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-2021-02354

March 10, 2023

Jodie Beall
Environmental Engineer
WSDOT Local Programs
P.O. Box 47390
310 Maple Park Avenue SE
Olympia, Washington 98504

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the National STEM School Project (HUC 171100190705).

Dear Ms. Beall:

Thank you for your letter of September 16, 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 National STEM School Project (Kitsap County).

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 is likely to adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon, PS steelhead, PS/Georgia Basin (GB) bocaccio rockfish, 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 rockfish, PS/GB yelloweye rockfish, and SRKW, but is not likely to result in the destruction or adverse modification of that designated critical habitat.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. Therefore, we have included the results of that review and conservation recommendations in Section 3 of this document.

Please contact Monette O’Connor in the Oregon Washington Coastal Office at monette.oconnor@noaa.gov or (360) 358-2246 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

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

National STEM School Project
(HUC 171100190705)

NMFS Consultation Number: WCRO-2021-02354

Action Agency: WSDOT-FHWA

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?
Puget Sound (PS) Chinook salmon (*Oncorhyncus tshawytscha)*	Threatened	Yes	No	Yes	No
PS steelhead *(O. mykiss)*	Threatened	Yes	No	N/A	No
Southern resident killer whale (SRKW) *(Orcinus orca)*	Endangered	No	No	Yes	No
PS/Georgia Basin (PS/GB) Bocaccio *(Sebastes paucipinus)*	Threatened	Yes	No	Yes	No
PS/GB yelloweye rockfish *(S. ruberrimus)*	Threatened	Yes	No	N/A	No

Fishery Management Plan That Identifies 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: March 10, 2023

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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.

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 September 16, 2021, the NMFS received a request for informal consultation along with a Biological Assessment (BA) from the Washington State Department of Transportation (WSDOT), which is the non-federal representative for the Federal Highway Administration (FHWA). In their BA, the WSDOT determined that the proposed action was not likely to adversely affect ESA-listed species or designated critical habitat, and was likely to adversely affect essential fish habitat within the action area.

However, the NMFS has determined that the proposed action is likely to adversely affect ESA-listed species and critical habitat within the action area. On November 2, 2022, NMFS notified the WSDOT that a formal consultation would be required as stormwater is known to have contaminants in effluent, even after treatment, that are detrimental to the quality of receiving water bodies, and to fish exposed to such contaminants. The WSDOT acknowledged via email the need for a formal consultation. This opinion will address formal consultation for PS Chinook salmon, PS steelhead, southern resident killer whales (SRKW), PS/GB bocaccio and PS/GB yelloweye rockfish.

On February 27, 2023, the WSDOT provided a Final Drainage Report and confirmed that the proposed action will meet the Minimum Requirements (MRs) in the 2021 Kitsap County Stormwater Manual Design.

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 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.

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 WSDOT proposes to permit Kitsap County to improve poor pavement conditions, resolve excessive queuing, upgrade substandard pedestrian facilities and correct absence of stormwater treatment by adding sidewalks and bike lanes, extending a turn lane, closing a street, providing pavement overlay, performing Americans with Disabilities Act (ADA) renovation, and installing stormwater improvements. The project is located adjacent to the West Hills STEM Academy School in unincorporated Kitsap County near the City of Bremerton, Washington, within Section 22 of Township 24 North, Range 01 East of the Willamette Meridian (**Figure 1**); the project's proximity to the STEM Academy influenced the naming of this consultation. The purpose of the project is to improve traffic flow, pedestrian safety and accommodate additional non-motorized use along South National Avenue and West Loxie Eagans Boulevard.

The project includes approximately 1,300 linear feet of nonmotorized improvements on South National Avenue, 5,000 linear feet of pavement overlay on South National Avenue and 1,800 linear feet of pavement overlay on West Loxie Eagans Boulevard, in addition to extending the southbound right turn lane on South National Avenue at West Loxie Eagans Boulevard and optimizing signal timing at the intersection (**Figure 2Error! No bookmark name given.**). New and/or reconstructed curb ramps would be provided in compliance with the Americans with Disabilities Act (ADA) requirements for pavement overlay.

The project also proposes the installation of two catch basins and conveyance piping to collect stormwater at the new sidewalk, curb, and gutter, and a bioretention cell on the southwest corner of South National Avenue and L Street for stormwater treatment and flow control (Figure 3). There is currently no stormwater treatment within the project area and stormwater flows into the existing conveyance system, which flows south and eventually discharges directly into Sinclair Inlet via two outfalls. Stormwater currently is conveyed by sheet flow in a shallow grade break in the pavement between the driving lane and the shoulder. The proposed non-motorized improvements (curb, gutter, sidewalk and bike lane) on the west side of South National Avenue from H Street to Arsenal Way would displace the existing stormwater pathways.

Figure 1. Vicinity map and project area (adapted from Figure 1 of the Biological Assessment).

Figure 2. The image depicts locations for pavement overlay in red and the cachement and discharge points for stormwater in black (adapted from Figure 2 of the BA).

As a result, new catch basins and conveyance piping would be installed on the west side of South National Avenue, where needed, to collect stormwater at the new sidewalk, curb, and gutter and discharge stormwater to the existing conveyance facilities. A bioretention cell would be constructed on a parcel (Parcel No. 4502-012-024-0002) located on the southwest corner of the South National Avenue and L Street intersection to serve as stormwater treatment and flow control. This parcel would be acquired as part of this project to accommodate the construction of the bioretention cell. There would be no changes to the two existing stormwater outfalls that flow into Sinclair Inlet, nor would there be any in-water work.

Stormwater Runoff and Detention Facilities

The project clearing area involves two drainage basins, separated by West Loxie Eagans Boulevard, which directly discharge to Sinclair Inlet via man-made conveyance (**Figure 3**). There would be no land clearing activities in the pavement overlay areas.

Basin 1 is north of West Loxie Eagans Boulevard and discharges westerly to the WSDOT Municipal Separate Storm Sewer System (MS-4) along State Route (SR) 3. Stormwater collected from the project vicinity within Basin 1 is conveyed by catch basins and stormwater piping under West Loxie Eagans Boulevard and heads west. At the intersection of West Loxie Eagans Boulevard and SR 3, Kitsap County storm facilities connect to the existing SR 3 WSDOT storm system and head south along SR 3 inside WSDOT ROW. The entire contributing area from Basin 1 to the WSDOT outfall is approximately 134 acres. Stormwater eventually discharges via an outfall (**Figure 4**) directly into Sinclair Inlet.

Basin 2 is south of West Loxie Eagans Boulevard and is entirely contained within the Kitsap County MS-4. Basin 2 contributes to the stormwater trunk line under South National Avenue. The entire contributing Basin 2 area has been estimated as 33.2 acres. A conveyance analysis of the existing 12-inch-diameter corrugated metal pipe (CMP) at ¼ mile downstream from the project confirms it does not have capacity for the 100-year peak storm flow without surcharging.

There would be no net new pollution-generating impervious surfaces (PGIS); the project would add 2,230 square feet of PGIS but convert 5,050 square feet of existing PGIS to sidewalk which is non-PGIS. The pavement overlay areas of the project are assumed to trigger the implementation of the nine Minimum Requirements (MRs) in the 2021 Kitsap County Stormwater Design Manual, which are summarized in **Table *1***.

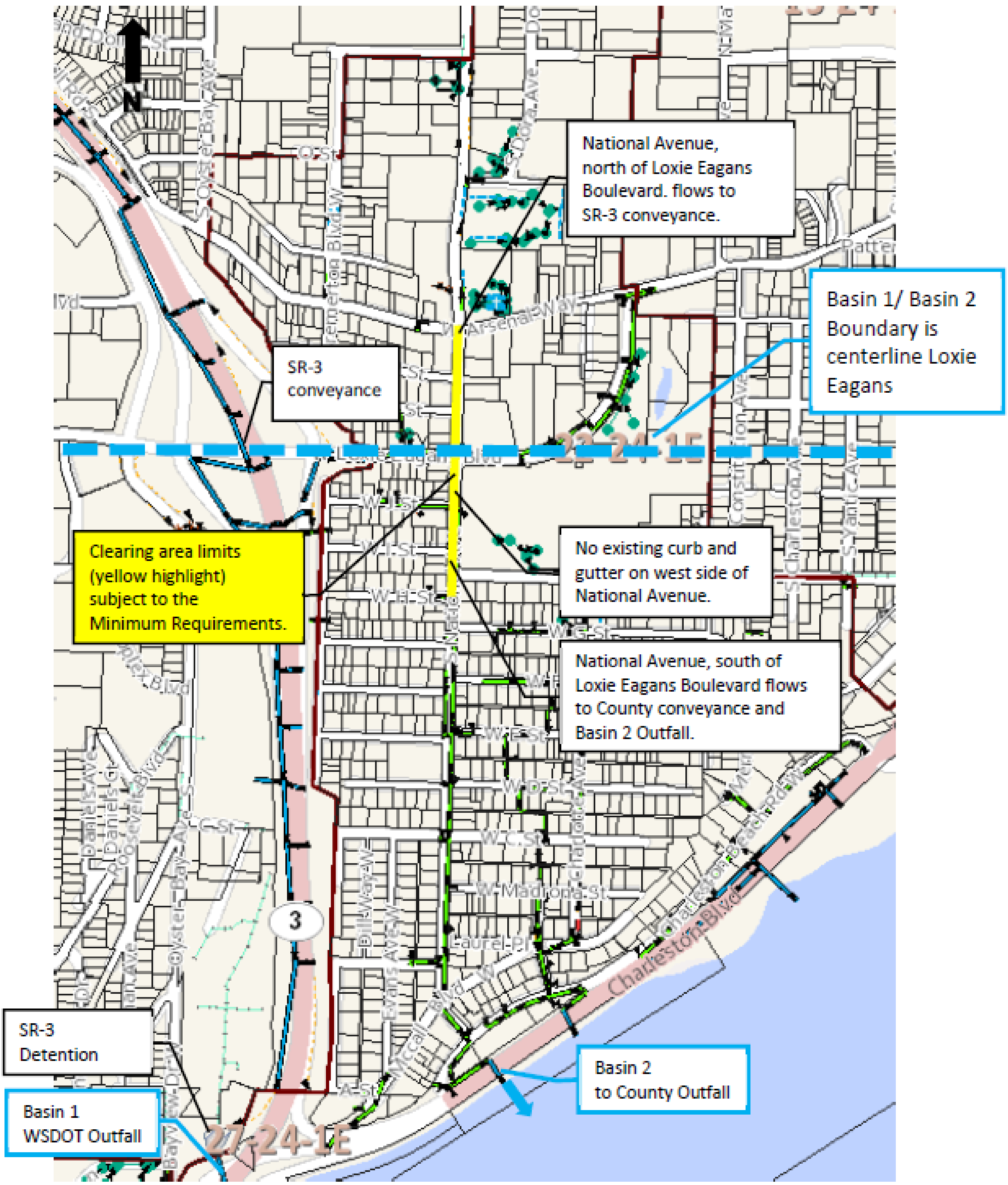

Figure 3. Existing drainage basins 1 and 2, conveyance, and clearing areas (adapted from Figure 2 of the Final Drainage Report).

Table 1. Minimum requirements from Kitsap County's 2021 Stormwater Design Manual

Minimum Requirement (MR)	Summary Description	WSDOT's Response
1. Preparation of Stormwater Site Plans	Projects shall prepare a Stormwater Site Plan, providing a comprehensive reporting of the technical information and analysis necessary to review compliance with the Stormwater Code.	A final drainage report has been prepared.
2. Construction Stormwater Pollution Prevention	Requires projects to prevent erosion and discharge of sediment and other pollutants into receiving waters during construction activities	A final drainage report has been prepared.
3. Source Control of Pollution	All known, available and reasonable source BMPs shall be applied to all projects	A final drainage report has been prepared.
4. Preservation of Natural Drainage Systems and Outfalls	Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which the runoff is discharged from the project site shall not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls shall provide energy dissipation.	A final drainage report has been prepared.
5. On-site Stormwater Management	Projects shall employ On-Site Stormwater Management BMPs in accordance with the prescribed projects thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on site to the extent feasible without causing flooding or erosion impacts.	A bioretention cells would be used to treat new hard surfaces.
6. Runoff Treatment	Projects shall provide runoff treatment to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms so that beneficial uses of receiving waters are maintained and, where applicable, restored.	The bioretention cells installed to meet MR#5 would also treat new PGIS areas and some of the existing PGIS.
7. Flow Control	Projects shall provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions.	The bioretention cells would provide flow reduction during peak storms to account for pipe capacity restrictions downstream.
8. Wetlands Protection	Projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system shall comply with Volume II, Chapter 6 on page 271.	Does not apply to this project since there are no wetlands within the action area.
9. Operation and Maintenance	An operation and maintenance manual that is consistent with the provisions in Volume II, Chapter 7 on page 273 shall be provided for proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified.	Provided by Kitsap County Public Works Stormwater Division (see the final drainage report).

The stormwater discharge from the new PGIS surfaces would be treated and/or detained in accordance with the 2021 Kitsap County Stormwater Design Manual. The new bioretention cells would meet MRs 5, 6 and 7 (See Table 1) for stormwater treatment and flow control. The bioretention cells would have an underdrain and overflow tied to the stormwater conveyance. There would be a 0.75-inch-diameter orifice in the underdrain that would detain treated water in the bioretention cell and meter it back to the storm system to match existing or reduce the 100-year peak stormwater flows to the conveyance system. Water from the bioretention cell would be discharged into the existing stormwater system and water would flow south into Sinclair Inlet via the existing outfalls. The proposed stormwater design adds water quality treatment and flow control that is currently lacking within the project area, bringing the roadway up to current standards for treatment of stormwater runoff.

Short-term, localized increases in stormwater volumes may result from construction and staging, as well as road runoff during construction before permanent stormwater facilities are completed. However, best management practices (BMPs) would be implemented to reduce runoff and to minimize erosion from staging areas and active construction areas. A Stormwater Pollution Prevention Plan (SWPPP) would be prepared by the Contractor and implemented during construction. Other construction stormwater may be dispersed into naturally vegetated areas before infiltrating or discharging off site.

There would be no changes to either of the existing outfalls (**Figure 4**), no in-water work, and no work done on the shoreline.

Figure 4. Riprap lines the shoreline surrounding the existing outfalls (adapted from Figure A-6 of Appendix A in the Biological Assessment).

<u>Construction Timing</u>

The project is expected to occur in one phase and the timing is dependent on obtaining permits. Generally, the majority of earth moving activities would occur early in the construction season (April, May and June), once BMPs and temporary erosion and sediment control measures are in place. Paving typically occurs before the wet season around the end of October. Fish work windows do not apply to this project because there is no in-water work proposed.

<u>Minimization Measures</u>

The following general conservation measures would be taken to ensure that environmental impacts are minimized and mitigated throughout the duration of the project:

- Equipment staging and/or materials storage would be limited to non-vegetated surfaces.
- Disturbance would be limited to those areas necessary for construction, which would be identified on site plans and marked on the site before construction begins.
- Waste materials would be transported off site for disposal in accordance with applicable regulations.
- Adequate materials and procedures to respond to unanticipated weather conditions or accidental releases of materials (sediment, petroleum hydrocarbons, etc.) would be available on site.
- Work would comply with all local, state and federal regulations and restrictions.
- A Spill Prevention Control and Countermeasure (SPCC) Plan would be prepared, approved by Kitsap County and implemented by the Contractor. The plan would be site-specific and cover the Project scope of work.
- A Stormwater Pollution Prevention Plan (SWPPP), including temporary erosion and sedimentation control (TESC) measures would be fully implemented. Appropriate erosion control measures would be implemented at appropriate locations. The Contractor is required to store TESC supplies onsite.
- Construction techniques would utilize BMPs such as those described in the current version of WSDOT's Standards and Specifications for Road, Bridge, and Municipal Construction (WSDOT 2021a) and Washington State Department of Ecology's (Ecology) Stormwater Management Manual for Western Washington (Ecology 2019).
- SWPPP BMPs and stormwater discharge from the site would be monitored by a Certified Erosion Sediment Control Lead (CESCL), in accordance with a National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit from Ecology.
- Minimize erosion and delivery of sediment laden water to offsite areas. Reduce sedimentation by use of BMPs and erosion control methods such as silt or filter fabric, silt or filter fencing, straw bales or wattles, and rain cover. Control measures such as silt fencing would be placed between the channel or water edge and project activities.
- Equipment used for the Project shall be free of external petroleum-based products while the work is performed around the water. Equipment shall be checked daily for leaks, and any necessary repairs shall be completed prior to commencing work activities. Heavy equipment shall be washed free of deleterious material prior to commencement of work.
- At project completion, all disturbed areas shall be protected from erosion by re-vegetation with hydroseed.
- Erosion prevention and control methods shall be used as necessary during and immediately after project implementation to minimize loss or displacement of soils and to prevent delivery of sediment into waterbodies.
- Disturbed ground with the potential to deliver sediment into waterbodies shall be revegetated or protected from surface erosion by seeding, mulching or other methods prior to the fall rainy season.
- Fresh concrete, concrete by-products or other construction generated chemical contaminants shall not be allowed to enter waterbodies. Structures containing concrete shall be sufficiently cured to prevent leaching prior to contact with a waterbody.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that the project also supports increasing bicycle use and pedestrian access along roadways.

1.4 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).

As described in Section 1.3 (Proposed Federal Action), the project would occur on land at South National Boulevard and West Loxie Eagans Boulevard (**Error! Reference source not found.**). While no in-water work is proposed, we anticipate some effects to water quality, caused by the discharge of stormwater. Water quality standards in Washington (WAC 173-201A) specify a mixing zone in which visible turbidity must not extend more than 150 feet from the construction location. However, the action area is bounded by the furthest extent of expected effects; water quality contaminants in stormwater, even post treatment, are likely to persist without settling out in the manner that suspended sediment does, and for these reasons, we consider the action area to extend well beyond the turbidity mixing zone. Based on water and sediment quality (Zhang et al 2016) to be affected by certain likely contaminants (PAHs and 6PPD-quinone for example), we estimate that the action area is 1 kilometer (km) radially from each outfall (Laws et al., 1997) which discharge into Sinclair Inlet.

Based on the likely downstream transport of stormwater contaminants such as 6PPD/6PPD-quinone and PAHs, we draw the downstream extent of the direct stormwater effects beyond Sinclair Inlet to Puget Sound. Additionally, trophic connectivity between PS Chinook salmon and the SRKW that feed on them extends the action area to the marine waters of Puget Sound, as forage (salmon) is a feature of SRKW critical habitat. The described area overlaps with the geographic ranges of the ESA-listed species and the boundaries of designated critical habitats identified in **Table *2*** and **Table *3***. 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.

Puget Sound Chinook salmon most likely to be present in relatively high proportion in the action area are from the Central/South Sound Multiple Population Group (MPG). Puget Sound steelhead most likely to be present in the action area in relatively high proportion are from Central and South Puget Sound MPG, and could be predominantly from the east Kitsap Peninsula Tributaries.

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 NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, 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 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 WSDOT determined that the proposed action is not likely to adversely affect SRKW. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.9).

2.1 Analytical Approach

This 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 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 PS Chinook salmon, SRKW and PS/GB bocaccio use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term 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 PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE 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 rangewide 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.

NMFS relied on the best available science on stormwater contaminants, stormwater treatment methods, the dispersal of contaminants in marine water, the associated contamination of marine sediments from certain stormwater contaminants, and the responses of fishes to exposed to stormwater contaminants. Where data was not specific to Puget Sound, NMFS relied on studies on the stormwater contaminants in other nearshore and deep marine waters. NMFS has based its action area on the effects of stormwater. Relying on the larger action area at 1 km waterward radially from the locations of the outfalls into Sinclair Inlet, NMFS expects likely adverse effects to PS Chinook salmon, PS steelhead, PS/GB bocaccio and PS/GB yelloweye rockfish due to exposure of these species to stormwater runoff. The NMFS also expects likely adverse effects to the critical habitats of PS Chinook salmon, SRKW, and PS/GB bocaccio and yelloweye rockfish. Our analysis includes these species and designated critical habitats that are present in the action area.

2.2 Rangewide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. 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 current function of the essential PBFs that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this Opinion, and aquatic habitat at large, is climate change. 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. These changes will not be spatially homogeneous across 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 (IPCC WGI 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al., 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al., 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but 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 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. Here 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 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 outbreak (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:

Cooper et al., (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter's precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al., (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

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

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

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

Marine and Estuarine Environments

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

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

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see 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 streamflows) 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; Williams et al., 2016; Ward et al., 2015). 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 intergravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al., 2020). 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 (Crozier et al., 2020; FitzGerald et al., 2020). Rising river temperatures increase the energetic cost of migration and the risk of *en 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 (Keefer et al., 2018; Barnett et al., 2020).

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 (Holsman et al., 2012; Burke et al., 2013). 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 (Healey 2011; Wainwright and Weitkamp 2013; Gosselin et al., 2021). 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).

2.2.1 Status of the Species

Table *2* provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this Opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 2. Status of the Species. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this Opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Puget Sound Chinook salmon	Threatened 6/28/05 (70 FR 37159)	Shared Strategy for Puget Sound 2007 NMFS 2006	NMFS 2016; Ford 2022	This ESU comprises 22 populations distributed over five geographic areas. All Puget Sound Chinook salmon populations continue to remain well below the TRT planning ranges for recovery escapement levels. Most populations also remain consistently below the spawner–recruit levels identified by the TRT as necessary for recovery. Across the ESU, most populations have increased somewhat in abundance since the last status review in 2016, but have small negative trends over the past 15 years. Productivity remains low in most populations. Overall, the Puget Sound Chinook salmon ESU remains at "moderate" risk of extinction.	• Degraded floodplain and in-river channel structure • Degraded estuarine conditions and loss of estuarine habitat • Degraded riparian areas 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
Puget Sound steelhead	Threatened 5/11/07	NMFS 2019	NMFS 2016; Ford 2022	This DPS comprises 32 populations. Viability of has improved somewhat since the PSTRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al., 2015). Increases in spawner abundance were observed in a number of populations over the last five years within the Central & South Puget Sound and the Hood Canal & Strait of Juan de Fuca MPGs, primarily among smaller populations. There were also declines for summer- and winter-run populations in the Snohomish River basin. In fact, all summer-run steelhead populations in the Northern Cascades MPG are likely at a very high demographic risk.	• Continued destruction and modification of habitat • Widespread declines in adult abundance despite significant reductions in harvest • Threats to diversity posed by use of two hatchery steelhead stocks • Declining diversity in the DPS, including the uncertain but weak status of summer-run fish • A reduction in spatial structure • Reduced habitat quality • Urbanization • Dikes, hardening of banks with riprap, and channelization
Puget Sound/ Georgia Basin DPS of yelloweye Rockfish	Threatened 04/28/10	NMFS 2017d	NMFS 2016d	Yelloweye rockfish within the Puget Sound/Georgia Basin (in U.S. waters) are very likely the most abundant within the San Juan Basin of the DPS. Yelloweye rockfish spatial structure and connectivity is threatened by the apparent reduction of fish within each of the basins of the DPS. This reduction is probably most acute within the basins of Puget Sound proper. The severe reduction of fish in these basins may eventually result in a contraction of the DPS' range.	• Over harvest • Water pollution • Climate-induced changes to rockfish habitat • Small population dynamics

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Puget Sound/ Georgia Basin DPS of Bocaccio	Endangered 04/28/10	NMFS 2017d	NMFS 2016d	Though bocaccio were never a predominant segment of the multi-species rockfish population within the Puget Sound/Georgia Basin, their present-day abundance is likely a fraction of their pre-contemporary fishery abundance. Most bocaccio within the DPS may have been historically spatially limited to several basins within the DPS. They were apparently historically most abundant in the Central and South Sound with no documented occurrences in the San Juan Basin until 2008. The apparent reduction of populations of bocaccio in the Main Basin and South Sound represents a further reduction in the historically spatially limited distribution of bocaccio, and adds significant risk to the viability of the DPS.	• Over harvest • Water pollution • Climate-induced changes to rockfish habitat • Small population dynamics
Southern resident killer whale	Endangered 11/18/05	NMFS 2008	NWFSC 2021	The Southern Resident killer whale DPS is composed of a single population that ranges as far south as central California and as far north as southeast Alaska. While some of the downlisting and delisting criteria have been met, the biological downlisting and delisting 63 criteria, including sustained growth over 14 and 28 years, respectively, have not been met. The SRKW DPS has not grown; the overall status of the population is not consistent with a healthy, recovered population. Considering the status and continuing threats, the Southern Resident killer whales remain in danger of extinction.	• Quantity and quality of prey • Exposure to toxic chemicals • Disturbance from sound and vessels • Risk from oil spills

2.2.2 Status of the Critical Habitat

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

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role.

A summary of the status of critical habitats, considered in this Opinion, is provided below in **Table *3***.

Table 3. Status of Critical Habitat. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this Opinion.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound Chinook salmon	9/02/05 70 FR 52630	Critical habitat for Puget Sound Chinook salmon includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.
Puget Sound/Georgia Basin DPS of bocaccio	11/13/2014 79 FR68042	Critical habitat for bocaccio includes 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPSs' ranges for all three species, critical habitat was not designated in that area. Based on the natural history of bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: 1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; 2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.
Southern resident killer whale	08/02/21 86 FR 41668	Critical habitat includes approximately 2,560 square miles of marine inland waters of Washington: 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. Six additional areas include 15,910 square miles of marine waters between the 20-feet (ft) (6.1-meter (m)) depth contour and the 656.2-ft (200-m) depth contour from the U.S. international border with Canada south to Point Sur, California. We have excluded the Quinault Range Site. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PCEs, or physical or biological features, essential for the conservation of Southern Residents: 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 in Puget Sound, in general, is degraded. Some pollutants in Puget Sound persist and build up in marine organisms including Southern Residents and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills, although oil spills can also have long-lasting impacts on other habitat features In regards to passage, human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whales' passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impacts foraging behavior. Reduced prey abundance, particularly Chinook salmon, is also a concern for critical habitat.

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).

Landscape Setting

The project is located in the Water Resource Inventory Area (WRIA) number 15 (Kitsap). Stormwater from the project area discharges directly into Sinclair Inlet. The Sinclair Inlet watershed drains an estimated 27,500 acres and has approximately 10 miles of shoreline (Haring 2000). Sinclair inlet is on the 303(d) list for several parameters that include: polychlorinated biphenyls, mercury, sediment bioassay (Ecology 2021). The shoreline is heavily developed in this area and does not have much refugia habitat for salmonid species (May and Peterson 2003).

Terrestrial Habitat

Terrestrial habitat conditions within the Project corridor are variable depending on location along the alignment. The area is highly developed with businesses, schools and residential development. In general, the project area slopes south towards Sinclair Inlet; however, the northern portion has more gentle slopes and the southern portion more steeply slope down. There is very little native vegetation within the project area. Vegetation that is present consists of mowed grasses and other landscaped vegetation. There are no areas of native vegetated areas and there are no undisturbed areas that could support terrestrial ESA-listed species.

Riparian and Aquatic Habitat

Sinclair Inlet is heavily degraded with invasive vegetation, human disturbance and constrained by adjacent development. It does not have an intact immediate vegetated buffer. Streams that discharge into Sinclair inlet are mapped as containing (WDFW 2021): chum salmon (*Oncorhynchus keta*); steelhead (*Oncorhynchus mykiss*); cutthroat trout (*Oncorhynchus clarki*); and coho salmon (*Oncorhynchus kisutch*). In addition, because this is marine waters there is also a potential for Chinook salmon (*Oncorhynchus tshawytscha*) to be present in Sinclair Inlet.

ESA-Listed Species and Critical Habitat within the Action Area

*Puget Sound Chinook salmon***:** PS Chinook salmon presence is documented within Sinclair Inlet. Puget Sound is a migratory corridor for adult Chinook salmon and provides habitat for out-migrating juvenile Chinook salmon from rivers into Puget Sound before their eventual oceanic phase as adults. Juvenile Chinook salmon habitat in the vicinity of the action area includes nearshore and estuarine areas. Adults are likely be present in deeper waters of Puget Sound and in central Puget Sound year-round, while juveniles may occur in the shallow nearshore during typical out-migration periods between February and July. The 15-year trend in log natural-origin spawner abundance for the Central/South Sound MPG averaged from 1990-2019 was 0.04 (Ford, 2022). Critical habitat for PS Chinook salmon does occur within the action area.

Physical and biological features (PBFs) of PS Chinook salmon critical habitat that is present in the action area include:

1. Estuarine areas free of obstruction with water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation
2. Near-shore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels

*Puget Sound steelhead***:** PS Steelhead are documented in streams surrounding Sinclair Inlet (WDFW 2021) and are likely to occur within the action area. Based on typical run timing for winter steelhead (December through mid-March) and summer steelhead (August through December) and spawning patterns, juvenile steelhead would be expected to outmigrate between mid-March and early June. There is no designated critical habitat for PS steelhead within the action area. No information was available for the East Kitsap Peninsula Tributaries and South Puget Sound Tributaries DIPs. It is assumed that these populations persist, but at very low levels. Total abundance for the Central and South Puget Sound MPG is still in the low thousands of fish (Ford 2022).

Southern Resident Killer Whales: SRKW have been sighted in Sinclair Inlet within the action area and are known to follow salmonids in Puget Sound for prey. The presence of SRKW in Sinclair Inlet during the fall months can likely be attributed to the whales following fall Chinook salmon and chum runs to stream systems located in south Puget Sound. Therefore, SRKW occur within the project area and could be exposed to effects from the project. Designated critical habitat for SRKW includes all marine waters in Sinclair Inlet and Puget Sound deeper than 20 feet, which includes the action area.

PBFs of SRKW critical habitat include:

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

Rockfish: There is designated critical habitat for larval and juvenile PS/GB bocaccio within the action area. Juvenile bocaccio use shallow nearshore areas within their designated critical habitat, and larval life stages float in the water column. Larvae are born with limited abilities to swim, maintain buoyancy in the water column, and feed. These larvae are pelagic for approximately 2 months and occur in the water column from near the surface to depths of 328 feet or more. Larval presence in Puget Sound peaks in spring and again in summer, and larvae commonly associated with kelp beds. Larvae and small juveniles located within the greater Puget

Sound during the spring and summer months are subject to currents that may potentially drift the fish into the action area. Larvae and juveniles may be exposed to stormwater runoff from the proposed action.

PBFs of juvenile PS/GB bocaccio critical habitat within the action area include:

1. Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge with the following site attributes:
    - Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and
    - Water quality and sufficient levels of dissolved oxygen (DO) to support growth, survival, reproduction, and feeding opportunities.

2.3 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 stated above in Section 1.3, there would be a decrease in total PGIS of approximately 2,820 square feet (0.06 acres) as a result of the project due to the replacement of 5,050 square feet of PGIS asphalt with non-PGIS sidewalk. Pre-project conditions have no stormwater runoff treatment prior to release into Sinclair Inlet. Post project, the new PGIS will receive basic treatment in accordance with the 2021 Kitsap County stormwater Design Manual via new bioretention cells prior to release into Sinclair Inlet. The increase in treatment of PGIS as a result of the proposed stormwater improvements (4,937 square feet) exceeds the amount of new PGIS (2,230 square feet).

Despite the use of minimization measures, temporary effects of the proposed action are associated with construction and include noise and habitat alteration in the terrestrial environment of the action area. Long-term effects of the action result from the presence of the outfalls and effluent discharged into Puget Sound.

2.3.1 Effects on Critical Habitat

There would be no in-water work as a part of the proposed action. Therefore, the temporary effects of construction-related noise and habitat alteration is not expected to impact the critical habitat for PS Chinook salmon, SRKW, and PS/GB bocaccio rockfish.

Water Quality: Water quality is a feature of critical habitat for each species considered in this Opinion, and is a feature of critical habitat for SRKW.

Stormwater runoff is a major contributing factor to water quality impairments throughout Washington State (EPA 2020). Impervious surfaces, such as roads and parking lots, alter the natural infiltration of vegetation and soil, and accumulate many diverse pollutants. During heavy rainfall or snowmelt events, accumulated pollutants are mobilized and transported in runoff from roads and other impervious surfaces. Individual stormwater outfalls ultimately discharge to streams, rivers, lakes, and marine waters. In chemical terms, runoff from roadways, parking lots, and other hardscaped elements of the transportation grid represents an extraordinarily complex mixture, consisting of thousands of distinct compounds, the vast majority of which have not been identified or characterized in terms of adverse environmental effects (Du et al., 2017, Peter et al., 2018). The proposed action intends to capture and treat stormwater prior to discharge into Puget Sound.

Despite water quality standards and treatment, environmental monitoring has documented pollution-driven degradation in nearly all aquatic habitats (freshwater, estuarine, and marine) for NOAA trust resources, including those presently listed for protection under the U.S. Endangered Species Act (ESA). In Puget Sound, for example, this includes habitat supporting several species of Pacific salmon and steelhead, rockfish, SRKW and humpback whales. The agency must consider potential direct and indirect (and/or delayed in time) impacts of toxics on species and their habitats, including critical habitat (under the ESA) and essential fish habitat (under the MSA, considered in Section 3 of this document). The physical, biological, and chemical dimensions of habitat quality, including aquatic food webs, encompass the abundance and productivity of freshwater macroinvertebrates (as prey for juvenile salmon), the health of shoreline macroalgal communities (e.g., sheltering eelgrass habitats), and the survival and abundance of shore-spawning herring and other marine forage fish (keystone species for marine food webs).

Recent research by NMFS' science team (Northwest Fisheries Science Center, Ecotoxicology and Environmental Chemistry Programs) has shown that untreated stormwater is highly toxic to aquatic species, including Pacific salmon and marine forage fish. Conversely, parallel studies have shown that clean water/green infrastructure treatment methods can remove pollutants from stormwater. We expect that despite treatment provided by the treatment cell, effluent will still contain some contaminants, such as PAHs and 6PPD/6PPD-quinone (6PPD-q). Water quality will improve, but discharges will still adversely affect water quality due to uncaptured contaminants. Stormwater may also include an array of contaminants depending on the surrounding land use and proximity to industrial facilities (**Table *4***).

Stormwater can discharge at any time of year. However, first-flush rain events after long dry periods typically occur in September in western Washington. As with stormwater runoff globally, the leading edge of hydrographs (the first flush) in Puget Sound have proportionally higher contractions of contaminants, including those long known to resource managers (as evidenced by existing aquatic life criteria under the Clean Water Act), as well as many chemicals of emerging concern, so-called because they were largely unknown a decade ago (Peter et al., 2020). Higher concentrations of pollutants occur less frequently between March and October as longer dry periods exist between storm events. In western Washington, most stormwater discharge occurs between October and March, when the region receives the most rain.

Table 4. Pollutants commonly found in stormwater runoff in Washington State.

Pollutant Class	Examples	Urban Sources
Petroleum hydrocarbons	PAHs (poly aromatic hydrocarbons)	Roads (vehicles, tires), industrial, consumer products
Metals	Mercury, copper, chromium, nickel, titanium, zinc, arsenic, lead	Roads, electronics, pesticides, paint, waste treatment
Microplastics	6PPD/6PPD-q	Vehicle tires
Common use pesticides, surfactants	Herbicides (glyphosate, diquat), insecticides, fungicides, adjuvants, surfactants (detergents, soaps)	Roads, railways, lawns, levees, golf courses, parks
Nutrients and sediment	Nitrogen, phosphorus fertilizers, fine-grained inorganic sediment	Fertilizer, soil erosion
Persistent bio-accumulative toxicants (PBT)	POPs (persistent organic pollutants) PCBs (polychlorinated biphenyls) PBDEs (polybrominated diphenyl ethers) PFCs (poly- and per-fluorinated compounds) Pharmaceuticals (estrogen, antidepressant)	Eroding soils, solids, development, redevelopment, vehicles, emissions, industrial, consumer products
Temperature and dissolved oxygen	Warm water, unvegetated exposed surfaces (soil, water, sediments)	Impervious surfaces, rock, soils (roads, parking lots, railways, roofs)
Bacteria	*Escherichia coli*	Livestock waste, organic solids, pet waste, septic tanks

Stormwater negatively impacts critical habitat of the ESA listed fishes and SRKW by degrading water quality, (water quality is also a feature of essential fish habitat, see the EFH analysis presented in Section 3 of this document). Contaminants in stormwater can be transported far downstream to estuaries and the ocean dissolved in surface waters, attached to suspended sediments, or via aquatic food webs (e.g., bioaccumulation). Aquatic organisms including ESA-listed fish and marine mammals may take up contaminants from their surrounding environments by direct contact with water and sediments, or ingestion of contaminated plankton, invertebrates, detritus, or sediment, indicating that prey and substrate are also adversely affected features of critical habitat.

We anticipate water quality to be degraded by the discharge of stormwater effluent despite the addition of treatment. The biocell will provide a slight reduction of pollutants in stormwater effluent, but the discharge itself will still result in some degradation of the water quality PBF of critical habitat for PS Chinook salmon, PS/GB bocaccio, and SRKW. However, given that discharges from would contain *less* contaminant than currently occurs without treatment, we believe that water quality, sediment quality, and prey communities would continue to support the conservation role (e.g. growth, maturation, survival) for individuals of each of the designated species.

2.3.2 Effects on Listed Species

Noise: Construction activity and noise in excess of background conditions generated during the project could temporarily permeate terrestrial habitats for up to approximately 869 feet and would not persist upon project completion. There are no activities that would occur in-water or generate in-water noise. Therefore, the exposure of PS Chinook salmon, PS steelhead, SRKW, PS/GB bocaccio and PS/GB yelloweye rockfish to construction-related noise is not expected.

Habitat alteration: Vegetation within the terrestrial portion of the action area that may be disturbed includes mowed grasses and other landscaped vegetation. These temporary impacts would occur along roadside edges and would be re-vegetated as needed following construction. There are no activities that would occur in-water, and therefore no habitat alteration is expected for any aquatic habitat. Therefore, exposure of the ESA-listed species within the action area to habitat alteration is not expected.

Construction-related turbidity: Exposure of fish downstream from increased sedimentation into the water (causing turbidity) would be temporary. The duration of exposure is limited to the duration of work during the work window and would expose smoltified PS steelhead, PS Chinook, and larval rockfish. Juvenile steelhead are larger, more mature and less dependent on the shallow nearshore and are expected to respond to pulses of turbidity by avoiding that area. Juvenile Chinook are younger relative to steelhead and more nearshore dependent and may be exposed to higher levels of sediment. Some of these salmonids may respond by avoidance, and others may have temporary physiological response such as cough; however, none of these juveniles are constrained to the area of high turbidity. We therefore expect exposure to be brief and response to be slight, and temporary. Juvenile larval rockfish can't avoid these turbid conditions because they float (do not swim). Some number of larval rockfish, if exposed to an area of high turbidity, may die.

Water quality: Assessments for transportation-related runoff and species/habitats protected under the Endangered Species Act (ESA) and Magnuson-Stevens Fishery Conservation and Management Act (MSA) would need to consider toxic risk in the aggregate. This would necessarily include chemicals beyond 6PPD-q and stressor-response dynamics involving complex chemical mixtures, effects that may be sublethal and/or delayed in time, impacts mediated through food webs, and interactions with non-chemical forcing pressures (most notably climate change).

Toxicity to fish early life stages

PAHs: Petroleum-related toxicity to the early life history stages of fish has been a primary scientific focus area for NOAA's Northwest Fisheries Science Center (NWFSC) for the last 20 years. This targeted research has centered on PAHs and related compounds in the context of two overlapping mission goals for NOAA. These are to understand and minimize the adverse ecological impacts of PAHs from 1) major oil spills, and 2) urban stormwater runoff. A large and growing body of environmental monitoring data (analytical chemistry) has established PAHs as a ubiquitous component of stormwater-driven runoff to Puget Sound streams, lakes, rivers, wetlands, and estuaries. Whether originating from oil spills or stormwater, PAH toxicity to fish can be framed as a bottom-up approach to understanding the impacts of complex mixtures, where one or more PAH compounds may share a common mechanism of action, interact with other chemicals in mixtures, and/or interact with non-chemical variables such as the thermal stress anticipated with a changing regional climate. The historical NOAA research on oil spills and urban stormwater are increasingly converging on a risk framework where certain PAHs (**Figure**; described in more detail below) cause a well-described syndrome involving the abnormal development of the heart, eye and jaw structure, and energy reserves of larval fish (Harding et al. 2020).

Toxicity to marine fish

The 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska, produced a dissolved PAH mixture in marine and nearshore habitats dominated by compounds with 2 to 4 benzene rings (**Figure**, top panel, Alaskan North Slope Crude Oil). The multiple ring structure is the basis for the descriptors “polycyclic” or “heterocyclic”, the latter for ring configurations having a slight modification, such as the dibenzothiophenes. Over the ensuing 30 years, combined research from NOAA’s Alaska Fisheries Science Center (AFSC) and the NWFSC clearly established the developing fish heart as the primary biological target organ for the toxic impacts of water-soluble chemical mixtures derived from petroleum (Incardona 2017; Incardona and Scholz 2016, 2017, 2018; Incardona et al., 2011). At the egg (developing embryo, pre-hatch) and larval stages, organ-specific detoxification pathways (e.g., cytochrome P450 enzymes in the liver) are not yet in place, and therefore do not offer the same intrinsic metabolic protections available to older fish with a fully developed hepatic function. Absent this protective metabolism in larval fish, petroleum-derived hydrophobic compounds such as PAHs bioconcentrate to high tissue levels in fertilized eggs, resulting in more severe corresponding toxicity.

Numerous controlled laboratory exposure-response studies have elucidated a toxicity syndrome with a distinctive and characteristic suite of developmental abnormalities. Severe PAH toxicity is characterized by complete heart failure, with ensuing extra-cardiac defects (secondary to loss of circulation) and mortality at or soon after hatching. More moderate forms of PAH toxicity, such as might be expected for untreated/unfiltered roadway runoff, include acute and latent alterations in subtle aspects of cardiac structure, reduced cardiorespiratory performance and latent mortality in surviving larvae and juveniles. These effects have been studied extensively and characterized in over 20 species of fish at the organismal, tissue and cellular levels (Marty et al., 1997; Carls et al., 1999; Heintz et al., 1999; Hatlen et al., 2010; Hicken et al., 2011; Incardona et al., 2013; Jung et al., 2013; Brette et al., 2014; Esbaugh et al., 2016; Morris et al., 2018). Unlike 6PPD-quinone, which varies in hazard across closely related salmonids (e.g., high acute toxicity to coho, low toxicity to chum; McIntyre et al., 2018, 2021), 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 (**Figure**).

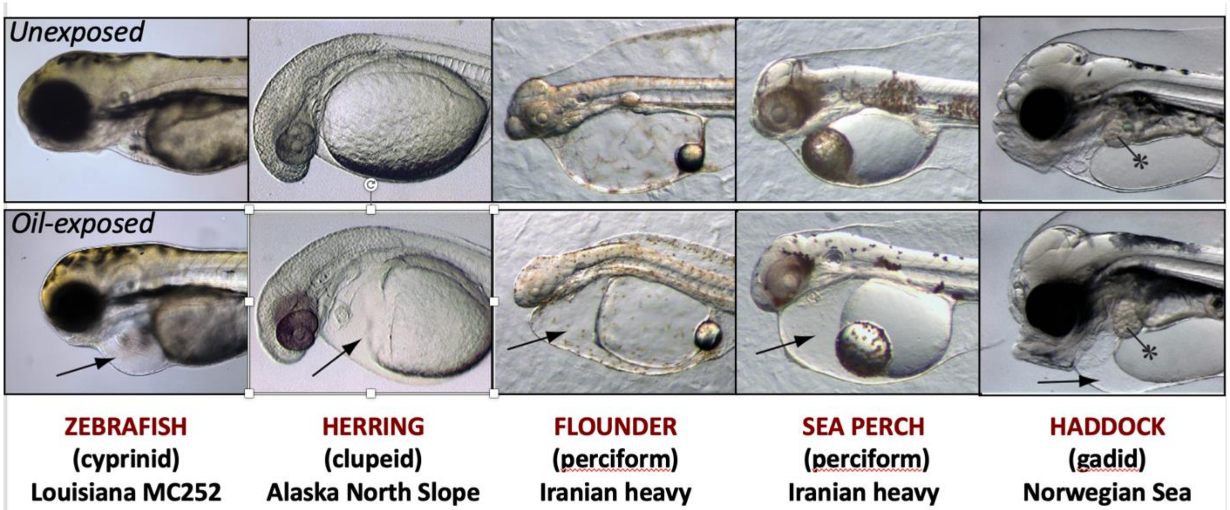

Figure 5. Examples of PAH-induced developmental abnormalities in a wide range of fish species (freshwater to marine, tropical to temperate). Our current understanding of PAH toxicity to fish embryos and larvae is drawn from several NOAA-F studies, representing major lessons learned from the Exxon Valdez and Deepwater Horizon disasters, and has been widely confirmed by independent research groups around the world. The primary form of toxicity is a loss of cardiac function, as exemplified by circulatory failure and accumulation of fluid in the pericardial space around the heart (arrows). The pattern of excess fluid (edema) varies according to the anatomy of each species. Related abnormalities include small eyes, jaw deformities, and a dysregulation of the lipid stores, or yolk, the animal needs to survive to first feeding. This suite of defects, while sublethal, will almost invariably lead to ecological death. Consequently, "delayed-in-time" toxicity is a common risk concern for fish that spawn in PAH-contaminated habitats.

PAH toxicity in fish is often sublethal and delayed in time. The latent impacts of low-level PAH exposures – i.e., representative of the cardiotoxic PAH concentrations and discharge durations comparable with conventional Puget Sound roadway runoff – have been particularly well studied in salmonids (pink salmon, *Oncorhynchus gorbuscha*). Large-scale tagging (mark-and-recapture) studies dating back to Exxon Valdez were among the first to show that embryonic exposure to oil-derived chemical mixtures with total PAH (∑PAH) levels in the range of 5 - 20 µg/L resulted in cohorts of salmon that survived the exposure (and appeared outwardly normal), but nevertheless displayed reduced growth and reduced survival to reproductive maturity in the marine environment. Follow-up studies at NWFSC have linked this poor survival to reduced individual fitness manifested by reduced swimming performance and subtle changes in cardiac structure. In essence, embryonic exposure to petroleum mixtures leads to juvenile fish that show signs of pathological hypertrophy of the heart (Incardona et al., 2015, 2021; Gardner et al., 2019). The latter is well known to be associated with considerable morbidity and mortality across vertebrate species in general, as evidenced by the downstream consequences of congestive heart failure in humans.

To illustrate how PAHs in runoff from the Puget Sound transportation grid align with historical NOAA research on oil spills, stormwater from the SR520 collection location at the NWFSC in Seattle shows considerable overlap with the pattern of PAHs derived from a pure oil spill (**Figure** top). Notably, as an added consequence of the engine internal combustion process, the mixture in stormwater is even more complex due to the appearance of larger numbers of 4-ring and ≥ 5-ring compounds. Much of this higher molecular weight PAH mass is associated with the fine particulate matter from vehicle exhaust. The bioavailability of compounds in waters that receive highway runoff is demonstrated by uptake into passive samplers, which have properties very similar to fish eggs. Passive samples vary in design, but generally consist of a housing for a membrane material that passively accumulates lipophilic compounds such as PAHs, which can subsequently be extracted for chemical analyses. They are particularly useful for profiling patterns of bioavailable PAHs in fish spawning habitats.

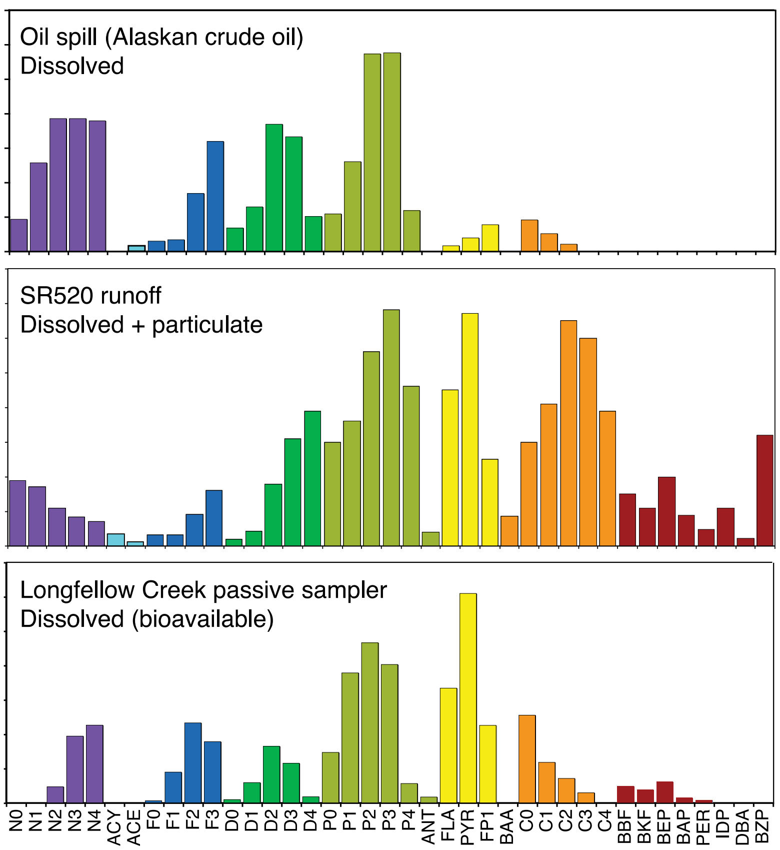

Figure 6. Patterns of PAHs in environmental samples. Top, effluent in seawater flowing over gravel coated with Alaskan crude oil (source for Exxon Valdez). Middle, runoff from the SR520 highway adjacent to NWFSC. Bottom, PAHs extracted from a polyethylene membrane device (PEMD) incubated one week in Longfellow Creek, West Seattle. X-axis shows proportion of total PAH, and values are omitted for simplicity to emphasize overall patterns. Abbreviations: N, naphthalenes; BP, biphenyl; AY, acenaphthylene; AE, acenaphthene; F, fluorene; D, dibenzothiophene; P, phenanthrene; ANT, anthracene; FL, fluoranthene; PY, pyrene; FP, fluoranthenes/pyrenes; BAA, benz[a]anthracene; C, chrysene; BBF,

benzo[b]fluoranthene; BKF, benzo[j]fluoranthene/benzo[k]fluoranthene; BEP, benzo[e]pyrene; BAP, benzo[a]pyrene; PER, perylene; IDY, indeno[1,2,3-cd]pyrene; DBA, dibenz[a,h]anthracene/dibenz[a,c]anthracene; BZP, benzo[ghi]perylene. Parent compound is indicated by a 0 (e.g., N0), while numbers of additional carbons (e.g. methyl groups) for alkylated homologs are indicated as N1, N2, etc.

The pattern of bioavailable PAHs in Seattle-area urban streams closely resembles a pure oil spill pattern, with the exception of a larger proportion of combustion-associated 4-ring compounds such as pyrenes and fluoranthenes (**Figure**). Accordingly, urban runoff is a transport pathway for PAHs, and the pattern of bioavailable PAHs closely resembles the relative enrichment of cardiotoxic phenanthrenes. Although more work is needed for Pacific salmonids (e.g., species beyond pink salmon), collected runoff from SR520 containing ∑PAH of 7.5 μg/L produced the stereotypical syndrome of heart failure and associated developmental defects in Pacific herring (Harding et al., 2020). Measured concentrations of PAH runoff from SR520 runoff are often considerably higher than the petroleum toxicity threshold for pink salmon. There is a risk that untreated runoff could cause delayed mortality in ESA-listed salmonids, and also the prey available to salmon and higher-trophic species such as killer whales through losses of nearshore spawning forage fish. This risk declines but may not be entirely avoided by treatment.

6PPD-Quinone**:** After years of forensic investigation, the urban runoff coho mortality syndrome has now been directly linked to motor vehicle tires, which deposit the compound 6PPD and its abiotic transformation product 6PPD-q onto roads. 6PPD or [(N-(1, 3-dimethylbutyl)-N'-phenyl-p-phenylenediamine] is used to preserve the elasticity of tires. 6PPD can transform in the presence of ozone (O3) to 6PPD-q. 6PPD-q is ubiquitous to roadways (Sutton et al., 2019) and was identified by Tian et al., (2020) as the primary cause of urban runoff coho mortality syndrome described by Scholz et al., (2011). Laboratory studies have demonstrated that juvenile coho salmon (Chow et al., 2019), juvenile steelhead, and juvenile Chinook salmon are also susceptible to varying degrees of mortality when exposed to urban stormwater (French et al., 2022). Fortunately, recent literature has also shown that mortality can be prevented by infiltrating road runoff through soil media containing organic matter, which removes 6PPD-q and other contaminants (Fardel et al., 2020; Spromberg et al., 2016; McIntrye et al., 2015). Research and corresponding adaptive management surrounding 6PPD is rapidly evolving. Nevertheless, key findings to date include:

- 6PPD/6PPD-q has been killing coho in Puget Sound urban streams for decades, dating back to at least the 1980s, likely longer (McCarthy 2008; Scholz 2011)
- Wild coho populations in Puget Sound are at a very high risk of localized extinction, based on field observations of adult spawner mortality in > 50 spawning reach stream segments (Spromberg 2011).
- Source-sink metapopulation dynamics (mediated by straying) are likely to place a significant drag on the future abundances of wild coho salmon in upland forested watersheds (the last best places for coho conservation in Puget Sound). In other words, urban mortality syndrome experienced in one part of the watershed could lead to

abundance reductions in other populations because fewer fish are available to stray (Spromberg 2011)

- Coho are extremely sensitive to 6PPD-q, more so than most other known contaminants in stormwater (Scholz 2011; Chow 2019; Tian 2020).
- Coho juveniles appear to be similarly susceptible to the acutely lethal toxicity of 6PPD/6PPD-q (McIntyre 2015; Chow 2021).
- The onset of mortality is very rapid in coho (i.e., within the duration of a typical runoff event) (French et al., 2022).
- Once coho become symptomatic, they do not recover, even when returned to clean water (Chow 2019)
- It does not appear that dilution will be the solution to 6PPD pollution, as diluting Puget Sound roadway runoff in 95% clean water is not sufficient to protect coho from the mortality syndrome (French et al., 2022).
- Preliminary evidence indicates an uneven vulnerability across other species of Puget Sound salmon and steelhead, and a need to further investigate sublethal toxicity to steelhead and Chinook salmon. For example, McIntyre et al., (2018) indicate that chum do not experience the lethal response to stormwater observed in coho salmon.
- Following exposure, the onset of mortality is more delayed in steelhead and Chinook salmon (French et al., 2022).
- The mechanisms underlying mortality in salmonids is under investigation, but are likely to involve cardiorespiratory disruption, consistent with symptomology. Therefore, special consideration should be given to parallel habitat stressors that also affect the salmon gill and heart, and nearly always co-occur with 6PPD such as temperature (as a proxy for climate change impacts at the salmon population-scale) and PAHs.
- Simple and inexpensive green infrastructure mitigation methods are promising in terms of the protections they afford salmon and stream invertebrates, but much more work is needed (McIntyre 2014, 2015, 2016a&b; Spromberg 2016).
- The long-term viability of salmon and other Puget Sound aquatic species is the foremost conservation management concern for NOAA, and thus it will be important to incorporate effectiveness monitoring into future mitigation efforts – i.e., evaluating proposed stormwater treatments not only on chemical loading reductions, but also the environmental health of salmon and other species in receiving waters (Scholz 2011).

2.4 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 earlier in the discussion of environmental baseline (Section 2.4).

Development in the vicinity of South National Avenue and West Loxie Eagans Boulevard have resulted in prior conversion of undeveloped land to residential and commercial uses. There is very little additional undeveloped land available within the action area that could be further developed. However, the action area is influenced by actions within Puget Sound marine waters, along the shoreline, and in tributary watersheds. The human population in the Puget Sound region is experiencing a high rate of growth. The central PS region (Snohomish, King, Pierce and Kitsap counties) has increased from about 1.29 million people in 1950 to over 4.2 million in 2020, and projected to reach nearly 6 million by 2050 (Puget Sound Regional Council 2020). Thus, future private and public development actions are very likely to continue in and around PS. Effects of additional development could include additional stormwater runoff from private roads, driveways and roofs as well as pollutant runoff from lawns and other landscaped areas. Sedimentation and/or pollutant loading into the stormwater system, which eventually discharges into marine waters, could result. Private upland activities include continued resource extraction, traffic, development, and other inwater activities such as boating and other recreation, are all likely to contribute to poor water quality in the marine environments of Puget Sound.

Several not for profit organizations and state agencies are also implementing recovery actions identified in the recovery plans for Puget Sound Chinook salmon, PS steelhead, and PS/GB yelloweye rockfish and bocaccio. The state passed House Bill 1579 that addresses habitat protection of shorelines and waterways (Chapter 290, Laws of 2019 (2SHB 1579)), and funding was included for salmon habitat restoration programs and to increase technical assistance and enforcement of state water quality, water quantity, and habitat protection laws. Other actions included providing funding to the Washington State Department of Transportation to complete fish barrier corrections. Although these measures won’t improve prey availability immediately, they are designed to improve conditions in the long-term.

Notwithstanding the beneficial effects of ongoing habitat restoration actions, the cumulative effects associated with continued development are likely to have ongoing adverse effects on all the listed salmonid and rockfish species addressed in this Opinion, Therefore, although NMFS finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, as described in the Environmental Baseline, these effects may occur at somewhat higher or lower levels than those described in the Baseline.

2.5 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.

2.5.1 ESA Listed Species

The status of each ESA-listed species considered in this Opinion is threatened, except for SRKW and PS/GB bocaccio which are endangered. The status of all species is based in low abundance relative to historic numbers, with reduced productivity, spatial structure, and diversity. This depressed condition is a function of many factors, including reductions in the amount or quality of habitat throughout their range, and overharvest in previous years. Baseline conditions in the action area, which were described earlier in this document, reflect habitat degradation typical in the near-marine environment.

To this status, we add the effects of the proposed action. Most of the effects of the proposed action are spatially very constrained (noise, turbidity) with very limited effect on any of the listed species. The exception is the discharge of effluent from the existing stormwater outfalls.

Contaminants in this discharge are likely to produce a range of adverse health effects – both acute and latent, particularly among larval rockfish of both species and juvenile salmonids. However, it is important to note that the project involves a net reduction in PGIS and proposes to capture and improve the treatment of runoff where there currently is no treatment. Because of this, we expect harm or death associated with the proposed action may occur at a lower rate than at the baseline (pre-project) level.

2.5.2 Critical Habitat

The action area contains designated critical habitat for PS Chinook salmon, PS/GB bocaccio, and SRKW. Water quality is a feature of critical habitat for each of these species.

All nearshore marine units of critical habitat for PS chinook salmon, including the action area, are rated as having high conservation value based on the vital role these locations serve for survival of the species (NMFS 2005). Critical habitat in the nearshore marine areas of Puget Sound are to have water quality conditions that support growth and maturation which allow juveniles to transition to their marine lifestage.

For PS/GB bocaccio, Puget Sound should have water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities of the species. For SRKW, water quality is essential to the conservation of the DPS to support growth and development of individuals.

The proposed project will discharge contaminants in the effluent from the existing outfalls. While the discharge itself contains degrading contaminants, the project adds stormwater treatment where there currently is none, which reduces the overall load of contaminants that discharge into Puget Sound. The outcome, while still retaining some detriment, is likely to provide a reduction in overall level of pollutant in Puget Sound, conferring a potential improvement to this feature of critical habitat for each species.

2.6 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of activities caused by the proposed action, and cumulative effects, it is NMFS' biological Opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, or SRKW. Further, the proposed action is not likely to destroy or adversely modify the designated critical habitat for PS Chinook, PS/GB bocaccio, or SRKW.

2.7 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 ITS.

2.7.1 Amount or Extent of Take

When take is in the form of harm from habitat degradation, it is often impossible to enumerate the take that would occur because the number of fish and marine mammals likely to be exposed to harmful habitat conditions is highly variable over time, influenced by environmental conditions that do not have a reliably predictable pattern, and the individuals exposed may not all respond in the same manner or degree. Where NMFS cannot quantify take in terms of numbers of affected individuals, we instead consider the likely extent of changes in habitat quantity and quality to indicate the extent of take as surrogates. The best available indicators for the extent of take, proposed actions are as follows.

As described in the effects analysis in Section 2.3, NMFS has determined that incidental take is reasonably certain to occur as follows:

- Injury or death of juvenile and adult PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SRKW from exposure to toxic chemicals in stormwater effluent discharged from the outfalls.

For take of PS Chinook salmon, PS steelhead, PS/GB bocaccio, PS/GB yelloweye rockfish, and SRKW resulting from the discharge of stormwater effluent, the 2,230 square feet of PGIS together with the 5,050 square feet of existing PGIS converted to sidewalk which is non-PGIS. This take indicator is causal and proportional to take we identified in this Opinion as it directly affects the amount of stormwater pollution that will be directed to the new treatment. Take would be exceeded if the amount of PGIS added is higher than 2230 square feet and/or the amount of PGIS converted to Non PGIS is reduced.

2.7.2 Effect of the Take

In the biological Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.7.3 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 following measure is necessary and appropriate to minimize the impact of incidental take of listed species from the proposed action.

1. Reduce take associated with stormwater pollution from the site; and
2. Ensure completion of a monitoring and reporting program for incidental take pathways.

2.7.4 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 WSDOT or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1: The WSDOT shall implement a maintenance and monitoring plan for the proposed stormwater treatment facility that ensures treatment structures and operations remain fully functional and effective at treatment of effluent.
2. The following terms and conditions implement reasonable and prudent measure 2: The USACE or the permit applicant shall provide to NMFS (projectreports.wcr@noaa.gov, reference WCRO-2021-02354) within 60 days of completion of the proposed action a report that provides the total area of PGIS, and indicate the intended maintenance protocols that will ensure best performance of the treatment structures.

2.8 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 further minimize effects of stormwater discharge, we recommend the WSDOT:

- Develop and implement an adaptive management plan for stormwater treatment which actively pursues and applies upgrades to its treatment methods with future advances in stormwater science and treatment; and
- Work with local jurisdictions to encourage green infrastructure and apply 100% stormwater runoff infiltration in contributing basins to reduce contaminants coming off roads.

2.9 "Not Likely to Adversely Affect" Determinations

Southern resident killer whales: The proposed action would occasionally expose SRKW to water quality impacts as a result of contaminants in stormwater discharges, when members of this species enter the action area. We expect such exposure to be brief, infrequent and at low concentration. While we anticipate water will contain stormwater effluent despite the addition of treatment, the bioretention cells would provide a slight reduction of pollutants in stormwater effluent. Given that discharge from the proposed action would contain *less* contaminant than currently occurs without treatment, we believe that exposure of SRKW to water quality effects as a result of the proposed action would be produce a indiscernible response. We believe this such exposure to be insignificant at the individual and population scale.

2.10 Reinitiation of Consultation

This concludes our ESA consultation for the National STEM School project.

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."

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect 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 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 Federal Highway Administration (FHWA) and WSDOT and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council (PFMC) 2005), coastal pelagic species (CPS) (PFMC 1998), and Pacific Coast salmon (PFMC 2014) 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 environmental effects of the proposed action may adversely affect EFH for Pacific Coast salmon, Pacific Coast groundfish and coastal pelagic species, all of which are present in the action area. The action area also contains Habitat Areas of Particular Concern (HAPC) for Pacific Coast salmon and Pacific Coast groundfish. Impacts to EFH include water quality degradation as a result of the discharge of stormwater effluent.

3.2 Adverse Effects on Essential Fish Habitat

The feature of EFH of Pacific Coast salmon, Pacific Coast groundfish and coastal pelagic species affected by the proposed action would include diminishments in water quality, as described above in this Opinion. We expect degraded water quality associated contaminants in stormwater discharged from the proposed facility.

3.3 Essential Fish Habitat Conservation Recommendations

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

1. Develop and implement an adaptive management plan for stormwater treatment, which actively pursues and applies upgrades to its treatment methods with future developments in stormwater science and treatment; and
2. Work with local jurisdictions to increase green infrastructure and apply 100% stormwater runoff infiltration in contributing basins to reduce contaminants coming off roads.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

3.4 Statutory Response Requirement

As required by Section 305(b)(4)(B) of the MSA, the FHWA and WSDOT must provide a detailed response in writing to 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 NMFS' EFH Conservation Recommendations unless 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 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, 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 FHWA-WSDOT must reinitiate EFH consultation with 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 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 users of this Opinion are the FHWA-WSDOT. Other interested users could include the citizens of Kitsap County, the

Department of Ecology, Tribal Nations within Washington State, or environmental groups. Individual copies of this Opinion were provided to the WSDOT-FHWA. 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 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 implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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