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

May 10, 2023

https://doi.org/10.25923/2vsb-n377

Refer to NMFS No: WCRO-2022-02707

Susan Poulsom,
Section Manager, NPDES Permitting Section
United States Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the National Pollutant Discharge Elimination System permit for Chief Joseph Dam (WA0026891).

Dear Ms. Poulsom:

Thank you for your letter of October 11, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the National Pollutant Discharge Elimination System permit for Chief Joseph Dam (WA0026891). The Environmental Protection Agency (EPA) proposes to finalize the permit, which will allow the discharge of specific levels of pollutants to waters of the State of Washington and of the Confederated Tribes of the Colville Reservation (CTCR). Chief Joseph Dam is a federal facility operated by the U.S. Army Corps of Engineers (USACE) on the Columbia River.

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

After reviewing the current status of the species, the environmental baseline, the effects of the proposed action, and the cumulative effects, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of ESA-listed Upper Columbia River (UCR) steelhead (*Oncorhynchus mykiss*). We also concur with the EPA that the proposed action is not likely to adversely affect UCR spring-run Chinook salmon or designated critical habitat for either UCR spring-run Chinook salmon or UCR steelhead. We provide rationale for our conclusions in the attached opinion. This opinion is based on information provided in your biological evaluation, additional information we requested that was provided by EPA and USACE, and other sources of information as cited.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the opinion. The ITS describes reasonable and prudent measures (RPM) that NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth terms and conditions, including reporting requirements, that the EPA must comply with in order to be exempt from the ESA take prohibition.

Please contact Lynne Krasnow, Columbia Hydropower Branch, Portland, OR, at (503) 347-7571, lynne.krasnow@noaa.gov, if you have any questions concerning this consultation or if you require additional information.

Sincerely,

Nancy L Munn

Nancy L. Munn, Ph.D.
Acting Assistant Regional Administrator for
Interior Columbia Basin Office

Enclosure

cc: [*File*]
Martin Merz, EPA, merz.martin@epa.gov
Jennifer Wu, EPA, wu.jennifer@epa.gov;
John Palmer, EPA, palmer.john@epa.gov

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

National Pollutant Discharge Elimination System Permit

for Chief Joseph Dam (WA0026891)

NMFS Consultation Number: WCRO-2022-02707

Action Agency: U.S. Environmental Protection Agency, Region 10

Affected Species and NMFS's 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?
Upper Columbia River spring-run Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered	No	N/A	No	N/A
Upper Columbia River steelhead (*O. mykiss*)	Threatened	Yes	No	No	N/A

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

Issued By: Nancy L Munn

Nancy L. Munn, Ph.D.
Acting Assistant Regional Administrator for Interior Columbia Basin Office

Date: *May 10, 2023*

TABLE OF CONTENTS

Table of Tables

Table of Figures

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

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

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600. We do not agree with EPA's determination that the proposed action would not adversely affect EFH for Pacific salmon due to effects on rearing habitat in Foster Creek as explained in Section 3.

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 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at NMFS's office in Portland, Oregon.

1.2. Consultation History

The U.S. Environmental Protection Agency (EPA) proposes to finalize and issue a National Pollutant Discharge Elimination System (NPDES) permit to the U.S. Army Corps of Engineers (USACE) for discharges from Chief Joseph Dam to waters of the State of Washington and of the Confederated Tribes of the Colville Reservation (CTCR). In July, 2020, NMFS completed consultation on the operation of the Columbia River System (CRS) with the USACE, U.S. Bureau of Reclamation (Reclamation), and U.S. Department of Energy - Bonneville Power Administration (BPA), collectively referred to as the CRS Action Agencies, and issued an opinion for the Continued Operation and Maintenance of the Columbia River System (CRS; WCRO 2020-00113), which includes Chief Joseph Dam (NMFS 2020). EPA was not an action agency for the 2020 consultation for activities they authorize or permit associated with these federal facilities. Thus, EPA has requested to consult with NMFS on its proposed issuance of the NPDES permit for discharges at this project.

The Clean Water Act (CWA) prohibits any entity from discharging "pollutants" through a "point source" into a "water of the United States" unless it has an NPDES permit. The NPDES permit contains limits on what can be discharged, includes monitoring and reporting requirements, and has other provisions to ensure that the discharge does not harm water quality or human health. Pre-consultation discussions with EPA began in September, 2021, when EPA provided information it expected to include in the draft NPDES permit. NMFS and EPA had pre-consultation discussions related to the proposed NPDES permit in December, 2021, through November, 2022. In these exchanges, NMFS provided technical information to EPA on the spatial and temporal distribution and the biological requirements of ESA-listed species, and on EFH requirements for Chinook and coho salmon. EPA sent NMFS a draft biological evaluation (BE) on July 18, 2022, and NMFS provided feedback to EPA, and written comments, September 23, 2022.

On October 11, 2022, EPA provided a final BE for the proposed action (EPA 2022a) and requested NMFS' concurrence with its determinations that issuance of the proposed permit was not likely to adversely affect Upper Columbia River (UCR) spring-run Chinook salmon or UCR steelhead or their designated critical habitat under Section 7(a)(2) of the ESA and would not adversely affect EFH for Pacific Coast salmon under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). After reviewing the BE, we were unable to concur with EPA's Not Likely to Adversely Affect determination for UCR steelhead and explained our reasoning in a meeting on November 18, 2022. EPA sent us an email on December, 1, 2022, expressing interest in proceeding with formal consultation, which we initiated on that date.

On December 15, 2022, NMFS sent letters to the Confederated Tribes of the Colville Reservation, the Spokane Tribe of Indians, the Nez Perce Tribe, the Coeur d'Alene Tribe, the Kootenai Tribe, the Shoshone-Bannock Tribes, the Kalispel Tribe of Indians, the Cowlitz Indian Tribe, the Confederated Tribes of Warm Springs, the Confederated Tribes of Grand Ronde, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes and Bands of the Yakama Indian Reservation to gauge their interest in government-to-government consultation or the exchange of technical information for this project. We also sent a letter to the Confederated Tribes of the Siletz Indians of Oregon on December 21, 2022. We had not received responses to these inquiries at the time we completed this biological opinion**.**

The BE provides a description of the proposed permit and an analysis of its effects on anadromous fish species, designated critical habitat, and essential fish habitat in the Columbia River. The present opinion and MSA consultation are based on information provided in the BE, and in the draft NPDES permit and the technical fact sheet (EPA 2022b and 2022c, respectively); existing analyses in the CRS opinion (NMFS 2020); and the Clean Water Act Section 401 certifications issued by the State of Washington (WDOE 2022) and the Confederated Tribes of the Colville Reservation (CTCR 2022). This consultation is not a reinitiation of the CRS opinion, and this new opinion does not replace the CRS opinion. We incorporate by reference relevant portions of the CRS opinion, provide information and additional analysis specific to the EPA's proposed issuance of this NPDES permit, and specify Reasonable and Prudent Measures and Terms and Conditions (RPM/T&Cs) that are applicable to EPA and the permit applicant, the USACE.

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

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02).

Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The EPA Region 10 is proposing to issue an NPDES permit for the discharge of pollutants to waters of the State of Washington and of the Confederated Tribes of the Colville Reservation (CTCR) from Chief Joseph Dam, a federal facility operated by the USACE on the Columbia River. This would be the first individual NPDES permit issued by EPA for this facility and would be effective for five years. The permit would authorize the following types of discharges: equipment cooling water, equipment and floor drain water, equipment backwash strainer water, and specific maintenance waters. The proposed permit also authorizes daily maximum effluent concentrations in stormwater discharges from a maintenance/refueling yard at the project to Foster Creek, a tributary to the Columbia River.

The proposed NPDES permit also addresses Section 316(b) of the CWA, which seeks to minimize adverse effects from cooling water intake structures (CWIS) on fish and which EPA applies to facilities with an NPDES permit (EPA 2022a). In the case of Chief Joseph Dam, the CWIS is located on the upstream face and does not affect ESA-listed steelhead or its designated critical habitat. We do not discuss aspects of the proposed permit that affect its operation further in this opinion.

We adopt by reference EPA's description of the proposed action contained in Section 2 of the BE. The proposed permit regulates the discharges of pollutants produced at the dam, and not those originating in water that flows over the spillway or passes through the turbines. The permit also does not authorize oil spills. It contains the following requirements and stipulations that have the potential to affect UCR steelhead or its designated critical habitat:

- Numeric effluent limits on discharges for oil and grease, pH, and heat.
- Narrative effluent limits restricting visible oil sheens; floating and suspended, submerged matter; and toxics.
- The use of environmentally acceptable lubricants (EALs), unless technically infeasible.
- Monitoring requirements for flow, oil and grease, pH, temperature, and polychlorinated biphenyls (PCBs), and in some outfalls, total suspended solids and chemical oxygen demand.

- A detailed best management practices (BMP) plan and BMP annual report to prevent and minimize oil releases, including oil accountability tracking.
- An EAL annual report to inventory equipment where EALs may be used and to report when and where EALs have been implemented.
- A PCB Management Plan and PCB Annual Report to inventory past actions to reduce/remove PCBs, identify potential current sources, and describe actions to reduce those sources.

The proposed permit requires that toxics be discharged in amounts that would not impair or harm designated beneficial uses[1] including aquatic life, and requires the USACE to use lubricants, paint and caulk that do not contain PCBs, unless technically infeasible. The proposed permit also requires the facility to submit a PCB management plan that characterizes sources of PCBs and describes how those sources will be controlled. The PCB Annual Reports must describe how the permittee is implementing the PCB Plan, evaluate the effectiveness of actions, and propose any new steps to optimize their effectiveness.

The proposed action also includes permit conditions added by the Washington Department of Ecology (WDOE) and the CTCR through their Clean Water Act section 401 certifications. We adopt by reference here the sections titled "Water Quality Certification Conditions" in WDOE (2022) and "General Conditions" in CTCR (2022). None of the conditions added to the permit will have negative effects and several are likely to benefit UCR steelhead and its critical habitat, which is designated in the mainstem portion of the action area. These include:

- The USACE must implement temperature control strategies to meet the load and waste load allocations in the final Columbia River Temperature total maximum daily load (TMDL)
- The USACE must achieve water quality standards of the Colville Reservation and the State of Washington; it must consult also with WDOE to develop a Water Quality Attainment Plan with a detailed strategy for achieving the state's water quality standards for temperature and associated beneficial uses.
- Except during involuntary spill events, dam operations—including spill to enhance fish passage—should not cause or contribute to exceedance of the applicable total dissolved Gas (TDG) water quality criteria or any short-term modification thereto authorized under Washington's or the CTCR's Water Quality Standards.
- The USACE must implement TDG abatement strategies and meet the load allocations stated in the Mid-Columbia River and Lake Roosevelt Total Dissolved Gas Total Maximum Daily Load issued June 2004.
- The USACE must monitor for evidence of gas bubble trauma during the fish spill season, in accordance with the requirements of a Water Quality Attainment Plan to be submitted to WDOE.

[1] Designated beneficial uses in the mainstem portion of the action area include core summer habitat for salmonids. At the point of discharge from Outfall 45, Foster Creek is protected for salmonid spawning, rearing, and migration (WAC 173-201A-600). Waters within the mainstem portion of the action area that are part of the Colville Reservation are protected for salmonid migration, rearing, and spawning, and harvesting (EPA 2022c).

- The EPA must ensure additional levels of review of the USACE's BMP, EAL, and PCB Management Plans

The USACE is required to develop the monitoring plan for gas bubble trauma during the 5-year term of the proposed permit. At this time, details of the monitoring plan such as the methods and gear types, target species, and the spatial and temporal extent of sampling are unknown. If USACE's adoption of a monitoring plan may affect listed species, any take of listed salmon or steelhead associated with that plan would be the subject of a separate ESA section 7 consultation.

1.4. Other Activities Caused by the Proposed Action

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

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

The EPA (2022a) determined the proposed action is not likely to adversely affect UCR spring-run Chinook salmon or UCR steelhead or critical habitat designated for either of these species. Our concurrence with EPA's determination for UCR spring-run Chinook salmon and it's designated critical habitat is documented in Section 2.11, "Not Likely to Adversely Affect" Determinations.

2.1. Analytical Approach

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

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

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

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

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

- Evaluate the rangewide status of the species expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species.
- Evaluate the effects of the proposed action on the species 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, analyze whether the proposed action is likely to 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.
- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

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

2.2.1. Status of the Species

For Pacific salmon, steelhead, and other relevant species, NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany et al. 2000). These "viable salmonid population" criteria therefore 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. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

"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 fundamentally 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 at 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, NMFS assesses 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 summary that follows describes the status of UCR steelhead as considered in this opinion. More detailed information can be found in the listing regulations published in the Federal Register (71 FR 834 January 5, 2006), the 5-year status review (NMFS 2022), the recovery plan (UCSRB 2007), and the biological viability assessment report (Ford 2022). We incorporate the information in these additional documents by reference and these documents are available on the NMFS West Coast Region website (https://www.westcoast.fisheries.noaa.gov).

The Upper Columbia River (UCR) steelhead distinct population segment (DPS) was listed as endangered on August 18, 1997 (62 FR 43937), and their status was downlisted to threatened on January 5, 2006 (71 FR 834). On August 16, 2022, in the agency's 5-year review for UCR steelhead, NMFS concluded that the species should remain listed as threatened (NMFS 2022). The UCR steelhead DPS is composed of a single major population group (MPG) which includes four naturally-spawned anadromous steelhead populations: Methow River, Okanogan River, Entiat River, and Wenatchee River. The DPS includes all naturally-spawned anadromous *Oncorhynchus mykiss* (steelhead) below natural and artificial impassable barriers in streams within the Columbia River Basin, upstream from the Yakima River, Washington, to the United States–Canada border, as well as six artificial propagation programs: the Wenatchee River, Wells Hatchery (Methow and Okanogan Rivers), Winthrop National Fish Hatchery, Omak Creek and the Ringold steelhead hatchery programs. Two additional steelhead MPGs likely spawned above Grand Coulee and Chief Joseph Dams, but have since become extirpated (Figure 1), and UCSRB (2007) determined that reintroduction was not required for ESA recovery. NMFS defines the UCR steelhead DPS to include only the anadromous members of this species (70 FR 67130; November 4, 2005).

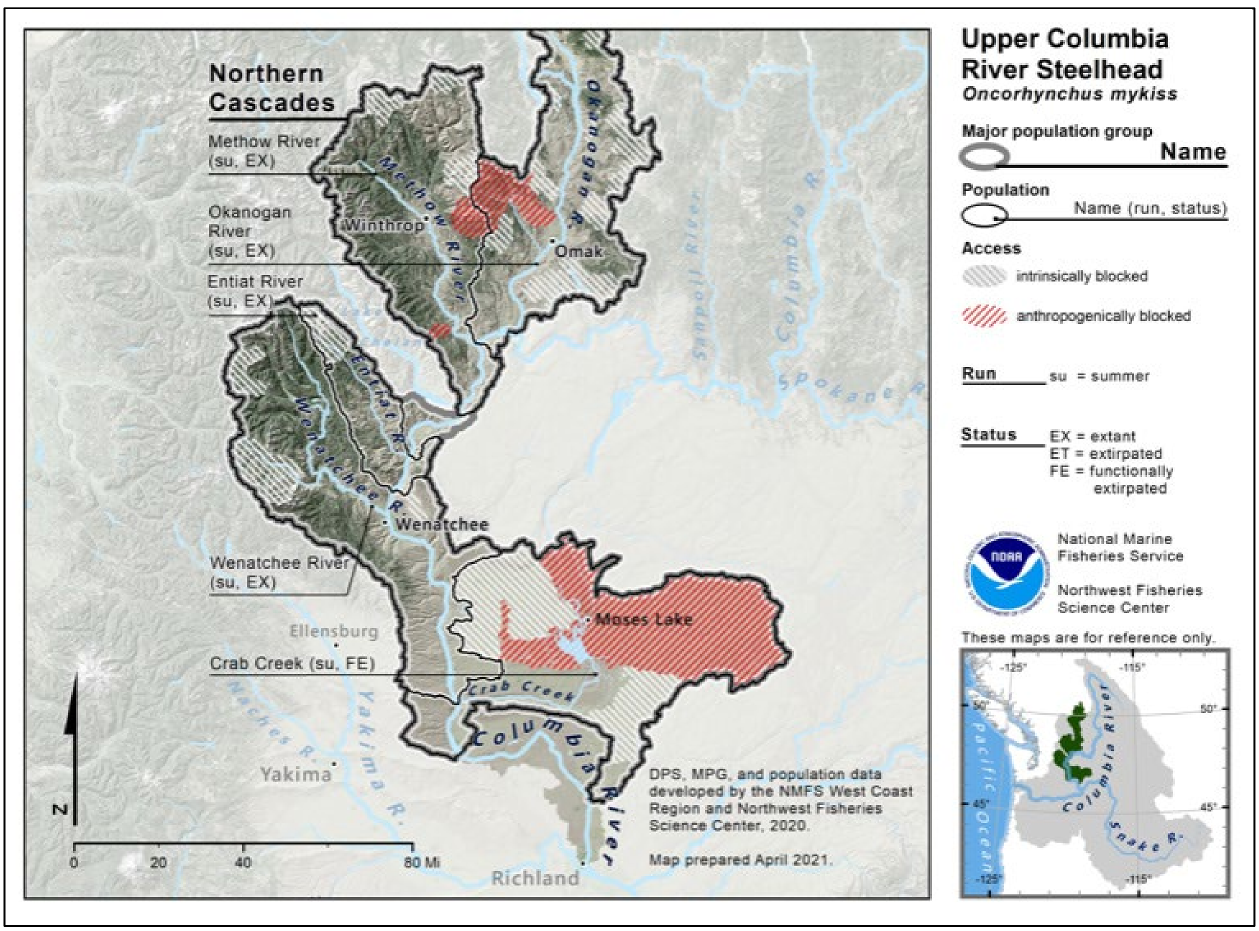

Figure 1. Map of the UCR steelhead DPS's spawning and rearing areas, illustrating populations and major population groups. Source: NWFSC (2015).

Factors contributing to the decline of UCR steelhead included the intensive commercial fisheries in the lower Columbia River that began in the latter half of the 1800s, continued into the 1900s, and nearly eliminated many salmon and steelhead stocks. With time, the construction of dams and diversions, some without passage (including Chief Joseph Dam), blocked or impeded salmon and steelhead migrations. Development has reduced the quality of shoreline habitat by eliminating native riparian vegetation, displacing shallow water habitat with fill material, and disconnecting the mainstem from its historical floodplain. Survival in the mainstem migration corridor is limited by the predation of UCR steelhead smolts by both native and introduced fish and by Caspian terns. In addition, non-native species that were introduced by both public and private interests have directly or indirectly affected salmon and steelhead (UCSRB 2007).

Early hatchery programs, designed to mitigate the impacts of dams on fish passage and spawning and rearing habitat, transferred fish among basins without regard to their origin. While these practices increased the abundance of stocks, they also decreased the genetic diversity and productivity of the populations they intended to supplement. The proportions of hatchery-origin returns in natural spawning areas remain high across the DPS, especially in the Methow and Okanogan River populations (NWFSC 2015). However, the management of fish being propagated in various hatchery programs has changed recently to focus on individual populations, using only fish from within that population (NMFS 2022).

Human population growth and land uses that have adversely affected UCR steelhead spawning and rearing habitat occurred at the same time as these other activities that have increased viability risk. Conservation partners are implementing many tributary habitat restoration projects across the DPS to improve habitat conditions for steelhead spawning, rearing, and migration. However, widespread areas of degraded habitat persist, including simplified stream channels, disconnected floodplains, impaired instream flows, and the loss of cold water refugia (NMFS 2022). An emerging risk is climate change and consequent threats to the juvenile rearing stage, which is vulnerable to low stream flows and high stream temperatures.

Life history. The life-history pattern of steelhead in the UCR DPS is complex. Adults return to the Columbia River in the late summer and early fall. Unlike some species of salmon, most steelhead do not move upstream quickly to tributary spawning streams. A portion of the returning adults overwinters in the mainstem reservoirs, passing into tributaries in April and May of the following year. That is, spawning occurs in the late spring of the year following entry into the Columbia River. Juveniles generally spend 1 to 3 years rearing in freshwater before migrating to the ocean, but have been documented spending as many as 7 years in freshwater. Most adults return to the upper Columbia after 1 or 2 years at sea.

Abundance and Productivity. The most recent estimates (2015-2019 5-year geometric mean) of total and natural-origin spawner abundance have declined dramatically (ranging from 28 to 63 percent reductions), largely erasing gains observed over the past two decades for all four independent populations (NWFSC 2015; Ford 2022). Recent declines are persistent and large enough to result in small, but negative 15-year trends in abundance, for all four populations. Annual brood year return-per-spawner estimates have been well below replacement in recent years for all four populations, and natural production has also declined consistently, resulting in an increasing fraction of hatchery fish on the spawning grounds each year. The Wenatchee River population has somewhat higher productivity than the remaining populations in the DPS, but still falls into a high-risk category due to the recent downward trend in both abundance and productivity. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5 percent extinction risk. For these reasons, the integrated abundance/productivity metric for all but the Wenatchee River population (moderate risk) remains at high risk.

Spatial Structure and Diversity. Spatial structure is rated at low risk for the Wenatchee and Methow populations, moderate risk for the Entiat population, and high risk for the Okanogan population (Ford 2022). Each extant natural population is considered at high-risk for diversity, largely driven by high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations. The basic major life history patterns (summer A-run type, tributary and mainstem spawning/rearing patterns, and the presence of resident populations and subpopulations) appear to be present (Ford 2022). Hatchery-origin returns continue to constitute a high fraction of total spawners in natural spawning areas for this DPS. The spawning aggregation of UCR steelhead in Foster Creek is considered part of the Okanogan River population (UCSRB 2007) by NMFS. The integrated spatial structure/diversity risk rating for all populations is characterized as high.

Recovery. The ICTRT (2007) recommended that three populations meet viability criteria, two of which meet high viability criteria for the DPS to be viable; the rationale behind this recommendation is because of the relatively low number of extant populations remaining in the DPS. The final recovery plan (UCSRB 2007) adopted by NMFS established a recovery goal of securing long-term persistence of viable populations of naturally produced steelhead distributed across their native range. The UCSRB identified five recovery criteria that address the viable salmonid population (VSP) metrics of abundance, productivity, spatial structure, and diversity. For recovery, the UCSRB recommended that all steelhead populations within the DPS, except the functionally extirpated Crab Creek population, meet abundance/productivity criteria that represent a 5 percent extinction risk over a 100-year period. In addition, the UCSRB recommended that naturally produced steelhead utilize four of the five major spawning areas in the Wenatchee subbasin, two major spawning areas within the Entiat subbasin, three major spawning areas in the Methow subbasin, and two of the major and minor spawning areas in the Okanogan subbasin. NMFS adopted the UCSRB recommendations as the recovery scenario. To achieve these criteria, significant improvement in all four VSP parameters is needed.

Many restoration and protection actions have been implemented in freshwater tributary habitat since 2015, but those actions do not change overall trends in habitat quality, quantity, and function. Habitat conditions throughout the range of the UCR steelhead DPS continue to limit recovery of the species, particularly with regard to water quality, water quantity, riparian condition, and floodplain function. The greatest opportunities to advance recovery of the species over the next five years include: (1) prioritizing actions that improve habitat resilience to climate change; (2) reconnecting stream channels with floodplains; (3) implementing restoration actions at watershed scales; and (4) reducing pinniped predation on adults returning to the lower Columbia River (NMFS 2022).

Crozier et al. (2019a, and 2019b) concluded that UCR steelhead have a high risk of overall climate vulnerability based on their high risk for biological sensitivity, high risk for climate exposure, and moderate capacity to adapt. Adult UCR steelhead are vulnerable to high stream temperatures during freshwater migration and spawning. However, the impact of climate change specifically on marine survival is uncertain. Risk during early life history is low because of the high elevation and relatively stable flows that influence the egg stage. However, the risk is high for the juvenile freshwater rearing stage because of the year-around reliance on freshwater habitat and sensitivity to changes in summer flows and stream temperatures. UCR steelhead may have some latitude to shift timing of adult migrations to avoid peak late summer temperatures (Robards and Quinn 2002), but the consequences of such timing shifts are not known. In each river population, individuals occupying the mid-to-lower reaches are subject to annual high stream temperatures and summer water deficits, and there are limited opportunities to shift juvenile rearing patterns. Anadromous *O. mykiss* may have some opportunities to expand summer rearing and overwintering to habitat areas upstream, but the amount of suitable habitat is limited compared to the potential loss of habitat in downstream reaches.

Summary. The overall viability of the UCR steelhead DPS remains largely unchanged from the prior 5-year review (NWFSC 2015; Ford 2022). Natural origin abundance has decreased over the levels reported in the prior review for all populations in this DPS, in many cases sharply. The abundance data for the entire DPS show a downward trend over the last 5 years, with the recent 5-year abundance levels for all four populations declining by an average of 48 percent. Relatively low ocean survival in recent years was a major factor in recent abundance patterns. There are high levels of hatchery spawners within natural spawning areas and a lack of genetic diversity among the populations. Based on the combined risk ratings for the VSP parameters, all four populations in the UCR steelhead DPS remain at a high overall risk. In order to achieve recovery, it is essential to continue implementing habitat protection and restoration actions directed at key limiting factors.

Limiting Factors. Limiting factors for this species include (UCSRB 2007):

- Adverse effects related to the mainstem Columbia River hydropower system.
- Impaired tributary conditions, including fish passage.
- Degradation of floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality.
- Hatchery-related effects.
- Predation and competition, including predation of smolts by both native and introduced fish, and by birds.
- Harvest-related effects.

2.2.2. Climate Change

Climate change generally exacerbates threats and limiting factors, including those currently impairing salmon and steelhead survival and productivity. The growing frequency and magnitude of climate change related environmental downturns will increasingly imperil many ESA-listed stocks in the Columbia River basin and amplify their extinction risk (Crozier et al. 2019a, and b; 2020; 2021). This climate change context means that opportunities to rebuild these stocks will likely diminish over time. As such, management actions that increase resilience and adaptation to these changes should be prioritized and expedited. For example, the importance of improving the condition of and access and survival to and from the remaining functional, high-elevation spawning and nursery habitats is accentuated because these habitats are the most likely to retain remnant snowpacks under predicted climate change (Tonina et al. 2022).

Climate change is already evident. It will continue to affect air temperatures, precipitation, and wind patterns in the Pacific Northwest (ISAB 2007, Philip et al. 2021), resulting in increased droughts and wildfires and variation in river flow patterns. These conditions differ from those under which native anadromous and resident fishes evolved and will likely increase risks posed by invasive species and altered food webs. The frequency, magnitude, and duration of elevated water temperature events have increased with climate change and are exacerbated by the Columbia River hydrosystem (EPA 2020; Scott 2020). Thermal gradients (i.e., rapid change to elevated water temperatures) encountered while passing dams via fish ladders can slow, reduce, or altogether stop the upstream movements of migrating salmon and steelhead (e.g., Caudill et al. 2013). Additional thermal loading occurs when mainstem reservoirs act as a heat trap due to upstream inputs and solar irradiation over their increased water surface area (EPA 2020; 2021). Some summer steelhead migrate through the Columbia River in late September and October, when temperatures are cooler. We cannot predict how this DPS will react to longer or more severe thermal barriers; effects could range from relatively minor if more individuals migrate in the later part of fall to catastrophic if the species is unable to adapt.

Columbia River basin salmon and steelhead spend a significant portion of their life-cycle in the ocean, and as such the ocean is a critically important habitat influencing their abundance and productivity. Climate change is also altering marine environments used by Columbia River basin salmon and steelhead. This includes increased frequency and magnitude of marine heatwaves, changes to the intensity and timing of coastal upwelling, increased frequency of hypoxia (low oxygen) events, and ocean acidification. These factors are already reducing, and are expected to continue reducing, ocean productivity for salmon and steelhead. This does not mean the ocean is getting worse every year, or that there will not be periods of good ocean conditions. In fact, near-shore conditions off the Oregon and Washington coasts were considered good in 2021 (NOAA 2023). However, the magnitude, frequency, and duration of downturns in marine conditions are expected to increase over time due to climate change. Any long-term effects of the stressors that fish experience during freshwater stages that do not manifest until the marine environment will be amplified by the less-hospitable conditions there due to climate change. Together with increased variation in freshwater conditions, these downturns will further impair the abundance, productivity, spatial structure, and diversity of the region's native salmon and steelhead stocks (ISAB 2007, Isaak et al. 2018). As such, these climate dynamics will reduce fish survival through direct and indirect impacts at all life stages (NOAA 2023).

All habitats used by Pacific salmon and steelhead will be affected by climate dynamics. However, the impacts and certainty of the changes will likely vary by habitat type. Some changes affect salmon at all life stages in all habitats (e.g., increasing temperature), while others are habitat-specific (e.g., stream-flow variation in freshwater, sea-level rise in estuaries, upwelling in the ocean). How climate change will affect each individual salmon or steelhead stock also varies widely, depending on the extent and rate of change and the unique life-history characteristics of different natural populations (Crozier et al. 2008). The continued persistence of salmon and steelhead in the Columbia basin relies on restoration actions that promote climate resilience (Jorgensen et al. 2021) in freshwater spawning, rearing, and migratory habitats, including access to high elevation, high quality cold-water habitats, and the reconnection of floodplain habitats across the interior Columbia River basin.

Crozier et al. (2019b) concluded that the UCR steelhead DPS has a high risk of overall climate vulnerability based on its biological sensitivity and level of exposure. This DPS may have some latitude to shift the timing of adult migrations to avoid peak late-summer temperatures (Robards and Quinn 2002), but the consequences of such timing shifts are unknown. Current information indicates that climate change will continue, and with expected diminished snowpacks, lower June through September stream flows, and higher summer water temperatures, this factor has negative implications for the likelihood of the survival and recovery of the UCR steelhead DPS into the future.

2.3. Action Area

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

The action area for the proposed action includes all waters within 500 meters (1,640 feet) downstream of Chief Joseph Dam, and Foster Creek from the point of the stormwater outfall located just upstream of Boat Launch Road to its confluence with the Columbia River (Figure 2).[2] Water quality dilution modeling indicates that effects from the pollutants addressed in the proposed action are negligible beyond this point.

[2] The stormwater outfall to Foster Creek is identified as number 044 in Figure 2, but as number 045 in the text in EPA (2022a) and in the draft permit (EPA 2022b). We refer to Outfall 45 in this opinion.

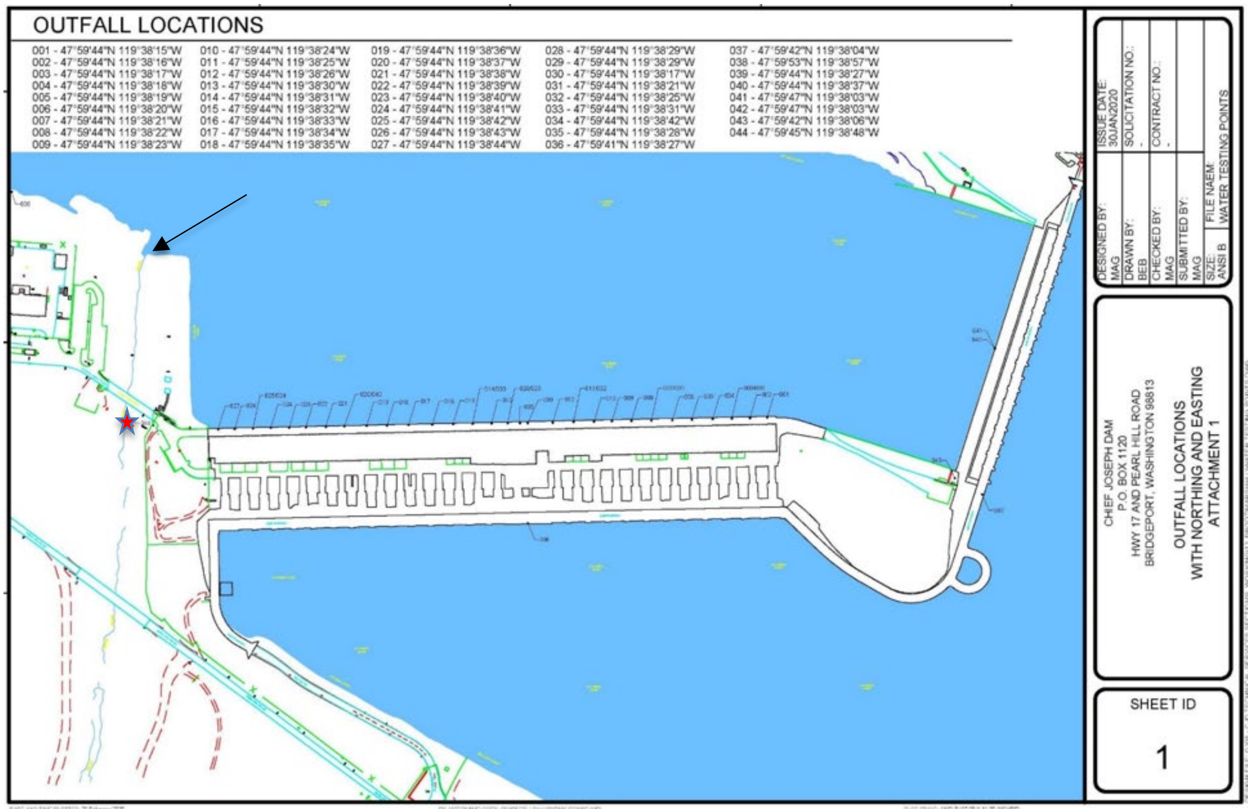

Figure 2. Diagram of outfall locations at Chief Joseph Dam. Arrow shows confluence of Foster Creek with the mainstem Columbia River. The discharge points for non-contact cooling water and drainage sumps are shown on the face of the dam and its spillway; the red star marks the location of the stormwater outfall from a project maintenance and refueling yard to Foster Creek. Source: EPA (2022a)

2.4. Environmental Baseline

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

The proposed action will affect the Okanogan River population of UCR steelhead. The UCSRB (2007) considered the spawning aggregation in Foster Creek to be part of the Okanogan population for the purpose of recovery planning. Per our recent 5-year review (NMFS 2022; Ford 2022), the Okanogan population remains at high risk of extinction with low abundance and productivity, and spatial structure and diversity below levels needed for recovery. The most recent 10-year geometric mean natural spawning abundance is 297, substantially below the ICTRT abundance threshold of 750 spawners (Ford 2022). Relatively low ocean survival in recent years was a major factor in the recent abundance patterns. The high-risk rating for diversity is largely due to high levels of hatchery fish in natural spawning areas and a lack of genetic diversity within the population.

We assume that adult steelhead in the mainstem portion of the action area are moving around or holding before returning downstream to spawning areas in Foster Creek or the Okanogan River. Incubation success is generally poor in the Okanogan basin because of rapidly warming spring water temperatures (NMFS 2022) and the same is likely true in the lower reach of Foster Creek. Washington State's Clean Water Act section 303(d) list of impaired waters includes excursions from water quality standards for dissolved oxygen and temperature in grab samples taken from Foster Creek near Outfall 45 in 2009 and 2007, respectively (WDOE 2023a, and b). Although these data are more than ten years old, they indicate that spawning and incubation habitat in the portion of Foster Creek within the action area is likely to be compromised. This is reinforced by Bartu and Andonaegui (2001), who described habitat in Foster Creek as naturally limited by conditions in the arid, shrub steppe ecosystem. R2 Resource Consultants (2004) reported that stream flows in the creek during were "moderate and declining" (around 5 cfs) in early June, 2003. Temperatures warmed to 18.5°C in the afternoon, approaching the optimum metabolic range for the rearing of cold-water salmonids. Stream flows were much lower during a survey in August, about 1.5 cfs, and a heavy silt load in the creek restricted visibility to 1-2 feet, adversely affecting their snorkel surveys.

NMFS designated critical habitat for UCR steelhead in the mainstem portion of the action area where the PBFs of freshwater rearing and freshwater migration are present. However, freshwater spawning only takes place in Foster Creek, which is not included in our critical habitat designation (NMFS 2005).

With respect to the mainstem portion of the action area, we incorporate by reference here Section 4, Description of the Environmental Baseline, in EPA (2022a), which summarizes influent data, ambient flow data, and ambient temperature data, as well as water quality impairments. In summary:

- Water storage operations above Chief Joseph Dam reduce spring flows, increasing travel times for out-migrating juvenile steelhead.
- The 7-day average daily maximum temperature for inflow at Chief Joseph Dam is close to 20ºC in August and September, exceeding the Washington and CTCR water quality criteria for the protection of aquatic life (17.5ºC and 18.0ºC, respectively).
- The Columbia River downstream of Chief Joseph Dam is impaired for dioxins, PCBs, total dissolved gases, and temperature, however:
    - The project does not generate or use dioxins.
    - Legacy PCBs are present only in a spare transformer, which is stored outdoors within a concrete containment structure.

The banks of the Columbia River within the action area are disconnected from the historical floodplain by levees that protect agricultural lands. Insects and benthic invertebrates associated with the floodplain are no longer available as prey for rearing juveniles, which are more likely to be dependent on plankton production in the mainstem and in Chief Joseph Reservoir.

We described the potential for oil and grease contamination of the mainstem Snake and Columbia Rivers from the mainstem hydroelectric facilities, including Chief Joseph Dam in the 2020 CRS opinion (NMFS 2020). Oils, greases, and other lubricants are used in hydropower turbines, hydraulic systems, lubricating systems, gear boxes, machining coolant systems, heat transfer systems, transformers, circuit breakers, and electrical systems. Leakage of oils, greases, or other lubricants into the tailrace at each project has the potential to expose salmon and steelhead to toxic concentrations of these compounds and could result in behavioral avoidance of contaminated water or sediments, or even, in some circumstances, death. The extent to which past discharges of oil and grease from Chief Joseph Dam have affected the behavior, health, or survival of salmonids is unknown.

To summarize, the environmental baseline is characterized by altered and degraded habitat including hydrology and water quality. Storage and release of water in upstream storage projects has altered the natural hydrograph in the mainstem portion of the action area; most notably, lower spring flows have resulted in increased travel times for juvenile salmonids during outmigration. The Columbia River is listed as impaired for dioxins, PCBs, total dissolved gases, and temperature; Foster Creek is impaired for dissolved oxygen and temperature. The mainstem is no longer connected to its floodplain, reducing the availability of insects and benthic invertebrates as forage. Chief Joseph Dam has been an obstruction in the adult migration corridor since construction began in 1949. These conditions will continue under the proposed action.

These factors are having negative effects on the abundance, productivity, and life history diversity of the UCR steelhead DPS and its component populations and spawning aggregations.

2.5. Effects of the Action

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

We evaluated the action as proposed in EPA (2022a), including the permit conditions added by WDOE (2022) and CTCR (2022) in their CWA section 401 certifications. The proposed permit establishes effluent limits, monitoring and reporting requirements, and other conditions necessary to comply with the CWA and applicable water quality standards. The permit includes either numeric or narrative effluent limits for each of the regulated parameters.

Discharges to the Columbia River allowed by the permit would be comprised of water used to cool equipment (non-contact), drained from equipment and floors, released when strainers are backwashed, and used in other maintenance activities at the dam; and in Foster Creek through a single stormwater outfall from a maintenance/refueling yard. A situation where the permittee was not in compliance with the permit (e.g., an oil spill) would not be authorized and thus is not addressed in EPA's BE or in this opinion. In this section, we describe the expected discharges and permit requirements in more detail.

Presence and Timing of UCR Steelhead in the Action Area

The portion of the action area in the mainstem Columbia River is within the migration corridor for adult and juvenile UCR steelhead, from the Okanogan River population. Migrating adults that overshoot the confluence of the Okanogan River or are returning to Foster Creek can be present throughout the year. Juveniles emigrating from Foster Creek, which UCSRB (2007) considered part of the Okanogan population for the purpose of recovery planning, are likely to be present in the 500-m reach of the mainstem within the action area from March through July. Eggs, larvae,[3] and fry can be present March through July, and older juveniles can rear year-round near or below the stormwater outfall in Foster Creek (Table 1). Because discharges allowed by the permit would also occur year-round, we expect some egg, larvae, fry, larger juvenile, and adult UCR steelhead to be exposed to project effects.

Table 1. Life. Life stages and timing of UCR steelhead within the action area.

Life Stage		Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Adult migration[a]													
Spawning[b]													
Incubation[b]													
Juvenile rearing													
Juv. Migration[c]													

[a] Adult steelhead could hold in the mainstem portion of action area for up to a year before spawning.
[b] Spawning and incubation in the Foster Creek portion of the action area, only.
[c] Juveniles migrate after rearing in Foster Creek for up to 2 years.

The number of spawners in Foster Creek has constituted about 5 percent of the hatchery- and 7 percent of the natural-origin steelhead in the Okanogan subbasin (i.e., not including Foster Creek) in the last ten years (Table 2). Surveys included the 1.25-km (4,000-foot) reach upstream of Outfall 45 to Foster Creek Dam, but most redds are found near or below the outfall (Figure 3).

Table 2. Numbers of hatchery-origin (HO) and natural-origin (NO) adult UCR steelhead in Foster Creek versus the Okanogan River subbasin (not including Foster Creek), 2013-2022. Source: Miller et al. (2023).

Year	HO Adults		NO Adults	
	Foster Creek	Okanogan	Foster Creek	Okanogan
2013	27	1,687	3	250
2014	14	838	0	518
2015	12	1,009	6	452
2016	77	1,175	13	391
2017	14	929	0	115

[3] Salmonid larvae are often referred to as alevins or sac fry. The latter indicates that they are still dependent on the yolk sac for nutrition.

Year	HO Adults		NO Adults	
	Foster Creek	**Okanogan**	**Foster Creek**	**Okanogan**
2018	27	333	76	120
2019	23	306	45	167
2020	5	114	19	260
2021	50	573	7	137
2022	75	203	9	111
Averages	32 (5%)	717	18	252 (7%)

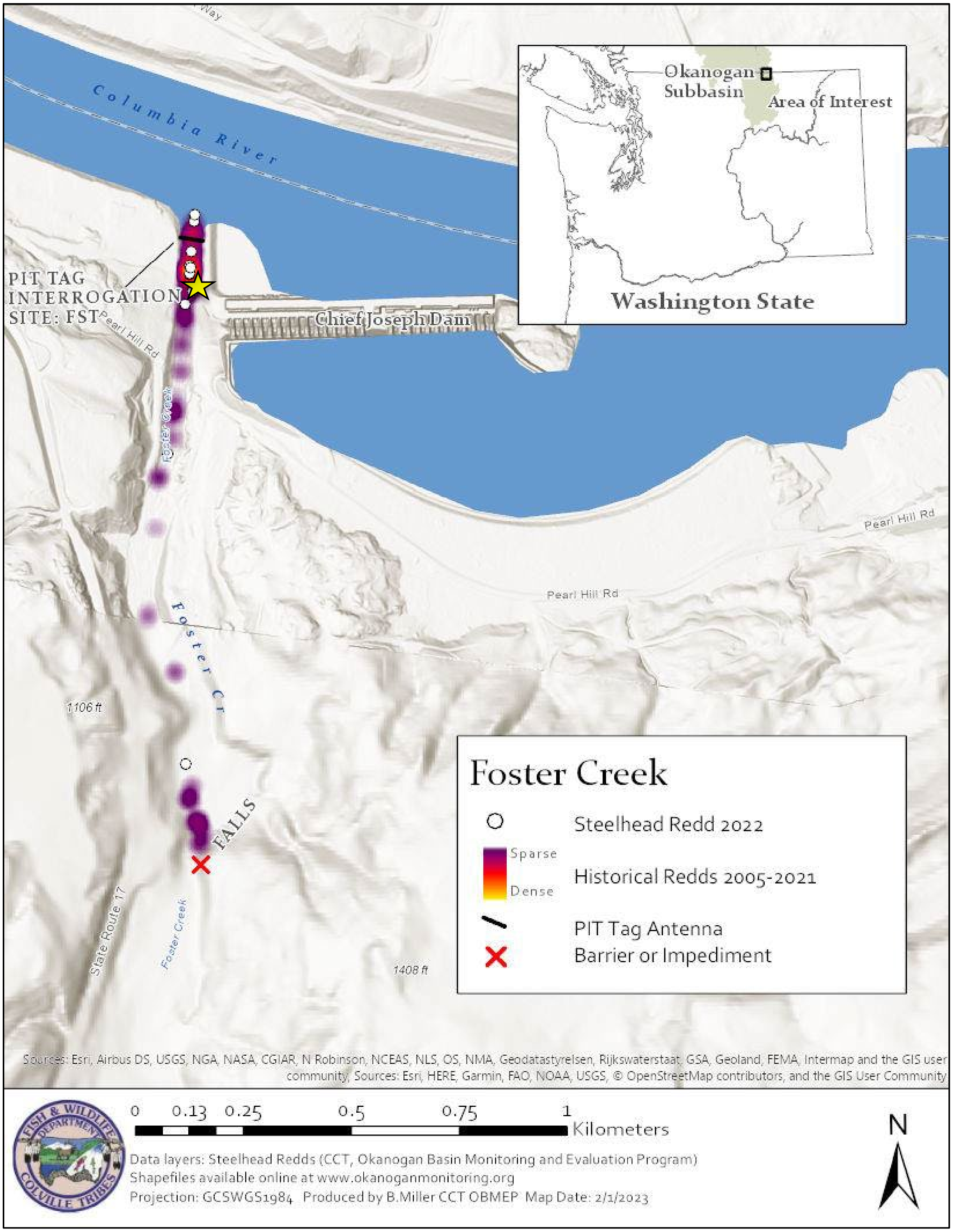

Figure 3. Distribution of steelhead redds in Foster Creek. Yellow star shows position of the stormwater outfall in the lower end of the creek. "X" shows the location of an impassable irrigation diversion dam. Source: Miller et al. (2023)

2.5.1. Effects to Species

2.5.1.1 Effects of the Numeric Effluent Limits

EPA (2022a) proposes numeric effluent limits for oil and grease, heat, and pH, for discharges of various types of water generated by operations at Chief Joseph Dam. It used these proposed limits, and effluent and flow data from the permit application, to estimate the impact of the discharges on receiving waters within the action area. For parameters without numerical criteria (total suspended solids [TSS] and oxygen-demanding materials) EPA used influent, effluent, and flow data from the permit applications to determine the maximum concentrations from the discharges, and to estimate the impact of the discharges on receiving waters within the action area. EPA estimated "end of pipe" pollutant concentrations, dilution factors, and the resulting concentrations at various distances downstream with the CORMIX (Cornell Mixing Zone Expert System) water quality model (Jirka et al. 1996).

Our exposure/response analysis in the following sections includes the results of this dilution modeling. Each table shows the estimated concentration of a regulated parameter (e.g., Table 3, which shows oil and grease concentrations) at various distances from a discharge port on the face of Chief Joseph Dam. These results are conservative for several reasons. First, the modeled outfall was assumed to be discharging at a high concentration of each parameter. For example, for oil and grease, the modeled outfall is assumed to discharge at the effluent limit of 5 mg/L, although USACE reported 36 out of 40 values of "non detect" for outfalls on the downstream face of the dam (EPA 2022a).[4] For BOD and COD, the model assumed the outfall was discharging at the maximum concentration reported in the permit application, despite a range of lower values reported in Table 30 in EPA (2022a). Second, the model assumed that the outfall was discharging at the maximum daily rate observed for any outfall despite variation from 150 to 4,000 GPM in Table 30 in EPA (2022a). Finally, we interpret the results as though the modeled outfall would operate continuously and although this is true of 8 of the 44 outfalls at Chief Joseph Dam, most do not (Table 2 in EPA 2022c). Because these assumptions are conservative, we expect that the actual downstream concentrations of the parameters discussed in the following sections are much lower than shown by the CORMIX results.

Oil and Grease

The water quality parameter "oil and grease" measures a variety of substances that can occur in the influent and effluent waters at Chief Joseph Dam. These include fuels, motor oil, lubricating oil, hydraulic oil, and animal- and plant-derived fats. The category "oil and grease" also includes environmentally acceptable lubricants (EAL). Most sources of oil and grease are insoluble in water, although agitation in the tailrace can create a temporary emulsion.

EPA (2022c) describes the following potential sources of oil and grease in discharges, limited to a daily maximum of 5 mg/L, from Chief Joseph Dam:

[4] USACE also reported three outfalls discharging at 5.6 mg/L and one at 6.2 mg/L in its permit application (EPA 2022a). These would have exceeded the permit's effluent limit, which is the subject of this consultation.

- Cooling Water Discharges, and Cooling Water Intake Structures (Outfalls 1 to 38)

The USACE uses water to cool down equipment such as generating units, air conditioning units, and transformer banks. Cooling water moves through a single-walled tube next to the generating and air conditioning units. In the case of a transformer that contains oil, cooling water moves through a double-walled tube to further minimize the likelihood of oil transfer. Because holes can form in these pipes allowing oil to leak into the cooling water, the proposed permit includes numeric effluent limits for oil and grease for these outfalls.

- Equipment Drainage and Floor Drainage Discharges (Outfalls 39 to 42)

Water continuously leaks into and through Chief Joseph Dam through a series of canals and tunnels. This water is collected in floor drains, trench drains, station sumps, and spillway sumps. Pumps with intakes near the bottom of each sump remove this water for discharge through discrete outfalls. Oil skimmers continuously remove any oil in the sumps and decant it into storage vessels.

River water also is collected in the sumps during periods of equipment, station, and facility maintenance. The sumps may contain residual oil and grease as well as detritus or silt.

- Stormwater Runoff from Maintenance/Fueling Area

Outfall 45 discharges stormwater from a 2,100 ft^2 maintenance and refueling area into Foster Creek, near the left abutment of Chief Joseph Dam. Water runs off the paved surface area into a catch basin, through a 1,000-gallon tank with an oil-water separator, into a second catch basin, and then through Outfall 45. The tank only overflows into the second catch basin during large storm events, but in that case, residual oil and grease could be discharged to the creek.

<u>Fish Exposure to Oil and Grease in the Mainstem Portion of the Action Area.</u> EPA interprets a maximum daily effluent limit of 5 mg/L as representing the State of Washington and the Colville Tribes' narrative criteria in their water quality standards, which prohibit discharges that would cause oil sheens, and are designed to be protective of aquatic life including UCR steelhead. EPA used this value to calculate exposure concentrations within the action area (Table 3). Steelhead will only be exposed to the 5 mg/L effluent limit within 1 m of the discharge, and effluent limits will dissipate to 1 mg/L within 5 m.

Fish can be exposed to oil and grease through their gills or through food, and exposures can be chronic or acute. Toxic effects include delayed growth, decreased survival, and carcinogenic and mutagenic activity (Ober 2010, Perhar and Arhonditsis 2014). Juveniles and adults may experience sub-lethal effects including avoidance behaviors and olfactory effects. EPA (1976) listed lethal toxicities to freshwater finfish of petroleum-based lubricants ranging from 10 ppm (approximately 10 mg/L) from soluble hydrocarbons to 180,000 mg/L for "lubricants." For other finfish, lethal toxicities ranged from 5 ppm (approximately 5 mg/L) from soluble hydrocarbons to greater than 10,000 mg/L from dispersants and residual oils. EPA (1976) describes long-term sublethal effects that interfere with cellular and physiological processes such as feeding and reproduction, but do not lead to immediate death of the organism. Pink salmon fry moved to the other end of the tank when water contaminated with Prudhoe Bay crude oil (1.6 mg/L) was introduced (Rice 1973). Exposure to 5 mg/L benzene caused an increase in the respiration rates of juvenile Chinook salmon irrespective of exposure time (1 to 96 hours; Brockson and Bailey 1973).

We do not expect UCR steelhead to be negatively affected by discharges of oil and grease at Chief Joseph Dam for the following reasons:

- An adult steelhead, or a juvenile emerging from Foster Creek, would have to hold within 1 meter of an outfall for hours at a time to receive an exposure of 5 mg/L, which is highly unlikely given the turbulent environment.
- Concentrations at the downstream end of the action area (500 m from the dam) are estimated to be between 0.011 and 0.016 mg/L, which will create a low risk of either acute or sub-lethal chronic effects.
- Although only eight of the 44 outfalls operate continuously and the observed concentrations of oil and grease have varied, EPA's dilution modeling assumes that all 44 discharge continuously at their maximum observed daily discharge rates (EPA 2022d). This means that the downstream concentrations of oil and grease encountered by an individual at any given time will likely be lower than indicated in Table 4.

Table 3. Calculated oil and grease concentrations, after dilution, within the action area. Source: EPA (2022a)

Effluent Limit (mg/L)	Distance Downstream (m)	Dilution Factor	Downstream Effluent Concentration (mg/L)
5	1	1	5
	6	5	1
	11	9	0.56
	15	13	0.38
	100	98	0.051
	300	320	0.016
	597	474	0.011

Some planktonic prey for juvenile and adult steelhead are likely to be exposed to the oil and grease discharges up to 5 mg/L in the water column right next to the outfalls at Chief Joseph Dam. These very brief exposures could affect the survival of individual invertebrates and their quality as prey, but the numbers affected are likely to be extremely small compared to the numbers available. In addition, a source of planktonic prey from upstream will be maintained. Therefore, NMFS does not expect prey exposure to oil and grease discharges at Chief Joseph Dam to negatively affect steelhead.

<u>Fish Exposure to Oil and Grease in Foster Creek.</u> The USACE's permit application did not include data on the oil and grease content of stormwater discharged from Outfall 45 to Foster Creek. Despite the presence of an oil-water separator between the maintenance/refueling yard and the outfall, discharges during large storm events could contain at least low concentrations of this parameter. Also, after decades of discharging even small amounts of oil and grease, it is likely that some of these compounds and their degradation products have accumulated in fine

sediments in Foster Creek. This outfall is in the immediate vicinity of UCR steelhead redds (Figure 3) and researchers have identified the developing fish heart as the primary target organ for the toxic effects of water-soluble chemical mixtures derived from petroleum (Incardona 2017; Incardona and Scholz 2016, 2017, 2018; Incardona et al. 2011). At the egg (developing embryo, pre-hatch) and larval stages, organ-specific detoxification pathways (e.g., cytochrome P450 enzymes in the liver) are not yet in place, and therefore do not offer the same intrinsic metabolic protections available to fish with fully developed hepatic function. Without this protective metabolism, petroleum-derived hydrophobic compounds such as polycyclic aromatic hydrocarbons (PAHs) bioconcentrate to high tissue levels in fertilized eggs, resulting in more severe toxicity. Numerous controlled laboratory exposure-response studies have shown a toxicity syndrome with a distinctive and characteristic suite of developmental abnormalities: heart failure, with ensuing extra-cardiac defects (secondary to loss of circulation), and mortality at or soon after hatching. More moderate forms of PAH toxicity, such as we might expect for untreated/unfiltered roadway runoff, include subtle alterations in cardiac structure, reduced cardiorespiratory performance, and latent mortality in larvae and juveniles. These effects have been studied in over 20 species of fish at the organism, tissue, and cellular levels (Marty et al. 1997, Carls et al. 1999, Heintz et al. 1999, Hatlen et al. 2010, Hicken et al. 2011, Incardona et al. 2013, Jung et al. 2013, Brette et al. 2014, Esbaugh et al. 2016, Morris et al. 2018). All fish species studied to date are vulnerable to PAH toxicity, with thresholds for severe developmental abnormalities often in the low parts-per-billion (µg/L) range. This suite of defects in developing eggs and larvae, while sublethal, will almost invariably lead to ecological death. Consequently, "delayed-in-time" toxicity is a common risk concern for the offspring of fish that spawn in PAH-contaminated habitats.

Given the high vulnerability of the egg and larval stages to oil and grease toxicity and their expected presence near Outfall 45, we make the conservative assumption that at least some of those present each year will experience developmental effects that result in decreased fitness and survival during incubation or later in the life cycle. Because of the relatively small number of adults and redds in Foster Creek, we expect only a small percentage of eggs and larvae from the Okanogan population will be affected. We are unable to estimate the numbers that will experience decreased fitness or be killed through this pathway, but assume that the magnitude of exposure to and the likelihood of reduced fitness is a function of the maximum daily concentration of oil and grease discharges allowed by the proposed permit (up to 5 mg/L). That is, each year over the 5-year term of the proposed permit, we expect a small number of egg and larval UCR steelhead to have decreased fitness and survival during incubation or later in the life cycle from oil and grease discharged into Foster Creek.

In addition to incubating eggs and larvae, a small number of juvenile steelhead rear in Foster Creek each year. These juveniles are likely to feed on drifting (plankton, insects) and benthic (e.g., amphipods) invertebrates. Benthic organisms in particular can bioaccumulate contaminants when they feed on the organic material adsorbed to fine sediments and particles of detritus; salmonids then consume the contaminated prey. Discharges of even small amounts of oil and grease are likely to accumulate in fine sediments in Foster Creek, decreasing the diversity and abundance of prey, and with the potential to increase the toxicity of prey items (e.g., Arkoosh et al. 1998). NMFS therefore expects decreased fitness and survival during rearing or later in the life cycle of a small number of juvenile steelhead rearing in the lower 55 m (200 feet) of the creek (i.e., below the outfall) from a decreased diversity and abundance of prey and from consuming contaminated prey items. We are unable to estimate the numbers of fish that will be killed or experience decreased fitness through this pathway, but assume that the magnitude of exposure to and the likelihood of decreased fitness and mortality is a function of the expected maximum daily concentration of oil and grease (5 mg/L) that will be allowed by the proposed permit to be discharged into Foster Creek.

Proposed Measures to Reduce the Likelihood of Permit Exceedances and the Toxicity of the Discharges. The proposed permit includes several measures designed to reduce the likelihood of the negative effects described above: (1) the use of EALs for all equipment with oil to water grease interfaces, unless technically infeasible; (2) monitoring and annual reporting; and (3) the development and implementation of a Best Management Practices Plan.

- EPA's 2011 Environmentally Acceptable Lubricants report defines EALs as "lubricants that have been demonstrated to meet standards for biodegradability, toxicity, and bioaccumulation potential that minimize their likely adverse consequences in the aquatic environment, compared to conventional lubricants." The USACE has been pursuing conversion to EALs at Chief Joseph Dam for several years (USACE 2022a), including replacing about 115,000 gallons of turbine oil with EALs in 2022. The USACE plans additional conversions over the 5-year term of the proposed permit including lubricants for the wicket gate bushings and the wire rope for cranes and an EAL hydraulic fluid for the service gate cylinders. Therefore, we expect the toxicity of any discharges of PAHs from the project to be reduced over time.

- The proposed permit requires the USACE to monitor effluent samples for oil and grease at all permitted outfalls at the project. Initial sampling frequency is once per week, but if none of the samples tested in the first year exceed the numerical effluent limit (5 mg/L as a daily maximum), the USACE can reduce sampling frequency to once per month. If monitoring indicates that the numeric limit for oil and grease is exceeded, a violation of the permit is entered into EPA's NPDES compliance and enforcement database for potential future enforcement action (EPA 2022a). Oil spills and visible sheens are not covered by the permit and any occurrence "that triggers an emergency action or notification under the facility's SPCC [Spill Prevention Control and Countermeasure] plan" must be reported to EPA within 24 hours. The USACE's compliance responsibilities are described in section IV of the proposed permit. These requirements will ensure that USACE takes the measures that are needed to comply with the permit limit for oil and grease.

- The BMP Plan will contain site-specific measures to reduce stormwater exposure to pollutants related to vehicle maintenance by minimizing:
    - Discharge of vehicle, equipment, and surface wash water.
    - Stormwater exposure to leaky or leak-prone vehicles and equipment awaiting maintenance.
    - Contamination of stormwater runoff from fueling areas through implementation of control measures.

The combined effects of these measures will be to reduce the likelihood that the permit limits are exceeded and to reduce the toxicity of oil and grease released at the project.

Heat Discharges

The proposed permit addresses heat discharged from Chief Joseph Dam in three types of cooling water effluents:

- Non-contact air-housing and thrust bearing cooling water that runs through pipes next to each generation unit.
- Non-contact water that runs through the central air conditioning system during summer for keeping the powerhouse cool
- Non-contact cooling water that runs through pipes next to each of the four transformer banks

<u>Far-field Effects of the Permitted Heat Discharges.</u> The proposed permit includes a facility-wide heat limit equal to the waste load allocation for Chief Joseph Dam in the Columbia River Temperature Total Daily Maximum Load (EPA 2020a): a monthly average of 6.36E+09 kcal/day, or 92.5 million gal/day at 18.2ºC. The proposed permit requires the USACE to calculate the average monthly heat loads for Outfalls 1 to 38 during June 1 to October 3 for compliance with the TMDL. The heat load is calculated by multiplying the monthly average effluent temperature by the monthly average flow for each outfall, times a conversion factor of 3.78E+06 kcals/day. Heat load is then summed across Outfalls 1 to 38 to derive a facility-wide average, which the permit limits to 6.36E+09 kcal/day. Compliance with the TMDL's load allocation will ensure that thermal conditions for UCR steelhead are not negatively affected by heat discharged from Chief Joseph Dam into the mainstem portion of the action area. It will have no effect on steelhead in Foster Creek. Therefore, we expect no adverse effect to UCR steelhead from far-field effects of heat discharges.

<u>Near-field Effects of the Permitted Heat Discharges.</u> EPA (2022a) also evaluated the potential for heat discharged at the project to exceed several benchmarks for harm that we interpret as representing nearfield effects: the risks of thermal shock and of instant lethality, and the risk of exceeding water quality standards for aquatic life within the action area below the dam.

- Risk of Thermal Shock

EPA (2003) defines thermal shock as a sudden increase of 10°C in temperature to 25°C or above. It evaluated the risk of exposure to these conditions by comparing the average influent temperature in April (4ºC), when incoming waters are coldest and adult steelhead are present, to the maximum temperature of generator-related cooling water (22ºC). EPA's dilution modeling shows that the maximum increase would be 10ºC above influent temperature only within 1 m of the dam. As discussed for oil and grease, adult steelhead are not likely to be that close to the dam due to the turbulent environment. And even in that zone, the exposure temperature of 22ºC would be below the 25°C threshold for thermal shock (Table 4). Therefore, NMFS does not expect steelhead to experience thermal shock.

Table 4. Risk of thermal shock in the tailrace of Chief Joseph Dam for an effluent temperature of 22.0ºC. Source: EPA (2022a)

Upstream Temperature (April) (ºC)	Effluent Temperature (ºC)	Distance Downstream (m)	Dilution Factor	Temperature Increase from Chief Joseph Dam (ΔºC)	Downstream Temperature (ºC)
4.0	22.0	1	1	18	22.0
		6	5	3.6	7.6
		11	9	2.0	6.0
		15	13	1.4	5.4
		100	98	0.18	4.2
		300	320	0.056	4.1
		597	474	0.038	4.0

- Risk of Instant Lethality

Short-term exposure (less than 10 seconds) to 32°C temperatures can cause instantaneous lethality to salmonids (EPA 2003). EPA (2022a) evaluated this risk by modeling the effect of the effluent on downstream temperatures during summer, when influent temperatures are near 20ºC (Table 5). The maximum temperature in the tailrace would be 22.0ºC, indicating no risk of instantaneous lethality.

Table 5. Risk of instant lethality during maximum summer temperatures. Source: EPA (2022a)

Influent Temperature (ºC)	Effluent Temperature (ºC)	Distance Downstream (m)	Dilution Factor	Temperature Increase from Chief Joseph Dam (ΔºC)	Downstream Temperature (ºC)
20.1ºC	22ºC	1	1	1.9	22.0
		6	5	0.38	20.5
		11	9	0.21	20.3
		15	13	0.15	20.2
		100	98	0.02	20.1
		300	320	0.0059	20.1
		597	474	0.0040	20.1

- Risk of Exceeding Water Quality Criteria for the Protection of Aquatic Life

The NPDES permit program requires that the conditions in the permit ensure compliance with the water quality standards of all affected States and Tribes. Outfalls at Chief Joseph Dam discharge to both waters of the Colville Reservation and the State of Washington. The state and tribal water quality standards for salmon and trout migration use, the only use expected in the mainstem portion of the action area, are 17.5 and 18°C, respectively. These numerical standards[5] are designed to protect against:

  - Lethal conditions for both juveniles and adults (21 to 22°C constant; McCullough et al. 2001).

[5] NMFS consulted with EPA on the effects of these temperature standards on ESA-listed species in NMFS (2008, 2015).

- Migration blockage conditions for migrating adults (21 to 22°C average; McCullough et al. 2001, Sauter et al. 2001).
- High risk of disease (greater than 18 to 20°C constant; Materna 2001)

According to the CORMIX model (Table 5), the cooling water discharges increase the tailrace temperature to 22°C within 1 m of an outfall, but the effect falls to less than 21°C at 6 m. As discussed above, juvenile and adult steelhead are not likely to be within 1 m of an outfall due to the turbulent, high velocity environment. As a result, we do not expect that heat discharges will have negative effects on the fitness of individual steelhead in the mainstem portion of the action area. Heat is not discharged from the stormwater outfall on Foster Creek. Therefore, we do not expect heat discharges to negatively affect juvenile or adult UCR steelhead in the Columbia River or Foster Creek.

- <u>Monitoring and Reporting Requirements for Near-field Effects on Heat Discharges.</u>

The proposed permit requires the USACE to take continuous measurements at 17 of the outfalls that discharge cooling water, and to calculate and report the 7-Day [rolling] Average Daily Maximum temperatures (7DADM), daily maximum temperatures, and daily average temperatures. The permit allows the USACE to take only monthly grab samples at the other 21 cooling water outfalls; those data will not be appropriate for calculating daily average or maximum temperatures. Based on the distribution of outfalls with continuous temperature monitoring (EPA 2022b), we expect that these will be representative of effects in the tailrace across the face of the dam.

pH

EPA proposes a numeric limit for pH, including discharges from sumps and stormwater outfalls, of 6.5 to 8.5 standard units with a human-caused variation of less than 0.5 units. EPA considers a pH of 6.5 protective of the effects of acidity for salmonids. At higher (more alkaline) levels, salmonids are sensitive to pH in the range of 9.2 to 9.7; levels greater than 9.0 could also harm benthic invertebrate populations, altering the prey base (ODEQ 1995).

The pH of the USACE's water samples taken between September and December, 2019, and submitted with the permit application ranged from 7.1 to 8.2 (EPA 2022a), within the toxicity benchmarks. We consider the pH range in the proposed permit (6.5 to 8.5 at the discharge point) to be protective for all life stages of UCR steelhead and do not expect the proposed effluent limit to have any negative effects on juvenile or adult steelhead or on habitat in the mainstem portion of the action area or Foster Creek.

2.5.1.2 Effects of Narrative Effluent Limits

The proposed discharge permit includes narrative limits for visible oil sheens or floating, suspended, or submerged matter; toxics; total suspended solids, and oxygen-demanding materials. The potential exposure and response of UCR steelhead resulting from the narrative limits for these constituents is discussed below.

Visible Oil Sheen or Floating, Suspended, or Submerged Matter

The proposed permit prohibits the discharge of a visible oil sheen or floating, suspended, or submerged matter of any kind "in concentrations causing nuisance or objectionable conditions or that may impair the designated beneficial uses of the receiving water. There shall be no foam other than in trace amounts."

With respect to a visible oil sheen, EPA (2022a) proposes a daily maximum oil and grease effluent limitation of 5 mg/L, which represents the highest concentration at which there is no oil sheen on surface waters. With the effluent limits for oil and grease of no more than 5 mg/L, the monitoring and reporting requirements, and the measures in the BMP Plan to prevent and minimize oil, grease, and hydraulic fluids from all sources from entering the river, we do not expect a visible oil sheen as a result of the proposed permit. We also would not expect an oil sheen by itself, or floating, suspended, or submerged matter, to have negative effects on the fitness of individuals; effects would be those that occur through any PAH toxicity to juveniles, eggs, and larvae in Foster Creek as described in Section 2.5.1.1.

Toxics

Dioxins. In 1991, EPA issued a TMDL for dioxins that applied to the Columbia River in Washington, identifying the major sources as pulp mills. Dioxins are usually a result of chemical processes at high temperatures. The waters just upstream from Chief Joseph Dam in Rufus Woods Lake are listed as impaired for this parameter, but not those within the action area (EPA 2022a). The permit includes a general prohibition on discharging toxic substances in concentrations that would impair beneficial uses, but EPA does not include effluent limits or monitoring requirements for dioxins because there are no chemical processes that would generate dioxins at this facility. We do not expect any juvenile or adult UCR steelhead to be exposed to dioxin as a result of the proposed permit.

PCBs. Polychlorinated biphenyls (PCBs) have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence these chemicals build up in the environment and can cause harmful health effects. Products such as transformers that were made before 1977 can contain PCBs in their hydraulic oils.

The USACE recently replaced all the transformers in use at Chief Joseph Dam with units that do not use PCBs. There is one older, air-cooled transformer at the project that contains PCBs, which the USACE can add to the system if needed. It is stored inside a concrete containment structure with drains that are closed except during maintenance (USACE 2022b). If deployed, this transformer would be used outdoors where any PCB contamination on the outside surface could be discharged to the river during a storm event. Swipes of the exterior surface in 2013 and 2019 resulted in 3 ppm and "non-detect" for PCBs, respectively, indicating that although the risk of stormwater contamination is very small, it is not zero. In any case, the proposed permit prohibits the discharge of any PCBs from the project. It requires the USACE to develop a PCB Management Plan (PMP) within the first year of the five-year permit cycle, including monitoring and reporting requirements. Purposes of the PMP are to:

- Identify potential sources and potential pathways for PCB discharges at Chief Joseph Dam.
- Document actions that have been and will be established to limit the likelihood of PCB discharges through removal, containment, or other mechanisms.
- Identify outfalls associated with potential PCB discharges.

After developing the PMP, the USACE must conduct two consecutive years of monitoring to characterize the presence of PCBs in the effluent. In designing the sampling plan, the USACE will consider the presence of transformers; exposure to equipment, paint, caulk, oil, or other materials that may have legacy PCBs; and outfalls that could discharge PCBs if there is a failure in containment equipment.

Because of the recent replacement of all the transformers in use at Chief Joseph Dam with units that do not use PCBs, and the assessment, containment, and monitoring activities that the USACE will complete under the PMP, we do not expect any juvenile or adult UCR steelhead to be exposed to PCBs as a result of the proposed permit.

Total Suspended Solids

Total suspended solids (TSS) includes both organic and inorganic particulate matter and refers to the dry weight of total solids retained on a 2-micron (or smaller) filter. Depending on the duration of fish exposure, elevated levels of TSS can reduce growth rates and disease resistance, increase mortality, harm the development of eggs and larvae, alter migratory behavior, and reduce prey abundance (EPA 1986). Herbert and Merkens (1961) found that suspended solids at concentrations of 270 mg/L caused fin rot. Concentrations of 90 to 270 mg/L decreased the survival of rainbow trout, although no effects on survival, gill health, or fin health were observed at 30 mg/L. Herbert and Merkins (1961) also found that TSS measurements above 1,000 mg/L were associated with reduced abundance of brown trout, whereas concentrations of about 60 mg/L had no effect. Similarly, Servizi and Martens (1992) reported that TSS concentrations of 240 to 2,550 mg/L caused a variety of effects including increased cough frequency and increased glucose levels in fish, but at 20 mg/L no adverse effects were found. After reviewing these studies, EPA (2021b) determined that No Observed Effect Concentration ranged from 20 to 60 mg/L.

No TSS was observed in forebay or effluent samples from Chief Joseph Dam submitted with the permit application (EPA 2022a). Any sediment entering the cooling water system at Chief Joseph Dam would be removed by strainers at the intakes, and the proposed BMP Plan requires the USACE to clean the intake screens and racks to reduce the likelihood that sediment will enter the project. The discharge from the stormwater outfall to Foster Creek does not include solids (EPA 2022a). For these reasons, EPA did not include TSS limits or monitoring in the proposed permit. We do not expect levels of TSS to exceed the 20 to 60 mg/L “No Observed Effect Concentration” or to have negative effects on eggs, larvae, fry, juvenile or adult UCR steelhead.

Oxygen-demanding Materials

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are measures of the degree to which an effluent can deplete oxygen in its receiving water while undergoing degradation. BOD represents the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter. Materials that contribute to BOD include organic matter used as food by aerobic organisms; oxidizable nitrogen from nitrites; ammonia, a breakdown product of animal or vegetable matter; and materials such as ferrous iron, sulfides, and sulfites that can be metabolized by some bacteria. The COD is a chemical test that measures the amount of oxygen needed to oxidize the organic matter in a volume of water. The COD test is more precise, accurate, and rapid than the BOD test.

Oil and grease are an example of an oxygen-demanding substance that can be added to the effluent by operations at Chief Joseph Dam. In addition, any oxygen-demanding substances that are present in both influent and dewatering and cooling water could become concentrated in the sumps (EPA 2022a). However, EPA does not include limits for BOD or COD in the proposed permit because even the highest concentration in the influent and effluent samples submitted by the USACE (33 mg/L) were much lower than EPA's toxicity benchmark of 310 mg/L (EPA 2022a); EPA based its benchmark on observations of no toxicity to *Pseudomonas putida*, *Vibrio fisheri*, zebrafish (*Brachydanio rerio*), or the green alga *Selenastrum capricornutum* when these organisms were exposed to effluents containing ≤310 mg/L COD.

Oxygen-demanding substances from the operations may arise from oil and grease, for which the permit has effluent limitations, monitoring, tracking, and minimization requirements. The permit also requires the USACE to minimize the presence of total suspended solids or detritus. As a result, EPA has determined there is no reasonable potential for oxygen-demanding substances in the permitted discharges from Chief Joseph Dam to affect dissolved oxygen concentrations in the Columbia River (EPA 2022c), and does not propose limits or monitoring for BOD or COD beyond those for oil and grease (Section 2.5.1.1). We agree with this assessment and do not expect negative effects to juvenile or adult UCR steelhead in the mainstem portion of the action area associated with BOD or COD.

The USACE did not provide data on the oxygen demand of stormwater discharged to Foster Creek in its permit application. Very small amounts of residual oil and grease could be decomposing on the surfaces of the oil-water separator tank, and this material could move from the outfall to Foster Creek during a large storm event. However, because we expect the concentration of oxygen demanding substances to be small, and this material would be exposed to the air during discharge, the risk of negative effects to incubating eggs and larvae or juveniles rearing in Foster Creek is extremely low.

2.5.1.3 Interactive and Synergistic Effects of Multiple Pollutants

The multiple pollutant discharges that would be authorized by the proposed permit do not act on aquatic organisms in isolation of one another. Mixtures of chemicals can have additive, synergistic, or antagonistic effects. An additive effect occurs when the individual toxic effects of chemicals in a mixture produce a biological effect that is the sum of the individual effects.

Synergism occurs when the toxicity of a mixture is greater than that which would be expected from a simple additive effect. Antagonism occurs when the toxicity of multiple chemicals in a mixture is less than that expected from a simple additive effect.

Many of the pollutants addressed in the proposed permit are not individual chemicals or compounds, e.g., oil and grease mixtures, pH, heat, and TSS and the concept that multiple stressors may act synergistically is important. For example, oil exposure can impair diffusion across gills and contribute to respiratory acidosis in fish, potentially compounding effects of low pH in the environment (Evans et al. 2005, Khursigara et al. 2019). pH affects many chemical and biological processes in water and thus affects toxicity of many pollutants. We therefore understand that the combinations of pollutants addressed in the proposed permit could reduce the tolerance of individual juvenile and adult steelhead to normal environmental disturbances (Khursigara et al. 2019).

Water temperature is known to affect toxicity of contaminants to aquatic organisms (either decreasing or, more often, increasing toxicity; Cairns et al. 1975). Fish metabolism increases at higher temperatures. Temperatures outside of an individual's thermal tolerance window can impact metabolic capacities, available energy stores, and fitness (Khursigara et al 2019). Increased water temperatures accelerate rates of aerobic decomposition and result in higher BOD levels. And chronic exposure to pollutants can reduce the upper thermal tolerance limits of freshwater fish (Patra et al. 2015).

The degree of synergistic effects on pollutant toxicity to UCR steelhead and its prey species are difficult to estimate because they will depend on the levels of specific pollutants and the magnitude and timing of exposures. The low concentrations of pollutants allowed by the proposed permit indicate that synergistic effects are likely to be minor for the discharges on the face of the dam. And because stormwater runoff is generally cold, we do not expect temperature to interact with the permitted levels of oil and grease in discharges to Foster Creek so that it would affect the survival or condition of either eggs and larvae or juvenile steelhead and their prey in Foster Creek. Therefore, NMFS does not expect negative effects to steelhead from synergistic effects on pollutant toxicity.

2.5.1.4 Effects of the Permit Conditions Added by WDOE and CTCR

The proposed action also includes the permit conditions added by WDOE and CTCR through their Clean Water Act 401 certifications of the proposed permit. The effects of these conditions will be to reduce the potential for discharge events (e.g., oil spills, releases of PCBs) or the pass-through of substances (excessive TDG, water temperature) that are not otherwise addressed by the proposed permit. These permit conditions could lead to actions that improve, compared to current conditions, the survival and condition of UCR steelhead.

Summary of Effects to Individuals

The proposed permit is not likely to have negative effects on juveniles or adults in the mainstem portion of the action area, but will affect eggs, larvae, and juvenile steelhead from the Okanogan population that are present below the outfall in Foster Creek. This is because, despite the presence of a large sump with an oil-water separator between the maintenance/refueling yard and the outfall, we expect residual amounts of oil and grease to reach the creek during large runoff events.

We conservatively expect that the fitness and survival of at least a small number of the eggs and larvae downstream of Outfall 45 will be decreased by oil and grease each year, resulting in mortality during incubation or later in the life cycle. In addition, a small number of juveniles rearing in the lower 55 m (200 feet) of the creek will have decreased fitness and survival from a decreased diversity and abundance of prey and from consuming contaminated prey items during rearing and later in the life cycle. However, we expect, in addition to authorizing the discharge of pollutants, the reduction in non-EAL discharges will improve water quality over the 5-year term of the permit, thereby increasing fitness and decreasing mortality of a very small number of steelhead eggs, larvae, and juveniles. We also expect the permit conditions added by WDOE and CTCR through their Clean Water Act 401 certifications of the proposed permit could lead to actions that improve, compared to current conditions, the survival and condition of UCR steelhead.

2.5.2. Effects to Critical Habitat

The proposed permit has effluent limits that could affect water quality or forage in rearing and migration areas in the mainstem portion of the action area.[6] Other PBFs will not be affected.

Numeric Effluent Limit for Oil and Grease

The permitted discharges of oil and grease will only affect water quality to a very limited extent close to the downstream face of the dam or affect prey in freshwater rearing and migration areas in the mainstem portion of the action area.

Numeric Effluent Limit for Heat Discharges

We expect tailrace temperatures to increase to 22°C within 1 m of an outfall, and to less than 21°C at a distance of 6 m due to dilution. This is unlikely to have a significant effect on the functioning of water quality or forage in rearing or migration areas because only a very small portion of the action area will be affected. Therefore, NMFS does not expect negative effects to water quality or forage at the scale of the action area from heat discharges.

Numeric Effluent Limit for pH

A pH effluent limit of 6.5 to 8.5 standard units (±0.5 units) is essentially neutral (i.e., neither acidic nor alkaline) and meets the biological needs of salmonids and their prey. We therefore do not expect water discharged within this limit to have negative effects on the functioning of water quality or forage in migration or rearing areas at the scale of the action area.

[6] We did not designate critical habitat for UCR steelhead in Foster Creek.

Narrative Effluent Limits
The proposed narrative effluent limits prohibit the discharge of a visible oil sheen or floating, suspended, or submerged matter of any kind "in concentrations causing nuisance or objectionable conditions or that may impair the designated beneficial uses of the receiving water." They also prohibit the discharge of foam in other than trace amounts, dioxins, or PCBs. These limits are designed to prevent negative effects, including risks to the functioning of water quality or forage in rearing and migration areas.

The permit does not include limits for TSS or oxygen-demanding materials. We do not expect levels of TSS to exceed the 20 to 60 mg/L No Observed Effect Concentration or to have significant effects on water quality in rearing or migration habitat. We also agree with EPA that there is no reasonable potential for oxygen-demanding substances in the permitted discharges to affect dissolved oxygen concentrations in the Columbia River (EPA 2022c). Thus, we do not expect negative effects on water quality or forage from a visible oil sheen or floating, suspended, or submerged matter of any kind at the scale of the action area.

2.6. Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4). Implementation of the Phase 2 Implementation Plan for the reintroduction of salmon into the upper Columbia basin (UCUT 2022) would require the construction of an upstream passage facility within the project area. Although the 2022 plan shows that its entrance could be located at the entrance to Foster Creek, no proposal has been submitted for environmental review. Thus, we are unable to describe potential effects on UCR steelhead in the action area at this time. To the extent the federal government takes future actions related to implementation of the plan that may affect NMFS's listed species, they would be subject to future ESA consultation.

We adopt by reference here Section 6 in EPA (2022a), which describes cumulative effects within the action area. Non-federal actions are likely to include activities associated with agriculture, grazing, aquaculture, road building, and recreational activities including fishing, hiking, and camping. Although not quantifiable, these non-federal actions are likely to have adverse effects on UCR steelhead at levels similar to those observed in recent years.

2.7. Integration and Synthesis

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

2.7.1. Species

UCR steelhead from the Okanogan population inhabit the action area and depend on it to support critical life functions of spawning, rearing, and migration. We expect the proposed action to affect eggs, larvae, juveniles and adults. Eggs and larvae will be impacted by oil and grease releases, and juvenile steelhead will be impacted by consuming contaminated macroinvertebrates in Foster Creek. We do not expect the permitted discharges to have negative effects on water quality in the mainstem portion of the action area beyond about a 1-meter distance from each outfall on the downstream face of the dam. Adult and juvenile steelhead are not likely to be present in that area long enough for acute or chronic effects on survival or condition.

The ICTRT (2007) recommended that three populations meet viability criteria, two of which should meet high viability criteria for the DPS to be viable. The rationale behind this recommendation is because of the relatively low number of extant populations remaining in the DPS. The final recovery plan adopted by NMFS (UCSRB 2007) established a goal of securing the long-term persistence of a set of viable populations of naturally produced steelhead distributed across their native range. For recovery, the UCSRB recommended that all the extant steelhead populations within the DPS meet abundance/productivity criteria that represent a 5 percent extinction risk over a 100-year period. In addition, the UCSRB recommended that naturally produced steelhead use four of the five major spawning areas in the Wenatchee subbasin, two major spawning areas within the Entiat subbasin, three major spawning areas in the Methow subbasin, and two of the major and minor spawning areas in the Okanogan subbasin. NMFS adopted these recommendations as the recovery scenario. To achieve these criteria, significant improvements will be needed in all VSP parameters: abundance, productivity, spatial structure, and diversity.

All of the extant populations of the UCR steelhead DPS have a high risk of extinction due to low abundance, productivity, spatial structure, and diversity (Ford 2022). The DPS also has a high risk of vulnerability to climate change and we expect increased effects on viability as air temperatures rise and snow packs diminish in the Pacific Northwest.

Factors limiting the likelihood of recovery of the DPS include the effects of reservoir operations on mainstem flows and passage through the federal hydrosystem. Flow alterations are primarily the result of large storage reservoirs and consumptive withdrawals at projects other than Chief Joseph Dam. However, combined with Grand Coulee Dam, Chief Joseph Dam is a complete barrier to historical habitat in the upper Columbia River. Development has reduced the quality of shoreline habitat by eliminating native riparian vegetation, displacing shallow water habitat with fill material, and disconnecting the mainstem from its historical floodplain. Survival in the mainstem migration corridor is limited by the predation of smolts by both native and introduced fish, and by colonial waterbirds.

The environmental baseline is characterized by altered and degraded habitat including hydrology and water quality. Storage and release of water in upstream reservoirs has altered the natural hydrograph in the action area. The Columbia River is impaired for dioxins, PCBs, total dissolved gases, and temperature, and Foster Creek is impaired for dissolved oxygen and temperature. These factors have negative effects on the abundance, productivity, and life history diversity of the UCR steelhead DPS and its component populations and spawning aggregations.

As described in Section 2.5.1, the proposed action is not likely to have negative effects on juveniles or adults in the mainstem portion of the action area, but will affect eggs, larvae, and juvenile steelhead from the Okanogan population that are present below the outfall in Foster Creek. This is because, despite the presence of a large sump with an oil-water separator between the maintenance and refueling yard and the outfall, we expect residual oil and grease to reach the creek during large runoff events. We conservatively expect that throughout the duration of the 5-year permit, the fitness of at least a small number of the eggs and larvae downstream of Outfall 45 will be damaged by oil and grease each year, resulting in mortality during incubation or later in the life cycle. In addition, a small number of juveniles rearing in the lower 55 m (200 feet) of the creek will experience decreased fitness and survival during rearing or later in the life cycle from a reduced diversity and abundance of prey and from consuming contaminated prey items. However, due to the small numbers of spawning adults and redds in Foster Creek, and the small number of rearing juveniles, we expect the loss a small number of eggs, larvae, and juveniles will only have a small effect on the abundance and productivity of the Okanogan population as a whole. Also, we expect the reduction in non-EAL discharges will improve water quality over the 5-year term of the permit, thereby increasing fitness and decreasing mortality of a very small number of steelhead eggs, larvae, and juveniles.

The permit conditions added by WDOE and CTCR have the potential to result in actions that improve the functioning of water quality and forage in rearing and migration areas designated as critical habitat as well as the survival and condition of UCR steelhead. We do not expect any negative effects on UCR steelhead or its habitat.

The loss of fitness and mortality of a small number of eggs, larvae, and juveniles emerging from Foster Creek each year are not expected to appreciably alter the abundance, productivity, spatial structure, or diversity of the Okanagan population of UCR steelhead and there will be no effects on the other populations in the DPS. It is NMFS's opinion that when the effects of the action and cumulative effects are added to the environmental baseline, and in light of the status of the species, the effects of the action will not cause reductions in reproduction, numbers, or distribution that would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of UCR steelhead.

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's biological opinion that the proposed action is not likely to jeopardize the continued existence of UCR steelhead.

2.9. Incidental Take Statement

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

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur due to reduced fitness from exposure to oil and grease. NMFS is reasonably certain the incidental take described here will occur because: (1) recent and historical surveys indicate that eggs, larvae, and juvenile UCR steelhead occur in the action area; and (2) the proposed action includes activities that are reasonably certain to harm or kill these individuals through direct exposure or due to effects to their prey.

Due to the highly variable number of individual eggs, larvae, and juveniles present in the action area at any given time, and difficulties in the ability to observe injury or mortality of fish, which may sink out of site, be consumed by predators, or have delayed death outside of the action area, we cannot determine the number of ESA-listed fish that will be killed, injured, or otherwise adversely affected. In such circumstances we use a habitat-based surrogate to account for the amount of take, which is called an "extent" of take. The extent of take is causally related to the harm that occurs, and is an observable measure for monitoring, compliance, and re-initiation purposes. This surrogate functions as an effective reinitiation trigger because it is a clear, measurable limit that can be readily monitored for any exceedances, so reinitiation could be triggered at any time during the period covered by the NPDES permit.

Incidental Take from Exposure to Oil and Grease

We are unable to estimate the numbers of UCR steelhead that will be injured or killed by the oil and grease discharges from Outfall 45 to Foster Creek, either via developmental effects (eggs and larvae) that decrease fitness and survival during incubation or later in the life cycle or through decreased fitness and survival from a decreased diversity and abundance or contamination of their prey (rearing juveniles). We therefore rely on a surrogate to define the limit of the extent of take. The extent of take is a daily maximum oil and grease concentration of 5 mg/L. This is an appropriate surrogate for this pathway because it is measurable and is causally related to the take because the scale of effect is related to the concentration of oil and grease. Thus, the extent of take will be exceeded if oil and grease concentrations exceed 5 mg/L in Foster Creek.

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 UCR steelhead.

2.9.3. Reasonable and Prudent Measures

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

The following reasonable and prudent measures and terms and conditions are appropriate to minimize the impacts of incidental take associated with the proposed issuance of the NPDES permit:

1. Revise monitoring frequency for Outfall 45 so that oil and grease discharges to Foster Creek (Outfall 45) are adequately characterized by USACE's monitoring.
2. Ensure that the USACE's Best Management Practices Plan includes measures to reduce the likelihood of oil and grease discharges to Foster Creek.
3. Make available to NMFS the required Best Management Practices, EAL, and PCB Management Plans and monitoring reports.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The EPA 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. To implement RPM 1, EPA will adjust the permit's monitoring frequency for Outfall 45 to better characterize discharges during storm events.

   a) Given the seasonality of rainfall and stormwater runoff, EPA will adjust the permit's monitoring frequency to once per week for years 1-3 before allowing USACE to reduce the frequency to once per month if no exceedances are detected.
2. To implement RPM 2, EPA will require that the USACE:
   a) Cleans solids from the stormwater catch basin that discharges to Outfall 45 two times per year over the 5-year term of the permit, with one clean-out to take place in January or February each year (i.e., before the expected start of spawning in mid-March).
   b) Operates, maintains, and inspects the oil-water separator just upstream of this catch basin according to the recommended procedures and applicable sections in the manufacturer's operations and maintenance manual.
   c) Maintains inspection and maintenance records for the oil-water separator for 5 years.
3. To implement RPM 3, EPA will make available to NMFS the required Best Management Practices, EAL, PCB Management Plans and the monitoring reports generated by these plans to Columbia Hydropower Branch Chief, Interior Columbia Basin Office, West Coast Region, NOAA Fisheries.

2.10. Reinitiation of Consultation

This concludes formal consultation for the EPA's proposal to finalize its National Pollutant Discharge Elimination System Permit for Chief Joseph Dam (WA0026891).

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

2.11. "Not Likely to Adversely Affect" Determinations

On October 11, 2022, NMFS received a request from EPA for a written concurrence that its proposed issuance of an NPDES permit for Chief Joseph Dam is not likely to adversely affect UCR spring-run Chinook salmon or its critical habitat, or UCR steelhead critical habitat designated under the Endangered Species Act (ESA). In this section we describe our concurrence with their conclusion that the proposed action is not likely to adversely affect UCR spring-run Chinook salmon or critical habitat designated for either UCR spring-run Chinook salmon or UCR steelhead. NMFS prepared this response to EPA's request pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparation of letters of concurrence.

2.11.1. Background and Action Agency's Effects Determinations

We adopt by reference here Section 1 of the attached biological opinion, including the Consultation History and the Proposed Federal Action.

2.11.1.1 UCR Spring-run Chinook Salmon

NMFS listed UCR spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) as endangered under the ESA on March 24, 1999 (64 FR14308). We did not recommend changes to the listing status for this ESU in the most recent 5-year review (NMFS 2022). We designated critical habitat for UCR spring-run Chinook salmon on September 2, 2005 (70 FR 52630). However, we did not designate critical habitat for this species upstream of the confluence of the Methow River with the Columbia River (i.e., not within the action area). UCR Chinook critical habitat will not be exposed to the effects of the action and all effects are discountable for critical habitat.

In its BE, EPA (2022a) determined that the proposed action would have insignificant or discountable effects on UCR spring-run Chinook salmon. This determination was based on the extremely low likelihood than any individuals would be within 1 meter of an outfall on the downstream side of the dam long enough to be exposed to undiluted amounts of the discharges regulated by the permit (e.g., oil and grease, pH, heat, and toxics). NMFS agrees with this reasoning. The nearest spawning tributary used by UCR spring-run Chinook salmon is the Methow River, located about 20 miles downstream of the action area. Although some adult spring-run Chinook salmon probably overshoot the Methow confluence as far as the tailrace at Chief Joseph Dam, it is unlikely that individuals hold within a meter of an outfall long enough to experience acute or chronic toxic effects of oil and grease or any of the other permitted parameters. Some juveniles leaving the Methow River subbasin may also move further upstream, but they are not likely to travel the 20-mile distance in the mainstem to Chief Joseph Dam. Thus, we expect all effects to the species in the mainstem to be discountable.

With respect to the potential for exposure to discharges from the stormwater outfall in Foster Creek, Bartu and Andonaegui (2001) reported that a WDFW biologist, Bob Steele, observed "juvenile spring Chinook salmon" during electrofishing surveys in the early to mid-1980s. However, they also stated that Foster Creek was too shallow during the August to October spawning period for spring-run (or unlisted summer/fall-run) Chinook salmon in most years. R2 Resource Consultants (2004) agreed, reporting observations of "spring Chinook salmon fry" (20-50 mm) during snorkel surveys in June and somewhat larger fish (75-100 mm) in August, 2003. However, these authors also stated that no adult Chinook salmon have been observed in Foster Creek and concurred with Bartu and Andoaegui (2001) that stream flows of sufficient depth to support spawning by Chinook salmon are "very spotty." Thus, it is highly unlikely that Chinook salmon redds with eggs and larvae will be present in the creek and the risk of oil and grease contamination of the eggs and larvae of this species is discountable.

Another potential pathway of effects is through the exposure of macrobenthic prey for juveniles rearing in Foster Creek to oil and grease discharged from Outfall 45, as described for UCR steelhead in section 2.5.1.1 of this opinion. The origin of the juvenile Chinook salmon observed in Foster Creek from the 1980s and in 2003 is uncertain, and it is much more likely that they were the progeny of unlisted summer/fall Chinook salmon, which are known to spawn in the mainstem upper Columbia River, than UCR spring-run Chinook salmon. Thus, we consider the likelihood that the proposed action will affect the quantity or quality of benthic prey for UCR spring-run Chinook salmon to be discountable.

2.11.1.2 UCR Steelhead

NMFS designated critical habitat for UCR steelhead on September 2, 2005 (70 FR 52630). The proposed action only affects freshwater migration habitat in the mainstem portion of the action area; we did not designate critical habitat in Foster Creek. Within the mainstem, the proposed effluent limits would reduce the functioning of water quality within a meter of each outfall, a change that is insignificant. That is, the physical or biological features of critical habitat will not be altered to the point that its ability to support the conservation needs of the listed species is reduced.

2.11.2. NMFS Effects Determinations

Based on the above analysis, NMFS concurs with EPA that the proposed action is not likely to adversely affect UCR spring-run Chinook salmon or their critical habitat, or UCR steelhead critical habitat because all effects of the action are expected to be discountable or insignificant.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

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

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction section to the biological opinion. The action area includes areas designated EFH for various life-history stages of two Pacific Coast salmon species: Chinook salmon and coho salmon (PFMC 2014). There are no habitat areas of particular concern (HAPCs) within the action area for this consultation.

Freshwater EFH for Pacific Coast salmon (Chinook and coho) consists of four major components: 1) spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and holding habitat, and overall can include any habitat currently or historically occupied by Council-managed salmon. Freshwater EFH for Pacific Coast Chinook and coho salmon found within the action area for this consultation includes juvenile rearing areas, juvenile migration corridors, and adult migration corridors (PFMC 2014).

3.2. Adverse Effects on Essential Fish Habitat

As described in detail in the preceding opinion, the proposed action is expected to affect EFH in Foster Creek, next to and downstream of Outfall 45, which discharges stormwater from a maintenance/refueling yard. We conclude that the proposed action will adversely affect designated EFH for Pacific Coast Chinook and coho salmon by reducing the functioning of juvenile rearing habitat in this portion of the creek through harm to the juvenile salmonid prey base (i.e., the quantity and quality of benthic invertebrate prey will be adversely affected by the periodic discharge of small amounts of oil and grease).

3.3. Essential Fish Habitat Conservation Recommendations

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

1. EPA should adjust the NPDES permit's monitoring frequency for Outfall 45 to better characterize discharges during storm events.
   a) Given the seasonality of rainfall and stormwater runoff, EPA should adjust the permit's monitoring frequency for this outfall to once per week for years 1-3 before allowing USACE to reduce the frequency to once per month if no exceedances are detected.
2. EPA should require that the USACE:
   a) Cleans solids from the stormwater catch basin that discharges to Outfall 45 two times per year over the 5-year term of the permit.
   b) Operates, maintains, and inspects the oil-water separator just upstream of this catch basin according to the recommended procedures and applicable sections in the manufacturer's operations and maintenance manual.
   c) Maintains inspection and maintenance records for the oil-water separator for 5 years.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, EPA 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's EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(1)].

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

3.5. Supplemental Consultation

The EPA 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's 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 EPA and the USACE. Other interested users could include the Washington State Department of Ecology, the Confederated Tribes of the Colville Reservation, other Indian tribes, ports, recreational and commercial vessel owners, recreational and commercial fishers, and environmental organizations. Individual copies of this opinion were provided to the EPA and the USACE. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

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

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion 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 the ESA and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. References

Arkoosh, M. R., E. Casillas, E. Clemens, A. N. Kagley, R. Olson, P. Reno, and J. E. Stein. 1998. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health 10:182-190.

Bartu, K. and C. Andonaegui. 2001. Salmon and steelhead habitat limiting factors report for the Foster and Moses Coulee Watersheds, Water Resource Inventory Areas (WRIA) 50 and 44. Final Report. Foster Creek Conservation District, Waterville, WA. March, 2001

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

Brockson, R. W. and H. T. Bailey. 1973. Respiratory response of juvenile Chinook salmon and striped bass exposed to benzene, a water-soluble component of crude oil. Pages 783-791. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13-15, 1973. Washington, D.C.

Caudill, C. C., M. L. Keefer, T. S. Clabough, G. P. Naughton, B. J. Burke, and C. A. Peery. 2013. Indirect effects of impoundment on migrating fish: temperature gradients in fish ladders slow dam passage by 37 adult Chinook salmon and steelhead. PLoS ONE 8:e85586. https://doi.org/10.1371/journal.pone.0085586

Cairns, J. Jr., A. G. Heath, and B. C. Parker. 1975. Temperature influence on chemical toxicity to aquatic organisms. Journal of the Water Pollution Control Federation 47(2):267-80.

Carls, M. G., S. D. Rice, and J. E. Hose. 1999. Sensitivity of fish embryos to weathered crude oil: Part I. Low-level exposure during incubation causes malformations, genetic damage, and mortality in larval Pacific herring (*Clupea pallasi*). Environmental Toxicology and Chemistry 18:481-493.

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

Crozier, L. G., M. M McClure, T. Beechie, S. J. Bograd, D. A. Boughton, M. Carr, et al. 2019a. Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem: PLoS ONE. https://doi.org/10.1371/journal.pone.0217711

Crozier, L. G., M. M. McClure, T. Beechie, S. J. Bograd, D. A. Boughton, M. Carr, et al. 2019b. S3 Appendix: Distinct population segment scores and narratives, supporting information for: climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. PLoS ONE:49. https://doi.org/10.1371/journal.pone.0217711.s001

Crozier, L. G., J. E. Siegel, L. E. Wiesebron, E. M. Trujillo, B. J. Burke, B.J., B. P. Sandford, and D. L. Widener. 2020. Snake River sockeye and Chinook salmon in a changing climate: Implications for upstream migration survival during recent extreme and future climates. PLoS ONE 15(9): e0238886. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0238886

Crozier, L.G., B. J. Burke, B.J., B. E. Chasco, D. L. Widener, and R. W. Zabel. 2021. Climate change threatens Chinook salmon throughout their life cycle. https://www.nature.com/articles/s42003- 021-01734-w.pdf

CTCR (Confederated Tribes of the Colville Reservation). 2022. Confederated Tribes of the Colville Reservation, Clean Water Act Section 401 certification for the NPDES Permit for Chief Joseph Dam, NPDES Permit No. WA0026891 and Grand Coulee Dam, NPDES Permit No. WA0026867. Confederated Tribes of the Colville Reservation, Nespelem, WA. September 29, 2022.

EPA (U.S. Environmental Protection Agency). 1976. Quality criteria for water. U.S. EPA Report 440/5-86-001 (Red Book). EPA Office of Water, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1986. Quality criteria for water. U.S. EPA Report 440/5-86-001 (Gold Book). EPA Office of Water, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 2003. EPA Region 10 Guidance for Pacific Northwest state and tribal temperature water quality standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA. April, 2003.

EPA (U.S. Environmental Protection Agency). 2020. Assessment of Impacts to Columbia and Snake River Temperatures using the RBM10 Model Scenario Report: Appendix D to the Columbia and Lower Snake Rivers Temperature Total Maximum Daily Load. U.S. Environmental Protection Agency, Region 10, Seattle, WA. May, 2020.

EPA (U.S. Environmental Protection Agency). 2021a. Columbia and Lower Snake Rivers Temperature Total Maximum Daily Load. U.S. Environmental Protection Agency, Seattle, WA. May, 2020.

EPA (US Environmental Protection Agency). 2021b. Biological Evaluation of EPA-issued NPDES permits for federal dams in the lower Columbia and Snake Rivers basin. U.S. Environmental Protection Agency, Region 10, Water Division, Seattle, WA. May, 2021.

EPA (U.S. Environmental Protection Agency). 2022a. Final Biological Evaluation of NPDES Permit for Chief Joseph Dam (WA0026891). EPA Region 10, Seattle, WA. October 11, 2022.

EPA (U.S. Environmental Protection Agency). 2022b. Draft Permit No. WA0026891. Authorization to discharge under the National Pollutant Discharge Elimination System. U.S. EPA, Region 10, Seattle, WA.

EPA (U.S. Environmental Protection Agency). 2022c. Draft NPDES Fact Sheet, Chief Joseph Dam. U.S. EPA, Region 10, Seattle, WA.

EPA (Environmental Protection Agency). 2022d. Email from M. Merz (EPA) to Lynne Krasnow (NMFS), RE: WCRO-2022-02707 NPDES permit for Chief Joseph Dam, 12/22/2007, 02:44 pm.

Esbaugh, A. J., E. M. Mager, J. D. Stieglitz, R. Hoenig, T. S. Brown, B. L. French, et al. 2016. The effects of weathering and chemical dispersion on Deepwater Horizon crude oil toxicity to mahi mahi (*Coryphaena hippurus*) early life stages. Science of the Total Environment 543:644-651.

Evans, D. H., P. M. Piermarini, and K. P. Choe. 2005. The multifunctional fish gill: dominant site of gas exchange, osmoregulation, acid-base regulation, and excretion of nitrogenous waste. Physiological Reviews 85, 97–177.

Ford, M. J., editor. 2022. Biological viability assessment update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-171. January, 2022. https://doi.org/10.25923/kq2n-ke70

Good, T. P., R. S. Waples, P. Adams. (eds.) 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-66. June, 2005.

Hatlen, K., C. A. Sloan, D. G. Burrows, T. K. Collier, N. L. Scholz, and J. P. Incardona. 2010. Natural sunlight and residual fuel oils are a lethal combination for fish embryos. Aquatic Toxicology 99:56-64.

Heintz, R. A., J. W. Short, and S. D. Rice. 1999. Sensitivity of fish embryos to weathered crude oil: Part II. Increased mortality of pink salmon (*Oncorhynchus gorbuscha*) embryos incubating downstream from weathered Exxon Valdez crude oil. Environmental Toxicology and Chemistry 18:494-503.

Herbert, D. W. M. and J. C. Merkins. 1961. The effect of suspended mineral solids on the survival of trout. International Journal of Air and Water Pollution 5:46-55.

Hicken, C. L., T. L. Linbo, D. W. Baldwin, M. L. Willis, M. S. Myers, L. Holland, et al. 2011. Sublethal exposure to crude oil during embryonic development alters cardiac morphology and reduces aerobic capacity in adult fish. Proceedings of the National Academy of Sciences 108:7086-7090.

ICTRT (Interior Columbia River Technical Recovery Team). 2007. Interior Columbia Basin TRT: Viability criteria for application to Interior Columbia Basin Salmonid ESUs. Available at http://www.nwfsc.noaa.gov/trt/trt_viability.cfm.

Incardona, J. P. 2017. Molecular mechanisms of crude oil developmental toxicity in fish. Archives of Environmental Contamination and Toxicology 73:19-32.

Incardona, J. P. and N. L. Scholz. 2016. The influence of heart developmental anatomy on cardiotoxicity-based adverse outcome pathways in fish. Aquatic Toxicology 177:15-525.

Incardona, J. P. and N. L. Scholz. 2017. Environmental pollution and the fish heart. In Fish Physiology, The cardiovascular system: phenotypic and physiological responses, A. K. Gamperl, T. E. Gillis, A. P. Farrell, and C. J. Brauner, Eds. Elsevier: London, 2017; Vol. 36B.

Incardona, J. P. and N. L. Scholz. 2018. Case study: the 2010 Deepwater Horizon oil spill. In Development, Physiology, and Environment: A Synthesis. W. Burggren, and B. Dubansky, Eds. Springer: London.

Incardona, J. P., T. K. Collier, and N. L. Scholz. 2011. Oil spills and fish health: exposing the heart of the matter. Journal of Exposure Science and Environmental Epidemiology 21:3-4.

Incardona, J. P., T. H. Swarts, R. C. Edmunds, T. L. Linbo, A. Aquilina-Beck, C. A. Sloan, et al. 2013. Exxon Valdez to Deepwater Horizon: comparable toxicity of both crude oils to fish early life stages. Aquatic Toxicology 142-143:303-316.

Isaak, D. J., C. H. Luce, D. L. Horan, G. L. Chandler, S. P. Wollrab, and D. E. Nagel. 2018. Global warming of salmon and trout rivers in the northwestern U.S.: road to ruin or path through purgatory? Transactions of the American Fisheries Society 147:566–587.

ISAB (Independent Scientific Advisory Board). 2007. Climate change impacts on Columbia River basin fish and wildlife. ISAB Report 2007-2, Portland, OR. May, 2007.

Jirka, G. H., R. L. Donneker, and S.W. Hinton. 1996. User's manual for CORMIX: A hydrodynamic mixing zone model and decision support system for pollutant discharges into surface waters. September, 1996.

Jorgensen, J. C., C. Nicol, C. Fogel, and T. J. Beechie. 2021. Identifying the potential of anadromous salmonid habitat restoration with life cycle models. PLoS ONE 16(9): e0256792.

Jung, J.-H.; C. E. Hicken, D. Boyd, B. F. Anulacion, M. G. Carls, W. J. Shim, and J. P. Incardona. 2013 Geologically distinct crude oils cause a common cardiotoxicity syndrome in developing zebrafish. Chemosphere 91:1146-1155.

Khursigara, A. J., K. L. Ackerly, and A. J. Esbaugh. 2019. Oil toxicity and implications for environmental tolerance in fish. Comparative Biochemistry and Physiology, Part C 220:52-61.

Marty, G. D., J. W. Short, D. M. Dambach, N. H. Willits, R. A. Heintz, S. D. Rice, et al. 1997. Ascites, premature emergence, increased gonadal cell apoptosis, and cytochrome P4501A induction in pink salmon larvae continuously exposed to oil-contaminated gravel during development. Canadian Journal of Zoology 75:989-1007.

Materna, E. 2001. Issue paper 4: Temperature interaction. EPA-910–D-01-004. U.S. Environmental Protection Agency, Region 10, Seattle, WA. 33 p.

McCullough, D. A., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Issue paper 5: Summary of technical literature examining the physiological effects of temperature on salmonids. EPA-910-D-01-005. U.S. Environmental Protection Agency, Region 10, Seattle, WA. 114 p.

McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA NOAA Technical Memorandum NMFS-NWFSC-42. June, 2000.

Miller, B.F., R. L. Johnson, M. L. Miller, R. S. Klett, and J. E. Arterburn. 2023. 2022 Okanogan Subbasin steelhead spawning abundance and distribution. Colville Confederated Tribes Fish and Wildlife Department, Nespelem, WA. Report submitted to the Bonneville Power Administration, Project No. 2003-022-00. February, 2023.

Morris, J. M., M. Gielazyn, M. O. Krasnec, R. Takeshita, H. P. Forth, J. S. Labenia, et al. 2018. Deepwater Horizon crude oil toxicity to red drum early life stages is independent of dispersion energy. Chemosphere 213:205-214.

NMFS (National Marine Fisheries Service). 2005. Final assessment of NOAA Fisheries' Critical Habitat Analytical Review Teams for 12 Evolutionarily Significant Units of West Coast salmon and steelhead. August, 2005. https://repository.library.noaa.gov/view/noaa/18667

NMFS (National Marine Fisheries Service). 2008. Endangered Species Act – Section 7 consultation biological opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat consultation, EPA's proposed approval of revised Washington water quality standards for designated uses, temperature, dissolved oxygen, and other revisions. NMFS Tracking No.: 2007/02301. NMFS, Northwest Region, Seattle, WA. February 5, 2008.

NMFS (National Marine Fisheries Service). 2009. Middle Columbia River steelhead distinct population segment ESA recovery plan. NMFS, Northwest Region. November 30, 2009.

NMFS (National Marine Fisheries Service). 2011. NMFS (National Marine Fisheries Service). 2011. 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead.

NMFS (National Marine Fisheries Service). 2015. Jeopardy or adverse modification of critical habitat, Endangered Species Act biological opinion, The Environmental Protection Agency's proposed approval of certain Oregon water quality standards including temperature and intergravel dissolved oxygen. WCR-2013-76. NMFS Northwest Region, Portland, OR. November 3, 2015.

NMFS (National Marine Fisheries Service). 2020. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, Continued Operation and Maintenance of the Columbia River System. NMFS Consultation Number: WCRO 2020-00113. NMFS, West Coast Region.

NMFS (National Marine Fisheries Service). 2022. 2022 5-Year review: Summary & evaluation of Upper Columbia River spring-run Chinook salmon and Upper Columbia River steelhead. NMFS, West Coast Region.

NWFSC (Northwest Fisheries Science Center). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. Northwest Fisheries Science Center, Seattle, WA. December 21, 2015.

NOAA (National Oceanic and Atmospheric Administration). 2023. Ocean Conditions Indicators Trends Web page. Accessed May 4, 2023. https://www.fisheries.noaa.gov/content/ocean-conditions-indicators-trends

Ober, H. K. 2010. Effects of oil spills on marine and coastal wildlife. University of Florida IFAS Extension. WEC285.

ODEQ (Oregon Department of Environmental Quality). 1995. pH. 1992 - 1994 Water Quality Standards Review. Final Issue Papers. Portland, OR. June, 1995.

Patra, R. W., J. C. Chapman, R. P. Lim, P. C. Gehrke, and R. M. Sunderam. 2015. Interactions between water temperature and contaminant toxicity to freshwater fish. Environmental Toxicology and Chemistry 34(8):1809-1817.

Perhar, G., and G. B. Arhonditsis. 2014. Aquatic ecosystem dynamics following petroleum hydrocarbon perturbations: A review of the current state of knowledge. Journal of Great Lakes Research, 40(Supplement 3):56-72.

PFMC (Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Philip, S.Y., S. F. Kew, G. J. van Oldenborgh, F. S. Anslow, S. I. Seneviratne, R. Vautard, et al.. 2021. Rapid attribution analysis of the extraordinary heatwave on the Pacific Coast of the US and Canada. Earth System Dynamics. DOI: 10.5194/esd-2021-90

R2 Resource Consultants. 2004. Fish Snorkel Surveys of Priority Streams in WRIA 44 & 50. Grant No. G0200263 (Step B – Field Implementation). Prepared for the Foster Creek Conservation District and the WRIA 44 & 50 Planning Unit. R2 Resource Consultants, Inc., Redmond, WA. August, 2004.

Rice, S. D. 1973. Toxicity and avoidance tests with Prudhoe Bay oil and pink salmon fry. Pages 667-670. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13-15, 1973. Washington, D.C.

Robards, M. D., and T. P. Quinn. 2002. The migratory timing of adult summer-run steelhead in the Columbia River over six decades of environmental change. Trans. Am. Fish. Soc. 131:523-536.

Sauter, S.T., J. McMillan, and J. Dunham. 2001. Issue paper 1: Salmonid behavior and water temperature. EPA-910-01-001. U.S. Environmental Protection Agency, Region 10, Seattle, WA. 36 p.

Scott, M. H. 2020. Statistical modeling of historical daily water temperatures in the lower Columbia River. Dissertations and Theses. Paper 5594. https://doi.org/10.15760/etd.7466

Servizi, J. A., and D. W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49:1389–1395.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Man Tech Environmental Research Services Corporation, Corvallis, OR. December, 1996.

Tonina, D., J. A. McKean, D Isaak, R. M. Benjankar, C. Tang, and Q. Chen. 2022. Climate change shrinks and fragments salmon habitats in a snow dependent region. Geophysical Research Letters 49. e2022GL098552. https://doi.org/10.1029/2022GL098552

UCUT (Upper Columbia United Tribes). 2022. The Phase 2 Implementation Plan: Testing feasibility of reintroduced salmon in the upper Columbia River basin. Prepared by the Upper Columbia United Tribes. August 4, 2022.

USACE (U.S. Army Corps of Engineers). 2002. Chief Joseph Dam, preliminary investigation of fish passage alternatives. US Army Corps of Engineers, Seattle District, Hydraulic Engineering Section, Seattle, WA. September, 2002.

USACE (U.S. Army USACE of Engineers). 2022a. RE: [Non-DoD Source] Use of Environmentally Acceptable Lubricants (EAL) at Chief Joseph Dam. Email from K. Cousins (Seattle District) to L. Krasnow (NMFS) on 11/22/22, 08:25 am.

USACE (U.S. Army Corps of Engineers). 2022b. RE: [Non-DoD Source] WCRO-2022-02707 NPDES permit for Chief Joseph Dam. Email from K. Cousins (USACE) to L. Krasnow (NMFS) on 12/6/22, 17:17 pm.

UCSRB (Upper Columbia Salmon Recovery Board). 2007. Upper Columbia spring Chinook salmon and steelhead recovery plan. NMFS, USFWS, and Upper Columbia Salmon Recovery Board.

WDOE (Washington Department of Ecology). 2022. Clean Water Act Section 401 certification for EPA National Pollution Discharge Elimination System Permit No. WA0026891, US Army Corps of Engineers – Chief Joseph Dam. WDOE, Olympia, WA. September 30, 2022.

WDOE (Washington Department of Ecology). 2023a. Dissolved oxygen excursions in Foster Creek. Downloaded from https://apps.ecology.wa.gov/waterqualityatlas/wqa/map on January 13, 2023.

WDOE (Washington Department of Ecology). 2023b. Temperature excursions in Foster Creek. Downloaded from https://apps.ecology.wa.gov/waterqualityatlas/wqa/map on January 13, 2023.

Wissmar, R. C., J. E. Smith, B. A. McIntosh, H. W. Li, G. H. Reeves, and J. R. Sedell. 1994. Ecological health of river basins in forested regions of Eastern Washington and Oregon. General Technical Report PNW-GTR-326. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. February, 1994.