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 Consultation No.:
WCRO-2018-00071

April 30, 2020

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Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Interstate 5 Horseshoe Lake Pump Station Project (XL 5183), Woodland, Washington (Hydraulic Unit Code 170800020606 Lewis River)

Dear Mr. Mathis and Ms. Walker:

Thank you for your letter and biological assessment (BA) of May 11, 2018, 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 Federal Highway Administration's Horseshoe Lake Pump Station 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).

The proposed project may affect, is likely to adversely affect Lower Columbia River (LCR) steelhead, LCR Chinook salmon, LCR coho salmon, Columbia River (CR) chum salmon, eulachon, and designated critical habitats for LCR steelhead, LCR Chinook salmon, LCR coho salmon, CR chum salmon, and eulachon. In this biological opinion (BO), NMFS determined the proposed action is not likely to jeopardize the continued existence of these species or result in the destruction or adverse modification of the designated critical habitats.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

The BO includes a description of the action's likely effects on EFH for two Pacific salmon and includes three EFH conservation recommendations to offset impacts to EFH. Federal agencies must provide a detailed written response to the conservation recommendations within 30 days of receipt of measures proposed to avoid, mitigate, or offset the adverse effects that the activity has on EFH.

Please contact Scott Hecht of the Oregon/Washington Coastal Area Office at (206) 534-9306 if you have any questions concerning this BO or if you require additional information.

Sincerely,

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

cc: Angie Haffie, WSDOT
Chris Regan, WSDOT
Cindy Callahan, DOT

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

Interstate 5 Horseshoe Lake Pump Station Project (XL 5183), Woodland, Washington
(Hydraulic Unit Code 170800020606 Lewis River)

NMFS Consultation Number: WCRO-2018-00071

Action Agencies: Federal Highway Administration
U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Lower Columbia River Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Columbia River chum salmon (*O. keta*)	Threatened	Yes	No	Yes	No
Lower Columbia River coho salmon (*O. kisutch*)	Threatened	Yes	No	Yes	No
Pacific Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No
Southern Resident killer whales (*Orcinus orca*)	Endangered	No	No	No	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: April 30, 2020

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1. INTRODUCTION

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

1.1 Background

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

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

1.2 Consultation History

On May 11, 2018, NMFS received a request for formal consultation and a biological assessment (BA) from the Federal Highway Administration (FHWA). The proposed project will replace and redesign the existing water pump that pulls water from the Lewis River into Horseshoe Lake, in the city of Woodland, Washington. The existing pump is worn out and needs to be replaced to fulfill water quality agreements made between the state of Washington and the city of Woodland. The project is funded in part from FHWA and requires a U.S. Army Corps of Engineers permit; thereby, triggering a nexus to the ESA. FHWA is the lead federal agency and the project will be administered by applicant Washington Department of Transportation (WSDOT).

In 1939, and subsequent revisions, WSDOT became obligated to avoid water stagnation in Horseshoe Lake created when a dike cut off an oxbow of the Lewis River and permanently redirected the river to connect with the Columbia River further upstream from its natural course. The dike served to contain the Lewis River within the channel to reduce flooding and to facilitate the construction of State Route 99; now Interstate 5.

FHWA anticipates the proposed project May Affect, is Likely to Adversely Affect Lower Columbia River (LCR) steelhead, LCR Chinook salmon, CR chum salmon, LCR coho salmon, Pacific eulachon, and designated critical habitats for LCR steelhead, LCR Chinook salmon, CR chum salmon, LCR coho salmon, and Pacific eulachon and will adversely affect EFH for Chinook salmon and coho salmon.

There have been numerous discussions between NMFS, FHWA, and WSDOT beginning in 2015. The following discussions occurred when WSDOT introduced their preferred design:

- In February 2017, additional correspondence occurred with a preliminary pump intake design.
- On February 15, 2018, the FHWA and WSDOT project office presented the preferred project design at a preliminary BA (preBA) meeting. Based on the proposed design, preBA presentation, and questions/concerns a BA was provided to NMFS on May 11, 2018 to explain in greater detail the project and site conditions.
- July 3, 2018, NMFS identified major concerns and issues with in a five-page document to WSDOT (Appendix A). Primary concerns include the project design and the pump operations would result in entrainment and impingement on eulachon eggs and larvae.
- August 14, 2018, NMFS, FHWA, USFWS and WSDOT staff met onsite and NMFS provided additional questions and concerns.
- August 24, 2018, WSDOT returned responses to the questions (Appendix B).
- October 24, 2018, NMFS held a teleconference with WSDOT and FHWA. It was determined afterward that a face-to-face meeting would be needed to further understand the project design and NMFS concerns about adverse effects to eulachon.
- February 27, 2019, site visit and meeting with WSDOT, NMFS, US Fish and Wildlife Service, Cowlitz Tribe, Washington Department of Fish and Wildlife, and project consultants.
- March 21, 2019, meeting notes and Horseshoe Lake studies summary sent from NMFS to participants in February 27, 2019 meeting (Appendix C).
- April 8, 2019, WSDOT sent additional information/responses to February 27, 2019 meeting questions posed by NMFS (Appendix D) and from Scott Hecht February 19, 2019 email (Appendix E).
- June 12, 2019, Letter of Initiation was received from FHWA.

With the inclusion of information from verbal discussions, design details, Cowlitz Tribe staff, the BA, Beaver Creek Hatchery Intake biological opinion (WCR-2017-7969), and follow up correspondence, formal consultation was initiated on 6/12/2019.

The FHWA did not request to consult on Southern Resident killer whales (SRKWs) (*Orcinus orca*). NMFS listed this species as endangered on November 18, 2005 (USDC 2005) and designated critical habitat on November 29, 2006 (USDC 2006). The proposed project adversely affects prey species for SRKWs that are themselves at risk of extinction. Therefore, NMFS has considered the effects of this action on SRKWs in Section 2.12.

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 regulations noted, “this 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, streamlines 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).

We considered whether or not the proposed action would cause any other activities and determined that there will be changes to existing conditions including an increased volume and duration of water pumping from the Lewis River and epizootic turbid plumes within the Lewis River when backflushing and maintaining the screen.

WSDOT is obligated to minimize water stagnation in Horseshoe Lake, located within the city of Woodland (City), Washington, Hydraulic Unit Code 70800020606 (Lewis River). The obligation dates back to 1939 when the Washington Highway Department (now Washington Department of Transportation) made an agreement with the City to isolate an oxbow of the Lewis River with the new Highway 99 (now Interstate 5) and straighten the river channel (WSHC 1957[1]). With pumping from the Lewis River into the isolated oxbow, it became a lake attracting housing and business development along the shoreline. Subsequent agreements support continued pumping water out of the Lewis River into Horseshoe Lake (city of Woodland 1998). In 1957, WSDOT replaced the original design with the current structure and mechanism. The proposed project replaces the aging pump, outdated intake design, and inefficient support structure. FHWA is partially funding the pump replacement and the action requires a fill permit from the U.S. Army Corps of Engineers; thus, creating a federal nexus to address 7(a)(2) of the ESA. The existing pump and structure has not undergone previous ESA consultation with NMFS.

Existing structure

The existing dock is 40 feet long by 14 feet wide (560 square feet) and has a steel substructure with creosote-treated wood decking. The dock is supported by eight steel H-piles, each 12 inches in width. Six of the eight piles are below the ordinary high water mark (OHWM) of the Lewis River. Most of the riverbank underneath and around the existing dock is armored with small angular rip-rap.

Immediately upstream of the existing dock, three vertical steel H-piles and a timber dolphin (consisting of four, 12-inch diameter creosote treated timber piles) protects the dock from floating debris. The dock supports the existing pump platform and 18-inch pipe until it goes underground adjacent to the existing pump station control building.

The existing pump intake is contained within a metal box that is three feet wide by three feet tall by 12 feet long (36 square feet). A metal pipe sheath protects the intake shaft up to the pump. Metal rails allow the fish screen around the intake box to slide up and down for cleaning and maintenance. In total, the metal railings, fish screen box, and six H-piles occupy approximately 66 square feet of riverbed area below the Ordinary High Water Mark (OHWM) of the Lewis

[1] 1957 letter from WSHC to Mayor Brant references a construction and water quality agreement made on January 19, 1939 but that document has not been discovered.

River. The existing fish screen does not meet current NMFS fish screening criteria[2] and therefore adversely affects ESA-listed salmonids (NMFS 2011a). Additionally, the existing screen must be manually cleaned by lifting the intake contraption from the riverbed an average of eight times per year or whenever it is clogged. The existing pump has maximum capacity of approximately 3,500 gpm due to wearing out and has experienced weeks to months of not working due to parts breaking.

The outlet and overflow structure in Horseshoe Lake is owned and maintained by the city of Woodland: therefore, the outlet is not part of the proposed project.

Proposed design

The proposed design replaces the existing structure and pump with a self-cleaning intake that is expected to reduce maintenance efforts (Table 1). The new structure on the bank will be adjacent to the existing structure while the new pump intake extends 50 feet out into the middle of the Lewis River.

Table 1. Proposed Pump Intake Design Guidelines and Criteria Summary

Criteria	Parameter
Pump Station Capacity	
Maximum Design Flow Rate	6,000 gpm (13.4 cubic feet per second [cfs])
Fish Screen	
Minimum Effective Screen Area	**33.4 sq. ft.**
Maximum Approach Velocity (Va) for active screens	0.4 fps
Sweeping Velocity (Vs)	Vs≥ 2 times Va
Screen Opening (max)	1.75 mm
Screen Open Area (min)	46%
Fish Passage Compliance Range of River Flow	5% to 95% exceedance

The project consists of the following general elements:

- Install new intake pump on the riverbank with fish screens that meet WDFW and NMFS criteria.
- Install new pump platform at top of riverbank.
- Connect new intake pump to existing pipe with new controls.
- Remove existing dock and all associated structural members except for three steel guard piles.

[2] No screening criteria exist for eulachon, as eggs and juveniles are too small to feasibly avoid entraining them during pump operation.

Water pump

The new pump intake will lay horizontally in an excavated pit in the river bed. An attached fish screen will be installed above the riverbed and will be retrievable using an inclined, pile-supported rail/ramp system. This fish screen will meet NMFS screening criteria for protection of juvenile salmonids, however there are no feasible criteria to screen out eulachon eggs and larvae from entrainment. The pump intake will be located between the duel-track rail retrieval system and screen assembly. The pump discharge head and motor will be attached at the upper end of the rail system and connect to the existing pipe passing under I-5 (Figure 1). The new pump will have an anticipated service life of 20 years but with proper maintenance FHWA/WSDOT anticipates the pump lasting for 50 years. As such, NMFS assumes the proposed action covers a 50-year period.

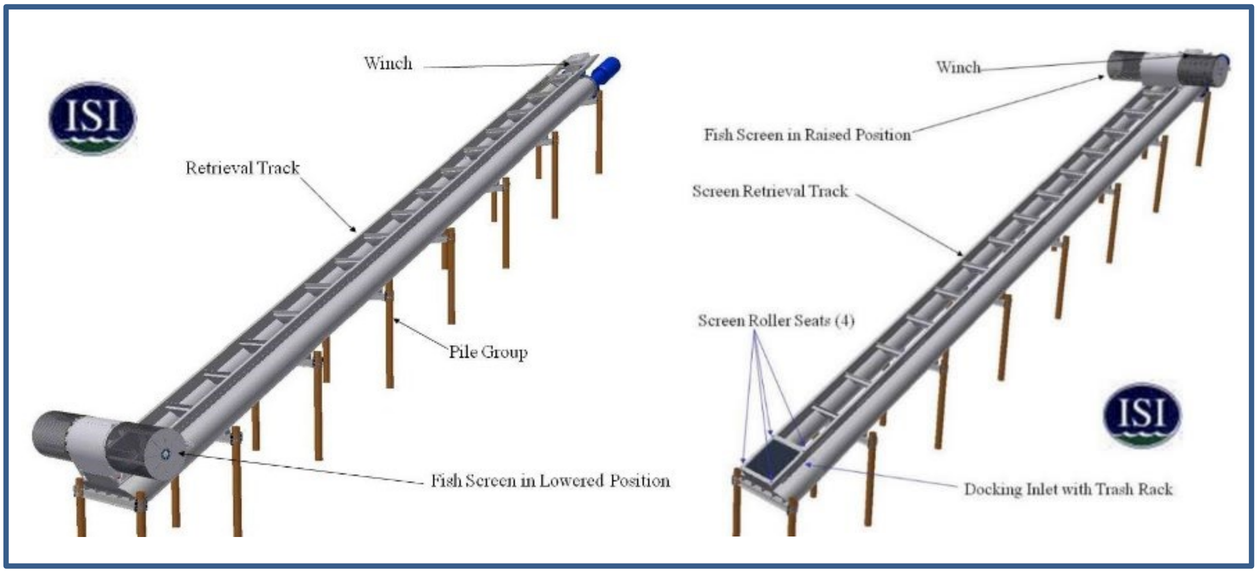

Figure 1. Proposed Water Pump Ramp (not to exact detail)

The intake pit will be approximately 1,000 square feet in area, five feet deep, and oriented to encourage river flow through it to maintain the area free of debris. The pit keeps the pump intake fully submerged and unobstructed at all flows. The rail ramp system will be supported by a total of twelve 12.75-inch diameter steel pipe piles, two of which will be below the OHWM. These two piles and the three deflector piles will occupy a total of 4.45 square feet of the new structure on the river bottom. The new pump platform will be grated to allow light transmission to the ground below. The riverbank around the track is currently armored with one to two-man angular rip-rap, covering approximately 600 square feet of riverbank, of which approximately 350 square feet is below the OHWM. This rip-rap will be temporarily removed during construction and then placed back onto the bank under the new structure. The reconstructed bank will be supplemented with light loose rip-rap as necessary.

The new pump is capable of moving 6,000 gallons per minute and has features to avoid and minimize impinging juvenile salmon and larger fish. The intake will back-flush and rotate to dislodge debris and maintain the approach velocity below 0.4 feet per second. Hydraulic sweep across the screen surface will be assisted with sloping the streambed pit downstream tailout to increase the sweep velocity across the intake. The design is intended to keep the intake operational all year round and avoid impinging juvenile salmonids with screen sized per NMFS criteria (NMFS 2011a). If the intake becomes clogged, the new screen retrieval structure will simplify the cleaning process with minimal disturbance in the river. WSDOT estimates the screen will need to be back-flushed for 30 minutes one time per month. Every seven to ten years the intake pit will be excavated to reestablish the desired pump depth. Any future in-water work will occur during established work windows identified for the Lewis River action area.

The proposed pump will run constantly year round at a rate of up to 4,000 gallons per minute during 1 December to 15 March and up to 6,000 gallons per minute 16 March until 30 November.

FHWA/WSDOT will actively monitor the pump operation throughout the year and annually inspect the sump pit that it is functioning as designed. FHWA/WSDOT shall meet/or report annually with/to NMFS to discuss pump operations, site characteristics, and environmental conditions, including the status of eulachon in the action area. FHWA/WSDOT shall notify NMFS as needed if there are revised operations or exchanges of equipment not described in this opinion or conditions of the pump mechanism are altered unexpectedly.

Fill

Portions of the bank at the existing and new pump structures may require up to 52 cubic yards of new additional rip-rap above the OHWM and 16 yards below the OHWM.

Staging

Staging will be located on existing asphalt, grass, or dirt surfaces.

Vegetation

Little, if any, vegetation will be removed to accommodate staging. Up to 600 square feet of riparian vegetation consisting of mainly invasive plant species will be removed to accommodate the new pump structure; however, the existing pump site will be replanted with approximately the same sized area with site-appropriate native vegetation.

In-water work

Appropriate in-water Best Management Practices will be determined during construction based on water depth and agreement with the project engineers. The methods chosen will minimize turbidity and not exceed background levels beyond 300 feet from the source. All in-water work will be completed between August 1 to September 15 in a single construction season.

The types of machinery used will be up to the contractor and all hydraulically operated machines operating next to or within the OHWM will use vegetable-based (or equivalent) hydraulic fluid. Machinery will be based landward of the OHWM but mechanical arms will swing over and below the OHWM. A temporary cofferdam will be installed to enclose the footprint of in-water work, including excavation of the pump intake pit and piles below the OHWM. WSDOT will enclose the 2,500 square feet of the Lewis River by using a vibratory hammer to install a wall of sheet piles extending approximately 50 feet into the channel and pump out water with the intent to keep depths less than three feet. Pumped water will be sent to an upland location for infiltration or Baker tanks to capture sediments.

Pile driving

WSDOT will remove eight existing piles located below the OHWM with a vibratory hammer. Four of these are creosote-treated timbers and four are steel piles. Three other existing steel piles will remain in place and three new steel 12.75-inch diameter piles will be added to deflect debris from hitting the new screen structure. The new pump station and rail will be supported by up to 12 hollow steel piles. Two of these piles are located below the OHWM to "pin" the intake pipe and screen to the bottom of the Lewis River at the end of the rail while the remaining ten support the rail and pump station are located on the bank above the OHWM. All piles, including three deflector piles, will be vibrated to resistance and proofed to depth if necessary.

Excavation

A 1,000 square foot (70 cubic feet) pit will be excavated in the Lewis River thalweg approximately 50 feet from the right bank. The trailing edge of the pit will be tapered to increase water flow across the pump screen that is intended to reduce clogging and surface suction. The excavation area will be enclosed within a temporary cofferdam to control turbidity. Fish will be removed from within the enclosure following the most current WSDOT fish exclusion protocols (WSDOT 2016).

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 provides 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.

The FHWA did not include an evaluation of the potential effects of the proposed project on Southern Resident killer whales (SRKW) or their critical habitat. NMFS has determined that the proposed action may affect this species as a result of the adverse effects on salmon, which are the primary prey for SRKWs and vital to their recovery. Although not requested by FHWA, NMFS has evaluated the potential effects independently and reached a determination that the proposed action was not likely to adversely affect SRKW, and therefore did not require formal consultation. This is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12).

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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. 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. 2014, Mote 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013, Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4 Fahrenheit (^{0}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). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3^0 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% 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. 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).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (NWFSC 2015). 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 (Mantua et al. 2010; Isaak et al. 2012). 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; Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright & Weitkamp 2013; Raymondi et al. 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 (McMahon and Hartman 1989; Lawson et al. 2004).

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 1.0-3.7º Celsius 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 (Tillmann and Siemann 2011, Reeder et al. 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38% to 109% increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios and is essentially irreversible over a time scale of centuries (IPCC 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al. 2012, Feely et al. 2012). Acidification also affects 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 10-32 inches by 2081-2100 (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 (Tillmann and Siemann 2011, Reeder et al. 2013). 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 (Tillmann and Siemann 2011, Reeder et al. 2013).

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 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

For Pacific salmon, steelhead, and certain other species, we commonly use the four “viable salmonid population” (VSP) criteria (McElhany et al. 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species’ “reproduction, numbers, or distribution” as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population’s capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

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

“Diversity” refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al. 2000).

“Abundance” generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

“Productivity,” as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms “population growth rate” and “productivity” interchangeably when referring to production over the entire life cycle. They also refer to “trend in abundance,” which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species’ populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of the six ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 2).

Table 2. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register (FR) decision notices for ESA-listed species considered in this opinion. Listing status: 'T' means listed as threatened.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Chum salmon *(O. keta)*			
Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon *(O. kisutch)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	2/24/16; 81 FR 9252	6/28/05; 70 FR 37160
Steelhead (*O. mykiss*) Lower Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Eulachon *(Thaleichthys pacificus)* Southern DPS	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	Not applicable

In general, salmonid populations are depressed in the lower Columbia River, which includes the project action area in the Lewis River. Of the 74 populations, only eight are at or above recovery goals.

Status of LCR Chinook Salmon

Recovery plan targets for this species are tailored for each life history type, and within each type, specific population targets are identified (NMFS 2013). For spring Chinook salmon, all populations are affected by aspects of habitat loss and degradation. Four of the nine populations require significant reductions in every threat category. Protection and improvement of tributary and estuarine habitat are specifically noted.

For fall Chinook salmon, recovery requires restoration of the Coast and Cascade strata to high probability of persistence, to be achieved primarily by ensuring habitat protection and restoration. Very large improvements are needed for most fall Chinook salmon populations to improve their probability of persistence.

For late fall Chinook salmon, recovery requires maintenance of the North Fork Lewis and Sandy populations which are comparatively healthy, together with improving the probability of persistence of the Sandy population from its current status of "high" to "very high." Improving the status of the Sandy population depends largely on harvest and hatchery changes. Habitat improvements to the Columbia River estuary and tributary spawning areas are also necessary. Of the 32 DIPs in this ESU, only the 2 late-fall run populations (Lewis River and Sandy River) could be considered viable or nearly so (NWFSC 2015).

<u>Spatial Structure and Diversity</u>. The ESU includes all naturally-produced populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White

Salmon River, and includes the Willamette River to Willamette Falls, Oregon, with the exception of spring-run Chinook salmon in the Clackamas River. On average, fall-run Chinook salmon programs have released 50 million fish annually, with spring-run and upriver bright (URB) programs releasing a total of 15 million fish annually. As a result of this high level of hatchery production and low levels of natural production, many of the populations contain over 50% hatchery fish among their naturally spawning assemblages.

The ESU spans three distinct ecological regions: Coastal, Cascade, and Gorge. Distinct life-histories (run and spawn timing) within ecological regions in this ESU were identified as major population groups (MPGs). In total, 32 historical DIPs were identified in this ESU, 9 spring-run, 21 fall-run, and 2 late-fall run, organized in 6 MPGs (based on run timing and ecological region; LCR Chinook populations exhibit three different life history types base on return timing and other features: fall-run (or "tules"), late-fall-run (or "brights"), and spring-run.

Abundance and Productivity. Of the seven spring-run DIPs in this MPG only the Sandy River spring-run population appears to be a currently self-sustaining population. Both of the two spring-run historical DIPs in the Spring-run Gorge MPG are extirpated or nearly so. In general, the DIPs in the Coastal Fall-run MPG are dominated by hatchery-origin spawners. In surveys conduct in both 2012 and 2013, no Chinook salmon were observed in Scappoose Creek. Overall, the Fall-run Cascade MPG exhibits stable population trends, but at low abundance levels, and most populations have hatchery contribution exceeding the target of 10% identified in the NMFS Lower Columbia River recovery plan (Dornbush and Sihler 2013). Many of the populations in the Fall-run Gorge MPG have limited spawning habitat available. Additionally, the prevalence of returning hatchery-origin fish to spawning grounds presents a considerable threat to diversity. Natural-origin returns for most populations are in the hundreds of fish. The two populations in the Late-Fall-run MPG the most viable of the ESU. The Lewis River late-fall DIP has the largest natural abundance in the ESU and has a strong short-term positive trend and a stable long term trend, suggesting a population near capacity. The Sandy River late-fall run has not been directly monitored in a number of years; the most recent estimate was 373 spawners in 2010 (Takata 2011).

Limiting factors. Limiting factors for this species include NMFS (2013):

- Reduced access to spawning and rearing habitat;
- Hatchery-related effects;
- Harvest-related effects on fall Chinook salmon;
- An altered flow regime and Columbia River plume;
- Reduced access to off-channel rearing habitat;
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary;
- Contaminants.

Status of CR Chum Salmon

Columbia River chum salmon are included in the Lower Columbia River recovery plan (NMFS 2013). Recovery targets for this species focus on improving tributary and estuarine habitat conditions, and re-establishing populations where they may have been extirpated, in order to increase all four viability parameters. Specific recovery goals are to restore Coast and Cascade chum salmon strata to high probability of persistence, and to improve persistence probability of the two Gorge populations by protecting and restoring spawning habitat, side channel, and off channel habitats alcoves, wetlands, floodplains, etc. Even with improvements observed during the last five years, the majority of DIPs in this ESU remain at a high or very high risk category and considerable progress remains to be made to achieve the recovery goals (NWFSC 2015).

Spatial Structure and Diversity. The ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, as well as four artificial propagation programs (Grays River Hatchery, Big Creek Hatchery, Lewis River Hatchery, and Washougal Hatchery). With the exception of the Grays River stock of fish raised at Big Creek Hatchery, all of the hatchery programs in this ESU use integrated stocks developed to supplement natural production. Ford et al. (2011) concluded that the vast majority (14 out of 17) chum populations remain extirpated or nearly so. The ESU is comprised of three MPGs – the Coastal Range MPG, the Cascade Range MPG, and the Gorge MPG.

In this ESU there have been a number of large-scale efforts to improve habitat accessibility, one of the primary metrics for spatial structure. On the Hood River, Powerdale Dam was removed in 2010 and while this dam previously provided for fish passage, removal of the dam is thought to eliminate passage delays and injuries. Condit Dam, on the White Salmon River, was removed in 2012 and this provided access to previously inaccessible habitat. Both of these dams were above Bonneville Dam, and at present there are few fish available (122 adults in 2014) to colonize these recently accessible habitats.

Abundance and Productivity. Populations in the Coast Range MPG other than the Grays River DIP exist at very low abundances, intermittently observed in very low numbers (<10) in most tributaries other than the Grays River. Two chum spawning aggregates in the mainstem Columbia River just upstream of the I-205 Bridge are part of the Washougal River aggregate. In November 2013, two adult chum salmon were observed at the North Fork Dam in the Clackamas River. Chum salmon have also been collected at a number of hatcheries and weirs throughout the Cascade Range MPG, but only in very limited numbers (<10). While the absolute numbers of fish present in many populations are critically low, they may represent important reserves of genetic diversity. Within the Gorge MPG, the Lower Gorge population includes chum salmon returning to Hamilton, Hardy, and Duncan Creeks, and the Ives Island area of the mainstem Columbia River below Bonneville Dam. Other mainstem Columbia River spawning aggregations include Multnomah and Horsetail Creeks on the Oregon shoreline, and in the St. Cloud area along the Washington shoreline. The overall trend since 2000 is negative, with the recent peak in abundance (2010-2011) being considerably lower than the previous peak in 2002. The Upper Gorge population is comprised of a small number (105.6±47.7) that migrate past Bonneville Dam to the upper Gorge population area in most years (NWFSC 2015).

Limiting Factors. Limiting factors for this species are (NMFS 2013):

- Degraded estuarine and nearshore marine habitat;
- Degraded freshwater habitat;
- Degraded stream flow as a result of hydropower and water supply operations;

- Reduced water quality;
- Current or potential predation;
- An altered flow regime and Columbia River plume;
- Reduced access to off-channel rearing habitat in the lower Columbia River.

Status of LCR Coho Salmon

This species is included in the Lower Columbia River recovery plan (NMFS 2013). Specific recovery goals are to improve all four viability parameters to the point that the Coast, Cascade, and Gorge strata achieve high probability of persistence. Protection of existing high functioning habitat and restoration of tributary habitat are noted needs, along with reduction of hatchery and harvest impacts. Large improvements are needed in the persistence probability of most populations of this ESU.

Spatial Structure and Diversity. This ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia River up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as multiple artificial propagation programs. Most of the populations in the ESU contain a substantial number of hatchery-origin spawners. Myers et al (Myers et al. 2006) identified three MPGs (Coastal, Cascade, and Gorge), containing a total of 24 DIPs in the Lower Columbia River coho salmon ESU (NWFSC 2015).

There have been a number of large-scale efforts to improve accessibility, one of the primary metrics for spatial structure, in this ESU. On the Hood River, Powerdale Dam was removed in 2010 and while this dam previously provided fish passage removal of the dam is thought to eliminate passage delays and injuries. Condit Dam, on the White Salmon River, was removed in 2011 and this provided access to previously inaccessible habitat. Fish passage operations (trap and haul) were begun on the Lewis River in 2014, reestablishing access to historically-occupied habitat above Swift Dam though, juvenile passage efficiencies are still relatively poor. Presently, the trap and haul program for the Upper Cowlitz, Cispus, and Tilton rivers populations are the only means by which coho salmon can access spawning habitat for these populations. A trap and haul program also currently maintains access to the North Toutle River above the sediment retention structure with a coho salmon and steelhead being passed above the dam (NWFSC 2015).

Abundance and Productivity. Long-term abundances in the Coast Range Cascade MPG were generally stable. Scappoose Creek is exhibiting a positive abundance trend. Clatskanie River coho salmon population maintains moderate numbers of naturally produced spawners. Washington tributaries indicate the presence of moderate numbers of coho salmon, with total abundances in the hundreds to low thousands of fish. Oregon tributaries have abundances in the hundreds of fish. In the Western Cascade MPG, the Sandy and Clackamas Rivers were the only two populations identified in the original 1996 Status Review that appeared to be self-sustaining natural populations. Natural origin abundances in the Columbia Gorge MPG are low, with hatchery-origin fish contributing a large proportion of the total number of spawners, most notably in the Hood River. With the exception of the Hood and Big White Salmon Rivers, much of the spawning habitat accessibility is relatively poor. There was no clear trend in the abundance data.

Limiting Factors. Limiting factors for this species include (NMFS 2013):

- Degraded estuarine and near-shore marine habitat;
- Fish passage barriers;
- Degraded freshwater habitat: Hatchery-related effects;
- Harvest-related effects;
- An altered flow regime and Columbia River plume;
- Reduced access to off-channel rearing habitat in the lower Columbia River;
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary;
- Juvenile fish wake strandings;
- Contaminants.

Status of LCR Steelhead

This species is included in the Lower Columbia River recovery plan (NMFS 2013). For this species, threats in all categories must be reduced, but the most crucial elements are protecting favorable tributary habitat and restoring habitat in the Upper Cowlitz, Cispus, North Fork Toutle, Kalama and Sandy subbasins (for winter steelhead), and the East Fork Lewis, and Hood, subbasins (for summer steelhead). Protection and improvement is also need among the South Fork Toutle and Clackamas winter steelhead populations.

Spatial Structure and Diversity. The DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive), and the Willamette and Hood Rivers, Oregon (inclusive), as well as multiple artificial propagation programs. There are 4 MPGs comprised of 23 DIPs, including 6 summer-run steelhead populations and 17 winter-run populations that comprise (NWFSC 2015). Summer steelhead return to freshwater long before spawning. Winter steelhead, in contrast, return from the ocean much closer to maturity and spawn within a few weeks. Summer steelhead spawning areas in the Lower Columbia River are found above waterfalls and other features that create seasonal barriers to migration. Where no temporal barriers exist, the winter-run life history dominates.

There have been a number of large-scale efforts to improve accessibility (one of the primary metrics for spatial structure) in this ESU. Trap and haul operations were begun on the Lewis River in 2012 for winter-run steelhead, reestablishing access to historically-occupied habitat above Swift Dam. In 2014, 1033 adult winter steelhead (integrated program fish) were transported to the upper Lewis River; however, juvenile collection efficiency is still below target levels. In addition, there have been a number of recovery actions throughout the ESU to remove or improve culverts and other small-scale passage barriers. Many of these actions (including the removal of Condit Dam on the White Salmon River) have occurred too recently to be fully evaluated.

Total steelhead hatchery releases in the Lower Columbia River Steelhead DPS have decreased since the last status review, declining from a total (summer and winter run) release of approximately 3.5 million to 3 million from 2008 to 2014. Some populations continue to have relatively high fractions of hatchery-origin spawners, whereas others (e.g., Wind River) have relatively few hatchery origin spawners.

Abundance and Productivity. The Winter-run Western Cascade MPG includes native winter-run steelhead in 14 DIPs from the Cowlitz River to the Washougal River. Abundances have remained fairly stable and have remained low, averaging in the hundreds of fish. Notable exceptions to this were the Clackamas and Sandy River winter-run steelhead populations, that are exhibiting recent rises in NOR abundance and maintaining low levels of hatchery-origin steelhead on the spawning grounds (Jacobsen et al. 2014). In the Summer-run Cascade MPG, there are four summer-run steelhead populations. Absolute abundances have been in the hundreds of fish. Long and short term trends for three DIPs (Kalama, East Fork Lewis and Washougal) are positive; though the 2014 surveys indicate a drop in abundance for all three. The Winter-run Gorge MPG has three DIPs. In both the Lower and Upper Gorge population surveys for winter steelhead are very limited. Abundance levels have been low, but relatively stable, in the Hood River. In recent years, spawners from the integrated hatchery program have constituted the majority of the naturally spawning fish. The Wind River and Hood River are the two DIPs in the Summer-run Gorge MPG. Hood River summer-run steelhead have not been monitored since the last status review. Adult abundance in the Wind River remains stable, but at a low level (hundreds of fish). The overall status of the MPG is uncertain.

Limiting factors. Limiting factors for this species include (NMFS 2013):

- Degraded estuarine and nearshore marine habitat;
- Degraded freshwater habitat;
- Reduced access to spawning and rearing habitat;
- Avian and marine mammal predation;
- Hatchery-related effects;
- An altered flow regime and Columbia River plume;
- Reduced access to off-channel rearing habitat in the lower Columbia River;
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary;
- Juvenile fish wake strandings;
- Contaminants.

Status of Eulachon

Eulachon were listed as a threatened species on March 18, 2010 (75 FR 13012). NMFS adopted a final recovery plan for eulachon on September 6, 2017 (NMFS 2017). On April 1, 2016, we announced the results of our 5-year review of eulachon status. After completing the review, we recommended the southern DPS of eulachon remain classified as a threatened species.

The major threats to eulachon are impacts of climate change on oceanic and freshwater habitats (species-wide), fishery by-catch (species-wide), dams and water diversions (Klamath and Columbia subpopulations) and predation (species-wide) (NMFS 2017).

Spatial Structure and Diversity. The southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Core populations for this species include the Fraser River, Columbia River and (historically) the Klamath River. They primarily spawn in their natal estuary systems. Eulachon begin entering the Columbia River in December, peaking in January-March and continue through May (Howell et. al. 2001; Reynolds pers. com 2019a). During daylight the adults are bottom-oriented (NPCC 2015). They typically spawn at night in the lower reaches of larger rivers fed by snowmelt when water temperatures are 4° to 10° Celsius. Spawning often occurs in the stream reach of tidal influence and have also been documented in the Columbia River near RM 100. Tidal influence in the Columbia River terminates at RM 146 by the Bonneville Hydroelectric Dam. Tidal influence in the Lewis River extends to RM 11, surpassing the project site located near RM 6.3 (LCFRB 2010). Eulachon spawn up to the base of Lake Merwin dam in the Lewis River (Reynold pers com 2019a). Most eulachon adults die after spawning but some return to spawn a second time (NMFS 2017).

After 15-30 days, the eggs are carried downstream and widely dispersed throughout the channel without stratification. Approximately half the eulachon eggs sink and adhere to sand granules on the streambed while the remaining free float in the water column. After another 19-30 days, eggs and larvae generally enter the Lower Columbia River estuary (Reynolds pers com 2019a). Eggs and larvae have been found in the mainstem Columbia River from mid-December to May downstream from the confluences with the Lewis, Kalama, and Cowlitz rivers. Most of the larvae were collected during March of the survey year (NMFS 2014).

Interestingly, some studies show the sex ratio greatly favors females but numerous other reports suggest males greatly outnumber females (N. Reynolds in NPCC 2015, NMFS 2017). There could be a wide variety of reasons for skewed sex ratios and it may very well be a 1:1 ratio if all variables of survey efforts are taken into account (NPCC 2015). Run timing may play a significant roll with males predominately returning before females in the Columbia River although this is very inconsistent with other rivers and may very well be an artifact of insufficient sampling effort (NMFS 2017).

Eulachon movements in the ocean are poorly known, although the amount of eulachon bycatch in the pink shrimp fishery seems to indicate that the distribution of these organisms overlap in the ocean. The southern DPS includes four major subpopulations: (1) Columbia, Klamath, Frazier, and British Columbia. However, these subpopulations do not include all spawning aggregations within the DPS. For instance, spawning runs of eulachon have been noted in Redwood Creek and the Mad River in California, the Umpqua River and Tenmile Creek in Oregon, and the Naselle and Quinault rivers in Washington (NMFS 2017).

Abundance and Productivity. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River with no evidence of returning to their former population levels since then (BRT 2008). Persistent low returns and landings of eulachon in the Columbia River from 1993-2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan in 2001 that provides for restricted harvest management when parental run strength, juvenile production, and ocean productivity forecast a poor return (WDFW and ODFW 2001). Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings have again declined to the very low levels observed in the mid-1990s (Joint Columbia River Management Staff 2009).

As a result of continued low eulachon returns and the listing of eulachon as a threatened species under the ESA, all recreational and commercial fisheries for eulachon were closed in Washington and Oregon in 2010, and in California in 2013. Beginning in 2010, ODFW and WDFW began eulachon biomass surveys similar to those conducted on the Fraser River (James 2014). Based on the two years of data that have been collected and analyzed, WDFW calculated a median spawner estimate of approximately 40 million eulachon in the Columbia River in 2011 and 39 million in 2012 (James 2014).

However, there are no consistent and reliable historical abundance estimates for eulachon. Spawning stock biomass estimations of adult eulachon in the Columbia River have ranged from a low of 783,400 fish in 2005 to a high of 185,965,200 fish in 2013, with an estimated 54,556,500 fish in 2016, and 18,307,100 fish in 2017 (NMFS 2017). WDFW estimates the Chehalis River produces 11 metric tons. An estimated 11.2 eulachon per pound equated to approximately 272,000 adult spawners (Gustafson et al 2016). NMFS estimates an annual average of 590,000,000,000 larvae hatch in the Columbia River. Average larvae yield in the North Fork Lewis River is limited to one sample season by the Cowlitz Tribe finding 0.0011 larvae per cubic foot[3] with a combined confidence of 0.0019 larvae per cubic foot (NMFS 2015).

There are no known productivity records for the Lewis River.

Limiting Factors. Limiting factors for this species include (NMFS 2017):

- Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success;
- Climate-induced change to freshwater habitats;
- Bycatch of eulachon in commercial fisheries;
- Adverse effects related to dams and water diversions;
- water quality;
- Shoreline construction;
- Over harvest;
- Predation.

2.2.2 Status of the Critical Habitats

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

[3] 95 percent confidence interval for larvae density + or –0.0008 (NMFS 2015). Therefore, to be conservative, NMFS used the higher level of the confidence interval resulting in 0.0019 (i.e., 0.0011 + 0.0008 = 0.0019).

Salmon and Steelhead. For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each listed species they support[4]. The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NMFS 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution of the population it served (e.g., a population at the extreme end of geographic distribution), or if it serves another important role (e.g., obligate area for migration to upstream spawning areas).

The physical or biological features of freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Table 3). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

[4] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NMFS 2005).

Table 3. Physical and biological features (PBFs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion and corresponding species life history events.

Physical and biological features (PBFs)		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing

CHART Salmon and Steelhead Critical Habitat Assessments

The CHART for each recovery domain assessed biological information pertaining to occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0 to 3-point score for the PCEs in each HUC_5 watershed for:

Factor 1. Quantity;
Factor 2. Quality – Current Condition;
Factor 3. Quality – Potential Condition;
Factor 4. Support of Rarity Importance;
Factor 5. Support of Abundant Populations; and
Factor 6. Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality – current condition), which considers the existing condition of the quality of PCEs in the

HUC5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

Southern DPS Eulachon. Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). All of these areas are designated as migration and spawning habitat for this species. In Oregon, 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek have been designated. The mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles is also designated as critical habitat. The Lewis River is designated critical habitat from the mouth with the Columbia River up to the base of Merwin Dam. This includes the project action area. Table 4 delineates the designated physical and biological features for eulachon.

Table 4. Physical or biological features of critical habitats designated for eulachon and corresponding species life history events.

Physical or biological features		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning and incubation	Flow Water quality Water temperature Substrate	Adult spawning Incubation
Freshwater migration	Flow Water quality Water temperature Food	Adult and larval mobility Larval feeding

The range of eulachon in the Pacific Northwest completely overlaps with the range of several ESA-listed stocks of salmon and steelhead. Although the habitat requirements of these fishes differ somewhat from eulachon, efforts to protect habitat generally focus on the maintenance of watershed processes that would be expected to benefit eulachon. The BRT identified dams and water diversions as moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. These same habitat degrading features are prominent in the Lewis River and are particularly associated with the proposed project. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath systems, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods (Gustafson et al. 2010). Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown (Gustafson et al. 2010). The BRT identified dredging as a low to moderate threat to eulachon in the Columbia River. Dredging and water diversion during eulachon spawning would be particularly detrimental.

The lower Columbia River mainstem provides spawning and incubation sites, and a large migratory corridor to spawning areas in the tributaries. Before the construction of Bonneville Dam, eulachon ascended the Columbia River as far as Hood River, Oregon. Major tributaries that support spawning runs include the Grays, Skamokawa, Elochoman, Kalama, Lewis and Sandy rivers. Spawning occurs at night. Eggs have been found in as little as three inches of water to greater than 20 feet across the width of a river. Eggs tumble with the currents and are expected to concentrate at eddies, pools, river bottom depressions, and move downriver with the faster flows (NMFS 2017).

The lower Lewis River rearing/migration corridor within the action area has a medium conservation value and was rated high for its connectivity corridor for eulachon. Eulachon production from the lower Lewis River, however, represents a minor component of the annual production of eulachon from the Columbia River, and the factors of decline for the species are primarily associated with ocean conditions, past harvest, dams, and water diversions (NMFS 2017).

Willamette-Lower Columbia Recovery Domain. Critical habitat was designated in the Willamette-Lower Columbia (WLC) recovery domain for LCR Chinook salmon, LCR steelhead, CR chum salmon, LCR coho salmon, and eulachon.

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom et al. 2005; Fresh et al. 2005; NMFS 2011b; NMFS 2013). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom et al. 2005; Fresh et al. 2005; NMFS 2013). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the USACE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals — such as arsenic and polycyclic aromatic hydrocarbons — have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems. Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom et al. 2005; Fresh et al. 2005; NMFS 2013). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood et al. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom et al. 2005; NMFS 2013). Diking and filling have reduced the tidal prism and eliminated emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxins that are harmful to aquatic resources (Lower Columbia River Estuary Partnership 2007). Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's capacity to support salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of estuarine habitats.

The CHART for the WLC recovery domain determined that most HUC_5 watersheds with PBFs for salmon or steelhead are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Only watersheds in the upper McKenzie River and its tributaries are in good to excellent condition with no potential for improvement. The lower Lewis River current PBF broadly range from poor to excellent but the restoration potential is poor to good.

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).

For the pump replacement project, the action area includes the construction footprint of the piles, existing intake structure, excavation pit, and new intake structure. In addition, the action area will temporarily include the turbidity mixing zone not to exceed above 5 Nephelometric Turbidity Units (NTU) above background levels at 300 feet downstream of the instream work.

Noise from impact pile driving used to proof piles in the water column will exceed ambient levels and extend approximately 0.5 miles upstream and 0.6 miles downstream until they terminate at bends in the river, between approximately river mile 5.6 to river mile 6.7. Therefore, underwater sound from impact pile driving defines the furthest extent of the action area.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). 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).

Native Americans occupied the banks and obtained resources from the Lewis River for thousands of years. Since European contact, the Lewis River has undergone significant alterations. Farmers and residents, weary of annual flooding, diked the lower seven miles of the river on several occasions, which includes the project area located near rivermile (RM) 6.5. River flows are control by four hydroelectric dams: Merwin, Yale, and Swift[5]. The dams back up reservoirs used to create hydroelectricity, drinking water, and support recreation. Adult fish first encounter Merwin Dam, a complete migration barrier at approximately RM 20 built in 1931. A trap and haul system was installed below the Merwin Dam in 2014 and selectively transports adult fish upstream of the three reservoirs. Once released, the fish can spread out and spawn in tributaries and the mainstem up to RM 72.5 at a natural waterfall barrier (Lower Falls). Outmigrating juveniles are collected in Swift Reservoir and similarly trucked and released downstream below Merwin Dam.

The dams restrict sediment transport and large wood recruitment and are used to manipulate flows; however, other land use alterations that also effect the Lewis River include: timber harvest, urbanization, farming, and roads. Effects from urbanization (high levels road density, stormwater runoff, and residential pollutants) diminish habitat quality in the action area. The history of land management activities resulting from past and present farming and timber practices have reduced water quality and quantity, riparian canopy, and altered river channel dynamics.

Interstate 5 is a channel migration barrier in the action area and is buffered from the Lewis River by the WSDOT Woodland State Airport.[6] Both are sources of stormwater pollutants that may flow into the Lewis River. The project action area serves as a migration corridor and rearing habitat for listed fish spawning upstream. No known spawning of listed species occurs in the action area.

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[5] Swift Reservoir has two dams controlling outflow into Yale Reservoir.

[6] Watts-Woodland Airport was built in 1919 atop fill excavated material from the adjacent Lewis River channel.

The Lewis River oxbow attracted housing and business development. In 1939, the oxbow was cut off from the Lewis River by the State of Washington Department of Highways (later to become Washington Department of Transportation). WSDOT appears to have made an agreement with the city of Woodland to pump water into the lake to avoid stagnation. WSDOT was not able to provide a copy of the 1939 agreement and is only known by reference in 1957 letter from the Washington State Highway Commission Secretary Lorenz Goetz to the Mayor of the city of Woodland Earle F. Bryant (Figure 2). WSDOT relies on this letter to support its plan to continue pumping water into the Lewis River oxbow.

Figure 2. 1957 Letter from WA to Woodland

Thomas

August 30, 1957

Honorable Earle F. Bryant, Mayor
City of Woodland
Woodland, Washington

Dear Mayor Bryant:

During recent meetings, the Washington State Highway Commission has given very thorough consideration, based on studies made by engineers of the Department of Highways, to the request of the City of Woodland that the Department of Highways assume responsibility for maintaining a constant water level in Horseshoe Lake adjacent to Primary State Highway 1 in the Woodland vicinity.

In addition to the engineering studies, the Highway Commission obtained an opinion from the Attorney General which states that the only obligation which has been assumed by the Department of Highways is to prevent stagnation. This obligation apparently originally derives from a permit issued by the United States Government on January 19, 1939 for a channel change of the north fork of the Lewis River and was met upon completion of the construction of inlet and outlet culverts. However, the correspondence files indicate that the reason for the construction of these culverts was to prevent the stagnation of water in Horseshoe Lake and that in furtherance of this purpose the Department of Highways assumed an obligation to circulate river water through the lake. This responsibility was specifically stated in a letter to you dated February 8, 1954 from Mr. O. R. Dinsmore, Assistant Director of Highways, in which it was agreed that the Department of Highways would correct the existing drainage facilities from the Lewis River into Horseshoe Lake in order to prevent water impounded in the lake from becoming stagnant during the summer season.

As you are aware, a ten-inch pump has been temporarily installed to provide circulation of water, and a sixteen-inch pump has been ordered for permanent installation. In addition to providing the necessary circulation of water, the pumping process may incidentally have an effect on the water level in the lake, but this would depend on variable factors over which the Department of Highways would have no control, such as weather conditions in any given year.

Honorable Earle F. Bryant   Page Two   August 30, 1957

After careful study of all available data, it is the opinion of the Highway Commission that the Department of Highways has not assumed any responsibility with respect to Horseshoe Lake beyond the prevention of stagnation, and, after full consideration, it is the Commission's conviction that further responsibility should not be assumed.

Very truly yours,

WASHINGTON STATE HIGHWAY COMMISSION

By: LORENZ GOETZ
Secretary

LG:cw
RH

cc: Mr. Bugge
Mr. Johnson
Mr. Bailey

Office of the Governor: Attention Mr. Bishop
Department of Game: Attention Mr. Biggs
Pollution Control Commission: Attention Mr. Neale

A pump suctions water out of the Lewis River and outfalls in the north end of the oxbow. The city installed an overflow outlet at the south end of the oxbow to control the lake's water level.

The lake is used for recreation (with residential docks and a park) and is stocked with trout as well as warm water, non-native fish species. Fish in the Lewis River cannot voluntarily access the lake; however, it may be possible for fish in the lake to escape through the overflow outlet.

In 1910, there were a few hundred people living in Woodland. The population slowly but steadily increased until 1990 when the rate of new residents increased markedly to the 2018 population estimate of 6,138 people (Census Bureau 2018). The city of Woodland is expected to grow at 2.3 percent per year and have up to 9,300 residents by 2035 (TDN 2015). The increased population is expected to equally increase the demand on resources, including the Lewis River by an increase in impervious surfaces, more storm water, rural land conversion to residential and urban land types.

For the last seven years, the existing pump had a typical operating range of 2,000 to 4,000 gpm. Average yearly pumping rates ranged between 2,095 gpm in 2015 and 3,063 gpm in 2016. During this time, the range of pump rates from minimum to maximum was 90 to 4,487 gpm. Highest pumping rates occurred in winter, and lowest pumping rates occurred in summer, but there was considerable variability in these trends. The existing pump has never been run in excess of 5,000 gpm in recent years. The pump has experienced periodic shutdowns for maintenance and repair. For example, in 2016, the pump was shut down four separate times for a total of approximately 18 weeks for repairs.

The existing pump screen does not meet current design standards to avoid impinging juvenile salmonids. The existing pump likely kills or injures an undetermined number of juvenile Chinook salmon, coho salmon, chum salmon, steelhead, and eulachon of equal-size or smaller, including larvae and eggs.

As discussed in Section 2.2, climate change is expected to affect the Lewis River with flashier flows, cause severe storm events and warmer and drier summers, and increase water temperatures. These factors will negatively affect fish habitat. Currently, the pump does not operate when flows in the Lewis River are less than 1,000 cfs from July 15 through September 15 or below 1,500 cfs during the rest of the year. Therefore, if storm events become more severe and flashier it may affect pump operations i.e., when the pump is on (negative effect) or turned off (beneficial effect) and when back flushes (negative affect) are needed. However, it is difficult to determine what levels of flows will occur and when they will occur, thus flow-related effects could be either slightly beneficial or detrimental.

Flows in the Lewis River below the Merwin Dam have significant decreases and increases within short periods (known as ramping). For example, on December 16, 2018, flows decreased approximately 2,000 cubic feet per second (cfs) within 12 hours. Then, on December 18, 2018, within a few hours flows increased 10,000 cfs (Figure 3). In the action area, the Lewis River width ranges from approximately 350 feet to 500 feet wide in a single confined channel, with the narrowest width at the location of the proposed water pump. Flows are highly controlled by the upstream dams. Average flows in the action area are approximately 7,500 cfs but are highly variable and controlled by dam operations (USGS 2020). These radical changes in flows are expected to adversely affect fish by limiting access to habitat, scouring the streambed, and thus hampering salmonid recovery (LCFRB 2010).

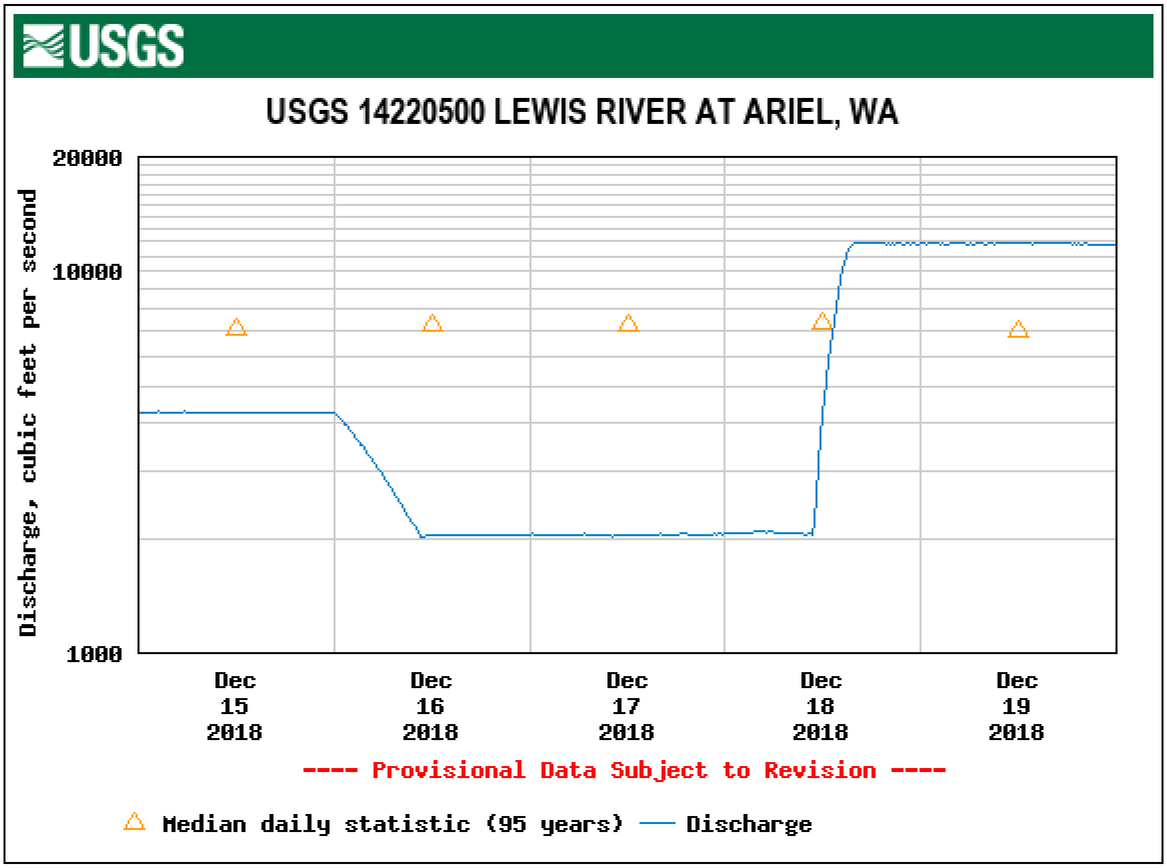

Figure 3. Lewis River Flow Gauge.

The terrestrial environment surrounding the project action area is urbanized with single and multi-family housing, roads, and a local airport. Regular maintenance of the roads and airport and adjacent vegetation is expected to sustain their use. The floodplain and historic oxbow (Horseshoe Lake) is severed by I-5 and the airport runway. The lake level is artificially maintained by the existing pump. The natural sinuosity of the floodplain is constrained to minimize disruption to human habitation resulting in further reductions of fish habitat in the Lewis River.

2.5 Effects of the Action

Effects of the proposed action are expected to occur during construction and later with operation of the pump. Effects from in-water construction are temporary from August 1 to September 15 during one season. The effects include noise in the Lewis River from impact and vibratory pile driving, turbidity during pile driving, riverbed excavation, displaced/destroyed benthic communities, and the removal of riparian vegetation. Effects from operation of the pump are for the lifetime of the pump. The new pump will have an anticipated service life of 20 years and with proper maintenance, FHWA/WSDOT anticipates the pump lasting for 50 years. As such, NMFS determined the proposed action covers a 50-year period.

2.5.1 Critical Habitat Effects

The proposed action will affect designated critical habitat for LCR Chinook salmon, CR chum salmon, LCR coho salmon, LCR steelhead, and eulachon. Given the location of the proposed action and life history expression, all four salmonid species considered in this opinion use the project action area for migration and rearing. Eulachon also use the action area for migration and rearing.

The PBFs for rearing and migration of adult and juvenile salmonids include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. Listed salmonids spawn upstream of the project action area; thus, the spawning habitat PBF is not relevant to this Opinion for supporting this adult life stage.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater; natural cover such as submerged and overhanging wood, aquatic vegetation, large rocks and boulders, side channels, and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. While the action area is within tidal influence, it is assumed that the entire action area is freshwater and other elements of this estuarine PBF are not present in sufficient amounts to qualify as estuarine.

The habitat features common to salmonid rearing and migration habitats are water quality, water quantity, and natural cover. Benthic communities and riparian cover are also common to salmonid rearing and migration areas. Substrate is a feature primarily associated with spawning.

Physical or biological features relevant to eulachon include:

(1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

(2) Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

(3) Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

As with the listed salmonids, eulachon spawn upstream of the project action area. The action area only supports freshwater migration habitat for eulachon.

Riparian areas in the footprint of the new pump structure (approximately 600 square feet) will be permanently cleared while the existing structure will be removed and planted with native vegetation. The proposed action will also alter stream substrate by excavating approximately 60 cubic feet for the intake pit. This pit will be maintained by a backflushing design built into the pump intake. Backflushing will occur at least once per month and is expected to create temporary turbid plumes during each event. We are not able to estimate the extent or duration of the plume but it is expected to operate in this mode only long enough to clear the intake screen from sediments and debris.

The project also will include several beneficial effects. For instance, the applicant proposes to replace the water intake screen that will be sized to reduce or eliminate entrainment of juvenile salmonids and larger fish, and thereby increasing safe passage relative to conditions in the environmental baseline, which will be an immediate effect. WSDOT expects fewer times to lift the pump intake out of the water to clean the screen and therefore less disturbance below the OHWM. Three creosote-treated wood piles will be removed and reduce the substrate footprint by four square feet and eliminate a current source of toxicants from the Lewis River.

Noise and Sound Wave Effects:
Installation of five (two for the ramp and three deflectors) hollow steel piles located below the OHWM will reduce safe passage and rearing habitat during construction due to underwater sound pressure waves created by the use of an impact hammer to proof piles over five days [7]of temporary and episodic pile driving. Fish of any size located within 40 feet of an impact driven

[7] FHWA/WSDOT estimates up to 30 impact strikes per pile. Approximately 3.8 minutes/pile x 5 piles = 19 minutes of total impact strikes.

pile would be injured or killed from peak sound pressures. Cumulative sound exposure levels from continuous multiple pile strikes would injure or kill fish ≥ 2 grams within 200 feet while fish ≤ 2 grams within 360 feet would be injured or killed (FHWG 2008). Any sized fish within 0.5 upstream and 0.6 miles downstream of the pile driving would be disturbed by the noise. It is unlikely that adults of listed species will be present in the action area during in-water construction but juveniles, particularly juvenile steelhead, may be present. Lowering the water depth below three feet within the isolated construction site is expected to reduce the amount of underwater noise transmitted through the substrate and into the river but it is not possible to predict the amount of attenuation. Shallow water depth or using a bubble curtain does little to hamper the unpredictable expression of sound flanking through sediments outside of the isolated area in the channel. However, if a hollow steel pile is near the sheet pile some sound flanking may be hindered by the wall of sheet piles.

Vibratory hammer sheet pile installation and pile driving is anticipated to be between average peak decibels (dB) of 170-174 measured at 10 meters from the source (Caltrans 2015). Thus, the installation of sheet piles to isolate the construction site will produce underwater noise at levels less than 206 dBpeak, the agreed upon level that could cause injury to fish and safe passage is unlikely to be adversely affected (FHWG 2008).

Turbidity:
Sediments will be episodically disturbed during construction and when backflushing the pump screen causing pulses of turbidity up to 300 feet downstream. The direction of the turbid plume will vary depending on the tidal influence. This will temporarily diminish water quality in a portion of the channel. WSDOT estimates the screen will need to be backflushed for 30 minutes one time per month. Every seven to ten years the intake pit will be excavated to reestablish the desired pump depth. Sediment particles suspended from these actions may cause gill abrasion, elevated cortisol levels, and behavior alteration. Predicted responses by all four listed salmonids and eulachon exposed to short periods of moderate levels of turbidity are low and may include avoidance and/or alarm (Newcombe and Jensen 1996; Bisson and Bilby 1982). However, eulachon larvae and eggs are not ambulatory and will not be able to move out of the plume. This could compromise their health and smother them.

Water Quantity:
At a pump rate of 6,000 gpm (13.4 cfs) and a flow volume of 1,000 cfs[8], the pump will divert approximately 1.3 percent of the river flow. At the same maximum pump rate and a flow volume of 4,083 cfs (the lowest average annual flow rate below Merwin Dam during a recent 10-year period [2008-2017]), the pump is anticipated to divert approximately 0.3 percent of the average annual river flow. Overall, this represents a fractional change in water quantity due to the suctioning of Lewis River flow into Horseshoe Lake. Therefore, water quantity is minimally affected.

Toxicants:
Because contractors will use several BMPs when operating heavy machinery on the streambank, the chance of toxic pollutants entering the river is extremely small.

[8] The pump does not operate when flows in the Lewis River are less than 1,000 cfs.

Benthic Prey:
Dewatering the construction site will temporarily reduce the amount of benthic invertebrates. These benthic organisms constitute forage for juvenile salmonids. The reduction in prey base will last for a period of weeks until it is colonized by invertebrates that drift into the area from nearby areas. The affected area is approximately 2,500 square feet extending 50 feet into the 350-foot wide channel, such that the reduction in prey base and alteration to substrate is not anticipated to substantially affect the prey base of juvenile salmonids.

Riparian Vegetation:
Habitat features within the riparian area will initially decline, as riparian vegetation is removed along the stream bank of approximately 600 square feet, but after re-planting an equal sized area, conditions will slowly and consistently improve, insofar as invasive vegetation along the streambank will be removed and replanted with native species. However, it will take years or decades for replanted species to provide adequate shade to affect water temperature or provide natural cover. Once mature, native plant species will improve habitat functionality in comparison to existing invasive species.

Artificial Obstructions:
Three deflector piles and two piles supporting the new rail will occupy 4.45 square feet of river bed. The new screen dimensions are similar in size to the existing screen but the new screen will rest in a 1,000 square foot pit dug into the river bed that currently doesn't exist. Adult and juvenile salmonids and adult eulachon must navigate around these features; though the new screen mesh is sized to avoid impinging juvenile salmonids and larger sized fish. Artificial obstacles in the river may attract piscivorous fish and birds that prey on listed salmonids and eulachon.

Eulachon larvae and eggs are subject to flows conditions and sediment transport and cannot propel themselves away from the pump; thus, will be sucked in and killed. The pit could become a sump where eulachon larvae and eggs become amassed further contributing to being sucked into the pump.

Summary of Salmonid Critical Habitat
For all of the life history values of the designated critical habitat for LCR steelhead, LCR Chinook salmon, LCR coho, and CR chum, the effects of the proposed action includes the temporary reductions of function. Disturbance related to noise has the briefest duration and ceases when work stops, decreased water quality will return to baseline levels within hours of work ceasing, alteration of benthic forage will persist for a period of weeks to months, and loss of riparian vegetation will take several years to re-establish. Reduced safe passage is temporary during work, but overall will improve with the installation of the replacement screens which are designed for less impingement of juvenile fish. Operation of the intake will reduce the amount of water in the river that constitutes between 0.3 to 1.3 percent of the streamflow, which is consistent with the baseline condition at this site.

Summary of Eulachon Critical Habitat
Overall the proposed project will exacerbate the negative effects on eulachon critical habitat for migration in the action area. The increased duration and volume of pumping will further reduce

safe passage compared to existing conditions. Additionally, the intake pit may act as a sump for larvae and eggs to settle out of the water column where they will be subject to the force of the pump flow and ultimately destroyed. Compromised water quality in the form of temporary turbid plumes will result from construction activities, backflushing the screen, and pit depth maintenance. Water quality is expected to return to ambient levels shortly after activities cease.

2.5.2 Effects on the Species

The proposed action will result in disturbing juvenile and adult salmon and steelhead and adult eulachon. It is also likely to kill or injure eulachon eggs and larvae that get sucked up by the pump (entrained or impinged). Eulachon would be killed during the entire outmigration (typically, December to May) at a rate higher than existing pump conditions because the new pump will run at a higher volume and reliably operate 24 hours a day/seven days a week; 365 days a year, and every year the pump is in operation. From March 16 to November 30 the pump will operate up to the maximum rate of 6,000 gpm. From December 1 to March 15 the pump volume will be reduced annually to 4,000 gpm. This may reduce, to some extent, the number of eulachon eggs and larvae that will be killed. NMFS expects the difference between the two rates will be inconsequential and therefore does not serve to minimize or avoid the killing of eulachon eggs and larvae.

The adverse effects to critical habitat, as described above, are likely to be experienced by individual fish of each of the three species of salmon, steelhead, and eulachon. The level of exposure and response to these effects varies based on the different densities and life history stages of the ESA-listed fish that will be present in the action area during the construction window, episodic backflushing the screen, pit re-excavation, during pump operation, and during the period of time when the riparian plantings mature (a period of several years). Due to the proposed in-water construction window from August 1 through September 15, not all species or life stages will be exposed to construction and maintenance of operations effects. We anticipate construction timing will reduce exposure of the species considered in this opinion because, as stated below, some species are present at low densities, if at all. All known spawning of listed species occurs upstream of the project action area.

Chinook salmon, coho salmon, chum salmon, and steelhead

Adult spring Chinook salmon typically return to spawn from March to June with numbers peaking in May. Fall Chinook salmon occur in greater numbers than the spring run and enter the Lewis River in September and usually finish by the end of October. Chinook salmon emerge in early spring and migrate to the lower Columbia River by May before in-water work begins. Thus, some late outmigrating Chinook salmon will be exposed to the effects of construction. Adults and juveniles will be exposed to year round pumping, monthly back flushing, intake pit maintenance, and riparian effects.

Adult coho salmon typically return to the Lewis River from September, October, and into November. After hatching, juvenile coho salmon rear for a year in the Lewis River and outmigrate by June. Few juvenile coho salmon are expected to be present during in-water construction due to the lack of quality habitat in the action area.

Adult chum salmon occur in the Lewis River during mid-October through December, with peak spawning occurring in late November (LCFRB 2010). The LCR chum salmon population is very low, likely less than 100 individuals (Hillson 2018). Juvenile chum salmon have a brief presence in the River after emerging in the spring and will likely have moved downstream of the project action area before the work begins on August 1. The construction work will be completed before adults return.

The Lewis River supports summer and fall run steelhead. Adults and juveniles of both runs may occur in the action area as they pass through from upstream spawning habitats. Adult summer run steelhead are in the Lewis River March to October with the peak in July just before in-water work begins on August 1st. Adult fall run steelhead return November to April and are expected to be upstream of the project before in-water work begins. Juvenile steelhead may spend multiple years rearing in the river thus some portion of them could occur in the action area during construction but the lack of quality habitat diminishes the risk of exposure.

We anticipate that late outmigrating juvenile Chinook salmon, juvenile coho salmon, and adult and juvenile steelhead will be present in the action area during the late summer and early fall and will be exposed to effects of the proposed construction. Based on their distribution in the Lewis River watershed all four salmonid species will be exposed to the permanent and temporary habitat effects and episodic turbidity resulting from the proposed action. Eulachon eggs and larvae will experience the greatest risk for injury or death when they get are sucked up by the pump because of the rate and duration of pumping. Eulachon eggs or larvae that end up in the excavation pit are not expected to survive the pump or entrainment into Horseshoe Lake.

Stream isolation-exposure and response

Temporarily isolating 2,500 square feet of the river may trap juvenile Chinook salmon, juvenile coho salmon, and adult and juvenile steelhead within the cofferdam. The containment area will be pumped, with appropriate fish screening, down and the area cleared of fish using current fish exclusion protocols (WSDOT 2016). Fish removal protocol requires experienced personnel following step-wise techniques to avoid and minimize handling fish. Only after low invasive herding and baited trapping options have been used will fish be netted and seined. Captured fish will be released immediately outside of the exclusion area. Electroshocking, if necessary, will be used as a last resort. Fish handling and electroshocking have inherent risks to stressing and injuring fish but experienced staff are expected to minimize exposure.

Underwater sound-exposure and response

As noted above, the contractor will isolate 2,500 square feet of the river channel. The material used to create the isolation barrier is unknown at this time but may include the worst-case scenario of pile driving a ring of sheet piles. Driving sheet piles is expected to be significantly louder than setting super sacs or similar structural material onto the streambed.

Results described in the Caltrans (2015) from vibratory hammer sheet pile installation in similar dewatered construction areas yielded between average peak decibels (dB) of 140-156 measured at 10 meters from the source. Thus, the installation of sheet piles will produce underwater noise at levels less than 183 dB, the threshold level at which fish are known to experience injury (Caltrans 2015; Popper et al. 2014). Fish may respond to increased levels of noise consistent with behavioral effects characterized by increased heart rate, blood cortisol levels, and startle response (Caltrans 2015). Yet, due to these relatively low intensity effects there are currently no established injury criteria for vibratory pile driving and contractors are instructed to use vibratory hammers to minimize sound production (Caltrans 2015).

The majority of underwater sound will occur as the contractor vibrates and impact proofs five hollow steel piles within the water column although some noise will also be created during demolition of the existing water intake structure. Safe passage for all fish within 0.5 miles upstream and 0.6 miles downstream in the action area will be disturbed during pile driving. Cumulative sound exposure levels from continuous multiple pile strikes would injure or kill fish >/= 2 grams within 200 feet while fish </= 2 grams within 360 feet would be injured or killed from barotrauma. Peak sound pressure during impact strikes are expected to injury or kill any size fish up to 40 feet from the source. Barotrauma may include immediate or delayed death to fish. It is unlikely adult Chinook salmon, coho salmon, and adult and juvenile chum salmon will be present in the action area during pile driving; however, juvenile Chinook salmon, coho salmon, and adult and juvenile steelhead may be affected by elevated sound pressure.

Due to the nature of the deconstruction and pile installation, construction noise will occur sporadically for several hours over the course of five non-consecutive days from August 1 to September 15. There will be a minimum of 12 hours break between daily pile driving to allow fish an opportunity to recover and/or move out of the area of effect.

Turbidity-exposure and response

The proposed action will result in increased turbidity and suspended sediment during construction from sheet pile placement, excavation of stream substrate, and riparian vegetation clearing. However, the intensity and duration of the turbidity plume created by in-water construction will be greatly reduced by cofferdam installation and lowering the isolated water depth, and use of sediment management BMPs. The majority of sediment will be transported downstream during installation/removal of hollow steel and sheetpile cofferdam. Turbidity from construction will not exceed five NTUs above background beyond 300 feet from the source.

Ongoing effects due to operation of the pump include monthly backflushing the intake screen which is expected to create turbid plumes. This design is new to this site and FHWA is unsure how far downstream turbid plumes will be detected. When these plumes occur, juvenile and adult salmonids will briefly encounter elevated levels of suspended sediment during construction. Over the longer time frame, salmonids will annually encounter plumes resulting from intermittent operations and may experience gill abrasion, elevated cortisol levels, and behavior alteration. Plumes at a density that can harm salmonids may extend as far as 300 feet, though likely less in most cases. Predicted responses by listed salmonids exposed to short periods of moderate levels of turbidity are low and may include avoidance and/or alarm (Newcombe and Jensen 1996; Bisson and Bilby 1982). Avoidance and alarm cause displacement of salmonids of all life stages which may result in salmonids moving into less desirable (e.g. shallow or deep water, swift currents, open canopy, expose to predation) habitats in the channel. These effects may reduce an individual’s fitness due to increased predation and less abundant prey for juveniles, and increased stress to adults.

Benthic forage reduction-exposure and response.
Isolating the streambed and instream construction will temporarily reduce the benthic prey productivity within the action area. Based on the small size of the construction area (2,500 square feet), the decrease in benthic prey will have a negligible effect on salmonids as prey items outside the dewatered area will remain plentiful where available habitat and forage is typically present (ODFW 2013). Furthermore, juvenile salmonids feed on prey from upstream sources that drift through the water column. As benthic prey from upstream sources are otherwise unaffected by the proposed action, it is extremely unlikely that juvenile salmonids will experience any change in the availability of forage. The temporary alteration of benthic prey within the action area will return to baseline levels within weeks to months (Williams and Hynes 1976). We do not anticipate a biologically meaningful reduction in benthic prey items available to juvenile salmonids as a result of the proposed action because aquatic insects will re-colonize this action area. Adult steelhead that may occur in the action area during construction are not expected to be foraging as they migrate to upstream spawning habitats.

Riparian habitat-exposure and response.
The removal of riparian vegetation within the action area will temporarily reduce the amount of shading and overhead cover at the project site. The size of the replanted area (approximately 600 square feet) will be too small to create any meaningful improvement of water quality parameters relative to the watershed. These water quality conditions will improve as native vegetation replanting will increase leaf litter input and shading and reduce erosion as riparian plantings mature. The size and magnitude of the both the negative and positive effects of vegetation removal and replanting on the Lewis River is small, and likely indistinguishable from the background effects on water quality occurring upstream.

Entrainment-exposure and response.
Incidental injury and death of juvenile fish at water diversion intakes have long been identified as a major source of overall fish mortality (Spencer1928; Hatton 1939; Hallock and Van Woert 1959; Hallock 1977). Fish diverted into power turbines incur up to 40% or more immediate mortality, while also experiencing injury, disorientation, and delay of migration that may increase predation related losses (Bell 1991). Fish entrained into agricultural and municipal water diversions may experience 100% mortality, particularly if no egress route back to the river is provided. The proposed reconstruction of the water intake includes installation of a new screen and a back flushing cleaning mechanism. The new screen will substantially reduce, if not avoid entrainment of juvenile salmonids when fry-migrating salmonids are present (NMFS 2011a). Therefore, the long-term operation of the new intake screen will substantially reduce or eliminate mortality of juvenile salmonids from entrainment in the water intake structure and eliminate the number of juveniles injured or killed due to incidental contact with the structure. This will improve survival for all species of salmonids.

Eulachon

Adult eulachon return to the Lewis River as early as December while late eggs and larvae will outmigrate by May. The in-water construction window is scheduled from August 1 to September 15, thus we anticipate that all life stages of eulachon will not co-occur with construction related activities unless eulachon shift their run timing. Therefore, all of the effects of the action are associated with ongoing pump operations, as the 20-50 year action will continuously affect eulachon eggs and juveniles in the Lewis River.

We estimated the amount of egg/larval eulachon entrainment/impingement from pump operations. The estimated egg and larval density was multiplied by the maximum pump intake volume running 24 hours a day for the time period analyzed (D/m^3 x flow rate). Eulachon outflow timing is dependent on timing of spawning and incubation, which vary with temperature, other environmental variables, and flow rate for passive movement downstream (JCRMS 2019). We relied on a variety of data to determine density and found that data for adult presence and egg and larval outflow in the Lewis River are limited.

The WDFW sampled eulachon plankton in the Lewis River in 2011 at four sites (RM 0.6, 1.9, 2.5, and 5.6) on four days (Storch et al. 2014). They identified eggs and larvae at all sites on all sample days, from January 18, when their first sample was taken, through March 31, when their last sample was taken (Storch et al. 2014). Surveys of eulachon in the Cowlitz River (a tributary to the Columbia River) indicate adults enter the river from December to February with inter-annual variability in the timing of returns (Reynolds, pers comm 2019a). Because larvae would be expected approximately 30 to 40 days after spawning (JCRMS 2019), egg and larvae outflow in the Cowlitz River could be present anytime between December and mid-April. In recent years, Reynolds (pers comm 2019a) reported shorter spawning run durations of approximately 7 to 14 days. Because of the limited data available for eulachon outflow timing and duration, we also looked at other available information to approximate egg and larvae timing. Anecdotal information on adult run timing, based on observations and reports from people fishing the Lewis River, indicate they were present at certain fishing sites from January through March or April for approximately three weeks to a month (Reynolds and Romano 2013). From the WDFW study, data from the Cowlitz Tribe, and information from Reynolds and Romano (2013), eulachon outflow in the Lewis River would be expected any time between December and the end of May for a period of approximately 28 days (Reynolds, pers comm 2019b) to more than 73 days (Storch et al. 2014). In comparison, egg and larvae timing in the Columbia River and Grays River (a tributary of the Columbia River) were documented from December into May with peak egg and larvae abundance from February to early April depending on the year and location (Lloyd and Langness 2018). The Columbia River had egg and larval outflow periods with durations of 14 to 20 plus weeks (based on 5-years of data) and the Grays River had outflow periods with durations of 15 or more weeks (based on two years of data). In summary, based on the limited information available, and because of the variability in inter-annual eulachon spawning, we assumed eulachon eggs and larvae could be present in the action area for 28 to 120 days from December to May.

We reviewed density estimates of eulachon eggs/larvae from the Lewis River. Published egg/larvae density estimates were available from WDFW for 1999 to 2003 and 2007 to 2011, and from the Cowlitz Tribe for 2011 (JCRMS 2019). Larval densities in these samples ranged from 0.0 to 36.2 larvae per cubic meter (m^3) of water (JCRMS 2019). Sampling was not systematic from year to year, which results in the inability to confidently make comparisons on inter-annual abundance. Instead of using a measure of central tendency from these variable data, we used the geometric mean from four years of more recent data from the Cowlitz Tribe, which found 10.0954 (rounded to 10.1) eggs and larvae per m^3 water (Reynolds, pers comm 2019b).

We estimated the entrainment and impingement rates for proposed pumping volumes at 4,000 gpm and 6,000 gpm. Using the estimated larval density, 10.1 eggs and larvae per m3, and maximum pump intake volume from December 1 through March 15, 4,000 gpm, we estimated an entrainment rate of 220,070 eggs and larvae per day. Using the same estimate of egg and larvae density and maximum pump intake volume after March 16, 6,000 gpm, the estimated entrainment rate is approximately 330,969 eggs and larvae per day until the end of the egg and larval outflow period, (April 30). These rates of egg and larvae loss do not take into consideration reduced pump operation during high flows or maintenance, which would reduce entrainment rates.

Using the maximum estimated days of plankton eulachon presence from the analysis above, we expect the duration of eulachon outflow to be a maximum of 120 days in the Lewis River. Because the pump can reach maximum pumping capacity after mid-March, we calculated the loss of productivity using, the worst case number of days at the maximum pump rate (6,000 gpm), 46 days from March 16 to April 30. The remaining 74 days of outflow were calculated at a pump rate of 4,000 gpm. Based on these pump rates, approximately 31,509,703 individual eggs and larvae would be lost annually. The annual loss of reproduction potential was calculated by dividing the average eulachon fecundity by the estimated number of eggs and larvae lost. Average fecundity of eulachon in the Columbia River and Cowlitz River was estimated to be 33,594 eggs per female (Lloyd and Langness 2018), resulting in a potential reproductive loss equivalent to 938 eulachon females each year during pump operation. This estimate could either be an overestimate or underestimate because of limited data of eulachon in the Lewis River and assumes egg and larvae survival is 100 percent with no natural mortality (Lloyd and Langness 2018).

There is considerable uncertainty on the effect of the water withdrawal on the eulachon because adult abundance is on a declining trend with eulachon returning in severely reduced numbers (Reynolds, pers comm 2019a). Operations of the pump will impinge and kill eulachon eggs and larvae for the life span of the pump. It is difficult to determine how the annual loss of 938 females effects eulachon recovery but their loss further contributes to the downward trend of the Lewis River population. However, no reliable fishery-independent, historical abundance estimates exist for eulachon. Spawning stock biomass estimates of eulachon in the Columbia River for the years 2000 through 2017 have ranged from a low of 783,400 adult fish in 2005 to a high of 185,965,200 adults in 2013, with an estimated 18,307,100 fish in 2017 (NMFS 2017). Therefore, the loss of approximately 938 fish from the Lewis River population is a very small impact when viewed in light of the size of the Columbia River population. Even to the extent that modeled estimate of 938 adults lost is subject to uncertainty and variation, the relative size of the Columbia River population as a whole assures that the impacts of the proposed action are minor. Currently, assuming a 50-year life span of the pump, approximately 1,575,485,150 eulachon eggs and larvae will be injured or killed. We do not know the quantities of eulachon eggs and larvae lost with the existing pump. However, with the new pump the quantity is expected to increase from current conditions because the existing system operates at an inconsistent and lower rate.

In summary, permanent effects from operation of the pump will result in measurable long-term adverse effects to migration habitat by screen entrainment and impingement, degrading 1,000 square feet of substrate where the pit will be located and impacts to water quality and habitat downstream of the pump facility. The long-term effects of degraded instream habitat and turbidity, will diminish habitat suitability for recovering eulachon and listed salmonid species. Overall, habitat effects will be small in scale relative to the amount of habitat in the action area and the lower Lewis River in general. The installation of updated fish screens will benefit juvenile salmonids but will directly compromise the recovery of eulachon populations through increased egg and larval entrainment and impingement for the estimated 50-year life span of the pump.

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). 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.

Such actions may include, but are not limited to additional road, residential and commercial development, maintenance and upgrading of existing infrastructure, and watershed enhancement.

Non-Federal actions that yield cumulative effects to eulachon and salmon critical habitats are likely to be related to human population growth and land use practices. In the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, shoreline growth management and resource permitting.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult to distinguish between the action area's future environmental conditions caused by global climate change that are part of the environmental baseline versus cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4). Regardless, listed salmonids and eulachon are expected to be adversely affected by changes in stream flows, water quantity, elevated temperatures, frequency of storms, and severity of storms. Climate change is also expected to alter ocean conditions including reducing prey abundance, increasing water temperature, and increasing habitat for predators on salmonids and eulachon.

Human population density in the city of Woodland and surrounding areas within the Lewis River watershed is reasonably certain to increase in future years and contribute to cumulative effects. This anticipated growth will increase contaminant loading from wastewater treatment plants, traffic, stormwater runoff, and sediments that recruit into the action area's waters from agricultural and non-point sources. Impacts from population growth in the watershed are reasonably likely to have cumulative adverse effects on eulachon and salmon critical habitats through two primary mechanisms: Firstly, we anticipate increased residential and commercial development and associated road construction in the foreseeable future for this watershed. This growth-induced development is anticipated to increase the use and application of pesticides, fertilizers, and herbicides, which will increase the delivery of contaminants into the waters of the action area. Secondly, increased demand on water resources from the basin from growth (e.g. for agriculture, residential and/or municipal use) will further limit the use of those water resources to support eulachon and salmon critical habitats. Non-federally permitted water diversions alter habitat in freshwater systems by affecting stream flows, and potentially causing entrainment—an effect particularly hard to avoid for eulachon larvae and eggs for which no screening guidelines have been developed. As stream flows are reduced from diversion, contaminants can also become more concentrated in these systems, exacerbating contamination issues.

Although these factors are ongoing to some extent and likely to continue, the future level of activity will depend on whether there are economic, administrative, and legal impediments or safeguards in place. Therefore, NMFS finds it likely that the cumulative effects of these activities will have adverse effects on eulachon population abundance and productivity, eulachon critical habitat, and similarly on Chinook salmon, coho salmon, chum salmon, and steelhead and critical habitats for these salmonid species.

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.

Considering the status of the ESA-listed species, all four salmonid species and eulachon considered in this opinion are threatened with extinction. Three of these species, adult and juvenile LCR steelhead, juvenile LCR Chinook salmon and juvenile LCR coho salmon, are likely to be exposed to construction temporary effects including the adverse effects of turbidity, fish exclusion during work area isolation, and sound pressure waves from impact pile driving that reduce exposed individual's fitness. All life histories of the four salmonid species and eulachon will be exposed to the ongoing effect resulting from the operation and maintenance of the water intake structure (water pump).

The project site provides migration and rearing habitat for listed salmonid species. In-water construction of August 1 to September 15 is scheduled to avoid the peak juvenile salmonid outmigrations and returning adults. Effects from construction will affect approximately1.1 miles of Lewis River habitat. Working during the proposed window minimizes the number of individuals exposed to turbidity and elevated underwater sound waves. The vast majority of each Lewis River salmonid population will pass through the action area without experiencing the effects of construction-related stressors. Overall, we anticipate the few individuals that would be exposed represent a small portion of each salmon ESU and steelhead DPS.

Operation of the pump will occur continuously year-round overlapping with the presence of listed species in the Lewis River. Most notably, the migration of eulachon eggs and larvae will be impinged on or entrained by the water pump's action of sucking Lewis River water and discharging it into Horseshoe Lake. We estimated above, 31,509,700 eggs and larvae may be killed yearly by the pump's action when eulachon are present. It is difficult to provide adequate context to what this means to the overall eulachon DPS due in part to inconsistent home river fidelity and straying, run timing, and insufficient baseline population knowledge. NMFS expects the Lewis River population will be detrimentally affected by this loss each year and that some years this will have a greater impact (lower adult returns) than other years (high adult returns). As noted above, the Lewis River population's contribution to the entire DPS has historically been a tiny fraction of the Cowlitz River and the mainstem Columbia River run.

The effects on listed salmonids of annual operations will be limited to inconsistent and short term turbidity plumes during backflushing the screen and intake pit maintenance. The new screen is designed to avoid impinging and entraining juvenile salmon and adults can simply avoid the site. Some individuals may experience compromised health from suspended sediments but the vast majority will pass through without exposure. Thus, those affected individuals represent a small fraction of their populations. As such, no substantial reduction in any of the VSP parameters is anticipated. Therefore, their respective ESUs and DPS' will not appreciably diminish their populations.

Construction will temporarily isolate a small area of aquatic habitat compared to the available designated critical habitat in the action area. The effects from construction-related activities will reduce fitness of the few exposed individuals, however the effects do not rise to the level of reducing any of the VSP parameters for their populations and therefore no meaningful reduction is anticipated for any of the ESUs and DPSs.

Impact pile driving will exceed ambient levels in 1.1 miles of the river. Any sized fish within 40 feet of the impact pile may be exposed to injury or death from barotrauma, while fish further out to 1.1 miles will experience minor disturbance. Impact pile driving will only be used to proof the piles to the desired depth. These actions are of short duration and affect and represent a 1.1-mile section of the sixty miles available to anadromous access and a fraction of the critical habitats for listed salmonid ESUs and DPS'.

The building with pump controls occupies 600 square feet of riparian habitat; however, an equivalent area will be restored in the footprint of the existing pump structure and will eventually provide improved riparian habitat compared to existing conditions.

We do not anticipate the eulachon DPS being significantly impacted by the proposed project because affected individuals are a tiny fraction of the overall population in the Columbia River. Recovery actions in the Lewis and Columbia rivers are unlikely to be impeded by the proposed action because they are widely spread throughout the Columbia River Basin; therefore, we do not anticipate the recovery trajectory of the entire DPS being affected. Recovery information will be gained by monitoring run timing in the Lewis River which adds to our limited knowledge of this species. Replacing invasive vegetation with native species in the riparian area will also further assist recommended recovery actions (NMFS 2017).

Persistent effects of operating the three hydropower facilities, historical shoreline alteration, transportation development, and water management practices are the primary factors contributing to degraded habitat conditions and PBFs in the action area. The effects of the action exacerbate these, but represent only incremental declines at small spatial scales, and do not preclude salmon and eulachon from using the action area currently or in the future. The expected effects of the action and the cumulative effects associated with future state, tribal, local, and private actions will not appreciably change the overall condition of critical habitat available in the Lewis River. Although the proposed action will maintain and exacerbate the current condition of the baseline, it is not expected to adversely affect designated critical habitat to such an extent that the PBFs would no longer function as intended due to the project timing and short term pulses of effects. Designated critical habitat within the action area will not be prevented from providing the intended conservation role for the species at the watershed scale.

Riverine systems are likely to have a range of changes associated with increasing variability of climate, including more intense episodes of flooding, more frequent and more extended periods of low flow, and chronically warmer water temperatures. In systems that have modified flow regimes due to impoundments for flood control, hydropower, or irrigation, climate change may compound habitat impairments caused by upstream dams. Such is the likelihood for the proposed project action area and the listed species and critical habitats in the Lewis River.

For the reasons described in the preceding paragraphs of this section, we anticipate the proposed action will not appreciably reduce the likelihood of both survival and recovery of the ESA-listed species covered in this opinion in the wild by reducing their numbers, reproduction or distribution nor will the proposed action appreciably diminish the value of their designated critical habitats.

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 LCR Chinook salmon, LCR steelhead, LCR coho salmon, CR chum salmon, and the southern DPS of Pacific eulachon, and or destroy or adversely modify their designated critical habitats.

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.

NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. Therefore to the extent this ITS contains RPMs and terms and conditions that address requirements other than monitoring, those are not mandatory until any future 4(d) rule goes into effect and should be treated as conservation recommendations. However, our jeopardy analysis is based on anticipated levels of eulachon incidental take and so we have included a take indicator for eulachon that will function as a reinitiation check on that no jeopardy conclusion. Monitoring requirements contained in the RPMs and terms and conditions go into effect immediately so that there is a way to know if the reinitiation trigger has been exceeded (50 CFR 402.14(i)(3)).

2.9.1 Amount or Extent of Take

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

All of the species of ESA-listed salmon, steelhead, and eulachon analyzed in this opinion will be temporarily exposed to sediment plumes during operation of the pump structure. Sporadic turbid plumes are expected during operation of the intake pump when it is back flushed to clear debris from the screen. This will likely occur once a month for the life of the pump. Adult and juvenile LCR steelhead, juvenile LCR Chinook salmon and juvenile LCR coho salmon, will be exposed to sediment plumes, fish exclusion, and vibratory and impact pile driving during construction. The in-water work is scheduled to minimize exposure to adults of all listed species but some salmonids may be in the action area and disturbed or injured by the stressors described. However, fish will be temporarily excluded from 2,500 square feet of the enclosed in-water work zone. FHWA will ensure biologists follow current WSDOT fish exclusion protocols. Following standard protocols is expected to greatly reduce touching fish but final sweeps may be needed to handle the last few remaining fish. Any fish handling and particularly electroshocking have inherent risks to stressing and occasionally killing fish. Eulachon eggs and larvae are expected to have already drifted downstream out of the action area during in-water work.

Take caused by habitat-related effects cannot be accurately quantified as a number of fish because the relationship between habitat conditions and the distribution and abundance of those individuals in the action area is highly variable. In cases such as this, where quantifying a number of fish is not possible, we use take surrogates or take indicators that rationally reflect the incidental take caused by the proposed action. See the specific take pathways below.

Extent of Take of Eulachon from Pump Operations
Incidental take in the form of harm is expected to occur because operations of the pump will impinge and kill eulachon eggs and larvae for the life span of the pump (20-50 years). In the biological opinion, NMFS determined that incidental take of roughly 31,509,700 individual eggs and larvae will occur annually or, assuming a 50-year life span of the pump, up to 1,575,485,150 eggs and larvae. However, this take cannot be meaningfully monitored and NMFS will instead rely on a surrogate take indicator, specifically, the number of days the pump is on during the presence of eulachon eggs and larvae. The duration of eulachon egg/larvae presence is difficult to estimate because this is expected to vary every season; however, eulachon eggs/larvae

presence have ranged from January 1 to June 15 (166 days). On average, they are present for approximately six weeks (42 days) during that range during which the pump will be operating every day. The number of operating days is rationally connected to the take pathway, since the extent of take is a direct consequence of how frequently the pump is operated while eulachon are present. Moreover, the number of days can be meaningfully monitored as part of the project's reporting requirements.

Extent of Take of Salmonids from Construction

Turbid plumes are expected during streambed excavation and pile installation/removal. We anticipate low numbers of juvenile salmonids could be present during this in-water work but density information is not available and therefore it is not possible to enumerate or monitor the take from this pathway. as such, we will rely on the extent of disturbed habitat as a surrogate to measure take. The specific surrogate is the area in which the plume will occur at a level that has the potential to harm salmonids by gill abrasion, elevated cortisol levels, and behavior alteration. We estimate intermittent turbid plumes from construction could adversely affect listed salmonids. Therefore, as a surrogate we will use a turbidity plume of 300 feet and not to exceed 5 NTUs above background at that distance.

This surrogate is rationally connected to the anticipated extent of take because take will expand or diminish with both the size and intensity of the plume. . Turbidity monitoring will be performed by FHWA/WSDOT to document that take from turbid plumes does not exceed 300 feet from the source.

Juvenile Chinook salmon, juvenile coho salmon, and steelhead present during construction will be disturbed by pile installation/removal. This may detour them entering the zone esonified by underwater sound, constituting take in the form of harassment. The extent of this take cannot be meaningfully monitored or measured, so we will rely on a take surrogate consisting of the area involved and the maximum volume levels. Specifically, underwater sound from pile driving exceeding background levels is not expected to extend beyond bends in the river at 0.5 miles upstream and 0.6 miles downstream of the site, and vibratory noise is not expected to exceed the level of disturbance identified as 150 dB (FHWG 2008).

A further form of take from construction is cumulative sound exposure. Similarly, NMFS cannot meaningfully measure the extent of the take and will rely on a separate surrogate, specifically the extent of the area, the zone of injury or death and the number of strikes per pile. The zone of injury or death is not expected to exceed 40 feet from the pile and the area of disturbance up to 0.5 miles and 0.6 miles upstream and downstream. Impact strike count is not expected to exceed 30 strikes per pile. Documenting the strike count (not exceeding 30 strikes) will verify the extent of elevated underwater sound.

Each of these surrogates – maximum volume levels, number of pile strikes, and areas of death, injury or effect – can be reliably monitored and are familiar to the applicant.

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).

1. Minimize incidental take of listed species from exposure to hydroacoustic effects associated with impact pile driving and from elevated turbidity.
2. Minimize and avoid entrainment of eulachon eggs and larvae when present in the action area[9]
3. Monitor and report pump operations annually to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in this ITS are effective in minimizing incidental take.
4. Monitor and report turbidity during construction and operations.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary unless noted, and the FHWA or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The FHWA 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:

    a. FHWA/WSDOT will isolate the smallest possible in-water area during construction and maintain depths of three feet or less during pile driving.

    b. FHWA/WSDOT will drive piles with a vibratory hammer to resistance and only utilize an impact hammer to proof piles to final depth if necessary.

    c. FHWA/WSDOT will minimize the maintenance of sump pit depth number to at least seven year intervals.

[9] NMFS expects to complete a 4(d) rule for eulachon at some future point, at which point the take of eulachon will be prohibited and a reasonable and prudent measure and additional terms and conditions may be necessary. Specifically, NMFS envisions a need to require the operator to minimize incidental take of eulachon by turning off pumps during egg and juvenile migration periods. If and when the 4(d) rule is promulgated, NMFS will confer with the operator and the action agency to explore how best to implement this or any other appropriate measures.

i. Unexpected emergency maintenance to preserve the sump pit function will not count toward the minimum seven-year intervals.
ii. FHWA/WSDOT shall notify NMFS within 48 hours if an emergency action is needed at this site. The notification will include a verbal or written description of what unexpected event happened, actions taken to stabilize the site, and which fish might be present during the event.
iii. Three emergency events in 10 years for this purpose will be considered a chronic environmental deficiency and FHWA/WSDOT will discuss with NMFS alternative measures to address the problem.

2. The following terms and conditions implement reasonable and prudent measure 2:

a. FHWA/WSDOT will monitor for the presence of eulachon eggs and larvae in the action area for five seasons.

b. FHWA/WSDOT will provide the monitoring method for approval by NMFS 60 days in advance of implementation.

c. FHWA/WSDOT will share with NMFS the monitoring results within 60 days after the seasonal outmigration is complete.

d. FHWA/WSDOT will meet with NMFS annually for five years to discuss all monitoring results.

3. The following terms and conditions implement reasonable and prudent measure 3:

a. FHWA/WSDOT will document pumping volumes throughout the year for five years and provide the annual monitoring information to NMFS[10] by 1 October.

b. FHWA/WSDOT will conduct annual protocol eulachon monitoring for five years to identify the beginning and end of eulachon migration and relative abundance. This information will be used to document take and guide discussions with NMFS about future operations.

c. FHWA/WSDOT will meet annually for five years with NMFS by 1 November to review operations and the most recent knowledge of eulachon presence in the project action area.

4. The following terms and conditions implement reasonable and prudent measure 4:

a. FHWA/WSDOT will monitor turbidity during construction and provide the results within 60 days after in-water is complete.

[10] Address to: National Marine Fisheries Service, Lower Columbia Branch Chief, 510 Desmond Drive SE, Suite 103, Lacey, WA, 98503

i. Turbidity during construction will not exceed five Nephelometric Turbidity Units above background levels beyond 300 feet down current of the source.

b. FHWA/WSDOT will monitor turbidity at locations150 feet and 300 feet down-current when the pump is backflushing. Monitoring shall occur during one cycle per month for one year after the new pump is operational and the results provided to NMFS within 60 days after the completion of that period. FHWA/WSDOT will discuss these results with NMFS and agree to adjustments in operations that may be necessary to meet the defined turbidity mixing zones.

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).

1. NMFS recommends the FHWA/WSDOT increase instream habitat function by including large woody material in the Lewis River to improve juvenile rearing habitat

2. NMFS recommends that FHWA/WSDOT identify other methods than pumping water from the Lewis River into Horseshoe Lake to address stagnation of Horseshoe Lake.

3. NMFS recommends FHWA/WSDOT will turn the pump off during egg and juvenile eulachon migration, which will be identified through monitoring.

4. NMFS recommends FHWA/WSDOT review obligations to maintain water quality in Horseshoe Lake that are reasonable and achievable and negotiate an end date to WSDOT's obligation to indefinitely maintain water quality in Horseshoe Lake.

5. NMFS recommends FHWA/WSDOT install piscivorous bird exclusion devices on the piles to prevent perching which reduces fish predation.

Please notify us if FHWA/WSDOT carries out any of these recommendations so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Interstate 5 Horseshoe Lake Pump Station Project.

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.

2.12 "Not Likely to Adversely Affect" Determinations

Southern Resident Killer Whales.

The Southern Resident killer whale (SRKW) Distinct Population Segment (DPS), composed of J, K and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). A 5-year status review under the ESA completed in 2016 concluded that SRKW should remain listed as endangered and includes recent information on the population, threats, and new research results and publications (NMFS 2016).

The limiting factors described in the final recovery plan included reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008). This section summarizes the status of SRKW throughout their range. This section summarizes information taken largely from the recovery plan (NMFS 2008), recent 5-year review (NMFS 2016), as well as new data that became available more recently.

The SRKW spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and then move south into Puget Sound in early autumn. While these are seasonal patterns, SRKW have the potential to occur throughout their range (from central California north to the Queen Charlotte Islands) at any time during the year.

Critical habitat for the SRKW includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet deep relative to extreme high water. The three specific areas designated as critical habitat are (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca.

SRKWs and SRKW critical habitats do not occur in the proposed project action area. The proposed project action area is not within SRKW critical habitat and SRKWs will not be present in the action area. However, Lewis River salmon, particularly Chinook salmon, serve as primary prey for SRKWs. The proposed project construction and long-term operation and maintenance of the pump are expected to adversely affect four listed species of salmonids: Chinook salmon, coho salmon, chum salmon, and steelhead. Though deleterious effects to these species is anticipated to be low, some individuals of each species may experience a risk of exposure and thus diminish available prey for SRKW recovery. And, as stated above in Section 2.5, the total number of individuals, particularly Chinook salmon, affected by this project are expected to be inconsequential to supporting sufficient prey abundance to measurably affect SRKWs. Therefore, prey quantity as a habitat feature is only insignificantly affected. Based on this analysis, the proposed action is not likely to adversely affect SRKW, or their designated critical habitat.

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 the FHWA/WSDOT 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. The EFH definition of a 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).

3.1 Essential Fish Habitat Affected by the Project

- Habitat Areas of Particular Concern (HAPC) for salmon are: complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation. No HAPCs occur in the project action area.

3.2 Adverse Effects on Essential Fish Habitat

Adverse effects to EFH for Pacific salmon (Chinook salmon and coho salmon) mirror those effects on critical habitats previously described in section 2.5.1 above. The proposed project construction will have epizootic and temporary adverse effects on water quality and will isolate and drive piles in a portion of EFH in the Lewis River. Long-term adverse effects result from piles and infrastructure permanently occupying a portion of the Lewis River and operations and maintenance of the water pump.

3.3 Essential Fish Habitat Conservation Recommendations

1. NMFS recommends the applicant increase instream habitat function by placing large woody material to compensate for juvenile rearing habitat limited capacity of critical habitat PBFs caused by placement of the bank hardening, pump structure, and protection piles.

2. NMFS recommends reviewing obligations to maintain water quality in Horseshoe Lake are reasonable and achievable and negotiate an end date to WSDOT's obligation to indefinitely maintain water quality in Horseshoe Lake.
3. Ensure that riparian vegetation planted in the disturbed area has an 85% survival rate after three years.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 0.5 acres of designated EFH for Pacific Coast salmon.

3.4 Statutory Response Requirement

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

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are FHWA and the U.S. Army Corps of Engineers. Other interested users could include WSDOT, Tribes, citizens of affected areas, and others interested in the conservation of the affected ESUs/DPS. Individual copies of this opinion were provided to the FHWA and US Army Corps of Engineers. 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.

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6. APPENDICES

Appendix A: Questions and Responses to initial review of the BA

Horseshoe Lake Pump Station Project
Response to NMFS Comments dated July 3, 2018
Prepared by Washington State Department of Transportation-Southwest Region on behalf of Federal Highway Administration

Please see questions and answers below.

Questions for I-5 Woodland Horseshoe Lake water pump

1. *Excavating 1,000 square feet of streambed:*
    a. *Quantify the cubic yards of excavated material.*

    Response. Cubic yards of excavated material is included in Table 3 of the BA, on page 16. Table is provided below. These amounts have not changed, but the excavation type ("net excavation") was changed to clarify that there will be net fill above OWHM and net excavation below OHWM.

    Table 3: Estimated Project Cut and Fill Quantities (cubic yards)

Type	Above OHWM	Below OHWM
Excavation	22	60
Fill	31	16
Net Excavation	-9	44

    b. *What will prevent the excavated screen pit from filling up with sediment? It is difficult to picture how the flushing fish screen box would be capable of maintaining this large open area. It seems likely that future dredging would be needed. Describe contingency plans.*

    Response. The screen cleaning system described in Section 2.2.2 of the BA (rotating drum combined with the brush) and sediment control jet system are designed to maintain active flow across the screen face, not keep the pit excavated. If sufficient debris, trash, etc. settle in the pit over time such that it impinges the screen box and prevents drum rotation, WSDOT will remove it. The frequency of these maintenance actions is currently unknown. WSDOT maintenance forces would perform any required work after all appropriate permits/approvals are obtained.

According to the design team, water jets are the standard technology for preventing sediment buildup under cleaners for flat screens. For example, there is one on a 2000 cfs fish screen used by Puget Sound Energy on the canal feeding Lake Tapps near Buckley. They are also used on the San Joaquin River and on the Sacramento River in California to maintain a sediment free area under the cleaner. They were also installed on an intake pump by Tacoma Utilities in the Green River to re-suspend sediment in the fish screen so it could be passed back out to the river and not impact the screen cleaner. If the system is used frequently it is expected to be self-maintaining. If a high sediment load event buries the intake, WSDOT maintenance will restore the intake to pre-event conditions, applying appropriate BMPs to minimize turbidity. Restricting the pump operation to seasonal or a longer period between usage is expected to increase sediment accumulation.

c. *The BA states that chum salmon spawn in the action area. Lower Columbia chum salmon are at serious risk of extirpation. Provide aerial maps displaying the proposed structure, action area, screen pit, and chum redd locations from recent years. Additional protective measure may be necessary to avoid take of this species.*

   Response. The BA does not state that chum salmon spawn in the action area. As stated in Section 6.1.1, on page 42, spawning for chum salmon is limited to the mainstem East Fork Lewis River between Eagle Island and Merwin Dam, upstream outside the action area, which is shown on Figure 13. No other additional information on chum salmon was identified for the project.

2. *Clarify the quantities of fill (replaced riprap and "supplemented light loose rip rap") below the OHWM.*

   Response. These quantities are provided in Table 3 (see response to Comment 1).

3. *Sect 7.1.7 - Please clarify how restoring 66 sf of area below the OHWM is different from the permanent installation of 66 sf of metal railings, fish screen box, and six piles. Is one area of current use being restored while another area of equal size be developed?*
   a. *It is unclear if these are H-piles or hollow piles.*
      i. *Pg 7: In total, the metal railings, fish screen box, and six H piles occupy approximately 66 square feet of area below the OHWM of the Lewis River.*
      ii. *Pg 12: The railing system will be supported by a total of eight 12.75-inch diameter steel pipe piles, six of which will be below the OHWM.*

   Response. Section 7.1.7 states that 66 square feet of area below the OHWM will be restored by removal of the existing structures. The existing structures as described on pages 6 and 7 consists of the metal railings, fish screen box and 6 H piles. In comparison, 6 (six) square feet of area will be filled by the new piles supporting the new screen box rail system (as described on page 12), resulting in a net reduction in structures below the OHWM. The piles under the existing dock are H-piles while the proposed pile are hollow steel pipe piles.

4. *Provide a copy of original and any subsequent binding agreements relevant to pumping water out of the Lewis River into Horseshoe Lake. It is unclear what, if any, legal obligations WSDOT has to pump water for a private use lake that was constructed less than 70 years ago. The 1998 "clarifications" described only refer to maintenance of the equipment. The City's duties are clearer but still only describe maintenance of the equipment. No definition is provided about what constitutes "avoiding stagnation".*

Response. Horseshoe Lake was established in 1940 when an oxbow of the Lewis River was cut off by construction of Highway 99 (now I-5). It was not constructed as a manmade lake; it was isolated as a result of the highway construction. In 1939, the US government issued a permit for the channel change of the North Fork of the Lewis River. No copy of this permit is available. WSDOT has found mention of it in a 1957 letter from the Washington State Highway Commission Secretary Lorenz Goetz to the Mayor of the City of Woodland Earle F. Bryant. See the attached letter. The letter indicates that the 1939 permit forms the basis for an obligation to maintain enough flow of water in the lake to "prevent stagnation" according to the Highway Commission and Assistant Attorney General. The term "stagnation" has not been defined by WSDOT or any other stakeholders. It was WSDOT's position in the letter than WSDOT does not assume responsibility for maintaining a certain water level in the lake.

Historically the lake has suffered from water quality issues that periodically require the lake to be closed to recreational use. In 1991-1992, researchers from the UW Department of Civil and Environmental Engineering conducted an intensive yearlong study of Horseshoe Lake to determine the lake's trophic state, compute water and nutrient budgets for the lake and recommend appropriate restoration techniques. The study was a joint effort between Cowlitz County, Clark County, City of Woodland, and WSDOT. WSDOT funded $5000 toward the study. The attached report "Horseshoe Lake Quality, Nutrient Loading and Management" (also known as the Phase 1 report), made recommendations of various actions to take in order to improve the lake quality. Specific to the pump, the report recommended increasing the flow of water to the lake from the approximately 3,000 GPM that was currently being pumped.

Following receipt of the report, the City of Woodland and WSDOT took steps to implement the recommendations, including the recommendation to increase the pumping rate. In 1993, the City of Woodland applied for funding from the Washington State Department of Ecology to secure a block grant to implement the Phase II Horseshoe Lake Restoration Project. The project was selected to receive funding from Ecology. The City and WSDOT proceeded to develop plans and obtain permits to implement the recommendation. In 1998, the City and WSDOT signed an agreement related to the replacement of the pump and increase in the pumping rate. The attached agreement, dated April 15, 1998, outlines the responsibilities of each party. In summary, WSDOT agreed to minimize the stagnation in Horseshoe Lake by pumping water from the Lewis River, the City agreed to use the grant from the Department of Ecology for improvement of water quality in the lake, and WSDOT was to provide a portion of the local match as required by the Ecology grant not to exceed $95,900. The City also agreed to execute the terms, conditions and requirements of the Ecology Grant Agreement, which was attached to the WSDOT agreement as Exhibit A (see attached). Exhibit A includes the following requirement "Increase pumping capacity to 6,000 gpm to increase the flushing rate of the lake, maintain high water levels, and prevent thermal stratification". The agreement also outlined ongoing maintenance and operation duties for the City and WSDOT. There is no more recent agreement in place between the City and WSDOT. Sometime in early 1999 the pump was replaced with a pump designed to meet the 6,000 gpm rate. Pump logs obtained for 1999 and 2000 show that the new pump was routinely running between 4,000 and 6,000 gpm. Pumping of lower rates in recent years is a result of decreased pump performance rather than a desire to pump less than the 4,000 to 6,000 gpm that the pump was designed to pump.

5. *Is the outlet structure operating as is should? If not, what is the plan to repair it? The outlet is arguably part and parcel of the pump project and needs to be addressed.*

Response. Photos of the outlet structure at low lake level are attached. A gate valve, located at the bottom of the outlet structure, allows lake water to enter the structure and discharge to the river. A back up valve is located midway along the outlet pipe at the Woodland Airport. Additionally a flap valve (tide gate) is located at the river outfall to prevent backflow under flooding conditions. The status of these valves is unknown. Once the water level exceeds 14.6 feet mean sea level, the lake can also drain via the top of the structure. Note that there is a metal grate on top of the structure and wire mesh screen with holes that are approximately 3/8" on the side of the structure. The spacing of the bars on the grate is not known. There are tarps and sandbags at the base which indicate that the outlet pipe and maybe the box are leaking. The outlet likely needs repairs or replacement to be properly functioning. WSDOT is not aware of any plans to repair or replace it in the near future

The outlet structure in the lake is outside the WSDOT right of way. The City of Woodland manages the valves on the outlet to regulate the lake level. In a 1992 letter from WSDOT Superintendent of Special Maintenance Ernest Garcia to the Mayor of the City of Woodland Sylvia Fields, Mr. Garcia informed the City that WSDOT had turned over the gate valve and outfall structure to the City of Woodland (as of March 31, 1992). Operation of the valves and management of the lake level have been solely the City's responsibility since 1992. WSDOT has no responsibility for the operation or maintenance of the outlet structure in the lake.

The current pump replacement project is limited in scope to the pump facilities. The project as funded and programmed is described as "I-5 Woodland Vicinity at Horseshoe Lake- Upgrade Pump System". The statement of deficiency and project purpose and need as identified in the project definition is described as follows:

The existing pump system conveying water under I-5 from the Lewis River to Horseshoe Lake has outlived its service life. Other pump-related appurtenances (dock, pump house, controller, electrical services, etc) are deficient or are at various stages of disrepair. The existing fish screens are also out of compliance with current DFW regulations and must be replaced. By agreement with the City of Woodland, the pump system is operated and maintained by WSDOT, preventing stagnation of Horseshoe Lake. WSDOT has been asked by WDFW to bring the screens up to current standards before issuing a new HPA permit. This project brings the Horseshoe Lake pump station into compliance with State and Federal laws.

Any work to address deficiencies in the outfall would be outside of the scope of the existing project and off the WSDOT right of way. WSDOT has no obligation to the City regarding the outfall structure. There would be no justification to work outside the scope of the pump upgrade and to obligate highway funds for repair of a structure that is off right of way and that WSDOT has no ownership of or obligation to maintain.

6. *What BMPs are/will be in place to prevent fish in the lake from escaping into the Lewis River?*

Response. No alterations of the outfall are proposed as part of this project. As described above in #5, there is a metal grate on top of the structure and wire mesh screen with holes that are approximately 3/8" on the side of the structure. The spacing of the bars on the grate is not known. Typically, unless the lake is quite high, the outfall structure would drain from the bottom, limiting fish access to the outfall pipe.

Additionally, much of the time the valves on the lake outfall have typically been closed, so lake water is not discharged and fish in the lake would not be able to escape to the river. The pump logs for 2013-2018 (see attached) indicate that even though the pump was operating the outlet valve was closed for the following dates:

- 6/7/13-2/16/14
- 6/12/14-12/28/14
- 4/27/15-1/12/16
- 5/13/16-12/21/16
- 7/3/17-1/11/18

7. The new pump has the capacity to pump 6,000 gpm while the existing has a maximum of 4,000 gpm. What assurances will there be not to exceed the existing rate? This will likely be a Term and Condition.

Response. As described above in question #4, the current pump was installed in 1999 with a design capacity of 6,000 gpm and routinely pumped over 5,000 gpm throughout late 1999 and 2000 (See attached pump logs). Records for the years between 2000-2009 and 2010-2012 are not available). The maximum recorded pump rate was 6,100 on 5/12/00. In more recent years, the pump has had performance limitations which have reduced its maximum pumping rate. The pump has been rebuilt and refurbished a number of times throughout the years to try to improve or at least maintain its functioning. In April 2009, WSDOT was contacted by the City of Woodland Public Works Director indicating that the pump logs showed the pump was averaging around 3,000 gpm while the agreement with the city was that the pump should be pumping 6,000 gpm. WSDOT pulled the pump and had the pump rebuilt in February 2010 to address performance issues. The pump rate was over 4,100 gpm when reinstalled. Since this output was still below expectations, WSDOT worked throughout 2010 and 2011 with various pump suppliers in an effort to either maximize the output or identify options for replacing the entire unit.

During this period, WSDOT identified pump replacement as the preferred option, but was advised by WDFW that pump replacement would require an HPA. A condition of the HPA would be upgrading the pump screens to meet current fish screening guidelines. This requirement significantly complicated the pump replacement plan and added considerable cost to the proposed work. At this point, WSDOT began working to identify a funding source for the pump replacement. Since that time WSDOT dedicated funding to the project and has been working through the design and permitting process to replace the pump and meet the 6,000 gpm obligation.

The intention of WSDOT throughout this entire process has been to return the pumping rate to 6,000 gpm to comply with the 1998 agreement. Even in recent years, the pumping rate has exceeded 4,000 gpm. The pump records from 2013-2018 indicate that the pump maximum recorded rate was 4,446 gpm. This maximum was a result of equipment performance limitations not a preferred pumping rate. WSDOT intends to operate the new pump up to its design capacity of 6,000 gpm. That actual rate will likely be variable depending on water levels in the river and lake.

8. *Why is there a 44 cy net increase of fill below the OHWM?*

Response. There is actually a net decrease of 44cy of fill below the OHWM due to the excavation of the pit. Table 3 has been edited. See below.

Table 3: Estimated Project Cut and Fill Quantities (cubic yards)

Type	Above OHWM	Below OHWM
Excavation	22	60
Fill	31	16
Net Excavation	-9	44

9. *What is the downstream area of turbidity (mixing zone) from flushing the new screen and "sediment control jet system"? Is there a schedule?*

Response. The downstream extent of turbidity associated with the active screen cleaning and sediment control system is very difficult to predict. There is no schedule. The internal rotation drum and cleaning brush run constantly while the pump is active, keeping the screen clean on a constant basis. This minimizes the accumulation of sediment and debris on the outside of the drum and prevents large plumes of sediment. The use of the sediment control jet system will be intermittent and on an as-needed basis. The jet system is under manual control, can be turned on and off at will, but will only run while the pump is active. It is anticipated that the turbidity from these jets would exceed that from normal operation of the pump screen. Extent of the mixing zone would depend on the amount of accumulation of sediment and debris. The water rights prevent pumping when the river is at flows below 1000 cfs. Even at a river flow of 1000 cfs, turbidity from flushing the screen would be expected to disperse fairly quickly. WSDOT has contacted the owners of the Lake Tapps project and Green River intake project mentioned above to request any data on turbidity that they may have collected. Results of this outreach are still pending.

10. *What water rights does the City have for pumping water out of the river and into the lake?*

    Response. WSDOT holds three water right certificates to draw water from the Lewis River. The total right shall not exceed 17.8 cfs (7,988.4 gpm). All diversions shall cease when flow of the North Fork Lewis River falls below 1500 cfs September 16 through July 14 or 1000 cfs July 15 through September 15.

11. *The screen intake location displayed in Figure 17 appears to be on the edge of the thalweg and conflicts with the statement on page 23 about proximity to the thalweg.*

    Response. Figure 17 is an output from the hydraulic model. It has an extremely exaggerated scale. The attached figures show a more normalized scale that better represents the reality of the cross-section of the river. In fact, the river is very flat, and in most cases, more than 700 feet wide. Therefore, the excavated pit is on the outer edge of the river channel.

12. *Warm water effluent into the Lewis River, especially during low flows, could create a thermal barrier to migration and rearing habitat. Describe the water quality monitoring (especially temperature) at the outfall. The effluent must be included in the action area because there likely wouldn't be a discharge if not for pumping into the lake. NMFS disagrees that effects from the outfall into the Lewis River are immeasurable.*

    Response. There is no water quality monitoring data available at the outfall of Horseshoe Lake. The Lower Lewis River, including the action area, is not on the Ecology 303(d) list for temperature. Some anecdotal monitoring information is collected in the lake by the City during their pump checks and log entries (see attached). In the past 5 years the outlet valve has been closed for extensive periods of time in the summer in order to maintain water levels in the lake, as water pumped in from the river is lost to groundwater. This closure minimizes warm water effluent discharge to the Lewis River. The Phase 1 report estimated that a flow of 116 m^3/s (4,048 cfs) in the Lewis River is required to reduce groundwater loss and maintain a steady lake volume when the pump is pumping at a rate of 2,753 gpm.

The action area currently includes an aquatic zone of impact that extends approximately 0.6 mile downstream of the pump site, which would include any reasonable mixing zone for warm water effluent. Based on the size and width of the river, mixing would likely occur relatively quickly and not reach the magnitude of a thermal barrier that would prevent migration up or down the river. Additionally, anytime flows in the river fall below 1000 cfs the pump would not be running and therefore presumably the lake would not be outfalling.

13. *It appears there was insufficient consideration for designs that place the intake in a location that would preclude or at least greatly decrease the danger to entrapment of eulachon larvae and eggs. Please provide a scour and reach analysis that analyses installing a design to protect these life stages of eulachon.*

    Response. Throughout this section of the Lewis River, from just upstream of the north end of the lake to just past the south end of the lake (approximately 3000 feet), the bank of the Lewis River is linear, uniform, and highly armored. There are no backwater or off channel areas that would be more suitable to avoid eulachon drift. Moving the pump intake any substantial distance upstream is not feasible because the current location is just downstream from a depositional area associated with the upstream bridge. Moving the pump upstream would increase the potential for the intake to be buried in sediment requiring excavation of the pit. Additionally the wastewater treatment plant outfall is upstream of the current location. Moving the intake closer to the treatment plant outfall would not be suitable. Additionally, the pump location as designed avoids impacting any mature cottonwoods trees lining the bank of the river. Moving the pump intake up or downstream would result in impacts to mature cottonwood trees. No scour or reach analysis specific to eulachon is available.

14. *Describe where the project is relative to tidal influence. If tidally influenced, this would slow or even reverse the flows in the Lewis River and alter the course of free floating eulachon larvae and eggs. Slowing/reversing flows would cause these life stages to settle out into the screen pit.*

    Response. The Lewis River subbasin description states that tidal influence extends upstream to approximately river mile 11 on the North Fork Lewis River, which is several miles upstream of the project site. The pump pit currently occupies less than one percent of the cross-section of the river, as well as less than 0.02% of the area of the river bottom in the action area. Tidal influence in this location is never large enough to reverse flows in this 700 foot wide river.

15. *NMFS believes the estimated 1,100 eulachon larvae/24 hour period at 3,000 gpm of pumping is significantly less than what should be expected. While we do not have an estimate of potential mortality, it is reasonable to assume the screen pit will disrupt*

downstream movement of eulachon larvae and eggs causing them to drop out in the depression. The intake is adjacent to the thalweg and further increases the risks to ingesting larvae and eggs; however, to state that "most" larvae and eggs occur in the thalweg is not substantiated. Even if this is accurate, these life stages are subject to the flow of current and therefore sucked out of the thalweg water column and into the intake due to the proximity of the structure. Should the pump operate at a higher rate, at a minimum, the risks proportionately increases for ingesting eulachon larvae and eggs.

Response. Entrainment rate in the BA was calculated in a similar manner to that used by NMFS in the BO for PacifiCorp pump intakes farther upstream (NOAA Case # NWR-2013-9721). Worst-case pumping rate would be 13.36 cfs (6,000 gpm max), which would equate to 2193 larvae per day based on Tribe's larval density measurement. However, it is highly unlikely that the pump would be running near max pumping rate during early spring when eulachon density is at its peak, if at all. The Tribe's density estimate is the only verified data point for eulachon density in the area. Also, it is based on sampling that occurred within the action area, so it should be a reasonable density measurement to use as a basis for entrainment rate estimates.

16. *The BA describes how the proportional of take is insignificant in the Lewis River relative to the larger population in the Columbia River. This comparison is irrelevant because this proposed project will primarily harm those individuals destined for the Lewis River, not the Columbia River. Please clarify.*

Response. Statement was meant to compare take to Lower Columbia eulachon run, which includes Lewis River. This statement mirrors a statement in the take section of the BiOp for the Lewis River Hydroelectric Project NWR-2013-9721 (NMFS, 2015) which compared estimated amount of eulachon entrainment from that project to the total production of eulachon larvae in the Columbia River. There is no available estimate for size of the eulachon run on the Lewis River for comparison.

17. *The BA describes the action area and upstream areas provides habitat for spawning eulachon. Adult and especially larvae, and egg life stages should be expected to occur and be at risk of injury or death from December 1 to April 30. NMFS believes the pump should not operate during that time frame. This restriction serves to avoid take of eulachon. Most winter precipitation occurs during this time frame and thus the lake naturally receives intake from run off and serves to recharge the lake.*

Response. Restricting operation of the pump between December and April does not meet the basic need of the project to provide circulation of water through the lake and prevent stagnation. Under the existing baseline conditions the pump runs year round to circulate water through the lake and minimize water quality issues in the lake (except when down for maintenance or at the request of the City due to high lake level). Precipitation alone is not sufficient to maintain acceptable water quality in the lake. The assertion that the lake would "recharge" from precipitation alone during the winter is not supported by the pumps logs that we have obtained (see attached) or the "Phase 1 Report". Pump logs for 2015-2016 show that the pump was down for maintenance or high river level for several periods during the winter and water in the lake was described in the logs as "yucky, yucky with yellow tint" (1/26/16) and "water is ugly" (2/1/16).

The pump logs also track the water level of the lake and it fluctuates greatly throughout the winter. The water balance of the lake is quite complicated and affected by pumping rate, precipitation, stormwater runoff, evaporation, outflow to the Lewis River, and loss to or gain from groundwater depending on the flow of the river (See Phase 1 Study). Flow in the Lewis River is controlled by discharge from Merwin Dam and daily fluctuations in flow can be significant. The river is tidally influenced at the pump station and the river elevation can change by several feet. The Phase 1 report estimated that a flow of 116 m^3/s (4,048 cfs) in the Lewis River is required to reduce groundwater loss and maintain a steady lake volume when the pump is pumping at a rate of 2,753 gpm). Looking at the pump logs you can see periods when the lake level dropped substantially even with the pumps running in the winter. These periods were often tied to low flows in the river. Not running the pumps throughout the entire winter would exacerbate this issue and not meet the project need of preventing stagnation.

A seasonal shutdown is also not feasible from an operational and maintenance perspective. Restricting the pump to run only from May 1 to November 30 would significantly increase the likelihood that the pit at the base of the pump would fill in with sediment during the period when the pump is turned off and the self-cleaning features are not active. If the pit fills in and excavation of the pit is necessary to get the pump running again, a significant effort will be required to acquire permits and approvals to do the work. The work would require an HPA from WDFW, as well as potentially a Corps permit and associated ESA consultation. The timeline to acquire approvals to complete the work and the in water work window limitations could prevent WSDOT from starting the pumps at the end of the seasonal shutdown in May and potentially require shutdown until the in water work window in August or beyond. This would not meet the need of the project and prevent WSDOT from meeting its obligation of preventing stagnation of the lake. The work to excavate the pit would also have an associated cost to complete the work and the permitting. Any significant costs for future environmental permitting and regular excavation of the pit are not funded in the current project budget. Funding limitations could further inhibit WSDOT's ability to get the pump back in service following the seasonal shutdown.

18. *Pg 55: Stating that improvements to Horseshoe Lake is beneficial to listed species is disingenuous. Horseshoe Lake does not support listed species or CH. In fact, it degrades the habitat for listed species by an agreement to take clean and cooler water out of the Lewis River and replace murky and warm water in the lake. The lake is surrounded by development, including a meat processing business, and subject to pollutant runoff from driveways and lawns. The lake provides recreation for swimming and fishing non-native species that eat listed species should they escape into the Lewis River. Outflow from the*

lake can only contribute to the degradation of the Lewis River and has no beneficial aspects to recovery listed species and habitats.

Response. Comment noted. Statement retracted.

19. *Provide more details about these projects. Will they require ESA consultation? If not, provide details about sw.*

SR-503 Widening Hillshire Drive to Evergreen Lane
I-5 at SR-503. Add turn lanes and traffic lanes.
I-5/SR 503 Interchange Upgrade
New gas pipeline from Woodland to Sumas, WA

Response. See below:

- SR-503 Widening Hillshire Drive to Evergreen Lane – City just applied for a grant for this project. It will install a sidewalk on one side of SR 503. No stormwater impacts anticipated because sidewalk will be non-pollution generating surface. Unsure if project will have federal funding to trigger and ESA consultation.
- I-5/SR-503 Interchange – City has some federal money to study operational improvements at the interchange. There is no construction money available at this time, so project is not certain to occur.
- I-5 at SR-503 – Project would add turn lanes at SR 503 intersection with I-5, relocate CC Street connection to A Street, and add eastbound through lane from Atlantic to past A Street. Project considered dependent on new Scott Avenue crossing being constructed across I-5. The Scott Avenue crossing is currently not funded.
- New gas pipeline from Sumas to Woodland – This project no longer exists. Was dependent on approval of Oregon LNG and Oregon Pipeline project, which withdrew their proposals to construct and operate an LNG import and export terminal in the Town of Warrenton in Clatsop County, OR. Northwest Pipeline withdrew its proposal to construct and operate its Washington Expansion Project which would have provided 750 MMcf/d of incremental capacity from Sumas, WA to Woodland, WA, to serve the withdrawn Oregon LNG import/export terminal.

20. *The following matrix assessments are followed by comments in red:*

Temperature	*FAR*	*Temperature monitoring by PacifiCorps between 1998 and 2000 found Lewis River below Merwin Dam to be about two degrees warmer on average than above. Maximum temperature recorded in the Lewis River below Merwin Dam during this time period was 16.3 degrees Celsius. High incident radiation in lower river due to lack of shading may contribute to higher temperatures in the action area.*

Removing 600 sf of riparian vegetation and increasing the volume of water outfall from the lake will contribute to degrading the stream.

Response. WSDOT contends that removal of the riparian vegetation will have no detectable or measurable effect on temperature in the Lewis River since only shrubs and grasses will be removed. Furthermore, the loss of the riparian vegetation will be offset by replanting native vegetation where the old dock is removed. See edits in table for response to outfall related comment.

Floodplain Connectivity	*NPF*	*The lower Lewis River is very disconnected from its historic floodplain due to flood control, diking, transportation infrastructure, and development.*

The proposed project will continue degradation of FP connectivity.

Response: Table already acknowledges that project will maintain ***not properly functioning*** status of this indicator.

Streambank Condition	*PF*	*Streambanks along the Lewis River in the action area are relatively stable, with a narrow but intact riparian fringe.*

The proposed project will increase the loss of riparian habitat.

Response: See updated table below

Change in Peak/Base Flows	*NPF*	*Presence of three major dams in the upper North Fork Lewis river has severely altered peak and base flows.*
Drainage Network Increase	*NPF*	*Road crossings are numerous in the heavily urbanized areas in and around the action area. Urban stormwater systems also have altered historic drainage patterns.*

The proposed project will increase the degradation of these conditions

Response: Table already acknowledges that project will maintain **not properly functioning** status of these indicators.

Temperature	*Maintain.*

I disagree. Outfall water will degrade stream temperatures in the Lewis River. Increased pumping rates will further degrade the river.

Response. See table below.

Width to Depth Ratio	*Maintain.*

I disagree. 1000 sf of substrate will be removed. How many cubic yards does that equate to?
Response: See response to Comment 10 above.

Change in Peak/Base Flows	*Maintain.*

I disagree. Increased pumping volume will reduce flows in Lewis River.
Response: Table already acknowledges that project will maintain not properly functioning status of this indicator.

See attached revised Appendix Table H-2 below. While several of the comments were attached to a portion of Appendix Table H-1 (existing conditions), all of the comments were relative to the effects of the project to the environmental baseline.

Appendix Table H- 1: NMFS/USFWS Checklist for Documenting Effects to the Environmental Baseline

Diagnostics/Pathways Indicators	Effects of the Action – Lewis River
Water Quality	
Temperature	Short term degrade due to loss of riparian vegetation and increased volume of outflow from Horseshoe Lake. Long term, project will maintain water temperature by replanting in area of existing dock removal and decreased overall temperature of water in Horseshoe Lake due to increased water circulation.
Sediment/Substrate	Short term degrade from temporary increased in turbidity. Long term maintain.
Chemical Contamination/Nutrients	Maintain.
Habitat Elements	
Physical Barriers	Maintain.
Substrate Embeddedness	Maintain.
LWD	Maintain.
Pool Frequency and Quality	Maintain.
Large Pools	Maintain.
Off-channel Habitat	Maintain.
Refugia	Short term degrade due to removal of small area of submerged aquatic vegetation for new pump pit. Long term maintain by eventual infilling of aquatic vegetation where existing pump intake is removed.
Channel Condition and Dynamics	
Width to Depth Ratio	Maintain.
Streambank Condition	Short term degrade from impacts due to construction. Long term maintain by restoration of riverbank where existing structure was located.
Floodplain Connectivity	Maintain.

Diagnostics/Pathways Indicators	Effects of the Action – Lewis River
Flow/Hydrology	
Change in Peak/Base Flows	Maintain.
Drainage Network Increase	Maintain.
Watershed Conditions	
Road Density and Location	Maintain.
Disturbance History	Maintain.
Riparian Conservation Areas	Maintain.
Bull Trout Subpopulation Characteristics	
Subpopulation size	Maintain
Growth and survival	Maintain
Life history diversity and isolation	Maintain
Persistence and genetic integrity	Maintain

21. The proposed design leaves the guard piles and dolphins in place. It appears these are creosote-treated wood piles. NMFS requests these are removed and, if needed, replace with untreated log piles or steel.

WSDOT agrees to remove the dolphin containing 4 wood piles. The existing guard piles are steel H-piles and will remain in place. WSDOT proposes to install 3 hollow steel piles to replace the dolphin. The piles will be the same size and type as the piles used to support the new pump structure. The new guard piles will be located closer to the new pump structure. See attached draft guard pile plan for details.

22. The following discussion is speculative without substantive support.
Several other avoidance and minimization measures were considered, but will not be implemented. These include:

1. *WSDOT considered a seasonal annual shutdown of the pump to avoid potential entrainment of eulachon larvae during their migration. However, this measure was considered infeasible due to unknown future river conditions, potential sedimentation concerns with shutting the pump down for prolonged period during winter high flows that carry large sediment loads, and increasing the potential for the pit to fill in while maintenance features are not active. This alternative would require regular impacts to the river outside the approved in-water work window in order to excavate the pit prior to running, potential impacting other listed fish species.*
2. *WSDOT considered installing deflectors to isolate the pump and minimize potential contact with eulachon larvae. However, deflectors raise the risk of altering river dynamics and creating downstream effects such as unintended scour.*

Response. Comment noted.

23. *This statement was taken out of context: NMFS has confirmed that no suitable screening guidelines exist that eliminate entrainment risk for eulachon larvae (MacDonald 2015). My response to the question was intended to mean that I personally have no additional knowledge of suitable screening but that certainly doesn't mean it doesn't exist. Please delete or accurately reflect my answer.*

Response. WSDOT contacted the NMFS liaison in 2015 and briefly described the upcoming Woodland pump project. At that point, WSDOT was beginning the design phase of the project and inquired if he knew of any screening guidelines or design features that WSDOT would be required to implement that would minimize impacts to eulachon larvae. The NMFS liaison provided WSDOT with the July 2011 Anadromous Salmonid Passage Facility Design document and indicated he had no knowledge of any other guidance that was available.

24. *The following statement is meaningless unless another more appropriate location was available but WSDOT decided instead to avoid increasing the impact of the project:*

Location of the new intake structure to take advantage of an existing opening in the riparian vegetation, thereby avoiding additional tree takes.
Please clarify this statement.

Response. WSDOT could have chosen to locate the new pump to the upstream side of the existing pump rather than the downstream side. Locating the pump upstream would have required removal of additional trees on the riverbank.

25. *Please verify that all BMPs and HiVis fencing will be removed after the project is complete***.**

Response. Confirmed. All BMPs and HiVis fencing will be removed after project completion.

Appendix B: Responses to site visit #1 questions:

Good afternoon Michael-
As a follow up to our onsite meeting at the I-5 Horseshoe Lake Woodland Pump on 8/14/18 , please see below for our response to questions that you raised during the site visit. I believe we captured all of your questions. If we have missed anything please let me know. At this point it's our understanding that you should have sufficient information to begin the project consultation. If there is any outstanding information needed please let me know as soon as possible so the review of the project is not delayed.

Questions Raised During Site Visit:

1. Should more guard piles be added to protect the screen system?
   a. Could adding more guard piles reduce the need for maintenance to go out and clear debris off the incline structure?
      - It is the opinion of our design team that this would not reduce the probability or frequency of any in water maintenance. Adding more piles would move the issue from the rail to the piles. Blockage from debris on a pile row could likely have hydraulic impacts to the area on the bank and at the screen that would require removal or other measures to maintain the required sweeping flow across the screen or scour under the pile supports.

2. What design considerations lead us to this pump sitting in an excavated sump hole in the streambed?
   a. Could the pump move up and down with the water level (like on a float)?
   b. Could the pump operate on the existing streambed without the excavated sump hole?
   c. Please provide an explanation for why the pump is designed to operate from the sump hole.
      - a. Floating pumps have been used but for this application they are not a practical option especially for a 6000gpm,. 50Hp pump. Both the pump and the required screen would require the same submergence at low water. The float draft would also occupy some of the submerged area so the intake screen may actually have to be lower than currently planned. Articulating the current screen and retrieval rail system would require significant addition of a truss type structure around the rail to allow the weigh to span (65 ft) between the float at the river and a articulating point at the platform. Both types of floating systems would require additional in-river lateral support for the pump to resist current and debris forces while still allowing vertical movement.
      - b. Not based on current survey. The survey that shows the existing ground surface is a snapshot in time and may be higher or lower at the time of construction. The excavation under the screen is shown to ensure the new screen is installed and can be fully inspected before being put into service. The NMFS 2011 fish passage guidelines require 'active screens' (NMFS 2011, 11.10.1.2) to be automatically

cleaned. The cylindrical screen was selected in the alternatives process to minimize the instream requirements necessary to achieve the required submerged screen area. If the screen is on the river bottom debris and sediment can rapidly wear out the seals and cleaning system. It can also prevent rotation of the screen thus eliminating any cleaning (the cylinder must rotate to clean). As discussed in 'c' below placing the screen on the streambed would not provide sweeping flow across the screen or uniform hydraulics both which are required by NMFS criteria.

- c. The depth of screen under the low water level set at the 5% exceedence flow in accordance with the NMFS 2011 guidelines (Section 11.11 is included below). The initial excavation depth is for installation and inspection to verify the screens meet the fisheries requirements and mechanical specifications upon startup. The permanent jetting system is as close to the bottom of the screen as possible but will effectively maintain the required clearance under the screen. Natural river morphology will deposit and scour the area under the screen over time and the facility operations and maintenance will address conditions as they occur. The best fisheries protection is to maintain a clear space around the cylinders with normal sweeping flows to minimize potential for attraction to the face of the screen and to minimize the potential time of exposure to the screen when operating.

  Source: NMFS, 2011 Anadromous Salmonid Passage Facility Design
  11.11 End of Pipe Screens (including pump intake screens)
  11.11.1.1 Location: End of pipe screens must be placed in locations with sufficient ambient velocity to sweep away debris removed from the screen face, or designed in a manner to prevent debris re-impingement and provide for debris removal.
  11.11.1.2 Submergence: End of pipe screens must be submerged to a depth of at least one screen radius below the minimum water surface, with a minimum of one screen radius clearance between screen surfaces and natural or constructed features. For approach velocity calculations, the entire submerged effective screen area may be used."

3. How will we maintain the excavated hole where the pump will be?
   - The 'hole' shape is not critical, the area immediately around the screen for flow area and sweeping current are what is critical for fish protection. This a regulated river so extreme high flows are somewhat limited in frequency and magnitude, but does have significant natural side flows and flooding will occur create differing conditions over time. We have provided as many low impact management tools as possible. First, the location on the outside of the bend and sweeping flow around the pile and screen will accelerate the flow and under normal conditions should maintain a free flow area around the

screen. Second level is the inclusion of the jetting system under the screen. Used regularly this will help maintain bigger areas if sediment is encroaching on the screen area that are not naturally swept away. Lastly, if the screen area becomes buried it will be necessary to physically remove the material. Historically at the existing pump this has rarely been necessary.

- It has been the experience of the design team, and has continually been reinforced in each update of the NMFS and WDFW intake screening guidelines, that maintaining a sweeping flow and full cleaned screen area to minimize approach velocity is critical. Compromising the cleaning puts every resource in the river at greater risk. We believe this facility has included as many low impact protections as possible to balance fish protection and short term water quality impacts.

4. Can we shut down the pump seasonally and backwash?
    - As described in #3 above, and in the response to NMFS questions sent on 8/9/18, shutting down the pump seasonally would not meet the purpose and need of the project and would compromise the self cleaning ability of the pump.

5. What exact legal obligations does DOT have to this pump system? Is there a certain water quality that must be maintained? What document states that there is a requirement to pump 6,000gpm?
    - The description of and documentation related to WSDOT's obligation to operate the pump system were provided in the 8/9/18 response to NMFS questions. The associated documents were provided as an attachment.There is no specific defined water quality measurement that must be maintained.

6. The outlet structure was brought up and it was asked why is this structure not a part of the project?
    - This information was provided in the 8/9/18 response to NMFS questions. The information can be found In the response to question #5.

Additionally, we discussed the potential extent of turbidity from flushing the new screen and the sediment control jet system. See question #9 from NMFS original list of project questions sent on July 3. WSDOT anticipates that any turbidity resulting from flushing of the screen via the jet system would meet state water quality standards and be limited to a 300-foot mixing zone from the pump location.

Thanks,
Angie

Angie Haffie

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Appendix C: 2/27/2019 Meeting Notes Summary

I-5 Woodland/Horseshoe Lake Meeting Summary
27 February 2018 9:00 a.m. to 12:30 p.m.
Attendees:
Attendees -

- Michael MacDonald (WSDOT/NMFS liaison writing BiOp)
- Pete Barber (Cowlitz Tribe rep)
- Paul Harrison (WSDOT)
- Shawn Stanley (WDFW engineer)
- Aaron Beavers (USFWS/NMFS engineer)
- Sharon Rainsberry (WSDOT/USFWS liaison writing LOC/BO)
- Paul Baake (USFWS geomorphologist)
- Angie Haffie (WSDOT)
- Frank Green (WSDOT)
- Casey Martin (WSDOT)
- Scott Hecht (NMFS)
- Jake Peters (SW Region Super)
- Mike London (SW Region wide bridge supervisor)
- Nathan Reynolds (Cowlitz cultural, petitioned for eulachon to be listed)
- Andrew Nishihara (Stantec)
- Chelsey Martin (WSDOT)

I-5 Woodland Pump Discussion		Febryary 27, 2019
Name	email	Organization
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Paul Bakke	paul_bakke@fws.gov	USFWS

Meeting Objective:
We met at the water pump project site at the north end of the city of Woodland airport and participants unfamiliar with the site could see the design layout. Shortly afterward we gathered back up at the WSDOT-Kelso office where it was warmer.

Purpose/need of Horseshoe Lake pumping:

• Clarify details on the agreement/contract between WSDOT and the City of Woodland. General purpose appears two fold- to keep lake from becoming stagnant, and to maintain certain water levels.

- Clarify criteria used to determine when stagnation is a problem and what water levels are required.
- Further discussion with WSDOT to assist in determining whether other measures could be used to avoid stagnation.

Additional Information Needed for Operation and maintenance of pumping operations:

• An operation and maintenance plan that includes how often self-cleaning mechanism would operate, how often jets would be turned on, pit maintenance, documentation and an adaptive management strategy to ensure the screen is operating effectively is needed to evaluate the effects of the action.

• Development of an adaptive management framework to address potential uncertainties in screen and pump operations/maintenance e.g., the frequency and magnitude of maintenance.

• How will WSDOT address sediment filling in the pit near the screen? What is the emergency plan to clear the pit? What is the response if the pit causes upstream headcutting and bed destabilization?

• We have insufficient information on the streambed composition and condition, bedload sediment sources, volume and size characteristics, and frequency and duration of sediment movement to assess the magnitude of the maintenance and destabilization problems presented by the streambed pit.

Pump Design
After introductions, WSDOT staff and consultant described how they reached the preferred design and the obligations to the city of Woodland they must meet.

Water rights?

Insufficient groundwater?
Would have to purchase additional real estate for well pumping.
Agreement made in 1939 when the city of Woodland dug new channel for Lewis River. Spoils used for base of future I-5. Isolated Horseshoe Lake. Passive water exchanged with pipes through the roadbed didn’t work out and a pump was added (1957). Agreement to minimize stagnation revised in 1959 and 1998. City controls outflow valve. Normally it’s closed.

Eulachon
Agencies recognize that the proposed screen design is appropriate for juvenile salmonid and larger sized fish but current technology isn’t sufficient to keep out very small eulachon eggs and larvae.
Nathan Reynolds spoke extensively of eulachon life histories, the importance to the Tribe, and the status of their surveys on the Cowlitz River. “Heritage” fish.
Based on Cowlitz River surveys and other sources, eulachon enter Columbia River tribs early November to March, peaking in December to February. The same level of survey effort have not been applied to the Lewis but eulachon are known to spawn up to Lake Merwin dam. Local

citizens and predatory wildlife activities provide clues when the adults are in the river. Males enter spawning areas first and release sperm upstream of females triggering them to release eggs. Spawning areas less determined by habitat or water quality but more tied to water temperature or chemical make up in the water. Adults die after spawning. Eggs and larvae 30 days after first adults. Eggs hatch 15-30 days after fertilization.

Fertilized eggs might adhere to sand granules and tumble along with sediments or freely drift in the water column. Eggs and larvae are evenly distributed throughout the width and depth of spawning streams. Takes eggs/larvae 19-30 days to float to Columbia River estuary. Outmigration subject to flows. Project site is within tidal influence.

Cowlitz surveys so far this year only had five adults. They are hoping they are just late. Decline seems mostly related to ocean conditions.

Pump Operation:

WSDOT explained pump screen rotates and back flushes to clear debris buildup and intended to help keep pit open. Old pump is single speed and new pump will be variable speed. Pump has not operated at times in the past because of breakdowns and rebuilding every couple years. Need lead time to have new pump built and time construction for in-water work window. How long of a lead time? Construction now delayed until summer 2020.

Old pump is ~40-50 years old. New pump life span is 20 years but anticipate maintenance will extend it beyond that to maybe 50 years.

Horseshoe Lake:

Around 2010 increase of docks in the lake. Now keeping lake level up higher for the docks. Frank Green stated the pumping design to 6000 gpm was stipulated by agreement with city of Woodland. WSDOT hasn't been able to meet 6000 gpm because the pump is aging. Regional Administration said WSDOT not meeting gpm agreement. Nathan stated that listing and current status of eulachon is new information since 1998 and would bring new information to agreement.

Pump Management to Minimize Effects to Eulachon:

With eulachon listing and current concerns over eulachon, the group discussed several potential ways to move forward?

1. Manage flows to reach 6000 gpm over the course of a year instead of constantly running the pump? E.g. a shut down during outmigration in exchange for full speed at other times of the year. Can the pump be shut off for duration of outmigration? Frank responded that it was driven by agreement with City to design to 6,000 gpm.
2. Peter Barber asked about letting gravity fed water entering through outlet. It was pointed out salmon were found in the lake in 2007. The outlet valve was thought the potential route of entry.

WSDOT added that the pump has been running 24/7 for past 8 months and city hasn't asked to shut it off.

A discussion of eulachon entrainment/ impingement followed and its relation to pumping rates. The square footage of screen not appropriate to calculate intake of eggs/lavae. Use volume of screen. Zone of intake velocity will be reduced with new pump but eggs/larvae will be in screened volume regardless if reduced pumping to 4000 gpm.

3. Is there a compromise volume between zero and 4000 gpm? Can there be a commitment to seasonally monitor outmigration to know when outmigration begins/ends?

4. Can aerators serve to avoid stagnation? There was a discussion that there was no clear definition of what "no stagnation" meant and what the standard when it was met. Nathan suggested using a combined approach with variable speed on the pump and sampling water quality. Other measures. A discussion ensued if other measures could be implemented to achieve water quality goal. One identified was in-lake aeration. Because it was a water quality issue, the rationale for leaving out the city was asked by Nathan. Frank Green responded that the obligation rested with the WSDOT. Nathan said that when thinking about avoiding stagnation - could there be a new study to inform the agreement. Sharon mentioned that water quality samples were recently taken and a new report was out.

Pump Pit Management

Paul Bakke, hydro-geomorphologist with USFWS, explained that excavating pit was likely to destabilize the riverbed and, based on his experience, in an active alluvial river, the pit would fill in. What maintenance would be needed if pit fills in?

Mike London explained that hydro dams control river flows and streambed movement. In 2004 a pit was excavated 12-15 feet deep in the streambed. There was "some" subsequent filling in but would also scour. New pit would be 10 feet further out than existing pump location and have tailout grading to streamline flows over intake pump. Paul Bakke noted there can still be channel downcutting and widening even with the dams.

No termination date of pumping commitment.

Next Steps

Scott Hecht, NMFS, stated that moving forward WSDOT will need to be creative with operation and maintenance. Operations will be built into the consultation. This is the time to "get it right" and minimize take of eulachon over the long term. Is ESA a one shot deal or is it ongoing? There can be adaptive management built in.

There was a discussion of educating the city of Woodland in light of changes since the 1998 agreement was made. It was noted that WSDOT (might have been Paul Harrison??) had told the HSL Management in 2011 of Cowlitz Tribes concern regarding eulachon. Nathan offered to do a presentation to the city regarding eulachon biology and importance to the tribe. WSDOT would look into getting Nathan on the Council agenda.

BA and subsequent Q/A is complete but depends on what happens with operations/design/maintenance.

Action Items

1. WSDOT will look into having Nathan Reynolds present eulachon life history to next Woodland city council.
2. WSDOT to respond to NMFS and USFWS engineering points sent out 2/19/2019.
3. Aaron Beavers will send a few more bullet points to group.

Appendix D: WSDOT follow up responses to questions from site visit #2

Scott,

As requested at the conclusion of the meeting on 2/27/19, WSDOT is providing responses to the questions you identified in your 2/19/19 email (April 2019 response to email questions.docx)[11]. These responses were coordinated with the Federal Highway Administration (FHWA), the Federal lead agency for this section 7 ESA consultation. A preliminary O&M Plan for the pump is also attached.

WSDOT and FHWA understand the concerns of NMFS and others about the ongoing eulachon take that will occur as a result of operation of the pump. We hope that the meeting also helped to clarify to NMFS the constraints that influence WSDOT's pump operations. Since at least 1999, the existing baseline of the site has been operation of a pump year round with the intent of pumping up to 6,000 gallons per minute (GPM), although actual rates have been highly variable. The pump operations as proposed in the Biological Assessment included year round operation at a rate of up to 6,000 gallons per minute.

In response to the NMFS' concern about the ongoing impact that pump operations would have on eulachon larvae, WSDOT will implement the following minimization measures to reduce estimated adverse effects on eulachon:

- From December 1 to March 15 of every year, limit operation of the pump to a maximum of 4,000 GPM

A complete seasonal shutdown of the pump will not support the purpose and need of the project and would constitute more than a minor change in the scope, duration, and timing of the proposed action. WSDOT and FHWA have incorporated reasonable minimization measures to reduce impacts, based on current information. We estimate that reducing volume from 6,000 GPM to 4,000 GPM will result in a 33% reduction in eulachon take.

Based on historic use of the pump and the best professional judgment of WSDOT engineering and maintenance staff, WSDOT has determined that seasonal reductions to 4,000 GPM will still meet the basic project need. WSDOT will also consider future pumping rate reductions, as feasible, as we become more informed over time about the new pump performance and resulting water quality conditions in the lake. At this time, we need to assume the 4,000 GPM rate to have adequate incidental take authorization. Given the uncertainty in long-term site conditions, our goal is to avoid repeated reinitiations of consultation because we have committed to pumping rates that are too low to meet our basic operational needs.

To address NMFS concerns regarding the ongoing nature of these operations and unknown future conditions, FHWA and WSDOT will implement the following adaptive management framework:

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[11] Appendix E below

- Annual coordination and reporting meetings between FHWA, WSDOT and NMFS. WSDOT would suggest holding these meetings in the fall to allow for the characterization of current lake conditions and forecasted pumping and maintenance operations, reporting on the previous winter's operations, and summarizing annual maintenance activities. During this meeting, we would ask NMFS to share information regarding the annual eulachon run and any other relevant status or scientific information and would respond to any questions raised about the information we provide.

WSDOT and FHWA submitted the Biological Assessment to NMFS on May 11, 2018. Since that time, we have provided supplemental information, answered all questions raised by NMFS, and conducted multiple site visits and meetings. The consultation has experienced significant delay with four months passing between the October 24, 2018 and the February 27, 2019 meetings called by NMFS. On February 6, 2019, Cindy Callahan of FHWA contacted Scott Anderson and Jennifer Quan of NMFS to express concern about the delay and request expediting of the consultation. With submittal of the attached information, we believe that there are no further outstanding information requests or outstanding issues that would prevent NMFS from moving ahead with the analysis of the effects of the proposed action and proceeding toward issuance of the Biological Opinion for the project.

I am requesting your further assistance with expediting this consultation.

Attachment to email:

Preliminary Operation and Maintenance Plan

I-5/WOODLAND VICINITY AT HORSESHOE LAKE – UPGRADE PUMP SYSTEM

Preliminary Operation and Maintenance Plan

Operations and maintenance (O&M) activities anticipated for the new pump and intake screen will include both mechanical and site activities. **Figure 1** at the end of this text shows a graphic of the ISI Retrievable Intake Screen that is to be installed. The new pump is installed within the framework of the ISI rail system. In addition to the ISI Retrievable Intake Screen, a grated steel platform or access decking will be installed at the top of intake screen to provide maintenance personnel access to the new pump and intake screen for routine inspection and maintenance activities.

Pile frames and Bank Protection

The pile supported screen and rail system will be constructed to accommodate a limited amount of scour or erosion around the base. Damage to the existing bank and riprap bank protection during construction of the new facilities will be repaired, and new erosion control rock will be placed during construction around the pile and access decking to limit erosion and the need for repair in the future. Following a flood event, the area will be inspected by WSDOT maintenance staff to determine if erosion or rock protection needs to be addressed. Any repairs would follow typical WSDOT maintenance procedures and would be subject to applicable laws and permit requirements (HPA, Corps permit, etc.) and would be conducted in compliance with the Regional Road Maintenance Program 4(d) guidelines. The current river bank is riprapped and scour around the current piles and intake screen has not been an ongoing issue. WSDOT anticipates that scour will not be a significant maintenance issue following construction.

Debris, logs or other material that is caught on the rail or support piling would be cleared from the structure and allowed to drift downstream. This process would be similar to the current maintenance activities and would likely involve a boat to pull large debris off the structure or hand removal of smaller debris. Any debris on the top or within the travel path of the screen assembly would be removed in a similar fashion. Based on observations of the current pump operations, WSDOT anticipates that removal of large debris around the structure frame and piles may occur approximately once every 5 years. Removal of smaller debris would be more common and completed on an as needed basis.

Intake Screen

The screen assembly includes two screen sections and a central transition frame that contains the screen cleaning system motors. The screen assembly rests on a rectangular opening with a debris rack over the pump suction area. An isolation slide gate is located behind the debris rack to isolate and protect the pump from debris and sediment when the screen is retrieved for maintenance or short-term shutdown and the pump station is off-line.

The intake screen is designed to allow inspection and maintenance activities to be conducted from the access deck. Screens are retrieved by closing the isolation gate between the screen assembly and the pump suction chamber and then raising the screen assembly up the rail system using the built-in hoist. The screen and hoist controls are located on the access platform. No access is needed down the bank to the screen or in the river to retrieve the screen. Maintenance of the self-cleaning brushes within the intake screen will be conducted per the manufacturer's recommendations. The screen drums are rotated in both directions with fixed brushes inside and outside removing sediment and debris. The cleaning cycle either is automatic, or it can be initiated manually at the control panel. If the screen drum cannot rotate due to debris, the screens will plug and the pump will automatically shut down to prevent damage to the pump.

Because the system will be new, WSDOT anticipates that the screens will require little to no maintenance for the first three years of operation. WSDOT maintenance staff will monitor the screen system for the first three years of operations and at that point develop a regular schedule for routine screen maintenance.

Mixed Flow Pump

The pump is installed in a casing constructed between the intake screen rails. The pump is installed and removed from the access deck area without need to enter the river or remove the fish screen. The pump column length will require special planning and equipment (such as a crane or ATV forklift) to remove and secure the pump casing according to manufactures instructions. These activities will require coordination with the Woodland Airport operations and may necessitate partial closure or notifications for air traffic.

Electrical and Instrumentation

O&M activities for the pump and screen electrical and instrumentation systems are common to electrical equipment. No special actions are required for the new equipment provided. Mechanical and electrical equipment maintenance will be recommended by the respective manufactures and will be outlined in equipment O&M Manuals to be provided with the equipment following fabrication. As part of the project, an automatic datalogger that will collect information regarding pumping rate and total gallons pumped will be installed. WSDOT maintenance personnel will collect data from this equipment monthly or conversely a wireless transmission system may be installed to directly transmit data to WSDOT staff.

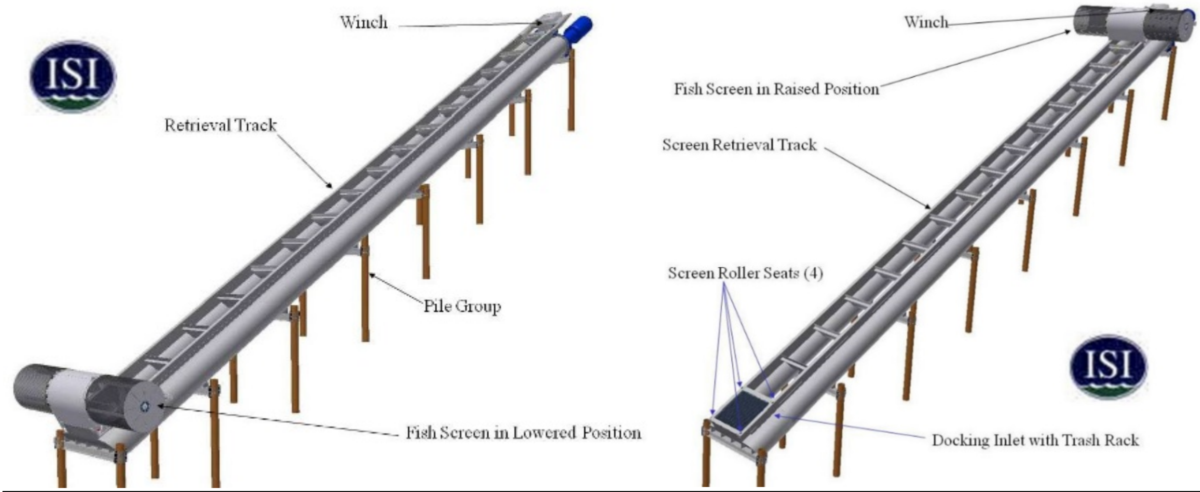
Intake and In-River Equipment

Hydraulically, the screens are intended to be freely suspended within the water column and fully submerged to meet fish screening requirements. The screens rely on sweeping flow from the river current to move debris off the screen and out of the influence area of the screen. If the sediment level is in contact with the screen drum and self-cleaning brushes not able to remove the sediment from the screens, as determined by visual inspection, maintenance should be performed as soon as possible. Depending on the severity (level of inundation), different actions can be taken:

Run the pump and screen cleaning system. If it can be determined the accumulations will not prevent the drums from rotating, the cleaning system can be activated, and the pump system used to flush material through the pump. The current into the screen and actions of the drum will create a zone around the screen where smaller suspended sediment can be moved. While the pump is in operation the automatic screen cleaning system will be activated.

Activate the sediment control jet system. If the pump and cleaner can be activated, the sediment control jet system can be used to agitate the sediment under and around the screen and intake box either allowing the river to move the material downstream and re-establishing a flow channel across the screen face, or suspending the material that would then be entrained in the pump discharge. This system is intended to be used for maintenance of the area around the screen at planned regular intervals when river conditions allow. Initially WSDOT intends to activate this system once per month, but will adjust as needed based on conditions. On at least an annual basis WSDOT will visually inspect the pit below the screen and determine if there have been significant changes to the level of the streambed and adjust the sediment control jet system operation as needed. The system may also be activated on an as needed basis prior to re-installing the screen after an outage or in anticipation of or during a high flow event as a preemptive measure to clear the area around the screen.

Physical/Mechanical sediment removal. If the screen is embedded to where the cylinders cannot rotate, or if WSDOT determines that it possible that the screens are obstructed, it will be necessary to physically remove sediment from the screen. If logs or significant quantities of sediment or debris are present on the screen or rail it may be necessary to bring an excavator or crane to the site for removal. Sediment removal from the area around the screen would be planned considering safety and environmental conditions. If possible, to prevent damage, the isolation gate should be closed and the screen assembly retrieved and secured at the service position prior to any excavation. Excavation or clearing activities should reestablish the "sump" around the screen intake area along with a relief channel downstream to re-establish a sweeping flow. It is not necessarily required that the "hole" be brought all the way back to "as built" conditions. At a minimum, the screen must be free to rotate and sweeping flow reestablished. Excavation may occur by hand by maintenance staff positioned within the river. If sedimentation is substantial then heavy equipment may be required. No permanent access ramps are proposed at part of this project for access to the river for maintenance, so equipment such as long-reach excavators, cranes or clamshell systems may be required. The need for mechanical sediment removal is dependent on river conditions and will vary. For initial planning we anticipate major maintenance requiring excavation by hand or using heavy equipment to occur every 7 to 10 years.



Screen in Operating Position Screen Retracted for Maintenance

(Photos courtesy of Intake Screens, Inc (ISI))

Figure 1: Isometric View of ISI Type Inclined Pump and Screen Assembly

Appendix E: WSDOT responses to Scott Hecht February 19, 2019 email

WSDOT response to topics and questions presented in 2/19/19 email from Scott Hecht to Frank Green

NMFS QUESTION: Clarify details on the agreement/contract between WSDOT and the City of Woodland. General purpose appears two fold- to keep lake from becoming stagnant, and to maintain certain water levels. What criteria are used to determine when stagnation is a problem and what water levels are required? Further discussion with WSDOT may assist in determining whether other measures could be used to avoid stagnation.

The legal obligation of WSDOT, relative to maintenance of the Horseshoe Lake pump, dates back to the original permit issued on January 19, 1939 by the federal government for the channel change of the Lewis River. No copy of this permit is available. WSDOT has found mention of it in a 1957 letter from the Washington State Highway Commission Secretary Lorenz Goetz to the Mayor of the City of Woodland Earle Bryant. The letter indicates that the 1939 permit forms the basis for an obligation to maintain enough flow of water in the lake to "prevent stagnation" according to the Highway Commission and an interpretation by the Assistant Attorney General. The term "stagnation" has never been defined by WSDOT or any other stakeholders. It was WSDOT's position in the letter that WSDOT does not assume responsibility for maintaining a certain water level in the lake. Specific duties associated with this obligation were clarified in an April 15, 1998, agreement between WSDOT and the City of Woodland. The agreement with the City states that WSDOT "has agreed to help minimize the stagnation in Horseshoe Lake by pumping water from the Lewis River". **Copies of these documents were provided to NMFS on 8/9/2018.**

In addition to the above information, more recent conversations have centered around water quality in the Lake. Historically the lake has suffered from water quality issues that periodically require the lake to be closed to recreational use. In 1991-1992, researchers from the UW Department of Civil and Environmental Engineering conducted an intensive yearlong study of Horseshoe Lake to determine the lake's trophic state, compute water and nutrient budgets for the lake and recommend appropriate restoration techniques. The study was a joint effort between Cowlitz County, Clark County, City of Woodland, and WSDOT. WSDOT funded $5000 toward the study. The final report "Horseshoe Lake Quality, Nutrient Loading and Management" (also known as the Phase 1 report), made recommendations of various actions to take in order to improve the lake quality. Specific to the pump, the report recommended increasing the flow of water to the lake from the approximately 3,000 GPM that was currently being pumped. Following receipt of the report, the City of Woodland and WSDOT took steps to implement the recommendations, including the recommendation to increase the pumping rate. In 1993, the City of Woodland applied for funding from the Washington State Department of Ecology to secure a block grant to implement the Phase II Horseshoe Lake Restoration Project. The project was selected for Ecology funding and the City and WSDOT proceeded to develop plans and obtain permits to implement the recommendation. In 1998, the City and WSDOT signed an agreement related to the replacement of the pump and increase in the pumping rate. The agreement, dated April 15, 1998, outlines the responsibilities of each party. In summary, WSDOT agreed to minimize the stagnation in Horseshoe Lake by pumping water from the Lewis River, the City agreed to use the grant from the Department of Ecology for improvement of water quality in the lake, and WSDOT was to provide a portion of the local match as required by the Ecology grant not to exceed $95,900. The City also agreed to execute the terms, conditions and requirements of the Ecology Grant Agreement, which was attached to the WSDOT/City of Woodland agreement as Exhibit A. Exhibit A includes the following requirement "Increase pumping capacity to 6,000 gpm to increase the flushing rate of the lake, maintain high water levels, and prevent thermal stratification". The agreement also outlined ongoing maintenance and operation duties for the City and WSDOT. There is no more recent agreement in place between the City and WSDOT. Sometime in early 1999 the pump was replaced with a pump designed to meet the 6,000 gpm rate. Pump logs obtained for 1999 and 2000 show that the new pump was routinely running between 4,000 and 6,000 gpm. Pumping of lower rates in recent years is a result of decreased pump performance rather than a desire to pump less than the 4,000 to 6,000 gpm that the pump was designed in 1999 to pump. All of the documentation and supporting information referenced in this answer was provided to NMFS on 8/9/2018.

NMFS QUESTION: Operation and maintenance plan of pumping operations:
An operation and maintenance plan that includes how often self-cleaning mechanism would operate, how often jets would be turned on, pit maintenance, documentation and an adaptive management strategy to ensure the screen is operating effectively is needed to evaluate the effects of the action.
An evaluation of the effects of maintenance and operation of the proposed pump should be considered in the context of the current baseline conditions, which include regular, routine maintenance activities associated with the existing pump. The following describes the current maintenance and operational activities that are occurring at the site.
Sump Excavation-The sump associated with the current pump requires cleaning approximately every 7 to 10 years. Excavation of the sump was conducted in approximately 2004 and 2011. In 2004, the pit was excavated to an elevation of approximately 12 feet below the riverbed, 28 feet in diameter, and 2:1 slope. The pit was dug using an excavator that was stationed on the dock. This excavation was conducted because accumulated sediment in the pit was affecting operation of the pump. In 2011, at the request of the City of Woodland during a high water event, WSDOT cleaned the sump of large woody debris that had collected around the pump and within the pit. Minimal sediment had accumulated in the pit. WSDOT excavated by hand, approximately four 5-gallon buckets full of sediment from the pump pit. Operation of the pump was not affected by the amount of debris or sedimentation and the action was taken at the request of the City of Woodland. Since that time, additional maintenance of the sump has not been necessary. During periods of low water WSDOT maintenance staff visually inspect the bottom of the pit. The depth of the sump is currently sufficient and there is no need to dredge the sump. WSDOT maintenance staff have observed that the river is dynamic and there may be periods characterized by increasing sedimentation in the sump, but these periods are then followed by scour events that will clear the sump and return it to roughly its previous depth. There has been no specific cycle identified with the scour and depositional events. They have varied seasonally and with various dam releases and tributary flow levels.
Debris Removal- Large trees and debris are removed from the pump structure approximately once every 5 years. In the past 15 years, large debris has been removed from the structure approximately 3 times. Debris is removed by WSDOT maintenance staff by tying a line to it and pulling it by boat off the structure. Once clear of the structure it is released and allowed to drift downstream. Small debris is removed from the structure more routinely when observed by

maintenance. Small debris is pulled off the structure with a pole and allowed to drift from the site.

Screen Cleaning- The agreement with the City of Woodland requires the City to clean the screens at least once per month. In 2018, WSDOT requested that the City increase the screening to twice per month. The existing pump wet well is anchored to the bottom of the river and is approximately 3x4x12ft, containing 1,000 gallons. The pump is contained within the stationary wet well box, screens are on the outside of the wet well on vertical rail system. Screen cleaning requires raising the screens vertically along the metal rails to the height of the dock. See photo below. Once raised they are hosed off with debris washing down into the river. Since the screens are on the outside of the pump structure and are set into the bed of the river, raising the screens off the riverbed likely causes a small sediment plume in addition to the debris that is hosed off into the river. Once cleaning is complete, the screens are lowered back onto position. It should be noted, if there are any obstructions on the riverbed it is possible that when lowered the screens do not sit entirely flush with the riverbed. In this case, a gap would occur at the base of the screen and juvenile fish could potentially access the wet well of the pump and pass through the pump.

Pump Maintenance: The current pump is on an every other year rebuild schedule due to state of disrepair. In reality, the pump is being rebuilt approximately every 5 years due to lack of funding. The pump is removed in compliance with the WDFW HPA. The pump, which is located in the wet well is lifted via a crane on dock to pick up the pump shaft. The pump shaft is then placed on a truck and removed for servicing. Following repair the pump is reinstalled. Because the pump shaft is located within the wet well, and all work to remove it is completed from the dock, it is likely that there is limited turbidity associated with this activity.

Other Routine Maintenance: Additional maintenance actions are conducted as the need arises. In the past WSDOT has replaced the flow meter associated with the pump and installed an automatic float switch. The float switch will shut off the pump when river water levels are low.

Preliminary Operation and Maintenance Summary For the New Pump
Please see the attached *Preliminary Operation and Maintenance Plan*. To summarize the general operations and maintenance schedule, WSDOT anticipates that maintenance actions taken with the new pump will occur at generally similar intervals as with the current pump. The automatic rotating screen cleaning system will be active at all times when the pump is in operation. WSDOT anticipates activating the jet cleaning system on a once per month cycle and will adjust as needed based on visual monitoring of the system. Based on historic observations regarding sediment transport of the river and the impact to pump operations, WSDOT anticipates that sediment excavation from the sump under the intake screen will occur approximately every 7 to 10 years. This removal is likely to occur in a similar manner to the 2011 by hand sump cleaning due to the difficulty of reaching the sump with heavy equipment once construction is completed. No permanent access ramps are proposed as part of this project so equipment such as long-reach excavators, cranes or clamshell systems will be required if a larger excavation action is necessary. All maintenance actions will be conducted in compliance with applicable laws and permit conditions. No work will be conducted until necessary permits have been acquired.

Development of an adaptive management framework to address potential uncertainties in screen and pump operations/maintenance e.g., the frequency and magnitude of maintenance.
See Preliminary Operation and Maintenance Plan. WSDOT maintenance staff will maintain all equipment based on manufacturers recommended maintenance schedules and will adjust as needed to address any emergent issues. WSDOT maintenance staff will visit the pump approximately monthly in the first few years of operation to assess operations. WSDOT maintenance staff have the equipment, skills, and resources to address maintenance needs as they arise and respond accordingly. Pump operations will be adjusted as needed based on river flow and lake conditions.

How will WSDOT address sediment filling in the pit near the screen? What is the emergency plan to clear the pit? What is the response if the pit causes upstream headcutting and bed destabilization?
As discussed above and in the Preliminary Operation and Maintenance Plan, WSDOT will respond to potential sediment filling of the pit in essentially the same manner that currently occurs in the existing pump sump. As needed, hand or equipment excavation will be conducted. There would be no “emergency” clearing of the pit. If the pit fills in to a point that the pump is not operational, WSDOT would proceed under normal maintenance and permitting procedures to obtain all appropriate funding, equipment, and permits to excavate the pit. WSDOT would not take “emergency” action to clear the pit.
Since 2004, WSDOT has not observed any significant signs of headcutting or bed destabilization associated with the existing pit. WSDOT would anticipate that the pit associated with the new pump would also not result in significant headcutting or bed destabilization. The river in this location is approximately 700 feet wide. No future channel work is proposed beyond the current construction activities.

We have insufficient information on the streambed composition and condition, bedload sediment sources, volume and size characteristics, and frequency and duration of sediment movement to assess the magnitude of the maintenance and destabilization problems presented by the streambed pit.

As stated above and in the Preliminary Operation and Maintenance Plan, WSDOT maintenance staff have been maintaining the sump around the existing pump since at least 2004 and have extensive firsthand knowledge of the river dynamics at this site, going back for many years before that. Based on historic use of the pump and the best professional judgment of WSDOT engineering and maintenance staff, maintenance of the pit is anticipated to be similar in nature to that of the existing pump. The river is a dynamic system and there is no way to accurately predict future conditions. However, WSDOT is using the information and observations available as a basis for future expectations. WSDOT will respond to future conditions as they arise and maintain the site as appropriate.