that are found in many cosmetics and personal care products, but some likely originate from other plastic objects that enter the wastewater stream. Although most microfibers are plastic, some probably originate from non-plastic sources (Mason et al. 2016).

Aquatic animals close to urban areas have high accumulations of microplastics in their tissues, with no significant difference in accumulation between fish species (Chan et al. 2019; Garcia et al. 2020; Gola et al. 2021). Ingestion of microplastics can cause physiological responses such as alterations in metabolic processes and intestinal activity, as well as altered predation behaviors and swimming performance (Chan et al. 2019; Garcia et al. 2020). Microplastics accumulate in the gills, guts, and liver of fish, and cause multiple toxic effects including inflammation, increased enzyme activity, and altered metabolic pathways (Lu et al. 2016). The accumulation of microplastics can create a false sense of satiety and or cause blockage of the gastrointestinal tract that may prevent the ability to consume adequate forage, both of which can lead to starvation (Chan et al. 2019; Garcia et al. 2020). Microplastics can also act as a carrier of other pollutants, and accelerate bioaccumulation through food chains. Organic pollutants, heavy metals, and other chemicals easily attach to microplastics, which enter the food web when the particles are mistakenly ingested by organisms that are subsequently consumed by other aquatic animals (Garcia et al. 2020; Gola et al. 2021).

Automotive-related pollutants are likely to be present in WWTP effluents during rainstorms for systems that are combined with stormwater drainage systems. They may also be episodically present when automotive-related products are improperly disposed of directly into sanitary sewer systems. The full suite of roadway-related chemicals under possible review now numbers in the thousands. However, three distinct but co-occurring classes of harmful automotive-related contaminants have been identified, and are ubiquitous in roadway stormwater runoff: PAHs (particularly phenanthrene), metals (particularly copper) and 6PPD and its abiotic transformation product 6PPD-q (NWFSC 2022a).

PAH toxicity in fish, including salmonids, is often sub-lethal and delayed in time, but all fish species studied to date are vulnerable to PAH toxicity, with thresholds for severe developmental abnormalities often in the low parts-per-billion (µg/L) range. PAHs bioconcentrate to high levels in fertilized fish eggs, and have been shown to cause complete heart failure and extra-cardiac defects that often lead to mortality at or soon after hatching. In larval fish, PAH exposure has been shown to cause abnormal development of the heart, eye and jaw structure, and energy reserves (Harding et al. 2020; NWFSC 2022a). In juvenile fish, PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality (Eisler 1987; Meador et al. 2006; Varanasi et al. 1993). Gill tissues are highly susceptible to damage from PAHs present in the water (USACE 2016). Other effects include damage to the skin, fins, and eyes, as well as damage to internal organs such as liver tumors.

Exposure to dissolved copper concentrations between 0.3 to 3.2 µg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon's vulnerability to predators in freshwater (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). However, copper is much less toxic to fish in saltwater than in freshwater. Baldwin (2015) reports that dissolved copper's olfactory toxicity in salmon is greatly diminished with increased salinity. In estuarine waters with a salinity of 10 parts per thousand (ppt), no toxicity was reported for copper concentrations below 50 µg/L. Sommers et al. (2016) report no copper-related impairment of olfactory function in salmon in saltwater.

6PPD and its abiotic transformation product 6PPD-q is deposited onto roads from motor vehicle tire ware, and is the primary cause of urban runoff coho mortality syndrome in adult Puget Sound coho (Tian et al. 2020). The mechanisms underlying mortality in salmonids is under investigation, but likely involve cardiorespiratory disruption (NWFSC 2022a). Coho juveniles appear to be similarly susceptible to the acutely lethal toxicity of 6PPD/6PPD-q (McIntyre 2015). Laboratory studies have also demonstrated that juvenile steelhead and juvenile Chinook salmon are also susceptible to varying degrees of mortality when exposed to urban stormwater (McIntyre and Scholz, unpublished results, 2020). The onset of mortality is very rapid in coho (i.e., within the duration of a typical runoff event), but more delayed in steelhead and Chinook salmon (NWFSC 2022a).

<u>Exposure:</u> The authorized mixing zones for the four outfalls considered here are cylinders of water that extend from the seafloor to the top of the water column around the outfalls. Discharged effluent is expected to mix with and become diluted by the surrounding waters within the authorized mixing zones, and it is beyond the boundary of the mixing zones where specified standards must be met. In theory, organisms that remain outside of the acute mixing zone are unlikely to experience acute lethality from exposure to the effluent, whereas organisms that enter the acute mixing zone could be exposed to lethal effluent concentrations. It is Similarly, the USEPA asserts that organisms that remain outside of the chronic mixing zone are unlikely to experience chronic effects from exposure to the effluent, but organisms that enter the chronic mixing zone are likely to be exposed to effluent concentrations capable of causing chronic effects (USEPA 2014).

However, there is no reasonable expectation that pollutants would be undetectable or unharmful immediately beyond the authorized chronic mixing zones. Being focused on human needs, many state and federal water quality standards are set above concentrations that are known to cause adverse effects in listed fish and other aquatic organisms, and there is a growing body of research that indicates current water quality standards and testing methods routinely underestimate the distances from outfalls where exposure is unlikely to cause adverse chronic effects in fish and other aquatic organisms (da Silva et al. 2023; Fabbri and Franzellitti 2016; Gerbersdorf et al. 2015). Also, there is little or no environmental toxicity information or testing for the vast majority of the compounds known to be in WWTP effluent (Meadore et al. 2016), many of which are known to be harmful to listed fish and other aquatic organisms, and the list of known harmful pollutants is growing. Further, many of the common pollutants discharged in the effluent of the 106 WWTPs in the Puget Sound basin (WDOE and Herrera 2010) don't readily disappear. Those pollutants and or their transformation products can remain in the water for extended periods and are carried by the currents (James et al. 2020). Consequently, the effluent from a given outfall would be diluted by water that already carries a background pollutant load, to which the new effluent pollutants would be added. Therefore, dilution models that assume dilution rates based on discharge into unpolluted water underestimate the distance from an outfall where pollutant concentrations would fall to specific levels. The degree of underestimation would depend on the volume and concentrations of adjacent effluent inputs, their distance from the given outfall, and the prevailing currents.

Therefore, it is almost certain that effluent-born pollutants at concentrations above the minimums required to cause chronic effects and or to be fish-detectable would extend beyond the authorized chronic mixing zones for the four outfalls considered here. However, no information is currently available to definitively establish those distances. Consequently, to avoid underestimating the potential impacts on our trust resources, this opinion assumes that action-related pollutants at concentrations capable of causing chronic effects and or to be fish-detectable could extend as far as 500 yards around each of the four WWTP outfalls under consideration here.

The outfalls for the Tulalip and both Nooksack WWTPs are in or immediately adjacent to shallow nearshore habitat with features that are considered very supportive of marine migration and rearing for juvenile Chinook salmon, as well as settlement, growth, and development for juvenile bocaccio. The Suquamish outfall is less than 500 yards away from similarly supportive habitat (Figures 6 - 9). The Tulalip and Suquamish outfalls are also within 500 yards of deep-water habitats that may support settlement, growth, and development for juvenile yelloweye rockfish, and growth and reproduction for adult bocaccio and yelloweye rockfish. Further, the outfalls themselves would provide structure that may be attractive to rearing juvenile bocaccio.

Therefore, action-related effluent would be continuously present within habitat zones that are extremely likely to be used annually by migrating and rearing juvenile PS Chinook salmon every spring through summer, and over time may occasionally be used by juvenile and adult PS/GB bocaccio and PS/GB yelloweye rockfish. It is also very likely that some adult PS Chinook salmon and adult and juvenile PS steelhead would annually migrate through the affected areas around all four of the outfalls. Over time, it is also reasonably likely that at least some larval bocaccio and yelloweye rockfish would pass through some of the affected areas.

At the outer edges of the fish-detectable effluent plumes, some subset of the listed fish that enter the area would experience avoidance behaviors when they detect effluent-altered water quality (Beitinger and Freeman 1983). However, some individuals are likely to enter far enough into the plume areas where some of those individuals are likely ingest and or absorb some combination of the pollutants discussed earlier in this section. Based on the best available information, direct exposure to the effluent outside of the acute mixing zone is likely to cause non-lethal behavioral and fitness impacts such as, areal avoidance, reduced long-term survival, and negative reproductive effects in some of the exposed individuals.

The increasing effluent concentrations, diminishing salinity, and increasing temperature within the chronic mixing zone would likely cause most fish to avoid the acute mixing zone. As such, few, if any, juvenile or adult fish are likely to experience acute mortality from effluent exposure. However, over the decades-long discharge through the four outfalls, it is very likely that some bocaccio and yelloweye rockfish larvae would be carried by currents through the acute mixing zones where some are likely to experience acute mortality.

Altered Environmental Conditions

In addition to directly exposing fish to the numerous contaminants discussed above, the effluent discharges would maintain altered habitat conditions within the detectable effluent plumes.

The effluent plumes would create temperature, salinity, contaminant, and dissolved oxygen gradients that would increase in intensity with movement toward the outfalls. Also, effluent-borne nitrogen and other nutrients likely affect local productivity, which alters forage quality and quantity, and potentially creates conditions that are favorable to certain harmful algae. Further, the settlement of suspended solids from the effluent would likely alter the benthic habitat around the outfalls. The exact extent of detectable effluent as well as the maximum settlement distance of sediments is unknown. However, as stated earlier, to avoid underestimating potential impacts, this assessment assumes that detectable effluent-borne contaminants could extend as far as 500 yards from the individual outfalls.

How the listed fish under consideration here would respond to the effluent-altered environmental conditions are likely to be highly variable even within a given species at the same life stage. Depending on the conditions of the exposure, some fish are likely to experience avoidance behaviors soon after detecting chemical changes in the water, whereas others may exhibit no overt response, and others may be attracted to the plume. Some individuals are likely to exhibit a mix of behaviors, such as an initial avoidance response that is followed by habituation and possible attraction, and vice versa.

Avoidance: In the case of juvenile Chinook salmon, avoidance of the affected area could delay migration past the affected areas and or induce the affected fish to swim over deep water to avoid the plume, both of which could cause negative impacts on their fitness and long-term survival. Swimming around the plumes would likely increase the migratory distance traveled by some affected individuals, which has been positively correlated with increased mortality in juvenile Chinook salmon (Anderson et al. 2005). Off-bank migration associated with plume avoidance would also reduce feeding efficiency and increase the energetic costs for affected individuals (Heerhartz and Toft 2015). Additionally, deep water favors predatory fish species and increases the risk of predation for migrating juvenile salmonids (Willette 2001). The numbers of exposed fish and the intensity of their responses would largely depend on effluent concentrations, current flows, and timing. Given the small authorized maximum effluent flows, the relatively low authorized pollutant concentrations, and the relatively small areas of effect, exposure to the effluent is likely to only episodically cause small migratory delays and or slightly altered migratory routes around the outfalls for small subsets of the Chinook salmon that migrate past them.

Avoidance of the affected areas is unlikely to cause any detectable negative impacts on adult Chinook salmon, adult and juvenile steelhead, juvenile and adult PS/GB bocaccio, and juvenile and adult PS/GB yelloweye rockfish.

Altered forage availability and quality: The effluent's nutrient load could slightly increase productivity and create small areas of slightly increased forage availability adjacent to the outfalls. Conversely, pollutants in the effluent could reduce forage availability through direct morality and or reduced fecundity among exposed forage organisms. The degree to which these opposing processes would offset each other is unknown. To avoid underestimating potential impacts, this opinion assumes, that on average, forage availability would be slightly decreased within the areas of affect. Additionally, as discussed earlier, organisms that are exposed to the plume are likely to uptake contaminants, and those that are consumed by other organisms will connect the effluent-borne contaminants to the food web.

For example, West et al. (2008) found that the three known Pacific herring populations in the Puget Sound region have different persistent organic pollutant (POP) loading patterns that are likely due to differential exposure to POPs based on where those herring populations feed. Further, because Pacific herring rely heavily on planktonic krill, calapnoid copepods, and larval invertebrates and fishes that have no direct connection to sediments, it is believed that those planktonic species are accumulating the POPs through the directly from the water column and from the planktonic food web (West et al. 2008).

Therefore, fish that forage in the affected areas are likely to consume contaminated prey. Additionally, the increased forage availability may create the situation where foraging species, including the listed fish under consideration here may preferentially remain within the affected areas. Those fish that forage in the affected area for extended periods would increase both their direct exposure to effluent-borne contaminants as well as their consumption of contaminated prey.

Harmful Algae: As described in the NMFS biological opinion for the reissuance of the NPDES permit for the Hyperion WWTP in Los Angeles, CA (NMFS 2018); nitrogen is the primary nutrient that limits phytoplankton production in coastal waters, the addition of nitrogen increases phytoplankton production, and reduced forms of nitrogen that are present in WWTP effluents can tilt phytoplankton communities toward the development of harmful diatom and dinoflagellate species and lead to harmful algal blooms.

Harmful diatoms such as the Pseudo-nitzschia delicatissima group and the P. seriata group produce domoic acid, which is a water-soluble neurotoxin that accumulates in shellfish and planktivorous fish. It is responsible for toxic events in marine mammals and birds, as well as amnesiac shellfish poisoning in humans, but its impacts on schooling fish are believed to be less intense. Under laboratory conditions, fish that ingested domoic acid producing diatoms seemed able to isolate and eventually excrete the domoic acid. However, it is unknown if there is a metabolic cost to this process for the fish.

Harmful dinoflagellates such as the Alexandrium tamarense complex produce saxitoxins, which have been implicated in numerous fish kills, and Paralytic Shellfish Poisoning (PSP) in humans. Studies have documented paralysis, morphological impacts, and heavy mortality in larval and juvenile fish that were exposed to direct saxitoxin intoxication and through the food web. The effects of saxitoxin on crustacean larvae ranged from lethality in brine shrimp to sublethal effects in crab larvae. The dinoflagellate Lingulodinium polyedrum produces a yessotoxin, which is a large family of toxins. Yessotoxins have been identified as the major causative agent in an invertebrate mass mortality event, but its potential impacts on fish are still unclear and under research.

Settlement of Suspended Solids: The WWTPs would each be authorized to discharge weekly averages of 94 to 231 pounds of TSS per day, depending on the facility. Those suspended solids that would be discharged through the outfall would be initially carried up in the rising effluent

plume, and carried laterally by the currents. However, in general, the greatest amount of deposition would occur near the outfalls, with decreasing levels of deposition occurring with increased distance from the outfalls.
The settlement of solids can alter the availability and quality of SAV and forage within the affected area. The discharges under consideration here are small, and unlikely to smother SAV and other sessile organisms. However, many heavy metals and persistent organic compounds, such as pesticides and PCBs, tend to adhere to solid particles discharged from outfalls. Therefore, the settled solids from the outfalls would very likely contain low but steady loads of heavy metals and persistent organic compounds that would be taken up by the benthic organisms within the affected areas, and those contaminants would likely bioaccumulate in the local food webs at higher rates than in unaffected areas.

<u>Dissolved Oxygen:</u> The WWTPS would each be authorized to discharge a weekly average of 94 to 231 pounds of BOD per day and a similar amount of TSS per day, depending on the facility, both of which reduce dissolved oxygen levels in the receiving water. Respiration related to the biological breakdown of the effluent's BOD reduces the dissolved oxygen concentration within the plumes. TSS typically reduces dissolved oxygen through decreased photosynthesis due to turbidity-related reduced light. Also, the increased water temperature within the effluent plume reduces the water's ability to hold oxygen. Additionally, algal blooms that may be triggered by the increased availability of nutrients within the plume can reduce dissolved oxygen in the water column due to respiration by the algae and or by increased respiration by bacteria during the decomposition of dead algae. Reduced dissolved oxygen may cause avoidance of the affected area (Hicks 1999). It can also reduce swimming performance (Bjornn and Reiser 1991), and mortality can occur when oxygen levels become severely depleted.

<u>In summary:</u> Juvenile and adult PS Chinook salmon and juvenile and adult PS steelhead are likely to be annually exposed to effluent-borne pollutants discharged through the four outfalls under consideration here. Also, over time, some mix of larval, juvenile, and adult PS/GB bocaccio and PS/GB yelloweye rockfish are likely to be occasionally exposed. In addition to possible avoidance behaviors, individuals that enter the plume areas of the four outfalls are likely to uptake contaminants directly from the water column and through the consumption of contaminated forage. The intensity of their exposures and responses are likely to be highly variable.

Due to the expectation that their exposures would be outside of the acute mixing zone, no acute mortality is expected for Juveniles and adults of all four species considered here. However, the small size and state of immaturity of exposed juveniles increases the likelihood that some exposed individuals would experience fitness impacts that would reduce their likelihood of survival to adulthood and or reduce their future reproductive success, both of which would be exacerbated by repeated exposures to other effluent discharges within Puget Sound. Some exposed adults of all four species are also likely to experience some level of fitness impacts that could reduce their reproductive success.

The exact numbers of juvenile and adult PS Chinook salmon and PS steelhead that would be annually exposed to the effluents at all four outfalls is unpredictable and likely to be highly variable over time, as would be the intensity of their responses to the exposures. However, the small areas of effect support the expectation that exposed individuals would comprise small subsets of their populations' cohorts, and the small authorized maximum effluent volumes, the relatively low authorized pollutant concentrations, and the small areas of effect further support the expectation that only small subsets of the individuals that pass through the areas are likely to be meaningfully affected. Therefore, the numbers of annually affected individuals would be too low to cause any detectable population-level effects on PS Chinook salmon and PS steelhead.

The exact numbers of juvenile and adult PS/GB bocaccio and PS/GB yelloweye rockfish that would be exposed to the effluents at all four outfalls is also unpredictable and likely to be highly variable over time, as would be the intensity of their responses to the exposures. However, based on the small authorized maximum effluent volumes, the relatively low authorized pollutant concentrations, the small areas of effect, and the historic and current rarity of both species within Puget Sound, the numbers of exposed individuals would be too small to cause any detectable population-level effects on PS/GB bocaccio and PS/GB yelloweye rockfish. Additionally, based on the low number and very small sizes of the action-related acute mixing zones, the historic and current rarity of both species within Puget Sound, and the extremely high level of natural mortality for larval fish, the numbers of larvae potentially lost due to action-related effluent exposure would be too small to cause any detectable population-level effects on PS/GB bocaccio and PS/GB yelloweye rockfish.

2.5.2 Effects on Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected Primary Biological Features (PBFs) from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely last for weeks, and long-term effects are likely to last for months, years or decades.

At four widely-spaced locations across Puget Sound, the proposed action would authorize the continued discharge of WWTP effluent with authorized individual maximum flows that range from about 0.4 to 0.6 MGD, and that contain relatively low concentrations of numerous pollutants, many of which are known to be harmful to listed fish and other aquatic organisms, and up to 94 to 231 pounds per day of material that would create a biological oxygen demand in the water. These effluent discharges are likely to adversely affect critical habitat for PS Chinook salmon, PS/GB bocaccio and PS/GB yelloweye rockfish, and SR killer whales.

Puget Sound Chinook Salmon Critical Habitat: At all four outfall locations, the proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS Chinook salmon as described below.

1. Freshwater spawning sites: None in the action area.

2. Freshwater rearing sites: None in the action area.

3. Freshwater migration corridors free of obstruction and excessive predation: None in the action area.

4. Estuarine areas free of obstruction and excessive predation:
   a. Obstruction and predation – The proposed action would perpetuate long-term minor adverse effects on this attribute. Depending on effluent concentrations, current flows, and timing, exposure to the effluent is likely to episodically cause a range of small migratory delays and or slightly altered migratory routes around the outfalls for some subset of the Chinook salmon that migrate past them. The effluent plumes may also increase the risk of predation for some juveniles that swim into deeper water to avoid them. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on obstruction and predation would be minor.
   b. Water quality and salinity – The proposed action would perpetuate minor long-term adverse effects on this attribute. The proposed action would authorize the continued total discharge of about 2 MGD of WWTP effluent into Puget Sound at four relatively distant locations. Within the 22- to 25-foot-radius acute mixing zones around the outfalls, some pollutant concentrations could be acutely toxic to some of the fish and other marine organisms that may enter them, especially to small and or immature individuals. Within about 500 yards around the outfalls, contaminant concentrations could be high enough to cause behavioral and non-lethal chronic effects such as avoidance of the area, reduced fitness, and reduced reproductive success in some of the fish and other marine organisms that may enter those areas, again, especially in small and or immature individuals. Additionally, the effluent is likely to reduce dissolved oxygen and salinity, particularly within the acute mixing zones immediately adjacent to the outfalls, but the effects would quickly diminish with distance, and would likely be undetectable beyond 500 yards. Given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on water quality and salinity would be minor.
   c. Water quantity – The proposed action would cause no detectable effect on this attribute.
   d. Natural Cover – The proposed action would perpetuate long-term minor adverse effects on this attribute. Sediment deposition and exposure to effluent-borne pollutants may slightly reduce SAV availability adjacent to the outfalls. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action attributable effects on natural cover would be minor.
   e. Forage – The proposed action would perpetuate minor long-term adverse effects on this attribute. The nutrient loads in the effluent at the outfalls could slightly increase productivity and create small areas of slightly increased forage availability adjacent to the outfalls. Conversely, pollutants in the effluent could reduce forage availability through direct morality and or reduced fecundity among exposed forage organisms. The degree to which these opposing processes would offset each other is unknown. To avoid underestimating potential impacts, this opinion assumes, that on average, forage availability would be slightly decreased within about 500 yards around each outfall. Additionally, some contaminants from the effluent would enter the food web and bioaccumulate in forage organisms that are directly and or indirectly exposed to the

effluent’s contaminants. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on forage would be minor.

5. Nearshore marine areas free of obstruction and excessive predation:
    a. Obstruction and predation – Same as above in 4a.
    b. Water quality and salinity – Same as above in 4b.
    c. Water quantity – Same as above in 4c.
    d. Natural Cover – Same as above in 4d.
    e. Forage – Same as above in 4e.

6. Offshore marine areas: None in the action area.

Critical Habitat for PS/GB bocaccio and PS/GB yelloweye rockfish: At all four outfall locations, the proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS/GB Bocaccio as described below.

1. Nearshore marine areas from the shoreline to a depth of 98 feet (30 m) with substrates such as sand, rock, and/or cobble compositions that support kelp (at the two Lummi and the Suquamish outfall sites):
    a. Prey quantity, quality, and availability – The proposed action would perpetuate minor long-term adverse effects on this attribute. The nutrient loads in the effluent at the outfalls could slightly increase productivity and create small areas of slightly increased forage availability adjacent to the outfalls. Conversely, pollutants in the effluent could reduce forage availability through direct morality and or reduced fecundity among exposed forage organisms. The degree to which these opposing processes would offset each other is unknown. To avoid underestimating potential impacts, this opinion assumes that, on average, forage availability would be slightly decreased within about 500 yards around each outfall. Additionally, some contaminants from the effluent would enter the food web and bioaccumulate in forage organisms that are directly and or indirectly exposed to the effluent’s contaminants. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on forage would be minor.
    b. Water quality and sufficient dissolved oxygen – The proposed action would perpetuate long-term minor adverse effects on this attribute. Within the 22- to 25-foot-radius acute mixing zones around the outfalls, some pollutant concentrations could be acutely toxic to some of the fish and other marine organisms that may enter them, especially to small and or immature individuals. Within about 500 yards around the outfalls, contaminant concentrations could be high enough to cause behavioral and non-lethal chronic effects such as avoidance of the area, reduced fitness, and reduced reproductive success in some of the fish and other marine organisms that may enter those areas, again, especially in small and or immature individuals. Additionally, the effluent is likely to reduce dissolved oxygen and salinity, particularly within the acute mixing zone immediately adjacent to the outfalls, but the effects would quickly diminish with distance, and would likely be undetectable beyond 500 yards. Given the relatively low authorized pollutant

concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on water quality and salinity would be minor.

2. Deep-water marine areas at depths greater than 98 feet (30 m) that possess or are adjacent to complex bathymetry consisting of rock and/or highly rugose habitat (at the Tulalip and Suquamish outfall sites):
   a. Quantity, quality, and availability of prey species – Same as above in 1a, with exception that the effects may be slightly less intense due to the increased distance between the outfalls and the adjacent rockfish deep-water critical habitat as compared to the proximity to nearshore rockfish critical habitat, and the inclusion of juvenile and adult yelloweye rock fish as potentially affected species.
   b. Water quality – Water quality and sufficient dissolved oxygen – Same as above in 1b, with exception that the effects may be to slightly less intense due to the increased distance between the outfalls and the adjacent rockfish deep-water critical habitat compared to the proximity to nearshore rockfish critical habitat, and the inclusion of juvenile and adult yelloweye rock fish as potentially affected species.

Critical Habitat for SR Killer Whales: At all four outfall locations, the proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for SR Killer Whales as described below.

1. Inland waters of Puget Sound waterward of a line at a depth of 20 feet (6.1 m) relative to extreme high water:
   a. Water quality to support growth and development – The proposed action would perpetuate long-term minor adverse effects on this attribute. Within the 22- to 25-foot-radius acute mixing zones around the outfalls, some pollutant concentrations could be acutely toxic to some of the fish and other marine organisms that may enter them, especially to small and or immature individuals. Within about 500 yards around the outfalls, contaminant concentrations could be high enough to cause behavioral and non-lethal chronic effects such as avoidance of the area, reduced fitness, and reduced reproductive success in some of the fish and other marine organisms that may enter those areas, again, especially in small and or immature individuals. As discussed in more detail in Section 2.12, exposure to the effluent is not likely to adversely affect SR killer whales. However, the continued discharge of effluent would contribute to maintaining water quality within about 500 yards around around the outfalls at a state where its ability to support SR killer whale growth and development of would be degraded as compared to non-impacted waters. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on water quality would be minor.
   b. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth – The proposed action would perpetuate long-term minor effects on this attribute. As described in the summary under Effluent-related Impacts, very low numbers of Chinook salmon, steelhead, bocaccio, bocaccio, and yelloweye rockfish are likely to experience some combination of reduced long-term survival and reduced reproductive success due to the uptake of action-related contaminants. Additionally, the exposures may slightly add to

tissue contaminant loads in fish that survive to adulthood. However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, and the naturally high attrition rates of larval and juvenile fish, action-attributable effects on prey quantity, quality, or availability would be minor.

c. Passage conditions to allow for migration, resting, and foraging – The proposed action would cause no detectable effects on passage conditions.

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 habitats within the action areas are described in the Range-wide Status of the Species and Critical Habitat and Environmental Baseline sections above. The non-federal activities in and inland of the action areas that have contributed to those conditions include past and on-going shoreline development; vessel activities; commercial, subsistence, and recreational fishing; forest management; agriculture; chronic inputs from point- and non-point pollution sources related to upland urbanization and industrialization; 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 of inputs from point- and non-point pollutant sources will likely continue and increase into the future.

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 Chinook salmon, PS/GB bocaccio, and PS/GB yelloweye rockfish. 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.

Of particular import to this action, there are at least 106 authorized WWTPs around Puget Sound, which in 2010 discharged a combined total flow of about 356 MGD into the sound and its tributaries (WDOE and Herrera 2010). There are also hundreds of stormwater outfalls. Over time, many of the WWTPs will increase their flows as their service populations grow, and increased upland development would likely lead to increased stormwater runoff. Depending on regulations and available technologies, it is reasonable to expect that at least some of the WWTPs and stormwater sources would increase their levels of treatment. However, it is also likely that population growth and the constant introduction of new pharmaceuticals and new domestic- and industrial-use chemicals will outpace available treatment technologies. Therefore, it is reasonable to expect that ever-increasing volumes of WWTP effluent and stormwater would discharge increasing amounts of pollutants into Puget Sound. Further, the best available science demonstrates that many common pollutants in WWTP effluent tend to persist in the water column and or to bioaccumulate in species that are directly or indirectly exposed to the them, and that pollutants are accumulating in the system. Consequently, moving into the future, background pollutant concentrations are likely to increase throughout Puget Sound, including within the action areas considered here.

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 PBF 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 Chinook salmon, PS steelhead, and PS/GB yelloweye rockfish are listed as threatened, and PS/GB bocaccio are listed as endangered, all 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. All four 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 each species are also likely to be negative. In this context we consider how the proposed action's impacts on individuals would affect the listed species at the population and ESU/DPS scales.

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat and degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to impact this species.

The most recent 5-year status review reported a general decline in natural-origin spawner abundance across all PS Chinook salmon MPGs over the most-recent fifteen years. It also reported that escapement levels remain well below the PSTRT planning ranges for recovery for all MPGs, and concluded that the PS Chinook salmon ESU remains at "moderate" risk of extinction (Ford 2022).

The proposed action would perpetuate, for 5 years, the decades-long discharge of WWTP effluent at four locations across Puget Sound (Figures 1 – 9). The PS Chinook salmon that are most likely to pass through the affected areas would be indeterminate mixes of all runs from nearly all of the populations within the ESU, with the populations that are closest to an individual outfall being the most likely to be exposed to that outfall's effluent.

The environmental baseline within the project's affected areas have been degraded by more than 100 years of maritime activity and upland urbanization, agriculture, industry, road building and maintenance, which have largely translated into impacts on water and substrate quality from nearby point and non-point wastewater and stormwater discharges, including the WWTP outfalls under consideration here. However, the affected areas continue to support marine nearshore rearing and migration for juvenile Chinook salmon, as well as marine migration for adult Chinook salmon.

The proposed action would result in the years-long continued discharge of WWTP effluent, the exposure to which is likely to annually cause sub-lethal fitness impacts in very low numbers of juveniles and adults that annually pass through the areas. The impacts would be in the form of slightly reduced long-term survival and or reduced reproductive success in some of the exposed juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their reproductive success.

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, the annual numbers of impacted individuals 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 Chinook salmon populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

<u>PS steelhead</u>

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 proposed action would perpetuate, for 5 years, the decades-long discharge of WWTP effluent at four locations across Puget Sound (Figures 1 – 9). The PS steelhead that are most likely to pass through the affected areas would be indeterminate mixes of all runs from the nearly all of the DIPs within the DPS, with the DIPs that are closest to an individual outfall being the most likely to be exposed to that outfall’s effluent.

The environmental baseline within the project’s affected areas have been degraded by more than 100 years of maritime activity and upland urbanization, agriculture, industry, road building and maintenance, which have largely translated into impacts on water and substrate quality from nearby point and non-point wastewater and stormwater discharges, including the WWTP outfalls under consideration here. However, the affected areas continue to support marine migration for juvenile adult steelhead.

The proposed action would result the years-long continued discharge of WWTP effluent, the exposure to which is likely to annually cause sub-lethal fitness impacts in very low numbers of juveniles and adults that annually pass through the areas. The impacts would be in the form of slightly reduced long-term survival and or reduced reproductive success in some of the exposed juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their reproductive success.

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, the annual numbers of impacted individuals 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 DIPs. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS/GB bocaccio

No reliable population estimates are available for PS/GB bocaccio. The best available information indicates that they were never a predominant segment of the total rockfish abundance in Puget Sound, and that abundance has declined by more than 70 percent since 1965. They are considered rare in the action area, and it is uncertain whether they currently utilize the habitat within the action area. Fishing removals and derelict fishing gear, combined with degraded water quality appear to be the greatest threats to the recovery of the DPS.

The proposed action would perpetuate, for 5 years, the decades-long discharge of WWTP effluent at four locations across Puget Sound (Figures 1 – 9). The PS/GB bocaccio that are most likely to pass through the affected areas would be indeterminate mixes of larvae and fish from any of the five PS/GB basins within the DPS, with individuals from the basin within which the outfall resides being the most likely to be exposed to that outfall's effluent.

The environmental baseline within the project's affected areas have been degraded by more than 100 years of maritime activity and upland urbanization, agriculture, industry, road building and maintenance, which have largely translated into impacts on water and substrate quality from nearby point and non-point wastewater and stormwater discharges, including the WWTP outfalls under consideration here. However, the affected areas continue to provide conditions that would be supportive of nearshore settlement, growth, and development for juvenile bocaccio, and at the Tulalip and Suquamish sites likely supports some level of deep-water settlement, growth, and development for juvenile yelloweye rockfish, as well as adult bocaccio and yelloweye rockfish growth and reproduction.

The proposed action would result in the years-long continued discharge of WWTP effluent, the exposure to which is likely to cause sub-lethal fitness impacts in extremely low numbers of larvae, juveniles, and adults that may occur in the affected areas. The impacts would be in the form of slightly reduced long-term survival and or reduced reproductive success in some of the exposed larvae and juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their reproductive success. Additionally, extremely low numbers of larvae that pass through the acute mixing zones may experience mortality.

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, the annual numbers of impacted individuals would be too small to cause detectable effects on any of the characteristics of a viable population (abundance, productivity, distribution, or genetic diversity) for the PS/GB bocaccio DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS/GB yelloweye rockfish

No reliable population estimates are available for PS/GB yelloweye rockfish. The best available information indicates that they were never a predominant segment of the total rockfish abundance in Puget Sound, and that abundance has declined by more than 70 percent since 1965. They are considered rare in the action area, and it is uncertain whether they currently utilize the habitat within the action area. Fishing removals and derelict fishing gear, combined with degraded water quality appear to be the greatest threats to the recovery of the DPS.

The proposed action would perpetuate, for 5 years, the decades-long discharge of WWTP effluent at four locations across Puget Sound (Figures 1 – 9). The PS/GB yelloweye rockfish that are most likely to pass through the affected areas would be indeterminate mixes of larvae and fish from any of the five PS/GB basins within the DPS, with individuals from the basin within which the outfall resides being the most likely to be exposed to that outfall's effluent.

The environmental baseline within the project's affected areas have been degraded by more than 100 years of maritime activity and upland urbanization, agriculture, industry, road building and maintenance, which have largely translated into impacts on water and substrate quality from nearby point and non-point wastewater and stormwater discharges, including the WWTP outfalls under consideration here. However, affected areas adjacent to the Tulalip and Suquamish outfalls likely supports some level of deep-water settlement, growth, and development for juvenile yelloweye rockfish, as well as growth and reproduction for adults.

The proposed action would result in the years-long continued discharge of WWTP effluent, the exposure to which is likely to cause sub-lethal fitness impacts in extremely low numbers of larvae, juveniles, and adults that may occur in the affected areas. The impacts would be in the form of slightly reduced long-term survival and or reduced reproductive success in some of the exposed larvae and juveniles, and some of the exposed adults may experience fitness impacts that may slightly reduce their reproductive success. Additionally, extremely low numbers of larvae that pass through the acute mixing zones may experience mortality.

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, the annual numbers of impacted individuals would be too small to cause detectable effects on any of the characteristics of a viable population (abundance, productivity, distribution, or genetic diversity) for the PS/GB yelloweye rockfish DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

Critical habitat was designated PS Chinook salmon, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales to ensure that specific areas with PBFs that are essential to the conservation of those listed species are appropriately managed or protected. These critical habitats will be affected over time by cumulative effects, some positive – as restoration efforts 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 trends are negative, the effects on the PBFs of these critical habitats are also likely to be negative. In this context we consider how the proposed action's impacts on the attributes of the action area's PBFs would affect these designated critical habitats' abilities to support the conservation of their respective species as a whole.

Critical Habitat for PS Chinook Salmon

Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, shoreline development, and point and non-point stormwater and wastewater discharges have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

Global climate change is expected to increase in-stream water temperatures and alter stream flows, possibly exacerbating impacts on baseline conditions in freshwater habitats across the region. Rising sea levels are expected to increase coastal erosion and alter the composition of nearshore habitats, which could further reduce the availability and quality of estuarine habitats. Increased ocean acidification may also reduce the quality of estuarine habitats.

In the future, non-federal land and water use practices and climate change are likely to increase. In particular, the volumes of WWTP effluent and stormwater discharged into Puget Sound and its tributaries are likely to increase as the region's human population grows. The intensity of those influences on salmonid critical habitat is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, by implementation of better treatments that may become available for WWTP and stormwater discharges, by the implementation of non-federal plans that are intended to benefit natural resources, and by efforts to address the effects of climate change.

The PBFs for PS Chinook salmon critical habitat at or adjacent to all four outfall sites is limited to estuarine and nearshore marine areas free of obstruction and excessive predation. The attributes of those PBFs that would be affected by the action are obstruction and excessive predation, water quality, forage, and natural cover. All four outfall sites are located offshore of moderately impacted marine shorelines that have also been impacted by years of WWTP effluent discharge from the subject outfalls, and all of the identified attributes currently function at reduced levels as compared to undisturbed estuarine and nearshore marine areas. As described in the effects section, the proposed action would perpetuate, for 5 years, long-term minor adverse effects on all of those attributes.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the estuarine and nearshore marine areas PBFs in the action areas. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for PS Chinook salmon.

Critical Habitat for PS/GB Bocaccio and PS/GB Yelloweye Rockfish

Nearshore rockfish critical habitat has been degraded by past and ongoing shoreline development that has altered shoreline substrates, and reduced eelgrass and kelp habitats in many areas of Puget Sound. Agriculture, industry, urbanization, and maritime activities have reduced water quality throughout Puget Sound, and the widespread presence of derelict fishing gear in both nearshore and deep-water critical habitat areas has altered bottom composition, reduced prey availability, and directly kills rockfish.

Rising sea levels, caused by climate change, are expected to increase coastal erosion and alter the composition of nearshore critical habitat for PS/GB bocaccio. Elevated sea surface temperatures and increased ocean acidification may also reduce the quality of nearshore marine habitats, and reduce prey availability by reducing ocean productivity.

Future non-federal actions and climate change are likely to increase and continue acting against the quality of rockfish critical habitat. In particular, the volumes of WWTP effluent and stormwater discharged into Puget Sound and its tributaries are likely to increase as the region's human population grows. The intensity of those influences is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable practices, by implementation of better treatments that may become available for WWTP and stormwater discharges, by restoration activities such as efforts to remove derelict fishing gear and to improve water quality, and by efforts to address the effects of climate change.

The PBFs for PS/GB rockfish critical habitat that are at and adjacent to all four outfall sites is a mix of: 1) nearshore marine areas with substrates such as sand, rock, and/or cobble compositions that support kelp; and 2) benthic areas deeper than 98 ft that possess or are adjacent to areas of complex bathymetry. The site attributes of those PBFs that would be affected by the action are prey quantity, quality, and availability; and water quality and sufficient dissolved oxygen. All four outfall sites are located offshore of moderately impacted marine shorelines that have also been impacted by years of WWTP effluent discharge from the subject outfalls, and all of the identified attributes currently function at reduced levels as compared to undisturbed estuarine and nearshore marine areas. As described in the effects section, the proposed action would perpetuate, for 5 years, long-term minor adverse effects on all of those attributes.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the deep-water rockfish critical habitat in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for

PBFs to become functionally established, to serve the intended conservation role for PS/GB bocaccio and PS/GB yelloweye rockfish.

Critical Habitat for SR Killer Whales

Past and ongoing land and water use practices have degraded SR killer whale critical habitat throughout the Puget Sound basin. Urbanization, shoreline development, and point and non-point stormwater and wastewater discharges have reduced water quality across the region. Shoreline industries and high levels of vessel traffic have increased ambient noise levels, and anthropogenic impacts on Chinook salmon and other fish species have reduced the availability and quality of forage resources for SR killer whales.

Future non-federal actions and climate change are likely to increase and continue acting against the quality of SR killer whale critical habitat. In particular, the volumes of WWTP effluent and stormwater discharged into Puget Sound and its tributaries are likely to increase as the region's human population grows. The intensity of those influences on SR killer whale critical habitat is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, by implementation of better treatments that may become available for WWTP and stormwater discharges, by the implementation of non-federal plans that are intended to benefit SR killer whales and their primary prey species (Chinook salmon), and by efforts to address the effects of climate change.

The PBF for SR killer whale critical habitat that exists at and adjacent to the project site is that of inland waters of Puget Sound deeper than 20 feet at extreme high water. The attributes of that PBF that would be affected by the proposed action include water quality to support growth and development, and prey species of sufficient quantity, quality, and availability. As described in the effects section, the proposed action would perpetuate, for 5 years, long-term minor adverse effects on both of these attributes.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the Inland Waters of Puget Sound PBF. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for SR killer whales.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitats, 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 Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish, nor is it likely to destroy or adversely modify designated critical habitat for PS Chinook salmon, PS/GB bocaccio, PS/GB yelloweye rockfish, and SR killer whales.

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 Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish from exposure to Effluent-related Impacts.

The NMFS cannot predict with meaningful accuracy, or reliably observe, the number of PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish that are reasonably certain to be injured or killed annually by exposure to the proposed action's effluent-related impacts. The distribution and abundance of the listed fish that occur within the action areas 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, 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 authorized discharge limits identified in the proposed NPDES permits, as summarized in the proposed action section of this biological opinion are the best available surrogates for the extent of take of PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish from exposure to effluent-related impacts. Effluent-related impacts would result from numerous pollutants, most of which are not specifically identified in the proposed NPDES permits, nor can they be practically monitored at this time. Therefore, the proposed authorized discharge limits that are currently being monitored are the only valid indicators of take that can be reliably monitored for this action. Those limits are appropriate surrogates for this action because, as pollutant loading in the effluents increase, as indicated by the monitored pollutants, the intensity of fitness and or behavioral effects that exposed fish would experience would also increase.

Therefore, the extent of PS Chinook salmon, PS steelhead, PS/GB bocaccio, and PS/GB yelloweye rockfish take for this action is defined as:

- Discharge of effluent from the Gooseberry Point, Sandy Point, Tulalip, and Suquamish WWTP outfalls in compliance with all effluent limits identified respectively in the June 2021 draft NPDES Permit No. WA0025666, the June 2021 draft NPDES Permit No. WA0025658, the April 2021 draft NPDES Permit No. WA0024805, and the September 2019 draft NPDES Permit No. WA0023256.

Failure to comply with the effluent limits in the respective permits may constitute an exceedance of authorized take that may trigger the need to reinitiate consultation, consistent with 50 CFR 402.16, for any permit or permits that exceed take. As described in the proposed action section of this opinion, effluent limit exceedances can occasionally occur at any of the four WWTPs considered here, which would trigger the Permittees to implement corrective actions to address the exceedances, and the authorized take for this action accounts for such variability and associated corrective actions. Therefore, only repeated, significant, and or uncorrected exceedances of the effluent limits that are likely to result in increased adverse effects on listed species and critical habitats above what has been evaluated in this biological opinion would be considered an exceedance of the authorized take that could trigger the need to reinitiate consultation for this action.

Although this take surrogate could be construed as partially coextensive with the proposed action, it nevertheless functions as an effective reinitiation trigger. This is because, over the life of the permits, the required monitoring and reporting would provide opportunities to examine whether the surrogate has been exceeded.

Further, should a reinitiation-triggering exceedance event occur at one of the WWTPs considered here, that event would affect the take authorization for that WWTP alone, and absent any other factors would not trigger the need to reinitiate consultation for the other WWTPs.

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 listed species or destruction or adverse modification of critical habitats under our jurisdiction.

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 USEPA shall require the Permittees to:

1. Implement 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 USEPA and the Permittees have a continuing duty to monitor the impacts of incidental take and must report the impact of the action 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 USEPA shall review discharge monitoring reports and notifications submitted by the Permittees to monitor authorized take, as specified in this ITS.
    a. If a potential reinitiation-triggering exceedance event occurs, the USEPA shall provide the NMFS with written notification of noncompliance that would include a summary of the overall compliance history for the subject permit, and a request to consider whether reinitiating consultation is required. That notification shall be provided to the NMFS within 90 days of the USEPA's receipt the of applicable documentation, and shall be sent to: projectreports.wcr@noaa.gov , with "Attn: WCRO-2021-02648" 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).

To reduce adverse impacts on water quality that the proposed action would perpetuate in Puget Sound through continued discharge of WWTP effluent:

1. The USEPA should support additional data collection to assist the Permittees in more completely identifying the pollutant loads in the effluents discharged from their WWTPs, including oil and grease, nitrogen congeners, and anthropogenic trace compounds (ATCs) such as pharmaceuticals and personal care products (PPCPs).

2. The USEPA should incorporate permit conditions that will result in decreased nutrient loadings, specifically nitrogen, over the permit term. Reducing nutrient loadings in the effluent is likely to result in the reduced loading of ATCs, such as PPCPs, as well as minimizing far-field impacts to dissolved oxygen.

2.11 Reinitiation of Consultation

This concludes formal consultation for the USEPA's Reissuance of NPDES Permits for four tribally-owned WWTPs that discharge to Puget Sound, Washington (WA0025666; WA0025658; WA0024805; WA0023256).

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 southern eulachon, North American green sturgeon, humpback whales of the Central America and Mexico DPSs, SR killer whales, and leatherback sea turtles. Detailed information about the biology, habitat, and conservation status and trends of these fish and whale species 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, effluent-related impacts are the action-related stressors expected to cause adverse effects. The extent of those effects is expected to be limited to the marine waters and substrates within 500 yards around the 4 WWTP outfalls considered in this opinion.

Southern eulachon, North American green sturgeon, and leatherback sea turtles

The best available information concerning the distribution, habitat preferences, and life history characteristics of all three of the species considered here support the understanding that they are all uncommon to rare in Puget Sound. Based on that, and the small affected areas around the four outfall sites (i.e. 500 yards), it is extremely unlikely that any individuals of any of these three species would approach close enough to any of the outfalls to be meaningfully affected by the proposed action. As such, the proposed action is not likely to adversely affect southern eulachon, North American green sturgeon, and leatherback sea turtles.

Humpback whales and SR killer whales

Humpback and killer whales could be directly and or indirectly exposed to effluent-related impacts as a consequence of the proposed action.

Because effluent impacts may also include trophic impacts, the following assessment considers work-related forage diminishment and effluent-related trophic impacts together. This assessment considers direct effluent exposure, and effluent-attributable trophic impacts.

Direct effluent exposure: Effluent exposure is extremely unlikely to cause more than minor effects on either whale species. As described in Section 2.5.1, the proposed outfalls would authorize the continued discharge of WWTP effluent to four nearshore locations in Puget Sound, and that effluent contains substances that are known to be harmful to fish, especially to small and or developing juvenile fish. The NMFS biological opinion for the reissuance of the NPDES permit for the Hyperion WWTP in Los Angeles, CA (NMFS 2018) concluded that the effluent from that WWTP would adversely affect numerous whale species. However, the volume of action-attributable effluent considered in this opinion is very small, especially when compared to large WWTPs like Hyperion, which is permitted to discharge a maximum of 850 MGD. By comparison, the 2010 combined effluent discharge of the 106 authorized WWTPs around Puget Sound was about 356 MGD (WDOE and Herrera 2010), and the combined discharge for the four outfalls considered here is about 2 MGD (USEPA 2021b), about 0.2 percent as large as the maximum Hyperion discharge.

In Section 2.5.1 of this biological opinion, we determined that fish would be adversely affected by direct exposure to action-attributable effluent. However, due to the much larger mass of the whales considered here, the whales must absorb much more contamination than would fish to elicit detectable effects, and being air breathers, instead of drawing oxygen from the water through gills like fish, whales likely absorb contaminants directly from the water at lower rates than do fish. Therefore, far more direct exposure to the effluent would be required to elicit detectable effects in whales than would be required for the fish considered in this opinion. Further, both whale species typically range widely during any given day. Based on this, on the relatively small size of the detectable effluent plumes, and on the very small volume of action attributable effluent, it is most likely that any individuals of either whale species would be exposed to action-attributable effluent extremely infrequently, and only for very brief periods of time, likely measured in minutes. Therefore, it is extremely unlikely that any exposed whales would absorb enough contaminants from the effluent to cause any meaningful fitness or behavioral effects, including with multiple exposures to the effluent over any given whale's lifetime.

<u>Effluent-attributable trophic impacts</u>: Effluent-attributable trophic impacts are extremely unlikely to cause more than minor effects on either whale species. The routine discharge of the WWTP's effluent to Puget Sound is likely to expose humpback whale forage resources, such as forage fish and planktonic invertebrate organisms, to harmful pollutants. Similarly, the effluent discharge is likely to expose the prime forage resource for SR killer whales, Chinook salmon, to harmful pollutants.

The uptake of pollutants may cause direct mortality or reduced fecundity in forage organisms that are exposed to the effluent. This, in turn, could reduce the availability of forage resources for the whales considered here. Additionally, the whales may be indirectly exposed to pollutants if they consume contaminated prey organisms.

Action-attributable loss of humpback forage organisms, and any trophic link to action-attributable contaminants would be too small to cause any meaningful effects on the fitness and or normal behaviors of humpback whales. As described in Section 2.5.1 and above, the volume of action-attributable effluent, and the size of the affected areas are both very small. Therefore, only extremely small proportions of the forage fish populations that reside in the regions near the outfalls may be exposed, and only a subset of those individuals may be lost due to direct exposure to the effluent and or effluent-related reduced fecundity.

Based on the best available information, as described below in the discussion about Chinook salmon smolt to adult ratios, the subset of forage organisms that may be lost or experience reduced fecundity due to the proposed action would be too small to cause any population-level effects in the affected forage species, and therefor too small to cause any detectable reduction in forage availability for humpback whales that forage in Puget Sound. Similarly, it is extremely unlikely that the numbers of action-attributable contaminated forage organisms that the whales may consume, and or the contaminant concentrations in those forage organisms would be high enough to cause any meaningful effect on the humpback whales that consume them.

Action-attributable loss of SR killer whale forage and any trophic link to action-attributable contaminants would be too small to cause any meaningful effects on the fitness and or normal behaviors of SR killer whales. As described in Section 2.5.1 and above, the volume of action-attributable effluent and the sizes of the affected areas in Puget Sound are both very small, and the annual numbers of Chinook salmon likely to be lost due to effluent exposure (almost exclusively juveniles), would be extremely small. The exact Chinook salmon smolt to adult ratios are not known. Even under natural conditions, individual juvenile Chinook salmon have a very low probability of surviving to adulthood (Bradford 1995). We note that human-caused habitat degradation and other factors such as hatcheries and harvest exacerbate natural causes of low survival such as natural variability in stream and ocean conditions, predator-prey interactions, and natural climate variability (Adams 1980; Quinones et al. 2014). However, based on the best available information, the annual numbers of project-affected juveniles would be too low to influence any VSP parameters of any of the affected populations, or to cause any detectable reduction in adult Chinook salmon availability to SR killer whales in marine waters.

It is extremely unlikely that the numbers of Chinook salmon that may be contaminated by action-attributable pollutants, and or that the attributable pollutant concentrations in affected fish would be high enough to cause any meaningful effect on SR killer whales. The adult Chinook salmon that would be exposed to action-attributable effluent would mostly likely be an extremely small subset of any year's cohort of returning adults. Additionally, those adults would most likely be exposed to the effluent plumes and effluent-contaminated forage when they would mostly be in the terminal phase of their oceanic life stage, and in route to their natal streams.

The duration of exposure to the effluent that adult Chinook salmon may experience, and or the amount of action-attributable contaminated forage that any adult Chinook salmon may consume before entering their natal stream would be highly variable over time, but both are expected to be very low. Therefore, very few adult Chinook salmon are likely to be contaminated with action-attributable pollutants, and the concentrations of action-attributable pollutants in specific adult Chinook salmon would be extremely low. Based on this, over the life of any specific SR killer whale, it is extremely unlikely that it would consume enough action-attributable contaminated Chinook salmon to cause any detectable effects of its long-term fitness and normal behaviors.

In summary, based on the best available information, as described above, the proposed action is not likely to adversely affect southern eulachon, North American green sturgeon, leatherback sea turtles, humpback whales of the Central America and Mexico DPSs, or SR killer whales.

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 USEPA and the descriptions of EFH for Pacific Coast Salmon (Pacific Fishery Management Council [PFMC] 2014), Pacific Coast Groundfish (PFMC 2005), and Coastal Pelagic Species (PFMC 1998) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected By the Project

The USEPA proposes to reissue NPDES permits to authorize the continued discharge of effluent from the Lummi Gooseberry Point, the Lummi Sandy Point, the Tulalip, and the Suquamish WWTPs, all of which discharge to the marine waters of Puget Sound, Washington (Figures 1 - 9). The waters and substrates at and adjacent to all four WWTP outfalls are designated as marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species.

The major components of marine EFH for Pacific Coast Salmon are: Estuarine rearing; Ocean rearing; and juvenile and adult migration. The important habitat features of this EFH are: 1) good water quality; 2) cool water temperatures; 3) abundant prey species and forage base; 4) connectivity with terrestrial ecosystems; and 5) adequate depth and habitat complexity including marine vegetation and algae in estuarine and near-shore habitats. Additionally, as part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined as: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation.

Pacific Coast Groundfish EFH is identified as: All marine waters and substrate from mean higher high water or the upriver extent of saltwater intrusion out to depths less than or equal to 11,484 feet (3,500 m); Certain specifically identified seamounts in depths greater than 11,484 feet; and Areas designated as HAPCs not already identified by the above criteria (PFMC 2005). Pacific Coast Groundfish HAPC includes: Estuaries; Canopy Kelp; Seagrass; Rocky Reefs; and Areas of interest.

For Coastal Pelagic Species, EFH is identified as all marine and estuarine waters from the shoreline to the offshore limits of the exclusive economic zone (EEZ) and above the thermocline where sea surface temperatures range between 10°C to 26°C (PFMC 1998).

All four outfall sites provide the estuaries, marine and estuarine submerged aquatic vegetation, and eelgrass HAPCs.

Succinct identification of specific habitat features that are necessary to support the full life cycles of Groundfish and Pelagic Species were not articulated in their respective EFH descriptions. However, the important features identified for Salmon EFH effectively address the habitat features that are necessary to support the full life cycle for all three species groups that may be affected by the proposed action. Therefore, the important features of marine Salmon EFH are used below to assess the impacts on EFH for all three species groups.

3.2 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, Pacific Coast Groundfish, and Coastal Pelagic Species. Based on the analysis of effects presented in Section 2.5 the proposed action will cause minor long-term adverse effects on marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species as summarized below.

1. Good water quality: The proposed action would perpetuate minor long-term adverse effects on this attribute. The proposed action would authorize the continued total discharge of about 2 MGD of WWTP effluent into Puget Sound at four relatively distant locations. Within the 22- to 25-foot-radius acute mixing zones around the outfalls, some pollutant concentrations could be acutely toxic to some of the fish and other marine organisms that may enter them, especially to small and or immature individuals. Within about 500 yards around the outfalls, contaminant concentrations could be high enough to cause behavioral and non-lethal chronic effects such as avoidance of the area, reduced fitness, and reduced reproductive success in some of the fish and other marine organisms that may enter those areas, again, especially in small and or immature individuals. Additionally, the effluent is likely to reduce dissolved oxygen and salinity, particularly within the acute mixing zones immediately adjacent to the outfalls, but the effects would quickly diminish with distance, and would likely be undetectable beyond 500 yards. Given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on water quality and salinity would be minor.

2. Cool water temperatures: The proposed action would perpetuate minor long-term adverse effects on this attribute. As discussed above, the proposed action would authorize the continued total discharge of about 2 MGD of WWTP effluent into Puget Sound at four relatively distant locations. Although not specifically addressed in the NPDES permit for the outfalls, the effluents would likely be of a higher temperature than the receiving waters, but would likely be undetectable beyond about 500 yards from the outfalls.

3. Abundant prey species and forage base: The proposed action would perpetuate minor long-term adverse effects on this attribute. The nutrient loads in the effluent at the outfalls could slightly increase productivity and create small areas of slightly increased forage availability adjacent to the outfalls. Conversely, pollutants in the effluent could reduce forage availability through direct morality and or reduced fecundity among exposed forage organisms. The degree to which these opposing processes would offset each other is unknown. To avoid underestimating potential impacts, this opinion assumes, that on average, forage availability would be slightly decreased within about 500 yards around each outfall. Additionally, some contaminants from the effluent would enter the food web and bioaccumulate in forage organisms that are directly and or indirectly exposed to the effluent's contaminants.

However, given the relatively low authorized pollutant concentrations and or masses, the small maximum flow volumes, and the relatively small areas of effect, action-attributable effects on forage would be minor.

4. Connectivity with terrestrial ecosystems: No changes expected.

5. Adequate depth and habitat complexity including marine vegetation and algae in estuarine and near-shore habitats: No changes expected.

Habitat Areas of Particular Concern (HAPCs)

The effects on the Estuaries HAPC are identified above at 1 - 3 under Marine EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. The proposed action would also perpetuate long-term minor adverse effects on the marine and estuarine submerged aquatic vegetation and eelgrass HAPCs. Sediment deposition and exposure to effluent-borne pollutants may slightly reduce SAV and eelgrass availability adjacent to the outfalls. However, given the relatively low authorized pollutant concentrations and or masses that would be discharged, and the small authorized maximum effluent volumes, action attributable effects on SAV and eelgrass availability would be minor.

3.3 Essential Fish Habitat Conservation Recommendations

The NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

To reduce adverse impacts on water quality, cool water temperatures, abundant prey species and forage base, and on SAV and eelgrass that the proposed action would cause through continued discharge of WWTP effluent at the four outfall locations across Puget Sound:

1. The USEPA should support additional data collection to assist the Permittees in more completely identifying the pollutant loads in the effluents discharged from their WWTPs, including oil and grease, nitrogen congeners, and anthropogenic trace compounds (ATCs) such as pharmaceuticals and personal care products (PPCPs).

2. The USEPA should incorporate permit conditions that will result in decreased nutrient loadings, specifically nitrogen, over the permit term. Reducing nutrient loadings in the effluent is likely to result in the reduced loading of ATCs, such as PPCPs, as well as minimizing far-field impacts to dissolved oxygen.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USEPA must provide a detailed written response to the NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of the NMFS' EFH Conservation Recommendations unless the NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with the NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(1)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, the NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USEPA 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 USEPA. Other interested users could include the applicants, the WDFW, the governments and citizens of the Counties within which the outfalls are located, and other Native American tribes in the region. Individual copies of this opinion were provided to the USEPA. 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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