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-2019-03115**

November 4, 2019

Tim Sovold
Chief, Technical Services Branch
HUD Multifamily, West Region
West Multifamily Regional Center
1670 Broadway
Denver, Colorado 80202

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Othello Square Building C Project in Seattle, Washington

Dear Mr. Sovold:

Thank you for your letter of October 17, 2019, 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 Othello Square Building C Project. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

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 Salmon essential fish habitat (EFH). Therefore, we have included the results of that review in Section 3 of this document.

The enclosed document contains the biological opinion (Opinion) prepared by the NMFS pursuant to section 7(a)(2) of the ESA on the effects of the proposed action. In this Opinion, the NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Puget Sound (PS) steelhead and Puget Sound Chinook salmon, or to result in the destruction or adverse modification of their designated critical habitat.

As required by section 7 of the ESA, the NMFS has provided an incidental take statement with this Opinion. The incidental take statement describes reasonable and prudent measures the NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action, and sets forth nondiscretionary terms and conditions that HUD must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

This document also includes the results of our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. The NMFS reviewed the likely effects of the proposed action on EFH, and concluded that the action would adversely affect designated EFH for Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

Please contact Melaina Wright in the North Puget Sound Branch of the Oregon Washington Coastal Office at 206-526-6155, or by email at Melaina.Wright@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Tim Sovold, HUD
David Melanson, HUD
Brian Sturdivant, HUD

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

Othello Square Building C Project
Seattle, Washington

**NMFS Consultation Number**: WCRO-2019-03115

**Action Agency**: U.S. Department of Housing and Urban Development

**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 steelhead (*Oncorhynchus mykiss*) | Threatened | Yes | No | N/A | N/A |
| Puget Sound Chinook (*O. tshawytscha*) | Threatened | Yes | No | Yes | 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 |

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

**Issued By**:

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

**Date**: November 4, 2019

**TABLE OF CONTENTS**

# 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 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

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 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 within two weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). A complete record of this consultation is on file at the Oregon Washington Coastal Office.

## 1.2 Consultation History

On October 9, 2019, NMFS received a request to initiate ESA section 7 consultation from the U.S. Department of Housing and Urban Development (HUD). The initiation package included an ESA section 7 consultation initiation email and biological assessment (BA). HUD determined the action may affect but is not likely to adversely affect (NLAA) Puget Sound (PS) Chinook salmon and PS steelhead, and will have no effect on PS Chinook salmon critical habitat. HUD also determined that the project would have no effect on Pacific salmon EFH.

On October 17, 2019, we informed HUD that we could not concur with all of their effects determinations. On October 17, 2019, HUD requested formal consultation with NMFS. Consultation was initiated on that date.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the new regulations noted, “[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamline consultations, and codifies existing practice.” We have reviewed the information and analyses relied upon to complete this biological opinion in light of the updated regulations, and conclude the opinion is fully consistent with the updated regulations.

### 1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). For EFH consultation, 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).

HUD is proposing to fund the Othello Square Building C Project at 3939 S. Othello Way, Seattle, WA (47.5370047, -122.2829589; HUC: 171100120302; Figure 1; Figure 2). The applicant is proposing to construct a seven-story building that will have 176 apartment units, a childcare facility, a medical clinic, and underground parking. The project will include 36,931 square feet of new plus replaced impervious surface. This includes 34,759 square feet of roof surface and 2,172 square feet of other imperious surface. Roofing material will be comprised of styrene butadiene styrene. Most of the metal roofing materials will be coated to prevent leaching. However, 85 square feet of galvanized sheet metal ductwork and flashing will be exposed.

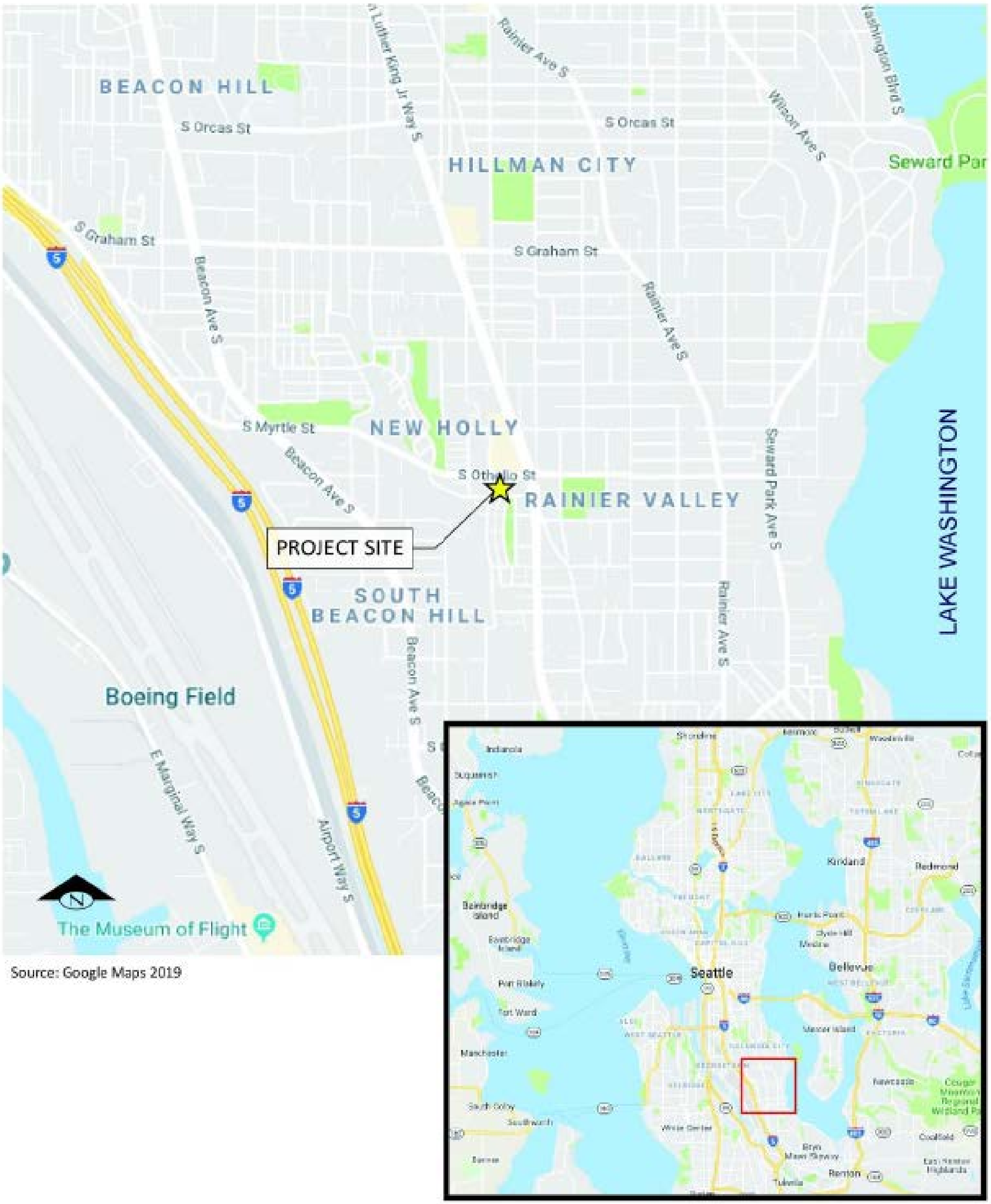
Work will occur year-round from the fall of 2019 to the spring of 2021. The applicant will remove the temporary stormwater pond that was used to accommodate portable classrooms that were previously onsite. They will excavate up to 27,600 cubic yards of fill material onsite, and keep 5,600 cubic yards of fill material for the proposed project. They will implement a Construction Stormwater Control Plan, Post Construction Soil Management Plan, and Stormwater Pollution Prevention Plan. They will implement best management practices designed to prevent sediment and contaminants from entering the City's stormwater system. These best management practices may include but are not limited to the following:

1. Stabilizing the construction entrance
2. Installing a silt fence, straw wattles, and plastic covering
3. Installing filter fabric in existing catch basins
4. Installing sediment traps
5. Installing spill protection

There is not enough space onsite to infiltrate stormwater from the new/replaced impervious surface due to setback requirements and the presence of bedrock about 10 feet below grade. However, the applicant will install eight bioretention planters, two vegetated roofs, and three small planted areas at grade over the parking garage (Figure 4). Fertilizers and pesticides will not be used. The vegetated roofs are designed to accommodate stormwater from 5,648 square feet of impervious surface. The eight bioretention planters are designed to accommodate stormwater from 29,111 square feet of impervious surface. Runoff will be routed to the vegetated roof areas and bioretention planters, and will percolate through 2 to 3 inches of compost and 18 inches of bioretention media. The applicant will source compost from Cedar Grove, which meets state standards for metal concentrations (Figure 5). The runoff will be collected by an underdrain that is 6 inches above an asphalt liner.

After treatment, the stormwater will enter the City's stormwater system. The outfall is located in Lake Washington (Figure 3). Stormwater from 2,172 square feet of impervious surface will not enter the vegetated roofs or bioretention planters. This stormwater will enter Lake Washington directly without treatment. However, this impervious surface largely consists of the plaza area, which only accommodates pedestrian traffic, rather than vehicle activity or parking.

We considered whether or not the proposed action would cause any other activities and determined that it would cause the following activities: increased vehicular traffic. Currently, there is no parking on site. The proposed action would provide 100 new parking spaces for vehicles. Increased vehicular traffic is a consequence caused by the proposed action, because it would not occur but for the proposed action and is reasonably certain to occur.




Source: Google Maps 2019

**Figure 1.** Vicinity Map

**Figure 2.** Aerial of project site.

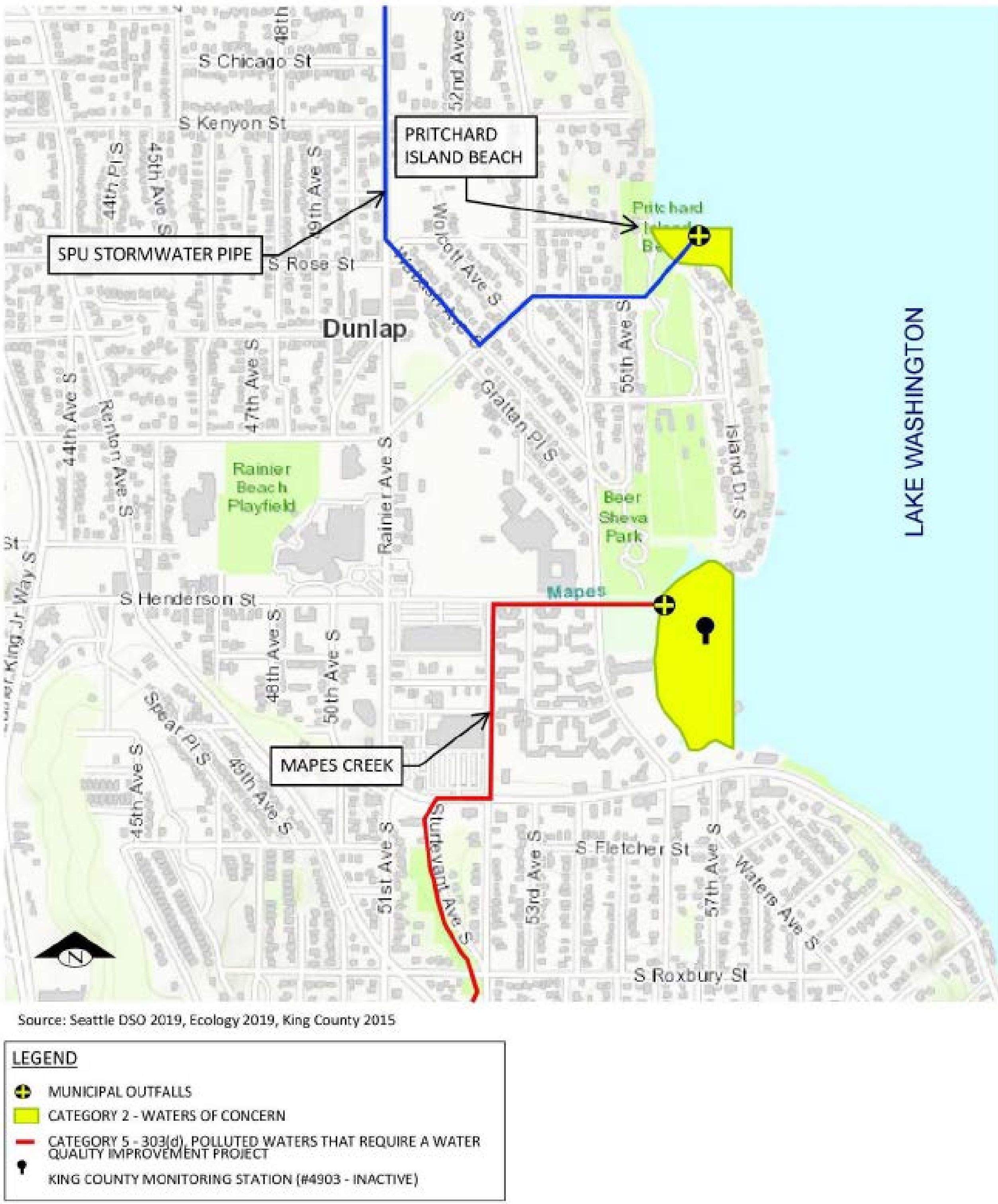



**Figure 3.** Stormwater pipe and outfall.

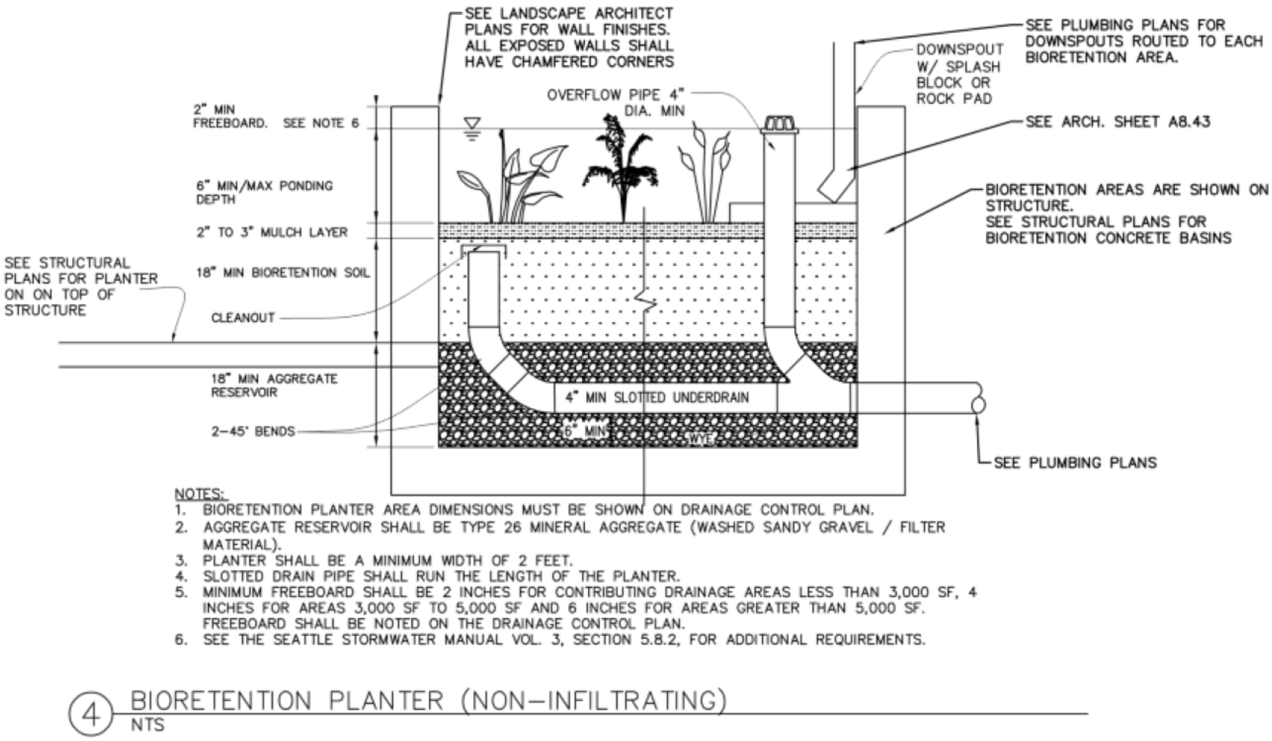



**Figure 4**. Proposed bioretention planter.

**Chart 2. Compost Quality Requirements - Washington Administrative Code *173-350 Sect. 220***

| | WAC 173-350-220 Standard | Cedar Grove Compost (10/15/2018) |
|---|---|---|
| **Metals** | *Parts per million (mg/kg), dry wt.* | |
| Arsenic | <=20 | **8** |
| Cadmium | <=10 | **<1.0** |
| Copper | <=750 | **65** |
| Lead | <=150 | **28** |
| Mercury | <=8 | **<1.0** |
| Molybdenum | <=9 | **1.6** |
| Nickel | <=210 | **16** |
| Selenium | <=18 | **<1.0** |
| Zinc | <=1400 | **180** |
| pH | 5-10 (range) | **7.41** |
| Salmonella (Pathogen indicator) | < 3 MPN / 4 grams of total solids | **Pass** |
| Sharps | 0 percent | **None Detected** |
| Manufactured Inerts | < 0.50 percent | **0.27 percent** |

**Figure 5**. Concentration of metals in proposed compost from Cedar Grove.

## 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 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 non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

### 2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the 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 designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 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 biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition 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 habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

## 2.2 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' "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 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. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2016; Mote et al. 2014). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Mote et al. 2014; Tague et al. 2013).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons based on average linear increase per decade (Abatzoglou et al. 2014; Kunkel et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Isaak et al. 2012; Mantua et al. 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Raymondi et al. 2013; Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Raymondi et al. 2013; Wainwright and Weitkamp 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (Lawson et al. 2004; McMahon and Hartman 1989).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0 to 3.7$^{o}$C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Reeder et al. 2013; Tillmann and Siemann 2011).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also impacts sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012; Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10 to 32 inches by 2081 to 2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Reeder et al. 2013; Tillmann and Siemann 2011). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Reeder et al. 2013; Tillmann and Siemann 2011).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these evolutionarily significant units (ESUs) (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

### 2.2.1 Status of the Species

This section provides a summary of listing and recovery plan information, status, and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. These documents are available on the NMFS West Coast Region website (http://www.fisheries.noaa.gov/).

***PS Chinook salmon***

We listed the PS Chinook salmon ESU as threatened on June 28, 2005 (70 FR 37160). Recovery plans for PS Chinook salmon include the Shared Strategy for Puget Sound 2007 Plan and the NMFS 2006 Plan (NMFS 2006; SSDC 2007). The most recent status review was in 2015 (NWFSC 2015). This ESU comprises 22 populations distributed over five geographic areas. Most populations within the ESU have declined in abundance over the past 7 to 10 years, with widespread negative trends in natural-origin spawner abundance and hatchery-origin spawners present in high fractions in most populations outside of the Skagit watershed. Escapement levels for all populations remain well below the Technical Recovery Team (TRT) planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the TRT as consistent with recovery.

Limiting factors for PS Chinook salmon include:

1. Degraded floodplain and in river channel structure.
2. Degraded estuarine conditions and loss of estuarine habitat
3. Degraded riparian areas and loss of in river large woody debris

4. Excessive fine-grained sediment in spawning gravel
5. Degraded water quality and temperature
6. Degraded nearshore conditions
7. Impaired passage for migrating fish
8. Severely altered flow regime

***PS Steelhead***

We listed the PS steelhead distinct population segment (DPS) as threatened on May 11, 2007 (72 FR 26722). There is a draft recovery plan for this DPS (NMFS 2018). The most recent status review was in 2015 (NWFSC 2015). This DPS comprises 32 populations. The DPS is currently at very low viability, with most of the 32 populations and all three population groups at low viability. Information considered during the most recent status review indicates that the biological risks faced by the PS Steelhead DPS have not substantively changed since the listing in 2007, or since the 2011 status review. Furthermore, the PS Steelhead TRT recently concluded that the DPS was at very low viability, as were all three of its constituent major population groups (MPGs), and many of its 32 populations. In the near term, the outlook for environmental conditions affecting PS steelhead is not optimistic. While harvest and hatchery production of steelhead in PS are currently at low levels and are not likely to increase substantially in the foreseeable future, some recent environmental trends not favorable to PS steelhead survival and production are expected to continue.

Limiting factors for PS steelhead include:
1. Continued destruction and modification of habitat
2. Widespread declines in adult abundance despite significant reductions in harvest
3. Threats to diversity posed by use of two hatchery steelhead stocks
4. Declining diversity in the DPS, including the uncertain but weak status of summer-run fish
5. A reduction in spatial structure
6. Reduced habitat quality
7. Urbanization
8. Dikes, hardening of banks with riprap, and channelization

### 2.2.2 Status of the Critical Habitat

We designated critical habitat for PS Chinook salmon on September 2, 2005 (70 FR 52630). Critical habitat for PS Chinook salmon includes 1,683 miles of streams, 41 square miles of lakes, and 2,182 miles of nearshore marine habitat in PS. The PS 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. Habitat threats include but are not limited to point and non-point source pollution, overwater cover, dredging, shoreline armoring, and fish passage barriers. These activities have diminished the availability and quality of nearshore marine habitats and reduced water quality across the region.

## 2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for this project includes aquatic areas within 1,000 feet (305 meters) from the stormwater outfalls, which discharge directly into Lake Washington (Figure 3).

## 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).

The project site is a vacant property surrounded by high-density residential and commercial development. Currently, the lot consists of 27,778 square feet of impervious surface from prior development. This includes a driveway, building foundations, compacted soils, and a temporary stormwater pond. The remainder of the site consists of grasses growing on fill material. The site was most recently used for temporary middle school portable classrooms. Only the stormwater pond for the portable classrooms remains onsite.

Currently, stormwater sheet flows northeast to South Othello Way and into the City's stormwater system (Figure 6). Untreated stormwater is conveyed 1.96 miles through the City's enclosed stormwater system and outlets into Lake Washington (Figure 3). The action area has been assessed for water and sediment quality, and is currently listed as "waters of concern" due to water quality issues in the area (WDOE 2018).

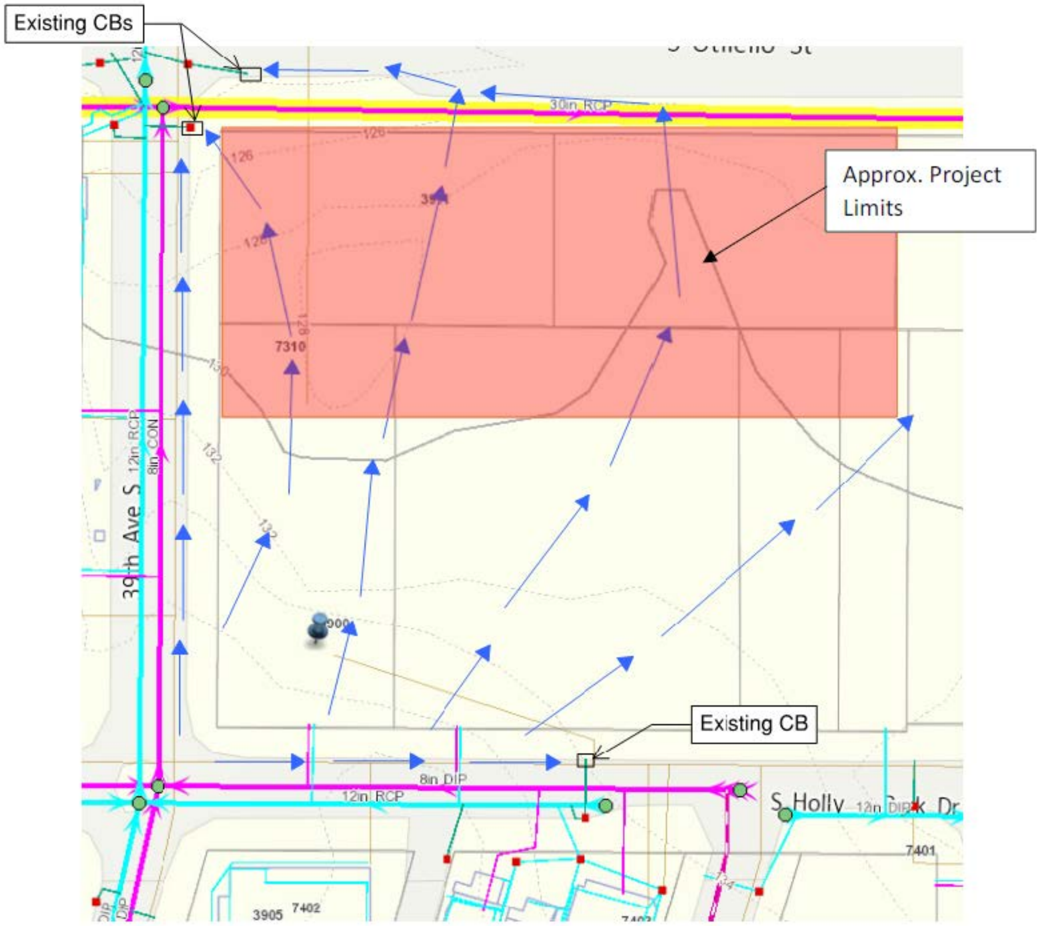



**Figure 6**. Stormwater sheet flow at project site and existing catch basins (CB).

In the Cedar River, the number of natural-origin spawning adult PS Chinook salmon has fluctuated between 306 and 1,893 individuals between 2004 and 2017 (WDFW 2019a). In the Sammamish, the number of natural spawners has fluctuated between 33 and 638 between 2004 and 2017 (WDFW 2019b). Adult Chinook salmon migrate through the Chittenden Locks from mid-June through September, with most adults moving through the Lake Washington Ship Canal and Lake Union in less than 1 day (City of Seattle 2008). Adult Chinook salmon generally enter Lake Washington between August and September. The average time spent by adult Chinook in Lake Washington is 2.9 days, and the average for Sammamish watershed fish is 4.9 days (Fresh et al. 1999).

Juvenile Chinook migration into Lake Washington from Cedar Creek is bimodal with Chinook fry migration peaking in February and March (from mid-January to mid-April) and smolt migration peaking in May and June (from mid-April and June) (WDFW 2005). The density of Chinook fry utilizing shoreline habitat decreases logarithmically with increasing distance from the Cedar River, and juveniles are concentrated at the southern end of Lake Washington from February to May (Tabor et al. 2006). Juvenile Chinook migration into Lake Washington from Bear Creek is generally unimodal with most Chinook migrating as smolts in May (WDFW 2005). Juvenile PS Chinook salmon generally migrate out of Lake Washington and Lake Sammamish from late May to early July.

There are very few Lake Washington Basin steelhead. In the Cedar River, 10 or fewer adult natural-spawners have returned each year since 2007 (WDFW 2019b). In tributaries to North Lake Washington and Lake Sammamish, fewer than 10 adult natural-spawners returned between 1994 and 1999 (WDFW 2019b). North Lake Washington and Sammamish tributaries have not been monitored since 2000. Due to the small numbers of steelhead seen at the Chittenden Locks and estimated in the Cedar River, it is unlikely there are currently many steelhead in these tributaries.

Wild steelhead are closely related to resident *O. mykiss*. Resident *O. mykiss* are abundant below Landsburg dam and are a native wild population. Marshall et al. (2004) found that resident Cedar River *O. mykiss* produce out-migrating smolts and speculated that steelhead could produce adult resident *O. mykiss*. They concluded that the conservation of resident *O. mykiss* is likely an important aspect of reducing extinction risk for steelhead.

Returning steelhead pass through Chittenden Locks and the Lake Washington Ship Canal between January and May, and may remain within Lake Washington through June (City of Seattle 2008). Juvenile steelhead enter Lake Washington in April, and typically migrate through the ship canal to the locks between April and May.

## 2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. 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 50 CFR 402.17(a) and (b).

### 2.5.1 Effects to Listed Species

Stormwater runoff from the new building would adversely affect listed salmonids. The new building will increase the amount of impervious surface, and would increase the volume of stormwater runoff that would come from the project site. It would also alter the chemical nature of the stormwater at the site. PS Chinook salmon and PS steelhead in the action area may be affected directly by the stormwater through exposure to water-borne contaminants and/or indirectly through exposure to contaminated prey.

Though the applicant will implement the best management practices described in in Section 1.3, some sediment and equipment-related contaminants may enter the City's stormwater system during construction. The major sources of ongoing pollutants from the new building would be contaminants that accumulate on the building rooftops (WDOE 2008; WDOE 2014), as well as vehicle-related contaminants that accumulate on the entryway to the proposed underground parking (McIntyre et al. 2015; McQueen et al. 2010; Peter et al. 2018; Spromberg et al. 2016). Contaminants are not expected from the vegetated areas, as fertilizers and pesticides will not be used.

Many common roofing materials leach metals, particularly arsenic, copper, and zinc (WDOE 2014). PAHs and phthalates may also be released from roofing materials. The Washington State Department of Ecology (WDOE) conducted a study of contaminants in roof runoff (WDOE 2014). The type of roof material proposed for this project (styrene butadiene styrene and asphalt roof liner) resulted in low, but detectable concentrations of metals, PAHs, and phthalates. The study used small, 3-meter sections of roof. WDOE (2014) indicated that longer roofs would likely increase contaminant loads. Rooftop structures that are made of unprotected galvanized steel, such as ductwork and flashing, may also leach high levels of zinc (WDOE 2008). Additionally, roof runoff is likely to contain pollutants that accumulate through atmospheric deposition (Lye 2009). Vehicle-related contaminants include petroleum-based PAHs, heavy metals, and a growing list of other contaminants that are just beginning to be identified (Peter et al. 2018).

PS Chinook salmon can uptake contaminants directly through their gills, and through dietary exposure (Karrow et al. 1999; Lee and Dobbs 1972; McCain et al. 1990; Meador et al. 2006; Neff 1982; Varanasi et al. 1993). Direct exposure to runoff-borne pollutants can cause effects in exposed fish that range from avoidance behaviors, to reduced growth, altered immune function, and immediate mortality in exposed individuals. The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Göbel et al. 2007; Incardona et al. 2005; Incardona et al. 2004; Incardona et al. 2006; McIntyre et al. 2012; Meador et al. 2006; Sandahl et al. 2007; Spromberg et al. 2016).

Beitinger and Freeman (1983) report that fish possess acute chemical discrimination abilities and that very low levels of some water-borne contaminants can trigger strong avoidance behaviors. Exposure to PAHs can cause reduced growth, increased susceptibility to infection, and increased mortality in juvenile salmonids (Meador et al. 2006; Varanasi et al. 1993). Zinc can bind to fish gills and cause suffocation (WDOE 2008). In freshwater, exposure to dissolved copper at concentrations between 0.3 to 3.2 µg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon's vulnerability to predators (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). Acute exposure to untreated stormwater runoff from roads and bridges has been directly linked to pre-spawner die off in adult coho salmon (McIntyre et al. 2015; Spromberg et al. 2016). However, the specific contaminants and mechanisms that cause the mortality are still not well understood. Some level of synergism between the various contaminants may be involved.

Indirect (trophic) exposure to runoff-borne pollutants can injure juvenile salmonids. Stormwater contaminants that settle to the bottom would be biologically available at the site into the foreseeable future. Amphipods and copepods uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other fish through the food web. Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the contaminated Duwamish Waterway. They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs. Meador et al. (2006) demonstrated that dietary exposure to PAHs caused "toxicant-induced starvation" with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon.

As described above, ongoing sources of contaminants include the styrene butadiene styrene roof, asphalt liner, galvanized ductwork and flashing, and vehicles. The compost for the vegetated roofs and bioretention planters may also result in small, but detectable levels of metals (Figure 5). However, most of the building's stormwater would be treated by two vegetated roofs and eight bioretention planters (Section 1.3).

The exact effectiveness of the proposed vegetated roofs and bioretention planters is unknown. However, recent research provides some insights. Ahiablame et al. (2012) found that bioretention reduces the volume of runoff from 40 percent to 97 percent, with the magnitude of reduction depending on the magnitude of rainfall. Bioretention reduces runoff flow rate, with values ranging from 33 percent to 56 percent for systems with an underdrain similar to what is proposed (Association of Washington Cities and WDOE 2013). Jones and Hunt (2009) found that bioretention reduces the temperature of stormwater. Bioretention effectively removes TSS and total copper, lead, and zinc in stormwater (Clary et al. 2017). Additionally, bioretention has been shown to prevent lethal and reduce sublethal toxicity of stormwater from roadways (McIntyre et al. 2015). Vegetated roofs also effectively reduce metals in stormwater (Gregoire and Claussen 2011).

Though research indicates that bioretention and vegetated roofs remove high levels of pollutants from the stormwater, they do not remove all of them. Because infiltration is not a feasible at the site, the stormwater with its residual contaminants would be discharged directly into Lake Washington. Additionally, stormwater from 2,172 square feet of new/replaced impervious surface will not be treated (Section 1.3). Though this area is expected to be used primarily by pedestrians, any contaminants that may accumulate on that impervious surface will be discharged directly into Lake Washington.

The concentrations of the various contaminants that would remain in the effluent are unknown and likely to be highly variable depending on the timing and intensity of individual storm events. The concentrations would be positively correlated with the length of time between precipitation events. The highest concentrations would likely occur near the start of heavy downpour events that occur after a long dry spell that allows pollutants to build-up on roofs and other impervious surfaces, such as in early- to mid-fall. Lower concentrations would occur later in given storm and/or later in the season when precipitation events are more frequent because the build-up of pollutants would be lower. Similarly, the distance from the outfall where the contaminants would dilute to levels too low to cause detectable direct and/or indirect effects is also unknown and expected to be highly variable.

Given the high level of treatment and the large volume of Lake Washington, it is very unlikely that project-attributable PAH and metal concentrations at levels high enough to cause detectable effects in salmonids would extend beyond 1,000 feet from the outfall (Figure 3). Although the individual discharges from the building would be small in comparison to the total volume discharged at the outfall, stormwater runoff from the site would persist for the life of the building. Along with other ongoing inputs of pollution in the area, it would incrementally add to the existing contaminant levels within Lake Washington. Therefore, to be conservative, the NMFS makes the assumption that any PS Chinook salmon and PS steelhead within 1,000 feet of the outfall may be exposed to contaminated stormwater that could be attributable to the proposed project.

The annual numbers of PS Chinook salmon and PS steelhead that may be exposed to stormwater from the new building are  unquantifiable with any degree of certainty, as is the intensity of any effects that an exposed individual may experience. However, the small affected area suggests that the probability of exposure would be very low for any individual fish. Therefore, the annual numbers of juvenile Chinook salmon that may be exposed to project-attributable stormwater effects would represent extremely small subsets of their respective cohorts, and the numbers of exposed fish would be too low to cause detectable population-level effects.

### 2.5.2 Effects to Critical Habitat

Designated critical habitat within the action area for PS Chinook salmon consists of freshwater rearing sites and freshwater migration corridors and their essential and biological features. The PBFs of designated PS Chinook salmon critical habitat in the action area include:

1) Freshwater rearing sites with
    i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    ii) water quality and forage supporting juvenile development; and
    iii) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
2) Freshwater migration corridors free of obstruction and excessive predation with
    i) water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

***Water Quantity***
The proposed action will have no effect on water quantity, and will cause no change in the quality and function of this PBF.

***Floodplain Connectivity***
The proposed action will have no effect on floodplain connectivity, and will cause no change in the quality and function of this PBF.

***Water Quality***
The proposed action would cause long-term minor effects on this PBF. Over the life of the new building, untreated and treated stormwater from the property would discharge residual levels of petroleum-based pollutants, metals, and other contaminants into Lake Washington. The area of affect would likely be limited to the area within 1,000 feet of the stormwater outfall (Figure 3). The action would cause no measurable changes in water temperature.

***Forage***
The proposed action would cause long-term minor effects on forage. Over the life of the new building, untreated and treated stormwater would provide a persistent source of contaminants that could be taken up by benthic invertebrates that are forage resources for juvenile Chinook salmon. The area of affect would likely be limited to the area within 1,000 feet of the stormwater outfall.

***Natural Cover***
The proposed action will have no effect on natural cover, and will cause no change in the quality and function of this PBF.

***Free of Obstruction and Excessive Predation***
The proposed action will not obstruct migration corridors or increase predation. Therefore, the proposed action will cause no change in the quality and function of this PBF.

## 2.6 Cumulative Effects

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

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

The current condition of ESA-listed species and designated critical habitat within the action area are described in the Status of the Species and Critical Habitat and the Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going shoreline development and upland urbanization. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of social groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, NMFS is reasonably certain that other future non-federal actions such as upland urban development are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from urbanization and chronic low-level inputs of non-point source pollutants will likely continue into the future.

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

## 2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. 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.

### 2.7.1 ESA-Listed Species

The species considered in this Opinion have been listed under the ESA, based on declines from historic levels of abundance and productivity, loss of spatial structure and diversity, and an array of limiting factors as a baseline habitat condition. Each species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, as described below, effects on viability parameters of each species are also likely to be negative. In this context we consider the effects of the proposed action's effect on individuals of the listed species at the population scale. The action area provides habitat for freshwater life histories of PS Chinook salmon and PS steelhead.

***PS Chinook Salmon***

The action area supports PS Chinook salmon adult and juvenile migration, as well as juvenile rearing. The long-term trend in abundance of the PS Chinook salmon ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat appear to be the greatest threats to the recovery of PS Chinook salmon. Degraded water quality and temperature, degraded nearshore conditions, and impaired passage for migrating fish also continue to impact this species.

The environmental baseline within the action area has been degraded by shoreline development, vessel activity, upland urbanization, and point and non-point pollution. The action area has been assessed for water and sediment quality, and is currently listed as "waters of concern" due to water quality issues in the area (WDOE 2018). The action area is located along the shoreline of

Lake Washington, which is utilized by the Cedar River and North Lake Washington / Lake Sammamish PS Chinook salmon populations.

PS Chinook salmon within the action area may be exposed to contaminated stormwater that could be attributable to the proposed project. The property would be a persistent source of contaminants that could be taken up by benthic invertebrates that are forage resources for juvenile Chinook salmon. Exposure to contaminants may result in reduced growth, increased susceptibility to infection, and increased mortality in some individuals. The number of PS Chinook salmon that are likely to be injured or killed by action-related stressors is unknown, but is expected to be very low, and such a small fraction of a returning cohort that it will have no detectable effect on any of the characteristics of a viable salmon population (VSP), abundance, productivity, distribution, or genetic diversity) for the affected population(s). Similarly, the annual number of juveniles that are likely to be injured or killed by exposure to action-related stressors is also unknown, but is expected to be too low to cause detectable effects on any VSP characteristics for the affected population(s).

***PS Steelhead***

The action area supports adult and juvenile migration. The DPS is currently at very low viability, and long-term abundance trends have been predominantly negative or flat across the DPS. Continued destruction and modification of habitat, widespread declines in adult abundance, and declining diversity appear to be the greatest threats to the recovery of PS steelhead. Reduced habitat quality and urbanization also continue to impact this species.

The environmental baseline within the action area has been degraded by shoreline development, vessel activity, upland urbanization, and point and non-point pollution. The action area has been assessed for water and sediment quality, and is currently listed as “waters of concern” due to water quality issues in the area (WDOE 2018). The action area is located along the shoreline of Lake Washington, which may be utilized by the Cedar River and North Lake Washington / Lake Sammamish demographically independent populations (DIPs). Ten or fewer adult natural-spawner Cedar River and North Lake Washington / Lake Sammamish PS steelhead are estimated to remain.

PS steelhead within the action area may be exposed to contaminated stormwater that could be attributable to the proposed project. Exposure to contaminants may result in avoidance behaviors, reduced growth, increased susceptibility to infection, and increased mortality in some individuals. The number of PS steelhead that are likely to be injured or killed by action-related stressors is unknown, but is expected to be very low, and such a small fraction of a returning cohort that it will have no detectable effect on any of the characteristics of a VSP, abundance, productivity, distribution, or genetic diversity) for the affected population(s). Similarly, the annual number of juveniles that are likely to be injured or killed by exposure to action-related stressors is also unknown, but is expected to be too low to cause detectable effects on any VSP characteristics for the affected population(s).

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, will be too small to cause any population level impacts on PS steelhead. Therefore, the proposed action will not appreciably reduce the likelihood of survival and recovery of this listed species.

### 2.7.2 Critical Habitat

As described above at Section 2.5.2, the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon. Past and ongoing anthropogenic activities have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region. Future non-federal actions and climate change are likely to increase and continue acting against the quality of salmonid critical habitat. The intensity of those influences on salmonid habitats is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, implementation of non-federal plans that are intended to benefit salmonids, and efforts to address the effects of climate change.

PS Chinook salmon critical habitat in the action area is limited to freshwater rearing sites and freshwater migration corridors. PBFs that will be affected by the action are limited to water quality and forage. As described above, the project site is located along a heavily impacted waterway, and currently functions at greatly reduced levels as compared to undisturbed freshwater migratory corridors.

The proposed action will cause long-term minor effects to water quality and forage. Over the life of the new building, untreated and treated stormwater from the property would discharge residual levels of petroleum-based pollutants, metals, and other contaminants into Lake Washington. The property would be a persistent source of contaminants that could be taken up by benthic invertebrates that are forage resources for juvenile Chinook salmon.

The proposed action will keep certain habitat conditions at slightly reduced functional levels as compared to undisturbed areas. However, based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, will be too small to cause any detectable long-term negative changes in the quality or functionality of freshwater migration corridor PBFs in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBF to become functionally established, to serve the intended conservation role for PS Chinook salmon.

## 2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS steelhead and PS Chinook salmon, or destroy or adversely modify PS Chinook salmon designated critical habitat.

## 2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "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.

### 2.9.1 Amount or Extent of Take

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

Harm of PS Chinook salmon and PS steelhead from exposure to:

- stormwater-related degraded water quality, and
- stormwater-related contaminated forage.

NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed annually by exposure to any of these stressors. The distribution and abundance of the fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action.

Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance.

The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take. The best available surrogates for the extent of take of PS Chinook salmon and PS steelhead from exposure to stormwater-related degraded water quality and contaminated forage are the amount of impervious surface, the number of parking spaces, the design of the stormwater treatment system, and the area of impervious surface able to be treated by the stormwater treatment system.

The amount of impervious surface is appropriate because the volume of stormwater would be directly related to the area of rooftops and other new/replaced impervious surface. Also, the amount of traffic-related contaminants in the stormwater would be directly related to the number of vehicles that would use the roads and onsite parking, which is directly related to the number of parking spaces. Any increase in the concentration of the contaminants within stormwater would increase in the amount of contaminants that enter Lake Washington. The design of the stormwater treatment system and the area of impervious surface able to be treated by the system is an appropriate surrogate, because the concentration of contaminants that would remain in post-treatment stormwater is directly related to the system's level of contaminant removal, and to the system's ability to manage flows before bypass of treatment occurs. Lower levels of contaminant removal and/or bypass of the system at lower flow levels would also increase the amount of contaminants that enter Lake Washington. An increase in the quantity of contaminants that enters Lake Washington increases the probability that an individual would be exposed to contaminant levels (directly or through the trophic web) that would result in take.

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

- The area of new/replaced impervious surface;
- The number of parking spaces; and
- The area of impervious surface able to be treated by the proposed vegetated roofs and bioretention areas described in the proposed action section of this biological opinion.

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

### 2.9.2 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.

### 2.9.3 Reasonable and Prudent Measures

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

HUD shall require the applicant to:

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

### 2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and HUD or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). HUD 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:
    i) Require the applicant to maintain and submit construction logs to verify that all take indicators are monitored and reported. The logs should indicate:
        (1) A maximum of 36,931 square feet of new/replaced impervious surface;
        (2) A maximum of 34,759 square feet of new/replaced roof;
        (3) A maximum of 2,172 square feet of other new/replaced impervious surface;
        (4) A maximum of 100 vehicle parking spaces;
        (5) Installation of 2 vegetated roofs designed to accommodate stormwater from 5,648 square feet of new/replaced impervious surface; and
        (6) Installation of 8 bioretention areas designed to accommodate stormwater from 29,111 square feet of new/replaced impervious surface.
    ii) Submit an electronic post-construction report to NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include the NMFS Tracking number for this project in the subject line: Attn: WCRO-2019-03115.

## 2.10 Conservation Recommendations

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

HUD should encourage the applicant to:
1) Not use coal-tar type pavements onsite;
2) Not use fertilizers and pesticides onsite;
3) Paint or coat all galvanized metal onsite with non-toxic paint or sealant;
4) Provision and regularly empty trash receptacles onsite;
5) Periodically sweep walkways onsite; and
6) Periodically inspect and clean spilled oils on the entryway to the proposed underground parking.

## 2.11 Reinitiation of Consultation

This concludes formal consultation for the Othello Square Building C Project in Seattle, Washington.

As 50 CFR 402.16 states, 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 if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) 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 (4) a new species is listed or critical habitat designated that may be affected by the 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. The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by HUD and descriptions of EFH for 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 proposed action and action area for this consultation are described in Sections 1 and 2 of this document. The action area includes areas designated as EFH for various life-history stages of Pacific Coast salmon (PFMC 2014). The action area is not designated as a habitat area of particular concern (HAPC).

## 3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document describes the adverse effects of this proposed action on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific coast salmon. Based on the analysis of effects presented in Section 2.5, the proposed action will cause small-scale adverse effects on this EFH through post-construction stormwater runoff that may cause direct or indirect physical, chemical, or biological alteration of the water or substrate, and through the contamination of prey. Therefore, we have determined that the proposed action would adversely affect the EFH identified above.

### 3.3 Essential Fish Habitat Conservation Recommendations

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 0.02 acres of designated EFH for Pacific Coast salmon.

To reduce adverse alteration of the physical, chemical, or biological characteristics of the water and substrates and available prey,

1) HUD should encourage the applicant to:
    i) Not use coal-tar type pavements onsite;
    ii) Not use fertilizers and pesticides onsite;
    iii) Paint or coat all galvanized metal onsite with non-toxic paint or sealant;
    iv) Provision and regularly empty trash receptacles onsite;
    v) Periodically sweep walkways onsite; and
    vi) Periodically inspect and clean spilled oils on the entryway to the proposed underground parking.
2) HUD should require the applicant to:
    i) Install 2 vegetated roofs designed to accommodate stormwater from 5,648 square feet of new/replaced impervious surface; and
    ii) Install 8 bioretention areas designed to accommodate stormwater from 29,111 square feet of new/replaced impervious surface.

### 3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, HUD 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 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

HUD 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 & PRE-DISSEMINATION REVIEW

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

### 4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is HUD. Other interested users could include housing project applicants, the citizens of Seattle, and tribes. Individual copies of this opinion were provided to HUD. The document will be available within two weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). The format and naming adheres 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 600.

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

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

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

# 5. REFERENCES


Abatzoglou, J. T., Rupp, D. E., and Mote, P. W. (2014). Seasonal climate variability and change in the Pacific Northwest of the United States. *Journal of Climate, 27*(5), 2125-2142. doi:https://doi.org/10.1175/JCLI-D-13-00218.1

Ahiablame, L.M., Engel, B. A., and Chaubey, I. (2012). Effectiveness of low impact development practices: Literature review and suggestions for future research. *Water Air Soil Pollution,* 23, 4253–4273. doi: 10.1007/s11270-012-1189-2

Association of Washington Cities and WDOE. (2013). White Paper for Stormwater Management Program Effectiveness Literature Review: Low Impact Development Techniques.

Beitinger, T.L. and L. Freeman. (1983). Behavioral avoidance and selection responses of fishes to chemicals. In: Gunther F.A., Gunther J.D. (eds) Residue Reviews. Residue Reviews, vol 90. Springer, New York, NY.

Brette, F., Machado, B., Cros, C., Incardona, J. P., Scholz, N. L., and Block, B. A. (2014). Crude oil impairs cardiac excitation-contraction coupling in fish. *Science, 343*, 772-776. doi:10.1126/science.1242747

City of Seattle. (2008). *Synthesis of salmon research and monitoring: Investigations conducted in the western Lake Washington basin*.

City of Seattle. (2019). *Elliot Bay seawall project: 2018 post construction monitoring report (year 1)*.

Clary, J., Jones, J., Leisenring, M., Hobson, P., and Strecker, E. (2017). Water Environment & Reuse Foundation. International Stormwater BMP Database. 2016 Summary Statistics. 1199 North Fairfax Street, Suite 900 Alexandria, VA.

Crozier, L. G., Hendry, A. P., Lawson, P. W., Quinn, T. P., Mantua, N. J., Battin, J., Shaw, R. G., and Huey, R. B. (2008). Potential responses to climate change in organisms with complex life histories: evolution and plasticity in Pacific salmon. *Evolutionary Applications, 1*(2), 252-270. doi:10.1111/j.1752-4571.2008.00033.x

Crozier, L. G., Scheuerell, M. D., and Zabel, E. W. (2011). Using time series analysis to characterize evolutionary and plastic responses to environmental change: A case study of a shift toward earlier migration date in sockeye salmon. *The American Naturalist, 178*(6), 755-773. doi:10.1086/662669

Dominguez, F., Rivera, E., Lettenmaier, D. P., and Castro, C. L. (2012). Changes in winter precipitation extremes for the western United States under a warmer climate as simulated by regional climate models. *Geophysical Research Letters, 39*(5). doi:https://doi.org/10.1029/2011GL050762

Doney, S. C., Ruckelshaus, M., Duffy, J. E., Barry, J. P., Chan, F., English, C. A., Galindo, H. M., Grebmeier, J. M., Hollowed, A. B., Knowlton, N., Polovina, J., Rabalais, N. N., Sydeman, W. J., and Talley, L. D. (2012). Climate Change Impacts on Marine Ecosystems. *Annual Review of Marine Science, 4*(11-37). doi:https://doi.org/10.1146/annurev-marine-041911-111611

Feely, R. A., Klinger, T., Newton, J. A., and Chadsey, M. (2012). *Scientific summary of ocean acidification in Washington state marine waters*. (Special Report). Retrieved from https://pmel.noaa.gov/co2/files/wa_shellfish_initiative_blue_ribbon_panel_oa_11-27-2012.pdf

Feist, B. E., Buhle, E. R., Arnold, P., Davis, J. W., and Scholz, N. L. (2011). Landscape ecotoxicology of coho salmon spawner mortality in urban streams. *PLoS One, 6*(8), e23424. doi:https://doi.org/10.1371/journal.pone.0023424

Fresh, K..L, E. Warner, R. Tabor, and D. Houck. (1999). Migratory behavior of adult Chinook salmon spawning in the Lake Washington watershed in 1998 as determined with ultrasonic telemetry. Draft Progress Report, October.

Giattina, J.D., Garton, R.R., Stevens, D.G. (1982). Avoidance of copper and nickel by rainbow trout as monitored by a computer-based data acquisition-system. Trans. Am. Fish. Soc. 111, 491–504.

Glick, P., Clough, J., and Nunley, B. (2007). Sea-Level Rise and Coastal Habitats in the Pacific Northwest: An analysis for Puget Sound, southwestern Washington, and northwestern Oregon. from National Wildlife Federation https://www.nwf.org/~/media/PDFs/Water/200707_PacificNWSeaLevelRise_Report.ashx

Göbel, P., Dierkes, C., and Coldewey, W. C. (2007). Storm water runoff concentration matrix for urban areas. *Journal of Contaminant Hydrology*. doi:https://doi.org/10.1016/j.jconhyd.2006.08.008

Goode, J. R., Buffington, J. M., Tonina, D., Isaak, D. J., Thurow, R. F., Wenger, S., Nagel, D., Luce, C., Tetzlaff, D., and Soulsby, C. (2013). Potential effects of climate change on streambed scour and risks to salmonid survival in snow-dominated mountain basins. *Hydrological Processes, 27*(5), 750-765. doi:https://doi.org/10.1002/hyp.9728

Gregoire, B.G., and Clausen, J.C. Effect of modular extensive green roof on stormwater runoff and water quality. *Ecological Engineering*, 37, 963-969.

Hecht, S.A., D.H. Baldwin, C.A. Mebane, T. Hawkes, S.J. Gross, and N.L. Scholz. (2007). An overview of sensory effects on juvenile salmonids exposed to dissolved copper: Applying a benchmark concentration approach to evaluate sublethal neurobehavioral toxicity. *In* U.S. Dept. Commer., NOAA Technical White Paper. March 2007. 45 pp.

Incardona, J. P., Carls, M. G., Teraoka, H., Sloan, C. A., Collier, T. K., and Scholz, N. L. (2005). Aryl hydrocarbon receptor-independent toxicity of weathered crude oil during fish development. *Environmental Healthy Perspectives, 113*, 1755-1762. doi:10.1289/ehp.8230

Incardona, J. P., Collier, T. K., and Scolz, N. L. (2004). Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. *Toxicology and Applied Pharmacology, 196*, 191-205. doi:https://doi.org/10.1016/j.taap.2003.11.026

Incardona, J. P., Day, H. L., Collier, T. K., and Scholz, N. L. (2006). Developmental toxicity of 4-ring polycyclic aromatic hydrocarbons in zebrafish is differentially dependent on AH receptor isoforms and hepatic cytochrome P450 1A metabolism. *Toxicology and Applied Pharmacology, 217*, 308-321. doi:https://doi.org/10.1016/j.taap.2006.09.018

IPCC. (2014). *Climate Change 2014: Synthesis Report*. Retrieved from Geneva, Switzerland: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf

Isaak, D. J., Wollrab, S., Horan, D., and Chandler, G. (2012). Climate change effects on stream and river temperatures across the northwest US from 1980–2009 and implications for salmonid fishes. *Climatic Change, 113*(2), 499-524. doi:10.1007/s10584-011-0326-z

ISAB. (2007). *Climate change impacts on Columbia River Basin fish and wildlife*. Retrieved from Portland, Oregon: https://www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-scientific-advisory-board/climate-change-impacts-on-columbia-river-basin-fish-and-wildlife

Jones, M.P. and W.F. Hunt. (2009). Bioretention impact on runoff temperature in trout sensitive waters. *Journal of Environmental Engineering,* 135. doi: 10.1061/(ASCE)EE.1943-7870.0000022.

Karrow, N., Boermans, H. J., Dixon, D. G., Hontella, A., Soloman, K. R., White, J. J., and Bols, N. C. (1999). Characterizing the immunotoxicity of creosote to rainbow trout (*Oncorhynchus mykiss*): A microcosm study. *Aquatic Toxicology, 45*, 223-239.

Kunkel, K. E., Stevens, L. E., Stevens, S. E., Sun, L., Janssen, E., Wuebbles, D., Redmond, K. T., and Dobson, J. G. (2013). *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6*. (NESDIS 142-6). Washington, D.C. Retrieved from https://scenarios.globalchange.gov/sites/default/files/NOAA_NESDIS_Tech_Report_142-6-Climate_of_the_Northwest_U.S_0.pdf

Landrum, P.F., and D. Scavia. (1983). Influence of sediment on anthracene uptake, depuration, and biotransformation by the amphipod *Hyalella azteca*. Canada. J. Fish. Aquatic Sci. 40:298-305.

Landrum, P.F., B.J. Eadie, W.R. Faust, N.R. Morehead, and M.J. McCormick. (1984). Role of sediment in t e bioaccumulation of benzo(a)pyrene by the amphipod, *Pontoporeia hoyi*. Pages 799-812 in M. Cooke and A.J. Dennis (eds.). Polynuclear aromatic hydrocarbons: mechanisms, methods and metabolism. Battelle Press, Columbus, Ohio.

Lawson, P. W., Logerwell, E. A., Mantua, N. J., Francis, R. C., and Agostini, V. N. (2004). Environmental factors influencing freshwater survival and smolt production in Pacific Northwest coho salmon (*Oncorhynchus kisutch*). *Canadian Journal of Fisheries and Aquatic Sciences, 61*(3), 360-373.

Lee, R., and Dobbs, G. (1972). Uptake, metabolism and discharge of polycyclic aromatic hydrocarbons by marine fish. *Marine Biology, 17*, 201-208. doi:https://doi.org/10.1007/BF00366294

Lye, D. J. (2009). Rooftop runoff as a source of contamination: A review. Science of the Total Environment. Volume 407, Issue 21, 15 October 2009, Pages 5429-5434.

Mantua, N., Tohver, I., and Hamlet, A. (2009). Impacts of Climate Change on Key Aspects of Freshwater Salmon Habitat in Washington State. In J. L. M.M. Elsner, L. Whitely Binder (Ed.), *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate* (pp. 217-253). Seattle, Washington: The Climate Impacts Group, University of Washington.

Mantua, N., Tohver, I., and Hamlet, A. (2010). Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. *Climatic Change, 102*(1), 187-223. doi:https://doi.org/10.1007/s10584-010-9845-2

Marshall, A. R., Small, M., and Foley, S. (2004). *Genetic relationships among anadromous and non-anadromous Oncorhynchus mykiss in Cedar River and Lake Washington: Implications for steelhead recovery planning*. Olympia and Mill Creek, WA: Progress Report to Cedar River Anadromous Fish Committee and Seattle Public Utilities Retrieved from https://wdfw.wa.gov/publications/01426/wdfw01426.pdf

McCain, B., Malins, D. C., Krahn, M. M., Brown, D. W., Gronlund, W. D., Moore, L. K., and Chan, S.-L. (1990). Uptake of aromatic and chlorinated hydrocarbons by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in an urban estuary. *Archives of Environmental Contamination and Toxicology, 19*, 10-16. doi:https://doi.org/10.1007/BF01059807

McIntyre, J. K., Baldwin, D. H., Beauchamp, D. A., and Scholz, N. L. (2012). Low-level copper exposures increase visibility and vulnerability of juvenile coho salmon to cutthroat trout predators. *Ecological Applications, 22*(5), 1460-1471. doi:10.1890/11-2001.1

McIntyre, J.K., J.W. Davis, C. Hinman, K.H. Macneale, B.F. Anulacion, N.L. Scholz, and J.D. Stark. (2015). Soil bioretention protection juvenile salmon and their prey from the toxic impacts of urban stormwater runoff. *Chemosphere* 132: 213–219.

McMahon, T. E., and Hartman, G. F. (1989). Influence of cover complexity and current velocity on winter habitat use by juvenile coho salmon (*Oncorhynchus kisutch*). *Canadian Journal of Fisheries and Aquatic Sciences, 46*(9), 1551-1557. doi:https://doi.org/10.1139/f89-197

McQueen, A.D., B.M., Johnson, J.H. Rodgers, and W.R. English. (2010). Campus parking lot stormwater runoff: physicochemical analyses and toxicity tests using Ceriodaphnia dubia and Pimephales promelas. Chemosphere 79, 561–569.

Meador, J. P., Sommers, F. C., Ylitalo, G. M., and Sloan, C. A. (2006). Altered growth and related physiological responses in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) from dietary exposure to polycyclic aromatic hydrocarbons (PAHs). *Canadian Journal of Fisheries and Aquatic Sciences, 63*, 2364-2376. doi:https://doi.org/10.1139/f06-127

Meyer, J. L., Sale, M. J., Mulholland, P. J., and Poff, N. L. (1999). Impacts of climate change on aquatic ecosystem functioning and health. *JAWRA Journal of the American Water Resources Association, 35*(6), 1373-1386. doi:10.1111/j.1752-1688.1999.tb04222.x

Mote, P. W., Abatzoglou, J. T., and Kunkel, K. E. (2013). Climate: Variability and Change in the Past and the Future. In P. W. M. M.M. Dalton, and A.K. Snover (Ed.), *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities*. Washington D.C.: Island Press.

Mote, P. W., Rupp, D. E., Li, S., Sharp, D. J., Otto, F., Uhe, P. F., Xiao, M., Lettenmaier, D. P., Cullen, H., and Allen, M. R. (2016). Perspectives on the cause of exceptionally low 2015 snowpack in the western United States. *Geophysical Research Letters, 43*, 10980-11098. doi:https://doi.org/10.1002/2016GL069965

Mote, P. W., Snover, A. K., Capalbo, S., Eigenbrode, S. D., Glick, P., Littell, J., Raymondi, R. R., and Reeder, W. S. (2014). Northwest. In T. C. R. J. M. Melillo, and G.W. Yohe (Ed.), *Climate Change Impacts in the United States: The Third National Climate Assessment* (pp. 487-513): U.S. Global Change Research Program.

Neff, J. M. (1982). *Accumulation and release of polycyclic aromatic hydrocarbons from water, food, and sediment by marine animals*. (600/9-82-013). N.L. Richards and B.L. Jackson (eds.) Retrieved from https://nepis.epa.gov/Exe/ZyPDF.cgi/9101R2QQ.PDF?Dockey=9101R2QQ.PDF

NMFS. (2006). *Final supplement to the Shared Strategy's Puget Sound salmon recovery plan*. Seattle, Washington Retrieved from https://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/puget_sound/chinook/ps-supplement.pdf

NMFS. (2018). *Proposed recovery plan for Puget Sound steelehad distinct population segment (Oncorhynchus mykiss)*. Seattle, WA Retrieved from https://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/puget_sound/proposed_puget_sound_steelhead_recovery_plan_12_13_18.pdf

NWFSC. (2015). *Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest*. Retrieved from https://www.nwfsc.noaa.gov/assets/11/8623_03072016_124156_Ford-NWSalmonBioStatusReviewUpdate-Dec%2021-2015%20v2.pdf

Peter, K.T., Z. Tian, C. Wu, P. Lin, S. White, B. Du, J.K. McIntyre, N.L. Scholz, and E.P. Kolodziej. (2018). Using High-Resolution Mass Spectrometry to Identify Organic Contaminants Linked to Urban Stormwater Mortality Syndrome in Coho Salmon. Environ. Sci. Technol. 2018, 52, 10317−10327.

PFMC. (2014). *Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18 to the Pacific Coast Salmon Plan: Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon*. Retrieved from Portland, Oregon: https://www.westcoast.fisheries.noaa.gov/publications/habitat/essential_fish_habitat/salmon_efh_appendix_a_final_september-25_2014__2_.pdf

Raymondi, R. R., Cuhaciyan, J. E., Glick, P., Capalbo, S. M., Houston, L. L., Shafer, S. L., and Grah, O. (2013). Water Resources: Implications of Changes in Temperature and Precipitation. In P. W. M. M.M. Dalton, and A.K. Snover (Ed.), *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities* (pp. 41-58). Washington, D.C.: Island Press.

Reeder, W. S., Ruggiero, P. R., Shafer, S. L., Snover, A. K., Houston, L. L., Glick, P., Newton, J. A., and Capalbo, S. M. (2013). Coasts: Complex Changes Affecting the Northwest's Diverse Shorelines. In P. W. M. M.M. Dalton, and A.K. Snover (Ed.), *Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities* (pp. 41-58). Washington, DC: Island Press.

Sandahl, J. F., Baldwin, D. H., Jenkins, J. J., and Scholz, N. L. (2007). A sensory system at the interface between urban stormwater runoff and salmon survival. *Environmental Science & Technology, 41*(8), 2998-3004. doi:http://dx.doi.org/10.1021/es062287r

Scheuerell, M. D., and Williams, J. G. (2005). Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). *Fisheries Oceanography, 14*(6), 448-457. doi:http://dx.doi.org/10.1111/j.1365-2419.2005.00346.x

Sommers, F., E. Mudrock, J. Labenia, and D. Baldwin. (2016). Effects of salinity on olfactory toxicity and behavioral responses of juvenile salmonids from copper. *Aquatic Toxicology*. 175:260-268.

Spromberg, J. A., Baldwin, D. H., Damm, S. E., McIntyre, J. K., Huff, M., Sloan, C. A., Anulacion, B. F., Davis, J. W., and Scholz, N. L. (2016). Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal storm water impacts. *Journal of Applied Ecology, 53*(2), 398-407. doi:doi:10.1111/1365-2664.12534

SSDC. (2007). *Puget Sound salmon recovery plan*. Retrieved from https://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/puget_sound/chinook/pugetsoundchinookrecoveryplan_wo_exec_summary.pdf

Sunda, W. G., and Cai, W. J. (2012). Eutrophication induced CO2-acidification of subsurface coastal waters: interactive effects of temperature, salinity, and atmospheric pCO2. *Environmental Science & Technology*, *46*(19), 10651-10659. doi:10.1021/es300626f

Tabor, R.A., H.A. Gearns, C. M. McCoy III, and S. Camacho. (2006). Nearshore Habitat Use by Juvenile Chinook Salmon in Lentic Systems of the Lake Washington Basin, Annual Report, 2003 and 2004. U.S. Fish and Wild Service. Olympia, WA.

Tague, C. L., Choate, J. S., and Grant, G. (2013). Parameterizing sub-surface drainage with geology to improve modeling streamflow responses to climate in data limited environments. *Hydrology and Earth System Sciences*, *17*(1), 341-354. doi:https://doi.org/10.5194/hess-17-341-2013

Tierney, K.B., D.H. Baldwin, T.J. Hara, P.S. Ross, N.L. Scholz, and C.J. Kennedy. (2010). Olfactory toxicity in fishes. *Aquatic Toxicology*. 96:2-26.

Tillmann, P., and Siemann, D. (2011). *Climate Change Effects and Adaptation Approaches in Marine and Coastal Ecosystems of the North Pacific Landscape Conservation Cooperative Region*. Retrieved from https://www.nwf.org/~/media/PDFs/Global-Warming/2014/Marine-Report/NPLCC_Marine_Climate-Effects_Final.pdf

Varanasi, U., Casillas, E., Arkoosh, M. R., Hom, T., Misitano, D. A., Brown, D. W., Chan, S. L., Collier, T. K., McCain, B. B., and Stein, J. E. (1993). *Contaminant exposure and associated biological effects in juvenile Chinook salmon (Oncorhynchus tshawytscha) from urban and nonurban estuaries of Puget Sound*. (NMFS-NWFSC-8). Seattle, WA: NMFS NFSC Retrieved from https://www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm8/tm8.html

Wainwright, T. C., and Weitkamp, L. A. (2013). Effects of climate change on Oregon Coast coho salmon: habitat and life-cycle interactions. *Northwest Science*, *87*(3), 219-242. doi:https://doi.org/10.3955/046.087.0305

Washington Department of Fish and Wildlife (WDFW). (2005). Evaluation of Downstream Migrant Salmon Production in 2004 from the Cedar River and Bear Creek. Olympia, WA.

WDFW. (2019a). *Puget Sound final abundance Chinook*. Retrieved from: https://data.wa.gov/dataset/Puget-Sound-Final-Abundance-Chinook-11152012/xzqf-dbht/data

WDFW. (2019b). *Puget Sound final abundance steelhead*. Retrieved from: https://data.wa.gov/dataset/Puget-Sound-Final-Abundance-Steelhead-10222012/w4dt-5axg/data

Washington State Department of Ecology (WDOE). 2008. Suggested Practices to Reduce Zinc Concentrations in Industrial Stormwater Discharges – Water Quality Program Pub. No. 08-10-025. June 2007. 34 pp.

WDOE. (2014). Roofing Materials Assessment – Investigation of Toxic Chemicals in Roof Runoff. Publication No. 14-03-003. February 2014. 132 pp.

WDOE. (2018). Washington State Coastal Atlas Map: Assessed sediments and assessed waters, Category 5 - 303(d). Retrieved from https://fortress.wa.gov/ecy/coastalatlas/tools/Map.aspx

Winder, M., and Schindler, D. E. (2004). Climate change uncouples trophic interactions in an aquatic ecosystem. *Ecology, 85*, 2100–2106. doi:https://doi.org/10.1890/04-0151

Zabel, R. W., Scheuerell, M. D., McClure, M. M., and Williams, J. G. (2006). The Interplay between Climate Variability and Density Dependence in the Population Viability of Chinook Salmon. *Conservation Biology, 20*(1), 190-200. doi:http://dx.doi.org/10.1111/j.1523-1739.2005.00300.x