EXECUTIVE SUMMARY

Columbia River System Operations Environmental Impact Statement

US Army Corps of Engineers®

BUREAU OF RECLAMATION

Bonneville POWER ADMINISTRATION

The U.S. Army Corps of Engineers, Bureau of Reclamation and Bonneville Power Administration, as co-lead agencies, have prepared this Columbia River System Operations (CRSO) Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA). NEPA requires federal agencies to review and disclose the environmental effects of taking an action. The action referred to in this EIS is a multi-faceted approach to system operations, maintenance, and configuration of the 14 federal dam and reservoir projects in Idaho, Montana, Oregon and Washington, called the Columbia River System (CRS). We prepared this document in response to the need to review and update management of the CRS, including evaluating impacts to resources in the context of new information and changed conditions in the Columbia River Basin. Information and insights from this process have enabled the development of a comprehensive approach to management of the CRS that meets multiple statutory authorities and complies with all applicable laws and regulations.

More than 30 entities from across the region, consisting of tribes, intertribal organizations, federal agencies, and state and local governments, agreed to participate as cooperating agencies in this NEPA process. We greatly appreciate their technical expertise and input on this document. We are especially grateful to our tribal partners for helping ensure that the document reflects tribal perspectives on the Columbia River System.

We released a draft EIS February 28, 2020, and held a 45-day public comment period during which we hosted six public meetings and five meetings with tribes. Due to the stay-at-home and social distancing orders from the COVID-19 pandemic, we hosted these meetings via teleconference calls and had robust attendance. We received almost 59,000 comments from the public meetings, letters, and an online database. We addressed these comments in the relevant technical sections of the EIS, the response to comments Appendix of the EIS, throughout this executive summary, and in a new section of the executive summary entitled "COMMON THEMES FROM THE COMMENT PERIOD." We sincerely appreciate the public and tribal participation on the important issues contained in the CRSO EIS.

The EIS identifies and evaluates alternatives for operations, maintenance, and configuration of the CRS. After evaluating the potential effects of the alternatives on flood risk management, water supply, hydropower generation, fish and wildlife, navigation, cultural resources, recreation and other environmental and socioeconomic resources, the co-lead agencies identified a Preferred Alternative that seeks to achieve a reasonable balance of multiple river resource needs and co-lead agency mission requirements. The Preferred Alternative is comprised of a suite of operational and structural measures that allow us to meet the Purpose and Need Statement and objectives of the EIS, including those to benefit species listed as threatened and endangered under the Endangered Species Act. Detailed descriptions of the alternatives are presented in Chapter 2 (No Action and Multi-objective Alternatives) and Chapter 7 (Preferred Alternative) of the EIS.

The co-lead agencies recognize the impacts that the configuration, operation and maintenance of the Columbia River System have had on endangered fish populations within the region, and we acknowledge the important role we play in addressing those impacts. Ultimately, achieving broader recovery objectives will also require additional regional actions to address other effects that are beyond the co-lead agencies' CRS authorities. We also recognize that the completion of the CRSO EIS will not end the debate about the future management of the Columbia River System. The Preferred Alternative allows for operational flexibility to meet the wide range of regional priorities and will allow for the compilation of critical data that can be used in the broader discussions. The co-lead agencies are committed to being active participants with the region in developing coordinated solutions that collectively achieve broader recovery objectives.

It was very important to us to seek input from a broad variety of stakeholders in the region as we developed this EIS. Not surprisingly, there is a wide range of views and opinions about the best approaches to managing the Columbia River System. However, it was also apparent that people throughout the Northwest share many common values and interests. Our goal has been to develop an approach to river management that balances these multiple perspectives and can serve as a springboard to continued progress in the region on recovery and mitigation for fish and wildlife, reliable and affordable clean electricity, and economic vitality for the tribes and other communities who depend on the Columbia River System for their way of life. Our understanding of the Columbia River System will continue to improve, and the perspectives of the people living in the region will continue to evolve as well. We look forward to working with our many partners throughout the region on these important and timely issues.

Sincerely,

D. Peter Helmlinger, P.E.
Brigadier General
U.S. Army
Division Commander

Lorri Gray
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PREFACE

The Columbia River Basin is one of the greatest natural resources in the western United States, and the rivers and their tributaries form the dominant water system in the Northwest. The headwaters of the Columbia River begin at Columbia Lake, on the west slope of the Rocky Mountain Range in Canada, and the river follows a circuitous path for more than 1,200 miles before emptying into the Pacific Ocean near Astoria, Oregon. As its largest tributary, the Snake River originates in western Wyoming and travels 1,078 miles before merging with the Columbia River near Tri-Cities, Washington. The rivers influence the lives of people, fish and wildlife throughout the Northwest. The Columbia River and its tributaries, including both those in the upper and lower river and the Snake River, impact nearly every resident of the Northwest in some way, by providing hydroelectric power, recreation, navigation, water supply, flood risk management, and more.

Indigenous peoples have depended on the river and its resources for spiritual and economic well-being since time immemorial. These resources are central to tribal culture, ceremony, and subsistence. Salmon, steelhead, Pacific lamprey, sturgeon, bull trout, and other native species found in the river are essential to many tribes' identities. Tribal populations also depended on the river for transportation, trade, fishing, and water supply.

As Euroamericans began arriving in the region in the 1800s, the Columbia River and its tributaries became an important resource for them as well. They too depended on the river for transportation, trade, commercial fishing, and irrigation water. By the 1920s, plans were being developed for the construction of multipurpose dams in the Columbia River to manage the river in new ways. With Congress's approval and funding, numerous dams were built along the Columbia River and its tributaries to provide for flood risk management, navigation, hydropower generation, fish and wildlife conservation, irrigation, recreation, and municipal and industrial water supply. The federal dams that are a part of the Columbia River System (CRS) were built and put into service between 1938 and 1976.

Today, the CRS continues to provide valuable social and economic benefits to the region. Operation of the CRS for flood risk management is an important purpose of the system, one that has reduced the risk to lives, property, and infrastructure in the basin. Large floods have occurred in the Columbia River Basin throughout history with catastrophic consequences. For example, in 1948, a flood destroyed Vanport, Oregon. At the time, Vanport was the second largest city in the state. Dozens of people lost their lives, and more than 18,000 were left

homeless. Today, the CRS provides flood risk management for communities along the river.

The Columbia-Snake Navigation System is an important component of the regional economy. Between 50 and 60 million tons of cargo are transported each year on the Columbia-Snake Navigation System, beginning on the Snake River near Lewiston, Idaho, and Clarkston, Washington, to the Snake River confluence with the Columbia River near Pasco, Washington, and then on the Columbia River to its confluence with the Pacific Ocean near Astoria, Oregon. The river system allows farmers to export grain and other crops grown in interior parts of the United States to overseas markets. Cruise line operators also use the system for tourism, which is a growing business on the Columbia and Snake rivers.

The CRS is a major source of economical, reliable, and clean power generation, providing the region with some of the least greenhouse gas (GHG) intensive electricity in the United States. On average, the CRS produces 8,500 average megawatts of carbon-free power (equivalent to the power needs of eight cities the size of Seattle), reducing the need to use carbon-emitting resources, like natural gas and coal plants. The flexibility of the CRS also helps integrate variable renewable resources like wind and solar by stabilizing the system when these resources are unavailable. In power grid operations, the amount of power produced must match the amount being consumed, second by second. Maintaining this balance requires flexible generating resources. Flexible resources are always available and can be ramped up and down as needed to manage normal fluctuations in supply and demand, as well as to help balance the variable output of renewable resources such as wind and solar. Hydropower is an example of a flexible resource that helps manage the moment-to-moment variability of these renewable generators' output. With 2,500 average megawatts or more of coal capacity expected to be retired in the 2020s, the hydropower system can continue to provide reliable power while helping to decarbonize the regional economy.

The Columbia River and its tributaries provide water for millions of people throughout the Columbia River Basin. Farmers depend on water from the system to irrigate crops that contribute to the national economy. These crops include grains, alfalfa, and fruits and vegetables, including the wine grapes that form the foundation of the Northwest wine industry. Water from within the study area irrigates nearly 1.4 million acres of land, with the potential for more.

While the region has derived many benefits from the CRS, there have also been adverse effects, particularly to populations of native fish. In addition to the initial construction and ongoing operations of the CRS, over the past century the development of the Columbia River Basin has brought with it many stressors that have collectively contributed to population declines of native fish species, including urbanization and development in wetlands and floodplains, overfishing, water diversions, water pollution, invasive species introduction, mining, farming, ranching practices, logging and riparian erosion, hatchery-produced fish and competition, and adverse ocean conditions. It is estimated that before the late 1800s, a range of five to 16 million salmon and steelhead returned to the Columbia River Basin each year. Numbers of anadromous fish began to decline in the late 1800s and continued to drop into the late 1900s. Bull trout, sturgeon, and other resident fish species have also experienced significant declines.

An **ANADROMOUS FISH** is born in fresh water, migrates out to the ocean where it spends most of its life, then returns to fresh water to spawn. Salmon, steelhead, and lamprey are all anadromous fish.

Construction of the CRS directly impacted many of the region's tribal communities. Tribal homes, villages, and resource gathering locations and traditional fishing sites were inundated. Some of the most well-known of these are Celilo Falls near The Dalles, Oregon, and Kettle Falls along Lake Roosevelt in Washington. These population declines were devastating to many tribes in the Northwest. As noted previously, fish are central to the identity of tribes.

MEGAWATT (MW) is the standard term of measurement for bulk electricity. One megawatt is 1 million watts. The total possible output of a generating plant is expressed in megawatts. For example, Grand Coulee, the largest dam in the Columbia River Basin and one of the largest in the world, has a maximum capacity of 6,735 megawatts. However, power plants are not operated at full capacity year-round. A generating plant's energy output over a certain period of time (often a year) is expressed in **AVERAGE MEGAWATTS**. One average megawatt is equivalent to one megawatt delivered continuously over a year. Grand Coulee's annual energy output is 2,400 average megawatts.

An elder from the Confederated Tribes of the Colville Reservation points to an inundated home site and fishing station on the north bank of the Snake River.

"Salmon are the centerpiece of our culture, religion, spirit, and indeed, our very existence. As Indians, we speak solely for the salmon. We have no hidden agenda. We do not make decisions to appease special interest groups. We do not bow to the will of powerful economic interests. Our people's desire is simple—to preserve the fish, to preserve our way of life, now and for future generations."

Donald Sampson, 1994. Meyer Resources Inc. 1999. Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes. Prepared for the Columbia River Inter-Tribal Fish Commission (CRITFC).

Today, the annual runs of salmon and steelhead average just over two million fish, of which 40% are naturally produced. The rest come from hatchery programs developed for conservation or safety-net purposes, or as mitigation for the construction of the dams. Since 1992, more than half of Columbia River salmon and steelhead species have been listed under the Endangered Species Act (ESA). Regional debate continues about the relative importance of the different factors that cumulatively led to this decline, but there is little debate that the construction and operation of the CRS has had a sizable impact on fish. Tremendous effort and billions of dollars have been invested in infrastructure, hatcheries, and other projects to improve passage and habitat for fish in the basin over the last 50 years, particularly since the passage of the Northwest Power Act in the early 1980s.

The co-lead agencies have made substantial improvements for resident and anadromous (both adult and juvenile) fish passage at the lower Snake River and lower Columbia River dams. The co-lead agencies have undertaken large-scale efforts to improve fish and wildlife habitat in tributaries and the estuary. In addition to the

The fish ladder at John Day Lock and Dam that allows adult fish to migrate upstream of the dam.

habitat restoration actions that have been taken to address direct impacts where they occur from operations, these actions typically enhance fish and wildlife habitat not directly impacted by the operation and maintenance of the CRS, but help mitigate for the effects of the CRS. The co-lead agencies have funded an extensive hatchery program that includes conservation hatcheries for ESA-listed fish and other hatcheries to mitigate for the construction and operation of the dams. Many of these hatchery fish support tribal, commercial, and sport harvest. While not inclusive of all actions that have been taken to benefit salmon, steelhead, Pacific lamprey, bull trout, sturgeon, and other native fish species, these examples help provide context for the level of effort that has gone into improving conditions for fish within the basin.

The co-lead agencies are committed to working with the region to continue to improve conditions for fish and wildlife affected by operations of the CRS.

1 INTRODUCTION

1.1 COMPLYING WITH NEPA

The U.S. Army Corps of Engineers (Corps), Bureau of Reclamation (Reclamation) and Bonneville Power Administration (Bonneville), as co-lead agencies, have developed the Columbia River System Operations Environmental Impact Statement in accordance with the National Environmental Policy Act (NEPA). The co-lead agencies prepared this EIS in response to the need to review and update operations, maintenance, and configuration of the 14 CRS multiple purpose dams and related facilities ("projects"). These projects are Libby, Hungry Horse, Albeni Falls, Grand Coulee, Chief Joseph, Dworshak, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville (Figure ES-1). The United States Congress authorized the Corps and Reclamation to construct, operate, and maintain the CRS projects to meet multiple specified purposes, including flood risk management (FRM), navigation, hydropower generation, irrigation, fish and wildlife conservation, recreation, and municipal and industrial (M&I) water supply (Figure ES-2). Bonneville is authorized to market and transmit the power generated by these coordinated system operations. Although the CRS has many purposes, it is operated as one interconnected system.

The October 19, 2018 *Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West* directed the co-lead agencies to complete the EIS and associated biological opinions (BiOps) by 2020.

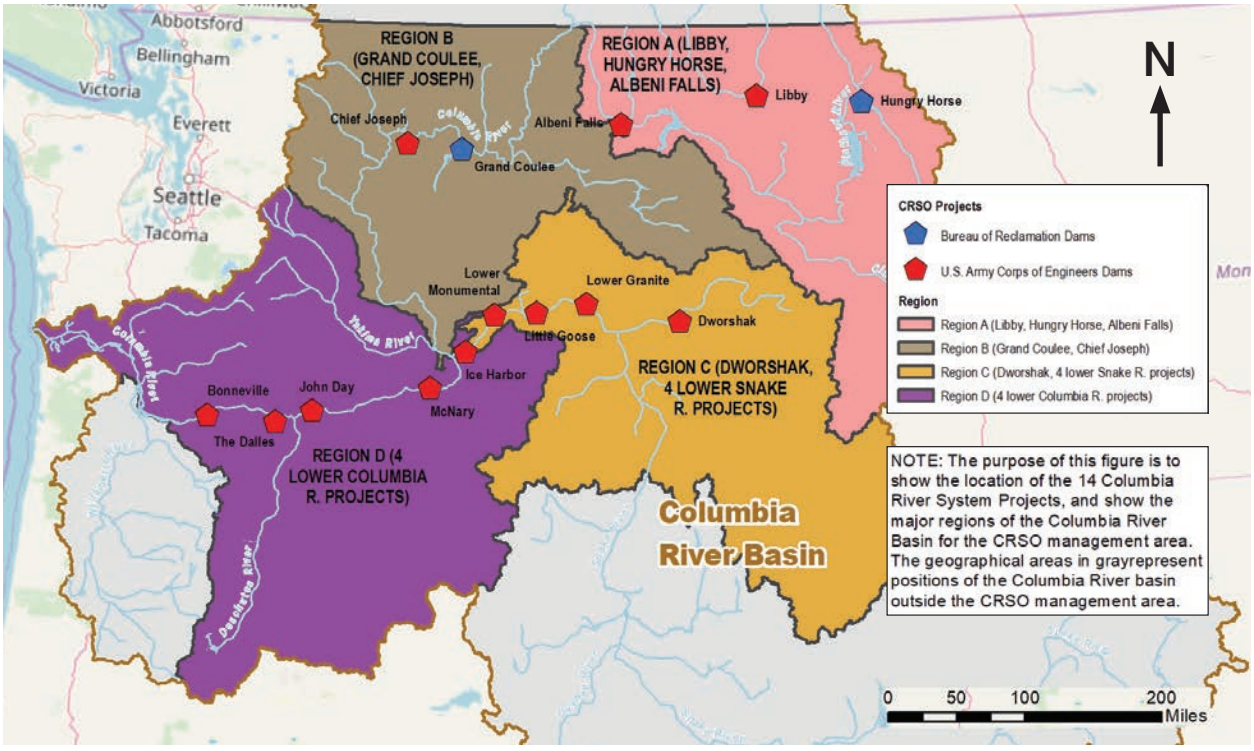


Figure ES-1: Columbia River System Projects

- The National Environmental Policy Act of 1969 (NEPA) is a sweeping federal law and is one of the first and most important of the nation's environmental laws.
- NEPA helps federal agencies make informed decisions.
- Under NEPA, federal agencies solicit broad input from citizens, tribes, states, local governments, other federal agencies, and anyone else who might have an interest or opinion on the project.
- NEPA considers a broad range of potential effects from a federal action.

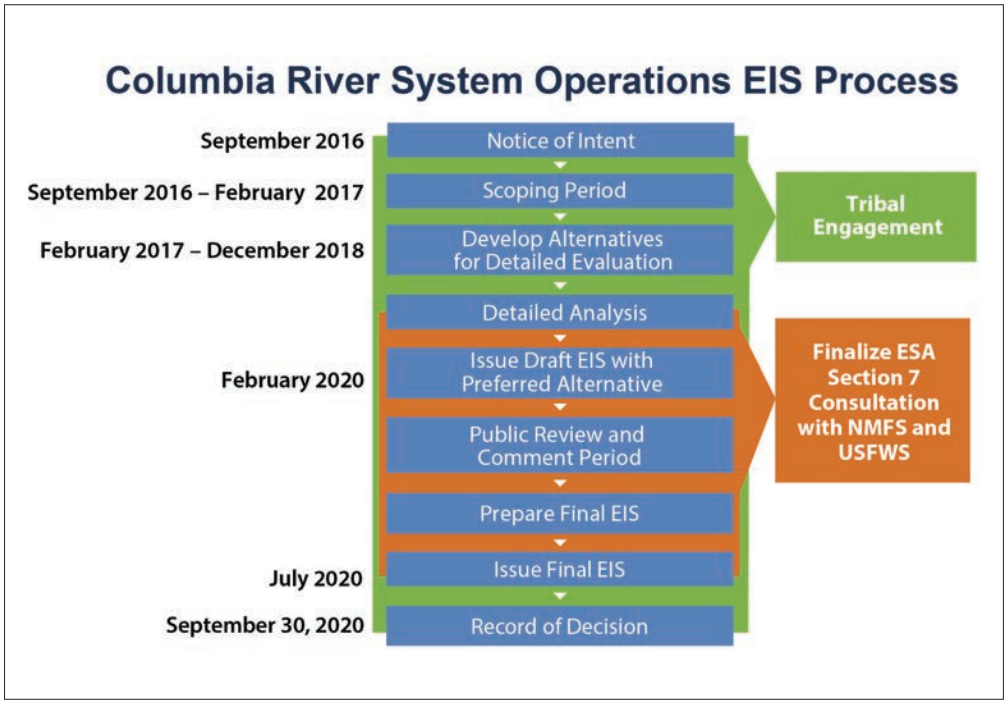


Figure ES-2: Uses of the Columbia River System

1.2 A COMPLEX OPERATION

To meet the many uses of the Columbia River System, the co-lead agencies manage a complex operation that includes storing and releasing water at just the right times and in just the right amounts to meet various needs throughout the year. Often, actions to meet one need make it more challenging to meet another. For example, in January, operators begin drafting reservoirs to make room for spring runoff and provide flood risk management space, but sufficient water must still be available in early April to help propel juvenile salmon and steelhead in their migration to the ocean. All of the system's purposes are important and must be carefully choreographed.

As part of the CRSO EIS, the co-lead agencies analyzed the environmental, economic, and social impacts of the No Action and Action Alternatives, reviewing new scientific information, where applicable, and responding to the Opinion and Order from the U.S. District Court for the District of Oregon.[1] The Opinion and Order states the EIS should evaluate how to ensure that the prospective management of the CRS is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of designated critical habitat. It also ordered the co-lead agencies to complete the Final EIS and records of decision by March 2021 and September 2021, respectively.

1.3 NAVIGATING THE EIS

This executive summary provides an overview of the EIS, which is a much larger document that contains highly detailed analyses and results. This executive summary also provides an overview of the major environmental effects of the Preferred Alternative, but it is not intended to be a substitute for the broader CRSO EIS document, which provides a comprehensive and detailed description of the environmental effects and mitigation for the Preferred Alternative. The table of contents below identifies the major topics and chapters of the EIS. Where possible, the executive summary points to the EIS chapter and section where the reader can find further details on a topic. Visit the *CRSO EIS website*.

[1] *National Wildlife Federation, et al. v. National Marine Fisheries Service (NMFS), et al.,* 184 F. Supp. 3d 861 (D Or. 2016).

1.4 SCOPE OF THE EIS

The geographic scope of the EIS encompasses the 14 federal projects on the Columbia River, the Snake River, and some other major tributaries. Other federal projects located across the Columbia River Basin (e.g., the Willamette Valley projects, the Yakima Valley projects, and other federal projects in the upper Snake River Basin), are not included in the specific geographic scope for the effects analysis in this EIS. Those projects are separate from CRS operations and are carried out under different legal authorities.[2] Additionally, non-federal projects in the geographic scope were included in the modeling of hydrology and outflows of operations into the system, cumulative effects considerations, and considerations for how federal operations may cause impacts to non-federal projects. However, these non-federal projects were not included in this CRS analysis for scoping new measures of how they could operate differently. Non-federal projects are subject to different regulations, and requirements for operations are outlined in Federal Energy Regulatory Commission (FERC) licensing. In addition, three projects in the Canadian portion of the basin are partially coordinated with the CRS under the Columbia River Treaty. These other projects are included in the direct effects analysis for power, as appropriate.

The temporal scope of the EIS is assumed to be 25 years from the signing of the record of decision, unless otherwise specified, in order to have a similar period of analysis for comparison of effects across resources for all multiple objective alternatives. However, the socioeconomic analysis uses a 50-year period to capture the full array of changing costs and investments, and to evaluate the total costs, benefits, consequences and tradeoffs of the alternatives considered. The 50-year period of analysis provides a long-term perspective that enables the co-lead agencies to distinguish between short-term socioeconomic impacts that may occur during the implementation of alternatives and long-term effects that would occur after implementation is completed. The range of measures evaluated, and the effects analysis in the EIS, allowed the co-lead agencies to understand the outcomes of taking certain actions, and to recommend a suite of measures to gain the best range of beneficial effects while minimizing adverse effects. Adaptive management will continue to be an important approach to managing the CRS moving forward.

1.5 THE ENDANGERED SPECIES ACT AND THE EIS

A biological assessment, or BA, is a document developed by an action agency, or agencies, such as the Corps, Reclamation or Bonneville, as part of interagency consultation required by the Endangered Species Act. The National Environmental Policy Act and the ESA have different standards for legal compliance, as well as different approaches to the analysis of the effects of the action. Therefore, the analyses conducted in the CRSO EIS and in the CRS BA are tailored to the requirements of each regulatory process.

Depending on the ESA-listed species that are likely to be affected by the action, an action agency submits a BA to the regulatory agency responsible for enforcing the ESA: National Marine Fisheries Service and the U.S. Fish and Wildlife Service. In the case of the CRSO EIS, the appended BA (see Appendix V) includes a proposed action that describes the management of the Columbia River System and the associated effects on listed species, including salmon, steelhead, bull trout, and Kootenai River White Sturgeon. The submittal of a BA initiates formal consultation on the effects of an action on ESA-listed species.

The regulatory agency then uses the information in the BA to analyze and determine if the action complies with the ESA. This documented determination, including any recommendations, is called a biological opinion, or BiOp. In the case of the CRSO EIS, NMFS produced a BiOp (see Appendix V) for the listed salmon and steelhead species and also assessed the effects of CRS operations on related species that may be affected such as Southern Resident killer whales and eulachon. The USFWS produced a BiOp for the ESA listed resident (freshwater) species: bull trout and Kootenai River White Sturgeon.

NMFS and USFWS determined the actions are not likely to jeopardize the continued existence of the ESA-listed species, (e.g., salmon and steelhead species; Kootenai River white sturgeon and bull trout) or not likely to adversely affect green sturgeon and Southern Resident killer whale. NMFS and USFWS also determined the actions were not likely to destroy or adversely modify designated critical habitat of any ESA-listed species. These determinations resulted in two “no jeopardy” biological opinions issued by NMFS and USFWS.

An environmental impact statement, or EIS, is a NEPA document prepared by an agency or agencies to evaluate the effects of its proposed action, and alternatives

[2] For example, the Willamette Basin System, operated by the Corps, is authorized in part by several of the same Flood Control Acts as some of the CRS projects. However, as outlined in these authorizations, the Willamette System was designed as a comprehensive plan of development specific to the Willamette Basin, which would be operated as a separate system from the CRS.

to that action on the environment. An agency then provides the public an opportunity to comment on the information in the EIS, responds to those comments in writing and uses both the information contained in the EIS and the comment responses to make an informed decision.

Note that a BiOp and an EIS are both different from a recovery plan under the ESA. A recovery plan serves as a resource to organize on-the-ground actions to recover a threatened or endangered species, considering all of the impacts to that species no matter the source. A recovery plan is a guidance and planning document for state, tribal and federal resource managers, among others, that does not obligate any public or private entity, or federal agency to take any action. A recovery plan describes a suite of actions to be taken by multiple agencies and organizations across the region that collectively are designed to move the listed species toward recovery. For example, NMFS' ESA Snake River Spring/Summer Chinook Salmon and Snake River Steelhead Recovery Plan should not be confused with the NEPA or ESA consultation process for Columbia River System operations, maintenance and configuration. This recovery plan is much broader in scope and includes actions that are beyond the capacity, authority, and responsibility of the Columbia River System action agencies.

1.6 WHAT'S NEW IN THE FINAL EIS

The final EIS documents the co-lead agencies' response to substantive comments on the draft EIS; documents minor corrections and additions identified by commenters, expert reviewers and the agencies during the review and comment period; and includes measures from the associated ESA consultations.

These corrections did not fundamentally change the analysis or conclusions documented in the draft EIS. The final EIS carries forward the Preferred Alternative identified in the draft EIS with minor changes. The final EIS includes an appendix with all comments and responses to substantive comments. In all, the agencies received almost 59,000 comments through teleconference calls, mail and online, which are included in Appendix T.

In this Executive Summary, we've added content to the existing section on TRIBAL COORDINATION AND PERSPECTIVES to provide a high-level description of comments and responses from the comment period. We added a section to address comments from the states of Oregon, Washington, Idaho, and Montana, and at the end of the Executive Summary, we added a section to address common themes that we heard from the comment period.

TABLE ES 1 COOPERATING AGENCIES
FEDERAL AGENCIES
U.S. Environmental Protection Agency, Region 10
U.S. Coast Guard, 13th Coast Guard District
U.S. Department of the Interior, Bureau of Indian Affairs
STATE AGENCIES
IDAHO
Governor's Office of Species Conservation
Governor's Office of Energy and Mineral Resources
Department of Fish and Game
Department of Agriculture
Department of Lands
Department of Environmental Quality
Historic Preservation Office
Department of Parks and Recreation
Department of Water Resources
Idaho Department of Transportation
OREGON
Department of Fish and Wildlife
Department of Energy
Water Resources Department
Department of Agriculture
Department of Environmental Quality
MONTANA
Montana Office of the Governor
Montana Fish, Wildlife and Parks
WASHINGTON
Department of Ecology
Department of Fish and Wildlife
Department of Agriculture
COUNTY AGENCIES
Lake County, Montana
TRIBES
Confederated Salish and Kootenai Tribes of the Flathead Reservation
Confederated Tribes of the Colville Reservation
Confederated Tribes of Grand Ronde
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes and Bands of the Yakama Nation
Cowlitz Indian Tribe
Kootenai Tribe of Idaho
Nez Perce Tribe
Shoshone-Bannock Tribes of the Fort Hall Reservation
INTERTRIBAL ORGANIZATION
Upper Snake River Tribes Foundation on behalf of: Burns Paiute Tribe, Fort McDermitt Paiute-Shoshone Tribe, and Shoshone-Paiute Tribes of the Duck Valley Reservation

In response to public comments, we have made some changes to the EIS. For power, changes included reducing the amount of replacement resources used for the dam breaching alternative in response to public input, incorporating updated costs for replacement resources from the Northwest Power and Conservation Council's draft 8th Power Plan, and more thoroughly describing the process for identifying potential replacement resource portfolios.

In addition to content that was added or changed based on public comments, the final EIS also reflects clarifications from independent, external, peer review on how we analyzed effects, including effects on endangered species, regional economics, and power.

2 REGIONAL INPUT

The co-lead agencies (Corps, Reclamation, and Bonneville) share responsibility and legal authority for managing the CRS and worked together to develop the EIS. While developing the EIS, the co-lead agencies understood the importance of seeking broad input from the region. The co-lead agencies gathered input from the public; tribes; local, state, and federal governments; water resource users, including utility customers, commercial navigation and port entities, irrigation users, recreational and commercial fishers; and other public interest organizations during the scoping process.

2.1 PUBLIC SCOPING

The co-lead agencies implemented a robust public scoping process to provide an opportunity for the public to help identify significant issues that should be evaluated in the EIS. The public scoping period extended from September 30, 2016, through February 7, 2017. Also during this time, the co-lead agencies conducted 16 public meetings and two webinars.

More than 400,000 comments were provided by members of the public, tribes, local and state governmental agencies, non-governmental organizations, and other stakeholders during the public scoping period. The scoping comments are summarized in the *Public Scoping Report* for the Columbia River System Operations Environmental Impact Statement, October 2017.

2.2 COOPERATING AGENCIES

The co-lead agencies requested tribes, federal, state, and local agencies to participate as cooperating agencies based on their jurisdiction by law, or their special expertise. More than 30 entities from across the region agreed to be cooperating agencies in this NEPA process. The current cooperating agencies are listed in Table ES-1. These cooperating agencies contributed to the EIS by providing information, participating on technical teams, and reviewing draft materials. The cooperating agencies retained the right to comment on the draft and final EIS during the public review and comment processes. As the federal agencies responsible for complying with NEPA, the co-lead agencies retained decision-making authority over the content of the draft and final EIS, as well as the ultimate content of the record of decision. Due to this, the cooperating agencies may or may not agree with or fully support all of the content of these documents.

2.3 TRIBAL COORDINATION AND PERSPECTIVES

Since time immemorial, the Columbia River Basin has been inhabited by Native American peoples, who successfully subsisted on the abundant natural resources of the region. They built thriving communities that relied on the lands to sustain their way of life.

Tribal reservations were formed through a number of different methods: treaties, executive orders, judicial decisions, and legislation. Tribes with treaties ceded territory to the United States and reserved reservation lands to themselves. When Congress prohibited further tribal treaties in 1871, the federal government used presidential executive orders to establish reservations. When Congress prohibited reservations through presidential executive order in 1919, tribal recognition was provided by statute.

The Northwest has a mix of tribes recognized by treaty, executive order, and statute. Treaty tribes retained certain off-reservation rights described within their treaties, such as hunting, fishing, and gathering. Tribes recognized by executive order and statute have established, through legal challenges and other methods, that some similar off-reservation rights may also belong to their tribes as well. The federal government also recognizes the rights non-treaty tribes have established through campaigning, court decisions, and legislation. The potentially affected area of the CRS includes portions of tribal reservations, trust lands, and ceded lands of 19 federally recognized tribes. Reservoirs that are part of the CRS system inundate parts of three existing Indian reservations: the Colville and Spokane reservations, which are partially inundated by Lake Roosevelt; and the Nez Perce Reservation, which is partially inundated by Dworshak Reservoir. In some cases, the U.S. Government has entered into special agreements with these tribes regarding management of the reservoirs because of their location within reservations.

In its relations with tribes, the United States "has charged itself with moral obligations of the highest responsibility and trust" (Seminole Nation v. United States, 1942). These trust responsibilities derive from the historical relationship between the federal government and tribes as expressed in treaties, statutes, executive orders, and

federal Indian case law. The co-lead agencies are committed to a government-to-government relationship with the tribal governments and recognize the unique character of each tribe. Tribal governments have the primary authority and responsibility for many reservation affairs, and may be co-managers of natural resources within their respective ceded, treaty, or usual and accustomed areas. As a result, the co-lead agencies have sought to involve the tribes from the beginning of this process to gain their perspective on the planning and management activities of water resources, fish and wildlife resources and other natural resources in order to achieve mutually beneficial results. The co-lead agencies engaged with tribes during the development of the EIS by inviting them to be cooperating agencies, participating in formal government-to-government consultations, and engaging with them through other existing mechanisms, such as the Columbia Basin Fish Accords. The co-lead agencies initiated government-to-government engagement with the tribes in Table ES-2.

The tribes of the Columbia River Basin represent diverse and distinct cultures, each different from the next. There is one theme, however, that the tribes all have in common: their association with the natural resources of the region permeates every aspect of their cultures. This association results in a strong sense of stewardship for the land.

It is difficult to overstate the effects the CRS has had on tribal culture, way of life, and traditions. These effects have been explicit—as in the loss of celebrated fishing sites of regional importance such as Celilo and Kettle Falls; and implicit—including the loss of the innumerable and unquantifiable intra- and inter-tribal interactions that occurred at these locations, such as loci-focused ceremonies, traditions, languages and customs, dances and song. The losses of these areas have adversely affected how tribal communities define themselves, interact with each other, and live full spiritual lives; and in the process has undermined the processes through which living cultures are nourished, maintained, and perpetuated.

TABLE ES 2
ENGAGEMENT WITH FEDERALLY RECOGNIZED TRIBES

Burns Paiute Tribe
Coeur D'Alene Tribe of Indians
Confederated Salish and Kootenai Tribes of the Flathead Reservation
Confederated Tribes of the Chehalis Reservation
Confederated Tribes of Grand Ronde
Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of the Colville Reservation
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of Warm Springs Reservation
Confederated Tribes and Bands of the Yakama Nation
Cowlitz Indian Tribe
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Kalispel Tribe of Indians
Kootenai Tribe of Idaho
Nez Perce Tribe
Shoalwater Bay Indian Tribe
Shoshone-Bannock Tribes of the Fort Hall Reservation
Shoshone-Paiute Tribes of the Duck Valley Reservation
Spokane Tribe of Indians

"The dams' effect on tribal culture is far-reaching. Youth in Keller are losing their traditional ways, the tainted river and loss of salmon damaged the CTCR way of life. Parents do not have the same opportunities to pass down their customs and traditions. Few know all the words to the different ceremonies anymore. No one person still remembers the names of all the fish. No one person remembers all the different names used for some species of fish, as they are called by different names as they move through the stages of their life … when sweats are not conducted, the language is not spoken as often, legends are not told, family history is forgotten, ritual practices are lost, and the status and role of the elders are diminished."

The Confederated Tribes of the Colville Reservation

Kettle Falls, before and after inundation. This area served as a major fishing location and focal point for tribal interactions, for millennia.

Celilo Falls before and after construction of The Dalles Dam inundated the area, putting the falls underwater. For thousands of years, Celilo Falls served as a culturally significant fishing site for tribes.

Many of the tribes have not only lost access to traditional places, but have lost access to the one thing that all these places on the river had in common, which bound them together- the salmon. The loss of these foundational aspects of tribal culture has manifested itself across tribal communities in very tangible ways. The tribes cope with levels of poverty, ill health, and unemployment at significantly higher proportional rates than any other ethnic group in the country, which in turn leads to significantly higher mortality rates in comparison to non-native communities.

Many of the facilities and much of the infrastructure that make up the CRS were put in place before legislation or enactment of executive orders that required the U.S. government to consider the effects these actions would have on the natural and cultural environment and tribes. When the tribes did raise their concerns, they were often ignored or minimized.

"Present tribal suffering stems, in large part, from the cumulative stripping away of tribal Treaty-protected resources to create wealth for non-Indians of the region … In earlier decades, bureaucrats working to convert the river to produce electricity, irrigate agriculture, carry commodities by river barge, and accommodate deposit of waste, asserted that 'uncertainty regarding impacts on salmon could be managed' as the conversion of the river moved forward."

Meyer Resources Inc. 1999. Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes. Prepared for the Columbia River Inter-Tribal Fish Commission (CRITFC).

Given the co-lead agencies' trust responsibilities, and their relationships with tribes that have deepened over the years through collaboration in the Columbia River Basin, it is important that tribal perspectives have a prominent place in this document, as well as in the management of the Columbia River System.

Most of the 19 tribes identified as being affected by the operations of the CRS provided extensive input into the CRSO EIS either as cooperating agencies or through their comments, or both. As co-managers of the natural and cultural resources of the Northwest, their expertise was essential to the effects analysis of those resources. All tribes desire a return to the abundance of natural resources that was seen when the tribes were the sole stewards of the resources, before the arrival of Euro-Americans. In their comments, the Confederated Tribes of the Umatilla Indian Reservation stated, "All alternatives studied in the CRSO EIS should have been analyzed for their effect on Columbia River fisheries and their ability to contribute to the recovery of stocks to harvestable levels that support tribal fisheries and communities."

While acknowledging that other factors have had an effect, all tribes attribute the loss of these natural and cultural resources on the construction and operation of the CRS and the development of power, irrigation, navigation, and population growth enabled by the dams. Most of the tribes supported breaching the four lower Snake River dams, which they see as offering the highest return rate of anadromous fish to the Snake River and tributaries. Although this argument was made by most of the tribes, there were regional differences resulting from differing tribal customs and practices. The issues identified below are intended to be a useful summary, however they do not fully illustrate the depth of content and range of issues described by the tribes.

The treaty tribes in the lower Columbia have treaty-guaranteed rights to take salmon at their usual and accustomed areas. They see the diminution of salmonids from historic yearly runs of up to 16 million to today's average run size of two million fish as a violation of their treaty rights.

Tribes in parts of the upper Columbia Basin advocated strongly for the inclusion of passage and reintroduction of salmonids in the blocked areas above Chief Joseph and Grand Coulee dams. As the Coeur d'Alene Tribe stated, "The loss of these habitats to anadromous fisheries has had a significant and continuing impact on Coeur d'Alene Tribal cultural, economic and social wellbeing."

With regards to breaching the four lower Snake River dams, the Upper Snake River tribes stated, "Chinook salmon have been central to the culture and diet of the … tribes for thousands of years … [and] these connections have been greatly diminished over the last century as eight dams on the Upper Snake River have prohibited Chinook salmon from reaching … traditional harvest areas."

The Shoshone-Bannock Tribe added, "The Tribe believes it is time to select an alternative that restores the systems and affected unoccupied lands to a natural condition." The importance of healthy salmon and steelhead populations to tribal cultures and economies are a central part of the rationale for selecting juvenile fish passage spill measures in the Preferred Alternative that have the potential to provide major improvements in smolt-to-adult returns. Continued investment in structural improvements for lamprey passage also reflects consistent feedback received from numerous tribes.

The affirmation and refinement of the Montana Operations, which include measures designed to carefully balance resident fish needs with downstream requests for flow augmentation, is the result of close coordination with state and tribal partners in the upper basin. Over the past 30 years, the Montana Operations have evolved to address the effects of Libby and Hungry Horse dams on natural resources, with emphasis on controlled flows and drafting rates (e.g., how fast and deep a reservoir is lowered to preserve riparian habitat and then refilled in the spring to provide flows that benefit ESA-listed bull trout, Kootenai River White Sturgeon and salmon).

2.4 RESPONSIVENESS TO THE STATES

The four states, Oregon, Washington, Idaho, and Montana, all provided invaluable expertise and contributions to the CRSO EIS as cooperating agencies. While each state brought a unique perspective, they also aligned around a number of common themes. The four states were unified in calling for a continued commitment to improving conditions for the region's fish and wildlife. The state of Idaho called for "increased predation control, increasing hatchery production and wild fish abundance, and improving natal habitat so that healthier fish are out-migrating." Montana is particularly focused on "hydro operations at Libby and Hungry Horse dams that affect resident fish, wildlife, and ecosystem processes." Oregon affirmed its "long-standing effort to recover salmon and steelhead in the Columbia Basin as a vital part of our ecological, cultural and economic heritage and prosperity," and Washington emphasized "protecting and restoring abundant, harvestable salmon and steelhead and other native fish species, including contributing to a reliable source of prey for Southern Resident orcas."

Each state also recognized the importance of optimization and balance across resource areas. In their comments on Multiple Objective 3, Oregon stated that "these likely benefits to salmon and steelhead need to be assessed along with the impacts to power generation, irrigation, flood control, and river-dependent commerce, and how

Yakima County, Washington. Adding wood structures reduces stream velocity and pushes water into streamside floodplains and wetlands, many of which have been disconnected for decades as a result of past forest practices.

Removing old agricultural dikes at the confluence of the Wallooskee and Youngs rivers near Astoria, Oregon, to allow water to inundate the historic floodplains and improve habitat for young fish on their way to the ocean.

these sectors can be made whole or provided reasonable offsets associated with potential removal of the Snake River dams." Washington highlighted the importance of "providing for a clean, affordable, and reliable energy system that meets our clean energy and climate goals; ensuring affordable and reliable transportation alternatives for wheat farmers in the Palouse and Tri-Cities areas; and ensuring reliable irrigation supplies for eastern Washington farms." Idaho asserted that "helping salmon thrive and fostering a strong Idaho economy that produces good jobs are not mutually exclusive," and Montana called for "balanc[ing] hydropower generation, flood management, and ecosystem benefits that improve conditions for resident species and their habitats without adversely affecting downstream and anadromous species."

Recovery is a regional goal that will require coordinated regional action to address the numerous threats to listed salmon and steelhead. (See section 1.5 of the Executive Summary for more information on the meaning and context of "recovery.") Many of the states highlighted the need for a broader regional process going forward that looks explicitly at achieving higher benefits for salmon and steelhead. Governor Brad Little of Idaho stated that "Unfortunately, ocean conditions and climate are more difficult to control. As you know, these factors play a major role in the life cycle of ESA-listed anadromous fish populations and so the region must continue to minimize mortality while improving freshwater natal habitat as much as possible. I look forward to working with the action agencies and regional stakeholders on this issue." Governor Kate Brown of Oregon shared a vision of a "formal partnership with the federal lead agencies, National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), and the federally recognized tribal governments. The process to formulate that vision must also provide meaningful engagement with and input from the public and others who depend on the Columbia River System, including the energy sector, agriculture, and navigation interests. It can draw upon the work of NOAA's Columbia Basin Partnership that seeks a collaborative approach to comprehensive, integrated solutions for salmon management with full consideration of energy, agriculture, transportation, recreation, and other community needs."

For almost 100 years, the Crooked River in north central Idaho's Nez Perce-Clearwater National Forest was trapped in a tangle of turns caused by dredge mining in the river and its floodplain. This tributary habitat restoration project removed mine tailings which blocked the stream for decades, and restored the natural floodplain and river flows.

Looking downstream at a portion of the restored Mission Creek channel, which used to be a ranch, near Moiese, Montana.

Governor Jay Inslee of Washington was "heartened by recent calls for, and steps toward, a regional collaboration about how to do more for salmon in a manner consistent with the energy, transportation, and irrigation needs of Washington and the Pacific Northwest."

The co-lead agencies support the idea of a regional forum focused on rebuilding salmon and steelhead runs and are hopeful that this EIS will provide a useful foundation of information as we work together on a shared vision for abundant salmon and steelhead and a clean, reliable, and affordable energy future for the Northwest. The intent of the Preferred Alternative is to provide substantial benefits for salmon and steelhead while still meeting the co-lead agencies' purpose and need of this EIS. While the Preferred Alternative is predicted to have a notably higher potential benefit for Snake River salmon and steelhead than the No Action Alternative, NOAA's climate change analysis in the 2020 CRS Biological Opinion (NOAA, 2020) reminds us that no one action in isolation can achieve the broader goal of recovery.

2.5 AREAS OF CONTROVERSY

Lower Snake River Dam Breach

The co-lead agencies received important feedback from tribal engagement, cooperating agencies, and through public scoping pertaining to breaching the four lower Snake River dams. Breaching the four lower Snake River dams has been a topic of public discourse for decades. This EIS provides an updated analysis of the many biological and sociological variables and a range of potential costs and benefits of retaining or breaching the lower Snake River dams. In combination with other sources of information and analysis available in the public domain, the CRSO EIS can help inform the regional conversation on this complex and polarizing issue. New congressional authority and associated appropriations would be required to implement the dam breaching measures evaluated in the EIS. However, the measures are carried forward in the analysis to align with the District Court's Opinion and Order, as well as in response to comments received during public scoping.

Fish Modeling

The EIS analysis uses two different approaches to estimate how the changes to CRS operations developed as part of this EIS would affect the rates of adult salmon and steelhead returning to the Columbia and Snake Rivers. These models are the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) Lifecycle Model (LCM), which includes the Comparative Passage (COMPASS) model, which was developed by scientists from throughout the Pacific Northwest, led by NOAA; and the Comparative Survival Study (CSS) model, which has been collaboratively developed by federal and state agencies and tribal sovereigns. Both models were used to estimate the magnitude of effects on spring Chinook salmon and steelhead, and where applicable, the model results were considered and applied to other species.

The models apply different assumptions and predict survival using different combinations of environmental variables, which are described in more detail in Chapter 3, Section 5. In general, the CSS model predicts that for juvenile salmon and steelhead on their way downstream, additional increases in spring spill (achieved by decreasing flow through the turbines) would reduce the number of powerhouses these young fish would swim through and increase the number of returning adults in subsequent years. The NMFS LCM does not predict the same magnitude of increases in adult returns due to increases in spill levels beyond performance standard spill, but instead predicts that variables such as ocean conditions or the number of fish transported (barged) past the dams have a bigger impact on how many adult fish return.

TOTAL DISSOLVED GAS (TDG) is the amount of gas present in water. Supersaturation of gases in water released at hydropower dams can cause gas bubble trauma that can lead to mortality if fish are exposed to harmful levels for extended periods of time. Similar risks occur for SCUBA divers when dissolved gases (mainly nitrogen) come out of solution in bubbles when returning to the surface too quickly and can lead to decompression sickness through temporary injury, paralysis, or death, often referred to as "the bends."

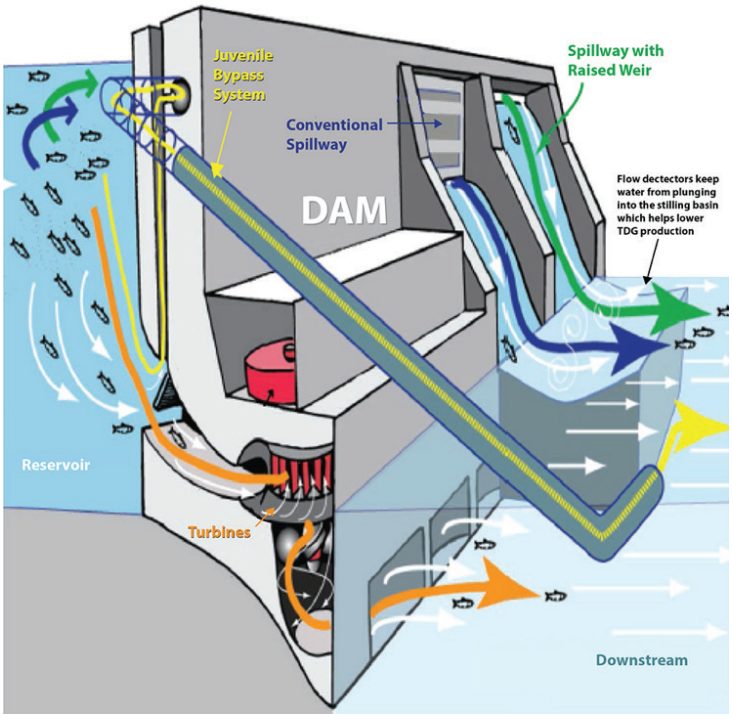
One element, delayed mortality, stands out as particularly important in explaining the models' different predictions. Delayed or "latent" mortality is mortality attributed to the CRS, but not experienced by juvenile salmon and steelhead until after they pass through the freshwater CRS. The CSS model attributes the majority of recent declines in returning adult salmon and steelhead to decreased ocean survival (delayed mortality) directly associated with passage past the dams, but the CSS models also consider numerous other factors including ocean conditions. NMFS's LCM attributes the majority of recent declines to the arrival time of juveniles entering the ocean (e.g., fish that enter the ocean later in their migration run-timing tend to have lower survival), and deteriorating ocean conditions (decadal scale cycles in ocean productivity and warming water in the Northeast Pacific). Future climate change predictions in the ocean (i.e., warmer surface temperatures) are anticipated to have negative effects on marine rearing of ESA-listed anadromous fish, but are not likely to be exacerbated by operations or maintenance of the CRS.

Given the ongoing regional and scientific debate over these two models, the co-lead agencies decided to use both models to evaluate the range of potential impacts in the CRSO EIS. This approach allows for a transparent examination of the results and assumptions embedded in the two primary analytical models and allows the co-lead agencies to share the assumptions and results of both models to inform decision making. The differences in the two models illustrate the complexity of predicting how anadromous fish would respond to different management actions and highlight the uncertainty that future research and management decisions will need to address.

Independent, external, objective peer review is regarded as a critical element in ensuring the reliability of scientific analysis. As part of agency requirements when developing analysis for an EIS, the Corps commissioned an Independent External Peer Review (IEPR) of the primary CRSO EIS Ecological Models. This review process was managed by an independent third party and used a panel of experts that were vetted and selected by the third party. The IEPR was external to the co-lead agencies and was conducted following Corps and Office of Management and Budget guidance described in USACE (2018) and OMB (2004). The ecological models reviewed as part of the CRSO IEPR included the COMPASS model, the NMFS LCM, CSS' Lifecycle models, and the University of Washington total dissolved gas model. Information on the selection and qualifications of the IERP can be found in Appendix B.

Through their review of the ecological models, the IEPR panel found that "The models are very comprehensive and provide a detailed comparison of alternatives under very flexible input specifications" and that in regards to the NOAA and CSS models that "both sets of models, the COMPASS/LCM and the CSS sets, are sensible and credible, and they allow for flexibility over a range of inputs that will be helpful for modeling future conditions." However, the Panel has identified a number of concerns and has provided specific recommendations to improve the models in the Final Panel Comments. Overall, 13 Final Panel Comments were identified and documented. Of these, two were identified as having high significance, four have medium/high significance, six have medium significance, and one has medium/low significance. The IEPR report and the co-lead agencies' responses to these six concerns as well as the remaining seven medium and medium-low level concerns can be found in Appendix X.

The first high significance comment is acknowledged and addressed above, and throughout the model-specific write-ups in Chapter 3, Section 5. The IEPR panel found that the uncertainty in model output due to differences in the attribution of salmon survival rates to the ocean



Juvenile fish passage routes on Columbia River System dams

SPILL FOR JUVENILE FISH PASSAGE

The co-lead agencies release (or spill) water through the federal dams in the spring and summer to help juvenile salmon and steel head migrate safely to the ocean. With spill, fish go past the dams in water that flows through spillway openings, rather than traveling through turbines or bypass systems. Spillway weirs allow juvenile salmon and steelhead to pass a dam near the water surface, under lower accelerations and lower pressures, providing a more efficient and less stressful dam passage route.

SMOLT-TO-ADULT RETURN RATIO (SAR)

is the rate at which a group of fish survive from their smolt life stage (typically measured at the first dam in their migration, such as Lower Granite Dam, but can also be from their fresh-water tributary or hatchery of origin) to an ending point as an adult (usually back to a dam in the CRS such as Bonneville—the first dam adults encounter—or Lower Granite Dam, which is the last dam that Snake River fish can pass).

environment versus Columbia River dam/reservoir operations used in the COMPASS/LCM and CSS models leads to increased uncertainty for decision makers. The panel also found the effects of TDG on fish should be carefully assessed in the CSS model. Both of these high significance comments raised by the IEPR panel are expected to be focal points as the co-lead agencies implement the Preferred Alternative using the adaptive management framework found in Appendix R.

In a common theme for all models, the IEPR panel noted that improved documentation would enhance future review efforts of these models. The panel found it challenging to navigate the various user guides and other material related to model development that was generated at other times and for other purposes than just the CRSO EIS analysis. The panel discussed how the lack of documentation of the specific model and parameters made it more difficult for the panel to establish that the models, analyses, results, and conclusions are theoretically sound, computationally accurate, based on reasonable assumptions, well-documented, and in compliance with the requirements of the OMB Peer Review Bulletin (OMB, 2004). From this feedback, the co-lead agencies will continue to encourage the model developers to enhance their model documentation and to provide additional information to inform future peer reviews such as the results of standard model validation.

The four medium/high significance comments noted by the IEPR panel would be addressed as the Preferred Alternative is implemented. Factors such as extrapolation beyond current datasets, focusing on key predictor variables while balancing the number of variables analyzed, and improved documentation of model assumptions would be addressed as these models are applied in assessing salmon and steelhead response to the operations associated with the Preferred Alternative.

Quantitative and qualitative lines of evidence were considered from NOAA's LCM and CSS models, and both models played an important role in shaping the Preferred Alternative. Through the Flexible Spill Agreement signed in 2018 (2019–2021 Spill Operation Agreement), the co-lead agencies have also sought to develop more collaborative and constructive working relationships with the proponents of the CSS model and foster improved technical exchange between LCM and CSS modelers. Through this EIS, the co-lead agencies are creating an additional opportunity to test the assumptions about the potential for significantly increased salmon survival embedded in the CSS model through the adaptive implementation of a flexible spill operation. This adaptive implementation framework includes careful monitoring and evaluation to ensure there are not adverse impacts on aquatic species or other unintended consequences and is described in more detail in Part 2 of Appendix R.

Reintroduction

The co-lead agencies received tribal input and scoping and public comments asking for the CRSO EIS to analyze reintroduction of salmon above Grand Coulee and Chief Joseph dams. Reintroduction of salmon above Grand Coulee Dam and installation of fish passage at Grand Coulee and Chief Joseph dams is an important and complex, large-scale concept. Its consideration, evaluation, and implementation should involve multiple tribal, federal, state, and other entities. To allow so many differing interests to coordinate on such a complex topic, which may include international considerations, a decision-making framework and a series of regional workshops would be necessary just to approach the first step of defining reintroduction objectives. Given the incompatibility of such a wildlife management decision-making framework with an analysis of the operation of the CRS, it is not feasible to proceed with a detailed consideration of reintroduction in this EIS. Moreover, to meaningfully analyze reintroduction as a measure, the details of the proposal would need to be understood well enough to include in hydrologic, water quality, and fish models. That information is not currently available, and development of those details was not possible in the timeframe of this NEPA process. The co-lead agencies recognize the importance of participating in regional efforts to address fish management topics in areas blocked by Grand Coulee and Chief Joseph dams, potentially including reintroduction. Between publication of the draft and final EIS, the agencies participated in an initial meeting with upper basin states and tribes to begin structured conversations around the issue, and will continue to support and participate in this dialogue.

Water Quality

The EIS analysis predicted water temperature and total dissolved gas effects under various dam configurations and operations as specified in the EIS alternatives.

Temperature

There are elevated water temperatures in the Columbia River Basin due to regular climatic events and climate variability. There is also regional debate over the role the federal projects may play in contributing to higher water temperatures. Due to this controversy, the co-lead agencies developed a model that could distinguish operational changes and water quality. While other water quality models for the Columbia River Basin exist (e.g. EPA's RBM-10 model), the co-lead agencies used CE-QUAL W2 due to its ability to simulate two-dimensional reservoir stratification (temperature differences at depths) that occurs in the CRS. This was particularly of interest for analyzing changes in Dworshak operations and the effects on water temperatures in the lower Snake River.

Elevated water temperature, above state water quality criteria of 20°C (68°F), within much of the Columbia and Snake rivers is a concern. Water management operations at the projects are able to provide more beneficial water temperatures than have historically been observed. Nonetheless, water temperatures in many locations of the Columbia River Basin are too warm. Concern about water temperatures increasing in the future and contributing to the decline of water quality was expressed by cooperating agencies. The co-lead agencies used regionally developed climate and hydrology projections from the River Management Joint Operating Committee (RMJOC-II) study to qualitatively assess potential effects to resources, including water temperatures. The climate science community is still developing quantitative models that can address possible effects in water temperature from climate change, and unfortunately, there are not reliable models at the appropriate resolution (river scale vs. regional or global scale) at this time. This data is critical to analyzing potential effects to fish quantitatively. In lieu of this information, the climate analysis used the output from resource models under historical conditions, such as water quality and fish, in addition to available climate change data and scientific literature to qualitatively assess potential effects to resources (described in Chapter 4).

Columbia and Lower Snake River Temperature Total Maximum Daily Load (TMDL)

Over the past two years, EPA has updated the RBM-10 one-dimensional temperature model to assess Columbia and Snake River water temperatures and evaluate the effects from the federal and non-federal dams as part of the re-initiation of the TMDL. Some stakeholders are comparing the scenarios analyzed in the TMDL effort against CRSO EIS results. There are similarities in the RBM-10 and CE-QUAL W2/HEC-RAS modeling assessments of the lower Snake River, and both project teams have evaluated the similarities and differences in the models as part of an uncertainty assessment. At the same time, direct comparisons are not appropriate given the differences between scenarios and assumptions made between the two projects. These differences are described in Appendix D, Section 2.2.2.

2.6 ISSUES TO BE RESOLVED

The co-lead agencies used the CRSO EIS to make a choice among alternatives. We developed a reasonable range of alternatives to be able to select a balanced operating strategy for the CRS. The effects analysis showed the impacts, benefits and tradeoffs to affected resources. This informed which measures would be identified in the Preferred Alternative. Some measures that provide the ability to meet one purpose or objective sometimes conflict with the ability to meet other purposes and objectives. The co-lead agencies worked together, with input from cooperating agencies, to identify a suite of measures to form a more balanced alternative.

In the Draft EIS, unresolved issues included water quality standards. Both Oregon and Washington have since finalized their respective water quality standard changes to accommodate spring juvenile fish passage spill up to 125% TDG in the tailrace. Previous state water quality standards limited juvenile fish passage spill to lower amounts of spill. As part of the Preferred Alternative, the co-lead agencies would increase planned spill up to 125% total dissolved gas levels in the tailrace at some projects during the spring, consistent with the principles of the flexible spill operation designed to optimize power and juvenile fish passage.

3 DEVELOPMENT AND COMPARISON OF ALTERNATIVES

Alternatives were developed to meet the Purpose and Need Statement and eight study objectives developed for the EIS, and to review and update the operations and management of the 14 CRS projects and the associated analysis of impacts since the last system analysis conducted in the 1990s (System Operation Review EIS, 1997). The three co-lead agencies convened technical subject matter experts from their agencies, as well as the cooperating agencies, to support developing the measures and alternatives.

The co-lead agencies also contracted with outside entities and agencies with specialized technical expertise, such as the Fish Passage Center and the Northwest Science Center, to provide quantitative modeling support for the anadromous fish analyses.

The EIS set forth eight objectives which, in tandem with the Purpose and Need Statement, establish the framework for evaluating the ability of an alternative to satisfy the co-lead agencies' numerous legal obligations. This discussion is important for general context and understanding, as well as to provide the framework within which a reasonable range of alternatives to the proposed action was identified.

Purpose and need for action

The U.S. Army Corps of Engineers (Corps), the U.S. Bureau of Reclamation (Reclamation), and the Bonneville Power Administration (Bonneville) are co-leads in preparing this Environmental Impact Statement (EIS) under NEPA on the coordinated water management functions for the operation, maintenance, and configuration ("management") of the 14 federal dam and reservoir projects that comprise the Columbia River System (System). The U.S. Congress authorized the Corps and Reclamation to construct, operate and maintain the System projects to meet multiple specified purposes, including flood control (also referred to as flood risk management), navigation, hydropower production, irrigation, fish and wildlife conservation, recreation, municipal and industrial water supply, and water quality, though not every project is authorized for every one of these purposes. BPA is authorized to market and transmit the power generated by these coordinated System operations.

The ongoing action that requires evaluation under NEPA is the long-term coordinated management of the System projects for the multiple purposes identified above. An underlying need to which the co-lead agencies are responding is reviewing and updating the management of the System, including evaluating measures to avoid, offset, or minimize impacts to resources affected by the management of the System in the context of new information and changed conditions in the Columbia River Basin. In addition, the co-lead agencies are responding to the Opinion and Order issued by the U.S. District Court for the District of Oregon[3] such that this EIS will evaluate how to ensure that the prospective management of the System is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat, including evaluating mitigation measures to address impacts to listed species. The EIS will evaluate actions within the co-lead agencies' current authorities, as well as certain actions that are not within the co-lead agencies' authorities, based on the District Court's observations about alternatives that could be considered and comments received during the scoping process. The EIS will also allow the co-lead agencies and the region to evaluate the costs, benefits and tradeoffs of various alternatives as part of reviewing and updating the management of the System.

The co-lead agencies will use the information garnered through this process to inform future decisions and allow for a flexible approach to meeting multiple responsibilities including resource, legal, and institutional purposes.

Resource Purposes

- Provide for a reliable level of flood risk by managing the System to afford safeguards for public safety, infrastructure, and property.
- Provide an adequate, efficient, economical and reliable power supply that supports the integrated Columbia River Power System.
- Provide water supply for irrigation, municipal, and industrial uses.
- Provide for waterway transportation capability.
- Provide for the conservation of fish and wildlife resources, including threatened, endangered, and sensitive species throughout the environment affected by System operations.
- Consider and plan for climate change impacts on resources and on the management of the System.
- Provide opportunities for recreation at System lakes and reservoirs.
- Protect and preserve cultural resources.

Legal and Institutional Purposes

- Act within the authorities granted to the agencies under existing statutes; and when applicable, identify where new statutory authority may be needed
- Comply with environmental laws and regulations and all other applicable federal statutory and regulatory requirements, including those specifically addressing the System such as requirements under the Northwest Power Act "to adequately protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, affected by such projects or facilities in a manner that provides equitable treatment for such fish and wildlife with the other purposes for which such system and facilities are managed and operated." 16 U.S.C.A. § 839b(11)(A)
- Protect Native American treaty and reserved rights and trust obligations for natural and cultural resources throughout the environment affected by System operations
- Continue to utilize a collaborative Regional Forum framework to allow for flexibility and adaptive management of the System
- Ensure project Water Control Manuals adequately reflect the management of the System

[3] NWF v. NMFS, 184 F. Supp. 3d 861 (D. Or. 2016).

Terminology

Objectives are what the federal agencies are trying to accomplish (the "why"). They are statements of the desired outcome of the EIS, as identified by the federal agencies and from scoping comments. An example of an objective is to improve ESA-listed anadromous salmonid adult fish migration within the project area.

A **measure** is the action the agencies would take to achieve an objective (the "how"). It describes an action, usually in a precise location, that meets an objective, in whole or in part. Using the objective mentioned above, a measure could be to provide structural enhancements for fish passage, such as improving fish ladders.

An **alternative** is a combination of one or more measures that, together, would address one or more of the objectives. In this EIS, the co-lead agencies designed the action alternatives to address several objectives, and are therefore calling them Multiple Objective Alternatives (MOs).

The co-lead agencies, working with the cooperating agencies, developed eight objectives for operating the System, using the Purpose and Need Statement and input from tribal coordination, cooperating agencies, and the public. Several of the objectives relate to key tribal resources and treaty reserved rights—an important consideration for decision makers.

COLUMBIA RIVER SYSTEM OPERATIONS OBJECTIVES

- Improve ESA-listed anadromous salmonid juvenile fish rearing, passage, and survival within the CRS through actions including but not limited to project configuration, flow management, spill operations, and water quality management. (**Improve Juvenile Salmon**)
- Improve ESA-listed anadromous salmonid adult fish migration within the CRS through actions including but not limited to project configuration, flow management, spill operations, and water quality management. (**Improve Adult Salmon**)
- Improve ESA-listed resident fish survival and spawning success at CRS projects through actions including but not limited to project configuration, flow management, improving connectivity, project operations, and water quality management. (**Improve Resident Fish**)
- Provide an adequate, efficient, economical, and reliable power supply that supports the integrated FCRPS. (**Provide a Reliable and Economic Power Supply**)
- Minimize greenhouse gas (GHG) emissions from power production in the Pacific Northwest by generating carbon-free power through a combination of hydropower and integration of other renewable energy sources. (**Minimize GHG Emissions**)
- Maximize operating flexibility by implementing updated, adaptable water management strategies to be responsive to changing conditions, including hydrology, climate, and the environment. (**Maximize Adaptable Water Management**)
- Meet existing contractual water supply obligations and provide for authorized additional regional water supply. (**Provide Water Supply**)
- Improve conditions for lamprey within the CRS through actions potentially including but not limited to project configurations, flow management, spill operations, and water quality management. (**Improve Lamprey**)

Using the Purpose and Need Statement and the objectives, the co-lead and cooperating agencies developed suites of measures and finally, combined measures into sets that represented a reasonable range of alternatives for balanced system operations. The alternatives consist of the No Action Alternative and five Multiple Objective Alternatives (MOs). (The Preferred Alternative is also considered to be the fifth multiple objective alternative.) The No Action Alternative describes the "status quo" when the Notice of Intent to Prepare the EIS was issued (September 2016) and provides a baseline to which the other alternatives are compared. The MOs include a range of spill levels for juvenile fish passage, varying levels of hydropower production, and differing actions to support the needs of Endangered Species Act (ESA)-listed salmonids and resident fish. The MOs include proposed means to support the future supply of water for irrigation and municipal and industrial purposes. The MOs also include increased water management flexibility that would allow water managers to react to unanticipated changes in river flow and climate variability, and would increase the likelihood of achieving refill of storage reservoirs. After evaluating the potential effects of the alternatives on the environmental, social, and economic resources; the ability to meet objectives and fulfill the Purpose and Need Statement; and effects to flood risk management, water supply, hydropower generation, navigation, fish and wildlife conservation, cultural resources, recreation and other purposes, the co-lead agencies developed a Preferred Alternative designed to achieve a reasonable balance of competing river resource needs and co-lead agency mission requirements. Detailed descriptions of the alternatives are presented in Chapter 2 and Chapter 7 of the EIS.

Definition of Effects

- **No Effect**: The action would result in no effect as compared to the No Action Alternative.
- **Negligible Effect**: The effect would not change the resource character in a perceptible way. Negligible is defined as of such little consequence as to not require additional consideration or mitigation.
- **Minor Effect**: The effect to the resource would be perceptible; however, it may result in a small overall change in resource character.
- **Moderate Effect**: The effect to the resource would be perceptible and may result in an overall change in resource character.
- **Major Effect:** The effect to the resource would likely result in a large overall change in resource character.

4 NO ACTION ALTERNATIVE

Overview

The No Action Alternative includes all operations, maintenance, fish and wildlife programs, and mitigation efforts in effect when the EIS was initiated in September 2016. Juvenile fish passage spill operations at the four lower Columbia River and four lower Snake River dams would follow the 2016 Fish Operations Plan developed by the Corps. This plan used performance standard spill developed under previous Endangered Species Act biological opinions.

Under the No Action Alternative, the co-lead agencies would also implement structural measures that were already budgeted for and scheduled as of September 2016. The majority of these structural measures are dam modifications to improve conditions for fish listed as threatened and endangered under the ESA. For example, installation of improved fish passage turbines planned for Ice Harbor and McNary dams would occur as planned. Other ongoing habitat and mitigation programs would continue as planned when the EIS process started. A detailed description of measures included in the No Action Alternative is included in Chapter 2 of the EIS.

Does the No Action Alternative address the EIS Objectives?

The No Action Alternative met the Purpose and Need of the EIS, but it did not meet all of the objectives developed for the EIS.

The No Action Alternative did not provide adequate improvements to meet the **Improve Juvenile Salmon**, **Improve Adult Salmon**, **Improve Resident Fish**, and **Improve Lamprey** objectives. As outlined in this alternative, improvements to fish survival and abundance would be achieved through construction of additional fish passage structural measures at the lower Columbia River and lower Snake River projects that were completed or planned as of 2016. The No Action Alternative also considered previous efforts in offsite improvements from actions such as habitat restoration and hatchery programs and assumed those programs would continue. The No Action Alternative did not provide adequate improvements to meet the juvenile salmon, adult salmon, resident fish, and lamprey objectives. Additional measures could be adopted to improve fish survival to meet these objectives.

The No Action Alternative generally satisfied the **Provide a Reliable and Economic Power Supply** objective as it resulted in no additional upward power rate pressure or potential regional reliability issues. However, the risk of power shortages is more than 30% higher than the Northwest Power and Conservation Council's target for regional reliability. The No Action Alternative only partially meets the objectives to **Provide Water Supply** and **Maximize Adaptable Water Management** because it would not provide the additional authorized regional water supply. Further, the No Action Alternative does not include a measure to assess operational restrictions that may result from important maintenance activities at Grand Coulee in the near term. (The multi-objective alternatives all include a measure for additional maintenance at Grand Coulee to assess the impact on operations from limited hydraulic capacity.)

The mainstem Columbia River, lower Snake River, Clearwater River, Kootenai River, Pend Oreille River, and Flathead River (the study rivers) provide water for millions of people and irrigated agriculture in Oregon, Washington, Idaho, and Montana. Water is pumped from the reservoirs of nine of the 14 federal projects: Grand Coulee, Lower Granite, Lower Monumental, Little Goose, Ice Harbor, McNary, John Day, The Dalles, and Bonneville. Annually, about 7 million acre-feet of water is supplied for irrigation, drinking water, and other municipal and industrial (M&I) needs (USGS 2017).

Water supply is defined as the water used for the irrigation of crops as well as municipal and industrial uses. The water supply analysis presented in chapters 2 and 7 describes the environmental consequences resulting from the alternatives. About 1,393,000 acres are irrigated with water diverted within the study area. Growers in the potentially affected areas depend on irrigation to produce a wide variety of crops, including alfalfa, small

Lamprey

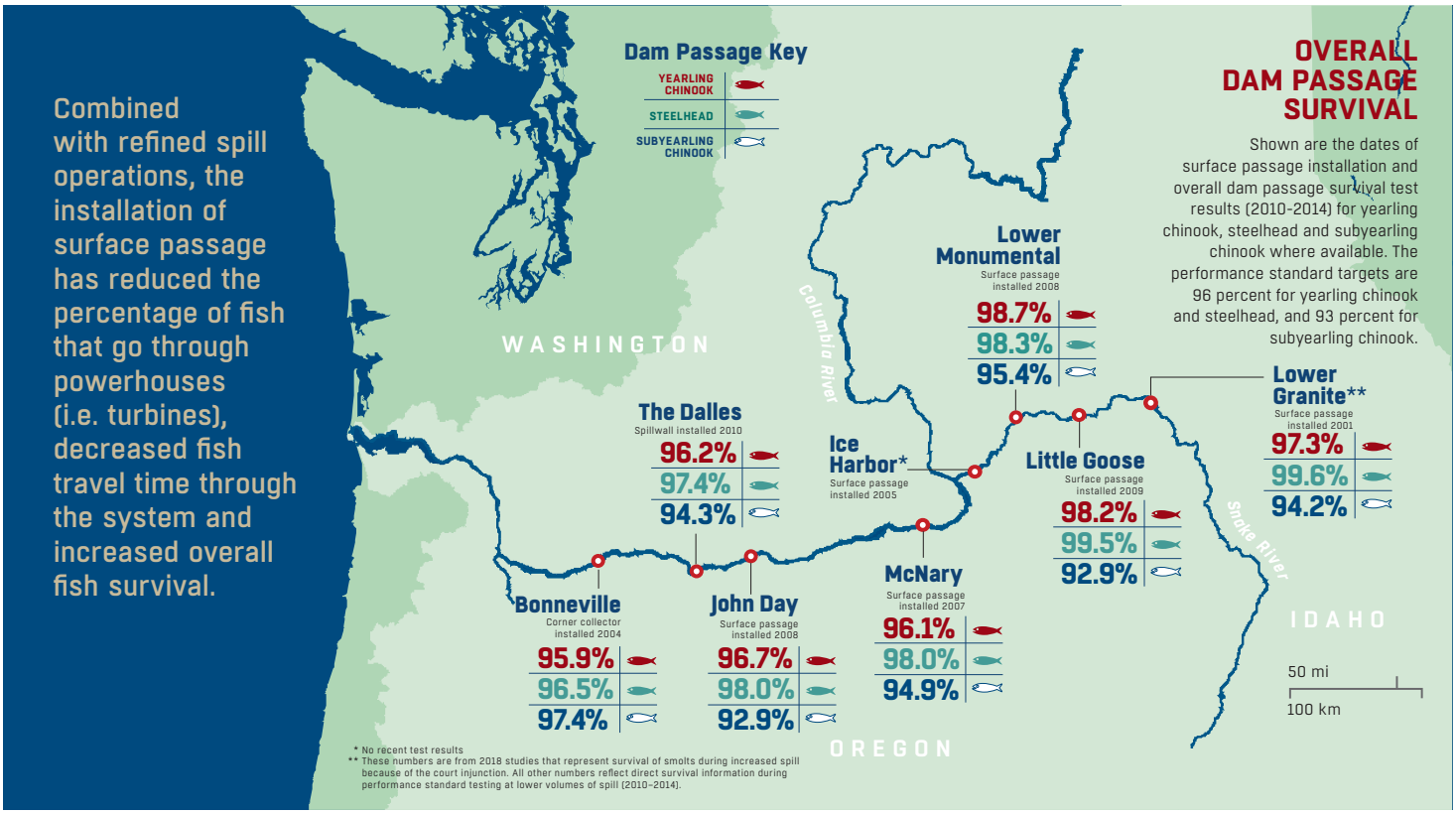


Figure ES-3: Dam Passage Survival estimates under Performance Standard Spill operations from the 2008–2014 (including supplementations) Federal Columbia River Power System Biological Opinion, as measured 2010–2018. Performance Standard Spill levels are described in the No-Action Alternative. Note: These are dam-specific survival estimates and do not include any system-wide or latent effects which are incorporated into the SAR estimates displayed in this report.

grains, vegetables, fruits, and wine grapes. About 5% of the Columbia River Basin's water is diverted for agriculture. Irrigation water is diverted directly from the rivers and from the reservoirs behind storage and run-of-river projects or pumped from groundwater wells. Diversion amounts can vary from year to year and from month to month in response to varying weather and hydrologic conditions.

The No Action Alternative partially meets the objective to **Minimize GHG Emissions** because, while it doesn't increase or decrease emissions in the region (it's the status quo), the operation of the CRS under the No Action Alternative results in carbon-free power that also helps integrate renewable resources in the region.

Additional Effects of the No Action Alternative

It is not expected that there would be any new moderate or major impacts to environmental, economic, or social resources as a result of continuing the No Action Alternative. Information gained from evaluating this alternative was used to inform the development of the Preferred Alternative that seeks to balance managing the system for all authorized purposes while providing additional benefits to fish.

PERFORMANCE STANDARD SPILL Spill levels from the 2008–2014 (including supplementations) Federal Columbia River Power System Biological Opinion that were tailored to meet the BiOp standards of 96% average per-dam survival for spring migrants and 93% for summer migrating fish (see Figure ES 3).

5 MULTIPLE OBJECTIVE ALTERNATIVE 1 (MO1)

Overview of the Alternative

MO1 was developed to meet all objectives while prioritizing benefits to lamprey and ESA-listed fish species relative to the No Action Alternative. MO1 differs from the other alternatives by carrying out a juvenile fish passage spill operation referred to as a block spill design. The block spill design alternates between two operations: a base operation that provides spill over the spillways using tailored spill levels at each project based on historical survival tests; and a fixed higher spill target at all projects. During the high spill block that uses the

same target at all projects, the operators would release water through the spillways up to a target of no more than 120% total dissolved gas (TDG) in the tailrace (below the dam) of projects and 115% TDG in the forebay (above the dam) of those projects. In addition, MO1 sets the duration of juvenile fish passage spill to end based on a fish count trigger, rather than a predetermined date. MO1 proposes to initiate transport operations (barging) for juvenile fish approximately two weeks earlier than under the No Action Alternative. MO1 also includes two predator disruption measures and fluctuating elevations in the John Day pool to limit both predator fish and birds from reducing ESA-listed juvenile fish populations during the spring migration.

MO1 also incorporates measures to increase hydropower generation flexibility in the lower basin projects and alters the use of stored water at Dworshak for downstream water temperature control in the summer. MO1 includes a number of measures similar to the other action alternatives, including increased water management flexibility and water supply, and using local forecasts in whole-basin planning. Detailed descriptions of the measures that are included in MO1 are described in Chapter 2 of the EIS.

Does MO1 Address EIS Objectives?

MO1 is predicted to provide benefits, although minor, as measured in both models, to most ESA-listed anadromous salmonid fish species, both juvenile and adult. MO1 also includes structural modifications to infrastructure at the dams to benefit passage of adult salmon, steelhead, and Pacific lamprey. MO1 is thus expected to meet the objectives to **Improve Juvenile Salmon**, **Improve Adult Salmon**, **Improve Resident Fish**, and **Improve Lamprey**. The expected degree of these benefits varies depending on specific species, location, and the outputs from the two separate models (CSS and NMFS's LCM). The CSS model generally predicted minor improvements for the species modeled, while the LCM generally predicted negligible decreases to minor improvements to anadromous species that were modeled. Overall, the expected degree of improvements to ESA-listed salmonids was predicted to be less than was desired by the co-lead agencies. MO1 results in both beneficial and adverse effects on resident fish. Cumulatively these effects are expected to be negligible, minor, or in some cases localized moderately adverse, as compared to the No Action Alternative. MO1 proposes additional mitigation for resident fish, as appropriate.

For **Cultural Resources**, there could be additional major effects at Hungry Horse, Lake Roosevelt, and Dworshak reservoirs due to increasing the frequency of elevation changes. Increased frequency in elevation changes typically correlates with increased erosion in reservoirs and exposure, which can displace or destroy cultural resources. An increased number of high draft events at Dworshak could also lead to major adverse effects. The Dworshak reservoir would also be at a lower elevation in June and July compared to the No Action Alternative. Changes in reservoir elevations could result in effects to the Kettle Falls sacred site due to increases in the potential for looting.

MO1 marginally could meet the **Provide a Reliable and Economic Power Supply** objective. MO1 reduces hydropower generation by approximately 130 average megawatts (aMW) a year (enough to power 100,000 Northwest homes) under average water conditions, and 300 aMW (enough to power 220,000 Northwest homes) under lower water conditions. A number of measures contributed to the decrease in hydropower production, including spring spill at higher levels than in the No Action Alternative and additional irrigation withdrawals. Hydropower reliability was impacted by these two measures and several others, including a measure to alter the timing of flows from Dworshak in late summer (a measure that was intended to but did not result in the improvement in lower Snake River water temperatures). An earlier end to summer spill partially moderated the power impact on generation and reliability. The alternative has roughly twice the risk of power shortages (blackouts or emergency conditions) compared to the No Action Alternative without replacement resources.

To maintain regional reliability at the same level as the No Action Alternative, additional resources would have to be built. The EIS provides a range of replacement resource costs with a low of $43 million a year (for fossil-fuel based replacement resources) and a high of $162 million a year (for zero carbon resources). For Bonneville's wholesale power rates, MO1 places upward base rate pressure of 4.5% to 8.6% over the No Action Alternative, depending upon the type of resources acquired and the source of funding for those resources. (Compared to Bonneville financing new resources, if public utilities acquire the new generation then the impact to Bonneville's wholesale power rate is generally lower, though the impact to retail customers of the public utilities is similar.) The base rate analysis only considered the costs of resources necessary to return regional reliability to the levels of the No Action Alternative and an estimate for the related structural, plus fish and wildlife, cost impacts.

A rate sensitivity analysis estimates the other potential impacts from reducing CRS power generation, such as the cost of integrating new renewable resources, potentially shorter financing timeframes, and the costs and availability of firm demand response.

As discussed in Section 3.7.3, including the rate sensitivities, MO1 could increase the wholesale rates by up to 14%. Section 3.7.3.3 of the EIS discusses the hydropower impacts including retail rate impacts of MO1 in more detail.

Regarding the objective to **Minimize GHG Emissions**, the reduction in hydropower generation under MO1 could slightly increase GHG emissions if there is an offsetting increase in generation from fossil fuel resources. However, if the reduction in hydropower is replaced with zero-carbon resources, GHG emissions from power generation may be slightly reduced relative to the No Action Alternative. That's because the quantity and seasonal shape of the zero-carbon replacement resources is sufficient to entirely offset the loss of hydropower, in addition to some existing fossil fuel generation, while maintaining regional reliability.

MO1 also met the objectives to **Maximize Adaptable Water Management** and **Provide Water Supply**.

MO1 provides for additional water supply of 1.15 million acre-feet from Lake Roosevelt at Grand Coulee, as well as changing the timing of delivery of recently developed water supplies for the Odessa Subarea of the Columbia Basin Project to when the water is needed.

Additional Effects of MO1

Under MO1, there would likely be moderate adverse effects to water quality in the lower Snake River. This is due to the modified Dworshak flow regime that would result in a moderate increase in water temperatures to above Washington State water quality standards (68 °F) downstream. Resident fish in the upper Columbia River Basin would also be moderately adversely effected under MO1. The Dworshak reservoir could be at a lower elevation in June and July (and at a higher elevation in August) compared to the No Action Alternative, resulting in a moderate increase in water temperatures in the lower Snake River during August.

There would likely be no major or moderate economic effects above and beyond the potential electricity rate impacts described above. The co-lead agencies used the analysis in MO1 to inform the development of the Preferred Alternative that seeks to balance managing the system for all purposes while providing additional benefits for fish and other study objectives.

6 MULTIPLE OBJECTIVE ALTERNATIVE 2 (MO2)

Overview of the Alternative

MO2 was developed to prioritize hydropower production and flexibility and reduce regional GHG emissions, benefit lamprey and ESA-listed salmon through structural measures, and benefit ESA-listed salmon through increased transport, while meeting the other study objectives and avoiding or minimizing adverse impacts to other resources. It would slightly relax the No Action Alternative's restrictions on operating ranges and generation ramping rates to evaluate the potential to increase hydropower production efficiency. This would also increase operators' flexibility to respond to changes in power demand and changes in generation of other renewable resources. The measures within MO2 would increase the ability to meet power demand with hydropower production during the most valuable periods (e.g., winter, summer, and daily peak demands). The upper basin storage projects would be allowed to draft slightly deeper, allowing more hydropower generation in the winter and less during the spring.

MO2 evaluates an expanded juvenile fish transportation operation season. This alternative proposes to transport all collected ESA-listed juvenile fish for release downstream of the Bonneville project, by barge or truck. It would also reduce juvenile fish passage spill operations to a target of up to 110% TDG, providing the lowest end of the range of juvenile fish passage spill operations evaluated in this EIS.

Structural measures in MO2 are aimed at producing benefits for ESA-listed fish and lamprey. These measures are similar to other alternatives and include making improvements to adult fish ladders, upgrading spillway weirs, adding powerhouse surface passage, and turbine upgrades at John Day.

Chapter 2 of the EIS provides a detailed description of the measures that are included in MO2.

Does MO2 Address the EIS Objectives?

In general, MO2 is less effective than the other MOs at meeting the **Improve Juvenile Salmon**, **Improve Adult Salmon**, and **Improve Resident Fish** objectives. However, the expected effects of MO2 on anadromous species varied depending on the species, location, and by the outputs from the two distinct models (CSS and LCM) used in this analysis.

Based on the NMFS LCM, MO2 was less effective at meeting the **Improve Juvenile Salmon** and **Improve Adult Salmon** objectives for Upper Columbia River Chinook salmon and steelhead. The LCM predicts a

1 to 4% relative reduction in in-river survival as well as a 1% relative reduction in the smolt-to-adult return (SAR) estimate for Upper Columbia River spring Chinook. The CSS models were not developed for upper Columbia fish so no results specific to the EIS alternatives are available.

For Snake River spring Chinook and steelhead, the CSS model generally predicted adverse effects, a 30% relative reduction in SARs for spring Chinook, while the LCM generally predicted negligible to minor beneficial effects relative to anadromous species that were modeled in the No Action Alternative. The minor beneficial effects result from increases in fish transportation rates.

MO2 also includes structural modifications at the dams to benefit passage of juvenile and adult salmon, steelhead, and Pacific lamprey. While structural modifications may provide some benefit to lamprey passage, the overall shift to more powerhouse flow and passage makes this alternative less effective at meeting the **Improve Lamprey** objective than the other MOs. Greater numbers of lamprey would likely pass near fish bypass screens and would be at a higher risk of injury or impingement compared to the No Action Alternative.

MO2 is expected to have a major adverse effect to resident fish in the upper Columbia Basin due to changes in reservoir operations and elevation for hydropower water storage. MO2 proposes mitigation, as appropriate, to minimize adverse effects to negligible and to meet the **Improve Resident Fish** objectives.

There would be ongoing major adverse social effects to **Cultural Resources** and tribal interests at Lake Roosevelt and Dworshak Dam due to changes in reservoir elevations. There could also be major adverse effects to the Kettle Falls sacred site if changed reservoir elevations result in looting.

Compared to the other MOs, MO2 resulted in the greatest benefits to the **Provide a Reliable and Economic Power Supply** and **Minimize GHG Emissions** objectives. The additional hydropower generation produced by MO2 would increase hydropower generation by 450 average megawatts (averaged over 80 historical water years). In the most adverse water year studied, generation would also increase, leading to an additional 380 average megawatts that Bonneville would be able to offer its preference customers (primarily public power utilities) under long-term, firm power-sales contracts. Three measures had the largest impact on these increases: limiting fish passage spill to 110% TDG, ending fish passage spill in August, and allowing storage projects to draft slightly deeper for hydropower.

With the increase in hydropower generation, MO2 would improve regional reliability compared to the No Action Alternative. Regional generating resource costs would also likely decrease, as additional hydropower generated under MO2 could partially eliminate the need to build additional resources for reliability purposes as the region retires coal plants. For Bonneville's wholesale power rate, MO2 would cause downward rate pressure by approximately 0.8%. As noted above, the base rate analysis includes the costs of resources necessary to return regional reliability to the levels of the No Action Alternative as well as related structural measures and fish and wildlife improvement costs. Rate impacts resulting from any other effects of MO2 were addressed in a rate sensitivity analysis. The high end of the rate sensitivity analysis identified rate pressure of up to 1.3% due to a potential increase in Fish and Wildlife Program spending of up to $53 million a year. This increased funding would be used to mitigate the possible impacts of MO2 on fish and wildlife. The low end of the sensitivity analysis found that by excluding one structural measure for fish collection at the McNary project (fish collection there could be accomplished more cost-effectively through other means), power rates could experience downward rate pressure of about 3.2%

compared to the No Action Alternative. Section 3.7.3.4 of the EIS discusses the hydropower impacts of MO2 in more detail.

The increase in hydropower generation under MO2 would displace fossil fuel generation (such as natural gas or coal-based generation) in the current resource mix, thus reducing electricity sector GHG emissions. Section 3.8.3.4 discusses the GHG emissions impacts in further detail. Furthermore, as the region seeks to rely less on fossil fuel resources, the additional hydropower capability from MO2 would also support the integration of more variable renewable resources, which rely on balancing services provided by flexible generating plants. Currently, hydropower and natural gas power plants provide the majority of integration services for variable renewable resources. As the Northwest increases its reliance on new variable renewable resources, increasing hydropower production and flexibility in MO2 would help reduce the reliance on natural gas generation. In addition to hydropower flexibility, technical advances in storage and other options may become viable to help integrate the variable renewable generation.

MO2 met the objectives for **Maximize Adaptable Water Management**. However, MO2 only partially met the **Provide Water Supply** objective. Specifically, MO2 met the existing contractual water supply obligations, but did not provide for authorized additional regional water supply. MO2 did not include the additional water supply because the co-lead agencies wanted to analyze a range of alternatives, including one without the additional water supply. Because water withdrawal for irrigation decreases hydropower production, exclusion of the water supply measure from MO2 was consistent with the broader theme of the measure.

Additional Effects of MO2

MO2 would have major beneficial economic effects to power if the measure for powerhouse surface passage with fish collection at the McNary project is excluded.

The McNary project was not carried forward into the Preferred Alternative because the final estimated cost for the structure was over $850 million yet it only provided negligible biological benefits for salmon and steelhead. Those same biological benefits could be obtained at much lower costs using alternate measures.

Information gained from the analysis of this alternative was used by the co-lead agencies to inform and improve the development of the Preferred Alternative that seeks to balance managing the system for all purposes while providing additional benefits for fish and other study objectives.

7 MULTIPLE OBJECTIVE ALTERNATIVE 3 (MO3)

Overview of the Alternative

MO3 was developed to evaluate the effects of breaching the four lower Snake River dams (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor) along with actions for water management flexibility, limited increases in hydropower generation in certain areas of the basin at specific times, and altered water supply (small increases in volume and small changes in timing). In addition to breaching these four projects, MO3 differs from the other alternatives by carrying out a spring juvenile fish passage spill operation that sets flow through the spillways up to a target of 120% TDG in the tailrace of the four lower Columbia River projects (McNary, John Day, The Dalles, and Bonneville). This alternative also includes an earlier end to summer juvenile fish passage spill operations than the No Action Alternative. Instead, reduced spill levels would allow for increased hydropower production during August when low numbers of juvenile fish are typically present.

Structural measures in this alternative include breaching the four lower Snake River dams by removing the earthen embankment at each dam, resulting in a controlled drawdown.

Operational measures in MO3 are intended to improve juvenile and adult fish travel times, improve conditions for resident fish in the upper basin, increase hydropower generation flexibility in certain portions of the basin in order to begin to offset the lost generation from dam breaching, provide more flexibility to water managers, and provide additional water supply. A detailed description of measures that are included in MO3 is provided in Chapter 2 of the EIS.

MO3 would only partially meet the overall Purpose and Need Statement, and meets some but not all of the objectives for the EIS to varying levels. For example, fish modeling for MO3 predicts the highest benefits among all of the alternatives for ESA-listed salmon in the Snake River and could, in the long-term, provide additional riverine type recreational opportunities. However, breaching the four lower Snake River dams would not allow the Corps to operate and maintain the dams for their other congressionally authorized purposes of navigation, hydropower, recreation, and water supply. MO3 has the highest adverse effects to other resources, especially social and economic effects. Implementing MO3 (breaching) would require congressional modification to current authorities, and there are potential short-term negative impacts associated with breaching that would need to be addressed. Because MO3 would be a relatively large change to how the CRS is managed today, there is uncertainty around how the river and associated resources would respond. However, in the case of fish, both salmon and steelhead models, CSS and the LCMs, align in their prediction that MO3 would have the highest potential benefits for Snake River salmon and steelhead. While the models align on the positive direction of the impact, the differences in their specific numeric estimates also highlight uncertainty around the magnitude of that benefit. More information on this is in the section below. In the case of cultural resources, MO3 in some cases would return access and opportunities to some of the traditional cultural properties for tribal purposes, but would have adverse effects on archaeological sites and built resources.

Many tribes have commented that the economic impacts of implementing this alternative must be viewed in the context of the ongoing and disproportionate social, cultural, and socioeconomic effects to Indian tribes and tribal communities from present and cumulative effects of the current System. They note that these negative effects, along with impairment of Indian treaty-reserved rights, would be reduced under MO3.

MO3 was carried forward in the analysis to align with the District Court of Oregon's Opinion and Order, and in response to comments received during public scoping that requested this alternative be evaluated. During the public comment period, the co-lead agencies received many comments both in favor of and against breaching the four lower Snake River dams. As noted above, new congressional authority and appropriations would be required to implement the dam breaching measures in MO3.

Does MO3 Address the EIS Objectives?

MO3 would meet the objectives of **Improve Juvenile Salmon**, **Improve Adult Salmon**, **Improve Resident Fish**, and **Improve Lamprey**.

Model estimates for MO3 showed the highest predicted potential smolt-to-adult returns (SARs) for Snake River salmon and steelhead among the alternatives. Quantitative model results from both the CSS and LCM were available and indicated a range of potential long-term benefits largely due to how the models address latent mortality, the delayed death of salmon following passage through the CRS. The CSS model predicts that juvenile spring/summer-run Chinook salmon migrating downstream from Lower Granite Dam would return to Lower Granite Dam as adults (SARs) at an increase of 170% relative to the No Action Alternative. The NMFS LCM predicted that returning adults (SARs) of Snake River spring/summer-run Chinook salmon from Lower Granite Dam to Bonneville Dam would improve by 14% relative to the No Action Alternative. The NMFS LCM predicted that SARs from Lower Granite to Bonneville would improve by 14% relative to the No Action Alternative. The LCM also assessed SARs under several levels of assumed latent mortality reductions (10, 25, and 50%). For these scenarios, the LCM also predicted that if latent mortality were further reduced, additional improvement in SARs would be expected. These results highlight the importance of how latent mortality is considered in the analysis and the strong effect it has on the predicted results. The degree to which latent mortality is affecting salmon and steelhead is one of the critical uncertainties in this EIS analysis. The CSS model also predicted similar improvements for Snake River steelhead to those described for Snake River Chinook. The LCM has not been developed for use on Snake River steelhead so no results specific to the alternatives are available.

Results from the NMFS LCM indicate that the level of improvement to Upper Columbia Chinook SARs is dependent on the level to which latent mortality affects this stock. If increased spill in the lower Columbia River does not improve ocean survival, (i.e. reduce latent mortality) the LCM model predicts negligible to minor improvements in SARs (1% relative increase). Larger reductions in latent mortality would result in larger predicted increases in both SARs and abundance for upper Columbia stocks (4 to 147% relative increase in abundance).

These changes are primarily due to increased spill levels (120% TDG) in the lower Columbia River. The CSS models were not developed for upper Columbia fish so no results specific to the EIS alternatives are available.

MO3 is also expected to provide a long-term benefit to species that spawn or rear in the mainstem Snake River habitats, such as fall Chinook. By breaching the four lower Snake River dams, major short-term adverse impacts to fish, riparian and wetland habitat in the Snake River and confluence of the Columbia River would occur. These impacts would be associated with the initial breaching of the dams, drawing down the reservoirs, and the time required for the river to move sediment and stabilize. These effects are expected to diminish over time. MO3 also includes structural modifications to remaining infrastructure at the dams (the concrete structures will remain in place in the river) to benefit passage of adult salmon, steelhead, and Pacific lamprey.

Breaching of the four lower Snake River dams would have major long-term beneficial effects to resident fish in the Snake River due to improved rearing and migration conditions. During the breaching, major short-term adverse effects would occur as described above for anadromous fish. In general, effects outside of the Snake River would be similar to MO1.

In the lower Snake River, MO3 could result in additional major adverse effects to **Archaeological Sites** due to potential exposure of 14,000 acres that are currently inundated. Following the drawdown, the long-term goal would be for the river to return to as natural a condition as possible which is expected to have a beneficial effect to traditional cultural practices such as fishing, gathering, and inhabiting traditional spaces. Conversion to a more natural riverine system would allow improved access for tribal communities to areas currently inundated. There is also the potential for additional major adverse effects to archaeological sites at Hungry Horse Reservoir due to the increased frequency and size of draw-downs to compensate for breaching the lower Snake River dams.

MO3 would not meet the objective to **Provide a Reliable and Economic Power Supply**. Under MO3, hydropower generation would decrease by 1,100 aMW (about 1,000 aMW from breaching the four lower Snake River dams) under average water conditions, and 730 aMW under low water conditions compared to the No Action Alternative.

The lower Snake River projects provide more than 2,000 MW of sustained peaking capabilities during the winter, and a quarter of the federal power system's current reserves holding capability. The dams play an important role in maintaining reliability in the production of power used to supply load in the Pacific Northwest. Their flexibility and dispatchability are valuable components of the CRS. MO3 would more than double the region's risk of power shortages compared to the No Action Alternative—from 6.6% risk of a year having power shortages in the No Action Alternative (roughly one year in 15) to 13.9% in MO3 (or nearly one year in 7) for the base case (current operation of coal-fired power plants). Increases in spring spill for juvenile fish passage at the lower Columbia River projects and increases in water withdrawal for irrigation included in the alternative further reduce hydropower generation while the end of summer spill in August increases generation in that month.

Significant quantities of replacement resources would have to be built to maintain regional power reliability at the No Action Alternative levels.

The EIS considers two potential resource replacement portfolios, which represent a range of potential resources that could be selected to replace lost capability from MO3, mostly lost through dam breaching, but also from other measures like water withdrawals for irrigation and additional spill on the lower Columbia River projects.

The lower end of this range is reflected in a conventional least-cost portfolio. This portfolio includes 1,120 megawatts (MW) of combined cycle natural gas turbines at an overall cost of about $250 million a year. For Bonneville's wholesale power rate, MO3's conventional least-cost resource portfolio, along with related structural and fish and wildlife spending adjustments, places upward rate pressure of between 8.2% and 9.6% over the No Action Alternative, depending upon whether Bonneville or regional utilities fund these new resources.

The upper end of the range is reflected in a replacement portfolio made up of zero-carbon resources. This portfolio reflects recent policies and legislation enacted by some Northwest states that seek to reduce reliance on carbon-fueled resources by requiring utilities to use non-carbon emitting resources to meet future demand. Washington enacted the Clean Energy Transformation Act (CETA) in 2019, requiring that Washington utilities eliminate coal costs from their retail rates by 2025.

CETA also directs Washington retail utilities to serve loads with 100% carbon-neutral power by 2030, and 100% carbon-free power by 2045 (RCW 19.405). Oregon has been considering a cap-and-trade program similar to California's program. Additionally, Nevada (Senate Bill 358, 2019) adopted 100% carbon-free goals for its electricity sector.

At the utility scale, the current zero-carbon options are solar and wind resources, batteries, hydropower, and demand response programs. These resource options were developed from data in the Council's 7th Power Plan

with battery prices from the upcoming 8th Power Plan since data on batteries were very limited in the 7th. Further, a rate sensitivity analysis updates all resource costs to reflect recent cost estimates from the upcoming Council's 8th Power Plan. To return regional reliability to the No Action Alternative level, approximately 1,960 MW of additional solar resources, 980 MW of battery storage, and 600 MW of demand response would be needed. These quantities are lower than those assumed in the draft EIS, and respond to public comments which suggested that the co-lead agencies reexamine the quantity of resources in this portfolio. The estimated cost of the zero-carbon portfolio is $406 million per year. For Bonneville's wholesale power rate, MO3's zero-carbon resource portfolio, along with related structural and fish and wildlife spending adjustments, place upward rate pressure of between 9.8% and 20.6% over the No Action Alternative, depending upon the source of funding for those resources. (If public utilities acquire the new generation directly, the impact to Bonneville's wholesale power rate is generally lower than if Bonneville acquires the resources. In either case, though, the impact to retail customers of the public utilities is fairly similar.)

This portfolio is captured in the Base Case section of the rate analysis described in Section 3.7.3.5 together with retail rate impacts.

The base case portfolio implicitly assumes that other regional resources, particularly existing natural gas and coal, would be available to support the power system's sustained peaking, storage, and dispatchable capability needs resulting from the loss of generation from the four lower Snake River dams. This assumption, however, is likely optimistic given current state policies and recent utility announcements to reduce reliance on fossil fuels. Further, the large fleet of solar and battery resources assumed in the zero-carbon portfolios would need dispatchable resources for balancing and integration services. Additional peaking (capacity) resources would be needed to supply these services in MO3.

To reflect these additional costs, a rate sensitivity analysis was performed for MO3 to estimate the rate pressure effect of an expanded zero-carbon resource portfolio on Bonneville's wholesale power rate. As described in Section 3.7.3.5, this expanded zero-carbon resource portfolio would include power capabilities similar to those lost with the breaching of the lower Snake River projects. The costs of an expanded zero-carbon resource portfolio designed to replace the full capability of the four lower Snake River dams would be significant: up to twice the $400 million assumed to maintain regional reliability. Additional variables such as resource financing uncertainties and the uncertainty in the cost and availability of demand response add to this rate sensitivity. If Bonneville had to replace the four lower Snake River projects' full capability with zero-carbon resources, the rate pressure could be up to 50% on wholesale power rates. Before acquiring such resources, Bonneville and the Northwest Power and Conservation Council, through a regional public process, would develop a resource plan to identify the least cost resource portfolio to assure Bonneville and its customers an adequate, economical power supply consistent with regional reliability and environmental policy criteria.

MO3 would also not meet the objective to **Minimize GHG Emissions**. GHG emissions were analyzed for the base case hydropower impacts discussed above without the effect of the additional coal-plant retirements. GHG emissions would increase the most if the hydropower were replaced with natural gas. This would lead to an additional 3.3 million metric tons (MMT) of CO_2, a 9% increase in power-related emissions across the Northwest. However, even assuming the new replacement resources

to maintain regional reliability are variable renewables (the base case of solar with batteries), some increase in fossil fuel-based generation from existing power plants would occur to maintain system reliability, leading to an additional 1.3 MMT of CO_2 annually (a 3.5% increase in power-related emissions in the Northwest). This seems counter-intuitive but occurs because the magnitude and timing of the reduction in hydropower generation would occur in particular times seasonally or daily (e.g., during peak demand) during which capacity resources would need to increase generation in order to maintain reliability (i.e., to meet the demand for power and avoid blackouts). As discussed above, based on currently available technology, other renewable resources (e.g., solar and wind) are variable; that is, they cannot always be dispatched on demand because they are reliant on external factors, such as sun exposure or wind speed.

Therefore, renewable fueled resources must be balanced and integrated by operating other flexible (dispatchable) capacity resources to maintain system reliability. By reducing the amount of hydropower available to provide this flexible capacity, the region would likely rely more on thermal-based resources that can quickly ramp up and down, such as natural gas, to integrate renewable resource generation. This increased reliance on fossil-fuel-based resources is estimated to increase power-related emissions by 3.5% (1.3 MMT of CO_2) across the region even assuming the new replacement resources are other renewables. In the future, technical advances in storage and other low-carbon options may become increasingly viable to help integrate variable renewable generation. With the expanded portfolio that is intended as a full replacement of the capabilities of the lost generation from the lower Snake River dams, the GHG emissions impact would probably be lower.

The loss of hydropower generation at Ice Harbor would require that a transmission reinforcement project be in place prior to breaching of the dams. The transmission reinforcement project is estimated to cost about $94 million.

In addition, MO3 would result in shipping activities shifting from barge to road and rail transport as described below. As barge transportation is a relatively low source of GHG emissions per ton-mile of freight compared with truck or train transportation, MO3 would also increase transportation-related emissions for wheat that is currently transported along the lower Snake River by up to 53% (an increase of 0.056 MMT of CO_2). Section 3.8.3.5 discusses the transportation sector GHG impacts in further detail.

MO3 would meet the objectives to **Maximize Adaptable Water Management and Provide Water Supply** in most areas. Along with additional supply of 1.15 million acre-feet from Lake Roosevelt at Grand Coulee, water supply in many areas is not affected by the dam breaching measures. However, some areas would be subject to major adverse effects. Entities pump water for irrigation at many locations in and near the reservoir pools of the four lower Snake River dams. This water is diverted under natural or live flow water rights issued by the states.

Under MO3, pumps that supply this water would no longer be operational once the dams are removed and nearby groundwater elevations drop up to 100 feet in some areas. Assuming 48,000 acres would no longer be irrigated as a result (primarily near Ice Harbor and Lower Monumental dams), the lost social welfare effect under MO3 is $17 million (annual equivalent). The regional economic effects stemming from a loss in crop production are $232 million in labor income and $460 million in output (sales) annually. This reduction in activity also results in a loss of 4,800 jobs (5.9% of the total economy in the Ice Harbor and Lower Monumental socio-economic analysis area). Further information can be found in Section 3.12.

MO3 could also affect pumped withdrawals for irrigation in the McNary reservoir due to increased siltation associated with breaching the lower Snake River dams. This may require increased maintenance activities to preserve pumping capabilities.

MO3 would impact municipal and industrial water supplies that pump from or near the lower Snake River reservoir pools. The estimated lost social welfare effect is $5 million to $8 million (annual equivalent); estimated regional economic effects are 55 jobs, $2.3 million in lost labor income, and $7.5 million in lost output (sales).

Additional Effects of MO3

MO3 would have multiple adverse and beneficial effects on environmental, socioeconomic, cultural, and river operations as described below.

Transportation

Major adverse effects would be anticipated under MO3. The lower Snake River shallow draft navigation channel would no longer be available, eliminating commercial navigation to multiple port facilities on the lower Snake River, including the four primary commercial navigation ports—the Port of Lewiston, the Port of Clarkston, the Port of Whitman County (Wilma, Almota, Central Ferry), and the Port of Garfield. As a result, the cost to transport goods to market would increase. For example, the cost to transport wheat, which accounted for 87% of the downbound tonnage on the lower Snake River in 2018, is estimated to increase by $0.07–$0.24/bushel. This is equivalent to an increase of 10 to 33% in average transportation costs. Cost increases for specific shippers would depend upon location and would vary throughout the region, depending on transportation options at

each location. Farmers could also experience increased production costs associated with higher transportation costs for upriver movements (i.e., fertilizer, crops). There would be additional demands on existing road and rail infrastructure as well as at barging facilities near the Tri-Cities, Washington, increasing traffic and air pollution. Additional capacity and infrastructure improvements would likely be required, borne by public and private entities, and would vary depending on how the rail industry adjusted its rates with reduced competition from the barge industry.

If rail rates remain the same or marginally increase, substantial increased demand on rail infrastructure would occur (with freight transportation by rail increasing by as much as 86%) that would likely exceed current rail capacity, and which would also put upward pressure on rail rates. Assuming new facilities would be required to accommodate the increase in capacity, costs could range from a total of $25 million to $50 million. In addition, upgrades to existing shortline rail lines of approximately $30 million to $36 million, or approximately $2 million annually may be needed.

If rail rates increase by 25%, there would be a 22% increase in average transportation costs. With a 25% rail rate increase, increased rail demands would likely exceed current shortline rail capacity, but somewhat less than if rail rates did not increase. Costs to increase capacity could be as high as $25 million under this scenario. Truck use would increase moderately, which would increase wear and tear on roadways and could result in additional road repair costs of up to $4 million annually.

If rail rates increase by 50% following dam breach, average transportation costs would increase by 33%. Under this scenario, rail infrastructure demand increases would not be anticipated. Instead, a substantial increase in truck use would occur (an increase of 84% compared to the No Action Alternative). Under this scenario, increases in vehicular accident rates, highway traffic and congestion would occur. In addition, additional wear and tear on roadways could result in additional road repair costs of up to $10 million annually.

Adverse regional economic effects would occur as the jobs and income provided by the four primary commercial navigation ports would be curtailed, including the Port of Lewiston, the Port of Clarkston, the Port of Whitman County (Wilma, Almota, Central Ferry), and the Port of Garfield. Commercial cruise lines that operate on the lower Columbia and lower Snake River, providing voyage to approximately 18,000 cruise line passengers per year, would be adversely affected by reduced numbers and distance of trips, with adverse effects to tourism revenues and associated jobs and income. Communities affected, such as Clarkston, Lewiston and Asotin, would lose their 'river port' community identity. Some port facilities within Lake Wallula, the reservoir behind McNary Dam, would require additional dredging to maintain access to the navigation channel following dam breach.

Environmental

Major adverse short-term effects to other environmental resources along the lower Snake River and confluence of the Columbia River and lower Snake River would occur from the initial dam breaching and river drawing down, but there are anticipated to be major long-term beneficial effects to vegetation, wildlife, wetlands, and floodplains in the lower Snake River. Overall, long-term water quality would improve in the lower Snake River under MO3. Water temperatures would be warmer in the summer (during the day) and may exceed water

quality standards, but spring and fall water temperature improvements are anticipated. In addition, riverine processes would be restored, eliminating some of the pH and harmful algal bloom problems that currently exist. Elevated TDG would also be eliminated.

Recreation

In terms of economic effects, major long-term adverse effects to lower Snake River reservoir-based recreation would occur. Major adverse effects would occur to reservoir-based recreation because these reservoirs and associated boat ramp access would cease to exist. However, there would likely be major long-term beneficial effects to river-based recreation, and improved recreational and tribal fishing.

As described in Section 3.5.3.6, MO3 would result in major beneficial effects on upstream migration of Snake River anadromous fish, including steelhead and salmon, in the long term. With increases in salmon and steelhead migration to the Snake River, there is the potential for increased fish abundance that draws additional anglers to the Snake River Basin relative to the No Action Alternative. Steelhead and salmon angler visitation to the Snake River Basin is estimated to be approximately 400,000 future annual trips, although visitation varies from year to year depending on a number of factors, notably fishing closures and bag limits. Salmon and steelhead migration under MO3 would likely support the salmon and steelhead recreational fishery in the Snake River Basin, supporting continued and increased angler visitation in the long term.

Despite the major benefits to fish expected from MO3, this alternative was not identified as the Preferred Alternative due to the adverse impacts to other resources such as transportation, power reliability and affordability, and greenhouse gas emissions. Given the level of interest on this topic, however, this EIS is not expected to end the regional conversation about the future of the four lower Snake River dams.

Throughout the CRSO process, the federal agencies have endeavored to engage in, and facilitate, more collaborative and constructive working relationships among regional stakeholders regarding the future of the Columbia River System and the long-term recovery of salmon populations. From the Columbia Basin Partnership and the Flexible Spill Agreement, to evolving relationships between public power utilities, environmental organizations, tribes and other river users, we have seen a desire among many regional interests to pivot to a more collaborative and constructive approach to address this broad array of regional issues. This EIS provides information and analysis to inform future regional conversations that will require continued engagement from a wide range of stakeholders including the action agencies.

8 MULTIPLE OBJECTIVE ALTERNATIVE 4 (MO4)

Overview of the Alternative

MO4 was developed with a primary focus on measures intended to benefit ESA-listed fish, integrated with measures for water management flexibility, hydropower production, and additional water supply. This alternative includes the highest level of spill in the range considered in this EIS, dry-year augmentation of spring flow with water stored in upper basin reservoirs, and annually drawing down the lower Snake River and Columbia River reservoirs to their minimum operating pools. This alternative also includes changes to juvenile fish transportation operations (barging), operations to help establish riparian vegetation downstream of Libby Dam, and improved surface passage spill for adult steelhead. The structural measures in this alternative are primarily focused on improving passage conditions for ESA-listed salmonids and Pacific lamprey. The inclusion of a measure for spillway weir notch inserts for adult steelhead downstream passage is unique to the MO4 alternative; the rest of the structural measures are variations of other measures described in the other MOs, including structural measures for Pacific lamprey.

The operational measures in MO4 are designed to make improvements to various project objectives, but with an emphasis on evaluating the impacts of high spill on ESA-listed fish. In MO4, juvenile fish passage spill is set up to 125% TDG during the spring and summer, which is the highest volume and longest duration of spill included in any of the alternatives. MO4 would explore the potential benefits and unintended consequences of high spill levels on travel time, juvenile downstream fish passage, and ultimately adult fish returns. The juvenile fish transport program would operate primarily in the spring and fall. This alternative also contains a measure for restricting winter flows from the Libby project to protect newly established downstream riparian vegetation, and to improve conditions for ESA-listed resident fish, bull trout, and Kootenai River White Sturgeon in the upper Columbia River Basin. Chapter 2 of the EIS describes the measures that are included in MO4 in more detail.

Does MO4 Address the EIS Objectives?

Similar to MO3, the potential benefits of MO4 for **Improve Juvenile Salmon and Improve Adult Salmon** varies greatly depending on which model is used (see Fish Modeling discussion in Section 2.5). The CSS model predicts large increases in all salmon and steelhead returns, to both the Columbia and Snake Rivers. These increases are predicted based on increased spill levels that would increase the number of fish passing via the

spillways and avoiding powerhouses, which the CSS model predicts would reduce latent mortality associated with CRS passage. Snake River spring Chinook and steelhead SARs are predicted to improve by 70 to 75% relative to the No Action Alternative, according to CSS.

The LCM predicts minor benefits to Upper Columbia spring Chinook and steelhead, with 2% relative increases in SARs and downstream survival. However, for Snake River Chinook, the model predicts that unless changes in passage through the CRS can increase ocean survival by 10% (i.e. latent mortality effects are decreased by 10%), the net impact to Snake River Chinook salmon would be adverse, a relative decrease in SARs of 12%. This potential decrease in overall adult returns is primarily driven by reductions in fish transport rates due to high spill, a relationship that could be similar for Snake River steelhead. The structural modifications at the dams would benefit passage of adult salmon, steelhead, and Pacific lamprey.

MO4 causes minor to major adverse effects to resident fish due to deep drafts of the upper basin storage projects. Resident fish in the lower basin would also be exposed to elevated TDG levels. MO4 proposes mitigation to reduce resident fish adverse effects to negligible, where changes in flow, reservoir elevations, and water quality would be altered, and the objective for **Improving Resident Fish** would be met.

Major social effects to **Cultural Resources** at Lake Roosevelt, John Day, and Hungry Horse reservoirs could occur. Lake Roosevelt would be at a lower elevation primarily in the spring and summer in dry years due to providing spring flow augmentation downstream. Hungry Horse reservoir would provide dry-year flow augmentation in the summer, and may not recover to the No Action elevation in some of the years. The overall result would be increased exposure and erosion of cultural resources. At John Day, the elevation of the reservoir is drawn down during the juvenile fish passage season. There would be additional moderate effects to cultural resources at the remaining lower Columbia River Projects due to additional drawdown. There could be major effects to Kettle Falls (sacred site) if changes in reservoir elevations lead to increased potential for looting. Changes in reservoir elevation at Albeni Falls may result in reduced access to Bear Paw Rock (sacred site), which may result in less tribal visitation.

MO4 would not meet the **Provide a Reliable and Economic Power Supply** objective. Under MO4, hydropower generation decreases by 1,300 aMW under average water conditions, and 870 aMW under low water conditions compared to the No Action Alternative, the largest impacts on hydropower generation of any of the alternatives. The primary reason for the reduced generation is the increase in juvenile fish passage spill, up to 125% total dissolved gas levels 7 days a week, 24 hours a day from March 1 to August 31, with most lower Snake and lower Columbia River projects operating at minimum generation levels in the majority of water conditions. This increase in spill, together with a measure that provides dry-year augmentation of spring flow with water stored in upper basin reservoirs, contributes to MO4 having the highest probability of power shortages of any of the MOs, with blackouts or emergency conditions in roughly one in three years.

Substantial additional resources would be needed to maintain regional reliability at the No Action Alternative levels. The conventional least-cost resource replacement portfolio would include 3,240 MW of simple cycle natural gas turbines at an annual cost of $242 million. Replacing the lost hydropower generation with variable renewable resources would require around 5,000 MW of solar (occupying nearly 47 square miles of land) and 600 MW of demand response at an estimated annual cost of

$578 million. For Bonneville's wholesale power rates, MO4 places upward base rate pressure of 23.5% to 25.3% over the No Action Alternative, depending upon the type of resources acquired and the source of funding for those resources. Additional rate sensitivities around this base analysis, discussed in Chapter 3.7.3.6, could lead to upward rate pressure as high as 40% in the Bonneville wholesale power rate. Chapter 3 also provides additional sensitivity analyses of impacts of M04 on reliability and cost given the higher expectations of coal plant retirements and restrictions on natural gas generation resulting from recent policy and state law changes. Retail rate impacts are also discussed in Section 3.7.3.6.

MO4 would not meet the **Minimize GHG Emissions** objective. GHG emissions would increase the most if the hydropower is replaced with natural gas (an 8.4%, or 3.1 MMT of CO_2 increase in power-related emissions across the Northwest). However, as with MO3, even if the new replacement resources to maintain regional reliability do not produce carbon emissions themselves, some increase would occur to maintain system reliability. This is because the magnitude and timing of the reduction in hydropower generation would occur in particular times seasonally or daily (e.g., during peak demand) during which capacity resources would need to increase generation in order to maintain reliability (i.e., to meet the demand for power and avoid blackouts). The region currently relies on the CRS to provide a significant amount of this back-up source of generation. If a substantial amount of hydro-electric generation is reduced, given the region's current resource portfolio, additional generation from existing thermal resources, such as natural gas, would likely be used to balance for the variable nature of renewable resources. Consequently, replacing lost hydropower generation with variable renewable resources would still increase power-related GHG emissions by 0.8% (0.31 MMT of CO_2) across the region. Section 3.8.3.6 discusses the GHG impacts of MO4 in further detail.

This analysis is based largely on existing technology and the region's existing resource portfolio. Future technology developments—such as advances in utility-scale storage, demand management, adding voltage support capabilities to wind or solar, other emerging renewable options like tidal or wave power, small modular nuclear reactors, pumped storage, and technologies not yet in the public eye—may reduce the need to rely on fossil-fuel power for integrating variable renewable resources.

MO4 would meet the objectives to **Maximize Adaptable Water Management** and **Provide Water Supply** because the CRS would be operated to meet the flood risk management measures and does not remove authorized water supply.

MO4 provides for additional water supply of 1.15 million acre-feet from Lake Roosevelt at Grand Coulee, as well as changing the timing of delivery of recently developed water supplies for the Odessa Subarea of the Columbia Basin Project to when the water is needed. While the ability to deliver water from Lake Umatilla (John Day Dam) would remain, pumping costs would likely increase due to a decrease in pool elevation.

Additional Effects of MO4

Additionally, in low water years, major adverse effects to water-based recreational access at Lake Pend Oreille could occur.

As with the other alternatives, the co-lead agencies used this analysis to inform and improve the Preferred Alternative that seeks to balance managing the system for all purposes while providing additional benefits to fish and other EIS objectives.

9 ALTERNATIVES CONSIDERED BUT NOT EVALUATED IN DETAIL

Initially, several important issues were identified during scoping for consideration in this EIS. This included the reintroduction of salmon above Chief Joseph and Grand Coulee dams into the upper Columbia Basin, where passage is currently blocked. Additionally, the co-lead agencies received requests to integrate the ongoing Columbia River Treaty negotiations between the United States and Canada into the analysis. Following the Sovereign Review process, the Regional Recommendation stated that Pacific Northwest states and tribes support the pursuit of a comprehensive flood risk management study to re-evaluate usage of flood plains and potential changes to current levels of protection. These concerns or measures were considered but removed from further analysis in the EIS for the reasons detailed in Section 2.5.

In addition, a preliminary suite of single objective focused alternatives were developed to maximize certain project purposes or benefit specific resources without attempting to minimize adverse effects on other resources. As information on how suites of measures from these alternatives performed became better understood, they were used to develop the MOs in order to meet the objectives in a more comprehensive manner. None of the single objective alternatives were retained for detailed analysis in the EIS. Additional information on these alternatives can be found in Appendix A—Alternatives Development.

10 PREFERRED ALTERNATIVE

Overview of the Preferred Alternative

The Preferred Alternative provides flexibility to adapt to changing conditions in the Columbia River Basin, ensures that human life and safety can be protected through flood risk management, provides benefits to fish and wildlife resources, supplies water to farmers and cities, and ensures adequate, affordable, and reliable power. Throughout this process, the co-lead agencies endeavored to identify a way to best meet the multiple purposes and objectives of the Columbia River System, and build on recent progress in establishing a more collaborative, creative approach to river operations and protection for salmon, resident fish and lamprey. Each co-lead agency has different criteria for the outcome of the EIS, but worked together to assemble an alternative that seeks to balance the multiple purposes of the federal projects, while complying with the relevant environmental laws and regulations.

The five multiple objective alternatives (the Preferred Alternative is also considered to be the fifth multiple objective alternative) met the study's Purpose and Need Statement and objectives to varying degrees and with varying levels of beneficial and adverse effects. The co-lead agencies selected a combination of measures from the alternatives to develop the Preferred Alternative based on how well the measures met the Purpose and Need Statement and EIS objectives, with consideration of environmental, economic, and social effects. Developing the Preferred Alternative allowed the co-lead agencies to refine several measures based on information learned during the process of modeling and evaluating the alternatives.

After the alternatives were initially developed, the implementation of spring spill operations in 2018 and the development of the Fish Operations Plan for 2019 led to new information regarding spill for juvenile fish passage to benefit downstream migration of juvenile anadromous fish. With this information, the co-lead agencies modified the juvenile fish spill operation for the Preferred Alternative using the analysis from the range of spill levels evaluated in the MOs. The intent was to create an opportunity for a major potential benefit to salmon and steelhead through increased spill, as indicated by the CSS model, while avoiding many of the adverse effects to power generation and reliability associated with spill operations for juvenile fish passage analyzed in MO4. The primary method to accomplish this in the Preferred Alternative is a flexible spill operation that spills more for fish passage when power generation is less valuable and spills less when power generation is more valuable. The Preferred Alternative also acknowledges the range of potential outcomes predicted by the models used to estimate impacts to anadromous fish, and therefore includes a study to evaluate the potential benefits and unintended consequences of significantly higher spill levels. The underlying principles and model of constructive collaboration established through the 2019–2021 Flexible Spill Agreement have been carried forward in the Preferred Alternative. The Preferred Alternative also emphasizes the importance of an adaptive approach to implementation, ensuring that any new learnings are regularly identified and applied to future operations. Any adjustments to the initial flexible spill operations would be bound by guiding principles that commit to no net reduction in fish or power benefits.

Nearly all measures included in the Preferred Alternative are either carried forward from the No Action Alternative, or are original measures or refined measures that were evaluated in MOs 1 through 4. The co-lead agencies added lamprey measures (closable floating orifice gates) and an operational measure analyzed under MO4 for steelhead overshoots, to the Preferred Alternative as a result of the ESA consultation process and ongoing tribal coordination. This led to a Preferred Alternative that seeks a balanced approach to enable the co-lead agencies to meet the multiple purposes of the System and requirements for fish and wildlife including ESA-listed

species. Following the initial development of the Preferred Alternative, the co-lead agencies shared it with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, tribes, and cooperating agencies to solicit feedback and further input. The feedback received from the services and the cooperating agencies was highly valuable and despite the sizable volume of comments, the co-lead agencies addressed and incorporated this feedback where appropriate.

Tribal partners provided valuable input and expertise throughout the development of the EIS and tribal interests and perspectives played an important role in how the co-lead agencies shaped the Preferred Alternative. The importance of healthy salmon and steelhead populations to tribal cultures and economies is a central part of the rationale for selecting fish passage spill measures that have the potential to provide major improvements in smolt-to-adult returns (SARs). Continued investment in structural improvements for lamprey passage also reflects consistent feedback received from numerous tribes.

The affirmation and refinement of the Montana Operations, which includes measures designed to carefully balance resident fish needs with downstream requests for flow augmentation, is the result of close coordination with state and tribal partners in the upper basin. Over the past 30 years, the Montana Operations have evolved to address the effects of Libby and Hungry Horse dams on natural resources, with emphasis on controlled flows and drafting rates (e.g. how fast and deep a reservoir is lowered to preserve riparian habitat productivity and then refilled in the spring to provide flows that benefit ESA-listed bull trout, Kootenai River white sturgeon and salmon).

Water Quality Standards

Implementation of the Juvenile Fish Passage Spill operations measure in the Preferred Alternative is constrained by the Washington and Oregon total dissolved gas (TDG) standards. The national TDG water quality standard is 110% saturation. Before 2019, Washington changed its TDG standard to allow for 120% TDG in the tailrace (below the dam) and 115% TDG in the forebay (above the dam), and Oregon changed to 120% TDG in the tailrace to enable juvenile fish passage spill on the lower Columbia and Snake rivers during the spring and summer. Beginning in April 2019, the Corps agreed to implement spill for juvenile fish passage as outlined in the 2019–2021 Flexible Spill Operation Agreement (Agreement). To facilitate higher juvenile fish passage spill in the spring, Oregon and Washington agreed to consider changing their TDG water quality standards. The Agreement called for spring spill up to 120% in the tailrace in 2019, a level allowed by Oregon but above the state of Washington's standard at that time. In 2019, Washington temporarily changed its TDG standard to 120% TDG in the tailrace and removed the 115% TDG forebay limit for a one year duration, allowing for the successful implementation of the first year of the Agreement.

Implementation of the second year of the Agreement started in April 2020, and required Oregon and Washington to increase the TDG standard up to 125% TDG in the tailrace to allow the Corps to provide 16 hours per day of spill in the spring of up to 125% TDG. In Oregon, the Environmental Quality Commission approved a spring TDG modification of 125% at its January 2020 Environmental Quality Commission hearing. The Oregon modification went into effect on February 11, 2020, once it was signed by the Oregon Department of Environmental Quality Director. In Washington, a permanent rule change to facilitate TDG spring spill up to 125% TDG for juvenile fish passage spill as detailed in the Agreement was approved by the U.S. Environmental Protection Agency on March 5, 2020.

Does the Preferred Alternative Address the Objectives?

The Preferred Alternative meets the Purpose and Need Statement and objectives developed for the EIS for operation of the CRS to varying degrees. Where appropriate, mitigation measures have been incorporated into the Preferred Alternative to address adverse impacts when compared to the No Action Alternative. For example, the Preferred Alternative includes a mitigation measure to evaluate and restore upstream passage at a minimum of two natal tributaries for bull trout on the Kootenai River, due to operations at and downstream of Libby Dam. Ongoing programs and operation and maintenance activities would continue from the time this EIS was initiated in 2016 unless otherwise described. Measures proposed by the co-lead agencies for compliance with the ESA are also included. Many of the measures in the Preferred Alternative are intended to improve conditions for ESA-listed fish and lamprey. Other measures are intended to provide more flexible ways for the co-lead agencies to meet water needs for fish and wildlife, flood risk management, water supply, and hydropower in the Columbia Basin. A detailed description of the measures included in the Preferred Alternative is included in Chapter 7 of the EIS.

The Preferred Alternative would meet the **Improve Juvenile Salmon**, **Improve Adult Salmon**, and **Improve Lamprey objectives**. According to the CSS model, Snake River Chinook and steelhead are expected to see relative improvements in SARs of 35% and 28% respectively. If latent mortality effects are reduced, the LCM

Snake River near Swan Valley, Idaho

models also predict that SARs would increase. However, if latent mortality effects are not reduced, the LCM predicts that SARs for Snake River spring Chinook may also be lower than the No Action Alternative (range of minus 7.5 to plus 28% change relative to the No Action Alternative) due to reduced rates of transport. Results for upper Columbia River stocks are beneficial based on LCM estimates. In-river survival and SARs are anticipated to increase. The ranges in potential effects are due to the different assumptions made by each of the fish models.

The Preferred Alternative is expected to address the adult migration delay caused by high spill predicted in MO4 analysis through the inclusion of periods of reduced spill. The Preferred Alternative is anticipated to, and is specifically designed to, test and evaluate whether increased spill would ultimately lead to an increase in adult fish. Spill operations would be managed adaptively, building off of the established Regional Forum processes, to address unexpected challenges, such as potential delays to adult migration and effects to navigation, that may require either a temporary or permanent change. As noted above, anadromous fish from regions other than the Snake River are expected to have minor improvements or similar effects compared to the No Action Alternative. However, if improved fish travel times and reduced powerhouse passage rates lead to reductions in latent or delayed mortality rates, additional improvements could be expected for those populations as well. This potential response was not predicted by NOAA's Lifecycle Models, which are not sensitive to latent mortality effects, but would be entirely consistent with CSS model results based on outcomes predicted for Snake River stocks as well as CSS analyses produced for non-CRSO purposes.

The Preferred Alternative includes modification of the John Day Reservoir for predator disruption. Reservoir levels would be increased before Caspian tern nesting season to dissuade nesting on islands in John Day's reservoir, and then dropped back down to the minimum operating pool range in June as is normal during the juvenile fish migration season. At John Day Dam, limits to the rate of change in reservoir elevations would be similar to the No Action Alternative. The effect of the John Day Reservoir Predation Disruption measure would have negligible effects on larval lamprey (such as stranding) compared to the No Action Alternative.

The Preferred Alternative is expected to have similar effects as the No Action Alternative on water temperature. TDG levels in the lower Snake and lower Columbia rivers in the spring are expected to increase relative to the No Action Alternative due to increased spill intended for juvenile fish passage. These TDG levels are expected to be lower than MO4 spill in the spring due to the inclusion of periods of reduced spill for hydropower generation under a flexible spill operation.

The Preferred Alternative would also meet the **Improve Resident Fish** objective. Effects to resident fish vary by region and by species but are generally minor relative to the No Action Alternative. For example, at Libby Dam, effects to resident fish are expected to have minor adverse effects due to higher river elevations during the winter and minor beneficial effects due to the changes in reservoir elevation, downstream water temperatures, and restoration of native riparian vegetation. Effects at Hungry Horse are expected to be minor beneficial due to higher reservoir levels in late summer. Resident fish in Lake Roosevelt at Grand Coulee are expected to experience minor adverse effects because of changes in reservoir levels, but this would be mitigated for by augmenting spawning habitat. The slightly deeper drafts at Dworshak resulting from a more formal calculation of winter drawdown are expected to have minor adverse effects to bull trout and kokanee because of increased entrainment risk and increased drawdown that may isolate fish from tributaries. In the lower Columbia River and lower Snake River, the Preferred Alternative could

have minor adverse effects on resident fish due to the higher TDG levels and minor beneficial effects from increased fish passage spill resulting in decreased powerhouse passage at dams.

Many of the tribal cooperating agencies provided valuable input on the broader historical context of **Cultural Resource** impacts resulting from the construction and operation of the CRS prior to 2016. Relative to the No Action Alternative, the effects of the Preferred Alternative generally have negligible effects on cultural resources. The current FCRPS Cultural Resource Program would continue under the Preferred Alternative.

Overall, the Preferred Alternative would result in less adverse effects to archaeological resources than the other action alternatives. Except for Lake Koocanusa, the Preferred Alternative is neutral or has slightly beneficial effects in comparison to the No Action Alternative. This does not mean that the Preferred Alternative would eliminate the ongoing adverse effects of operating the reservoirs, but there may be a slight reduction in the rate at which archaeological sites decay. At Libby, the adverse effects to archaeological resources resulting from the Preferred Alternative are minor.

As with the other alternatives, and similar to archaeological resources, traditional cultural properties would continue to experience major adverse effects associated with the operation and maintenance of the CRS. The effects that have occurred and would continue to occur under the Preferred Alternative are summarized in Section 3.16 and listed in Table 3-299. However, based on available information, and with reference to the assumptions and constraints previously described for traditional cultural properties, the Preferred Alternative would likely not result in an appreciable increase in adverse effects relative to the No Action Alternative.

Consistent with the sacred sites identified for Chapter 3, the Preferred Alternative evaluates effects to two sacred sites. Operational changes at Grand Coulee and Albeni Falls as described for the Preferred Alternative would be negligible when compared to the No Action Alternative. The analysis shows that the period of site exposure at Kettle Falls and Bear Paw Rock would not increase. Based on the similarity between the Preferred Alternative and the No Action Alternative, the effects to sacred sites under the Preferred Alternative are expected to be negligible.

The Preferred Alternative would meet the **Provide a Reliable and Economic Power Supply** objective. Hydropower generation decreases under the Preferred Alternative by 210 aMW, assuming average water, and 330 aMW, assuming low water, in large part due to the increased spring spill for juvenile fish passage. While overall hydropower generation would decrease under the Preferred Alternative, reliability is comparable to that of the No Action Alternative because other measures increase hydropower generation slightly in the winter, and more substantially in late August, and increase hydropower flexibility in some locations and periods. Therefore, no additional resources are needed to maintain regional reliability at the No Action Alternative level.

For Bonneville's wholesale power rates, the Preferred Alternative places additional rate pressure of 2.7% relative to the No Action Alternative. Additional rate sensitivities not included in the base analysis could lower the rate pressure to 0.8%. These estimates compare the Preferred Alternative to the No Action Alternative, which is not the same as comparing the Preferred Alternative to current operations. Consequently, the estimates are not a comparison to the BP-20 wholesale power rates, which were set assuming the financial impact of the 2019–2021 Spill Operation Agreement, and therefore already include a substantial portion of the cost pressures found in the Preferred Alternative. The remaining rate pressure associated with the Preferred Alternative falls within a level that Bonneville has historically been able to mitigate through the costs over which it has significant control.

For instance, over the past two years, Bonneville and its partners took steps to offset the costs of reduced hydropower generation resulting from the Opinion and Order from the District Court. The spill operations contained in the Preferred Alternative are designed to test the potential biological benefits of increased spill while maintaining cost neutrality for regional electricity ratepayers relative to the 2018 spill injunction.

Due to the reduction in hydropower generation, air quality would most likely be degraded slightly and greenhouse gas emissions in the Northwest would likely increase by an estimated 0.54 MMT (or 1.5 percent) compared to the No Action Alternative.

The Preferred Alternative also meets the **Maximize Adaptable Water Management** and **Provide Water Supply** objectives. Water would continue to be provided for millions of people and irrigated agriculture in Oregon, Washington, Idaho, and Montana, with about 7 Maf of water supplied for irrigation, drinking water, and other municipal and industrial needs (USGS 2017). Up to an additional 45,000 acre-feet of water could be pumped from Lake Roosevelt at Grand Coulee to supply authorized project acres, with the timing and extent based on the development of new water supply projects. Additionally, the timing of delivery of recently developed water supplies for the Odessa Subarea of the Columbia Basin Project would be shifted to when the water is needed.

11 COMMON THEMES FROM THE COMMENT PERIOD

On February 28, 2020, the Draft EIS was issued for a 45-day comment period. Almost 59,000 comments were received. Many of the comments the co-lead agencies received were technical in nature, and those are addressed in the relevant sections of the EIS. Others were more thematic, and those are addressed here as well as in the EIS. You can find all of the comments and responses in Appendix T.

Many comments were supportive of the Preferred Alternative. This section, Common Themes from the Comment Period, focuses and responds only on the comments that oppose the Preferred Alternative and other aspects of the EIS.

Comment: The Preferred Alternative is no different from the status quo.

Although the question of breaching the lower Snake River dams is one of the most widely publicized issues in management of the Columbia River System, the co-lead agencies analyzed a reasonable range of alternatives in the EIS to address current and anticipated operations, maintenance and configuration. While the Preferred Alternative does not include breaching of the lower Snake River dams, it calls for actions that are substantially different from those that have been implemented in the past.

- **Flexible spill for juvenile fish passage.** One major change that the Preferred Alternative represents is a new spill operation which tests an innovative approach to balancing fish benefits and energy goals by spilling more water in the spring for juvenile fish passage. This flexible spill operation in the Preferred Alternative builds off the 2019-2021 Flexible Spill Agreement signed in 2018. This type of operation is very different from the No Action Alternative and how the co-lead agencies have operated the system historically.

  The intent of the Juvenile Fish Passage Spill Operations measure in the Preferred Alternative is to increase spill when the projected value of power is relatively low, passing higher proportions of fish through the spillway, and spill less water for limited durations when the projected value of power is relatively higher (e.g., during peak power demand). The spill operation creates the potential for a major benefit to salmon and steelhead through increased spill, as indicated by the CSS model, while avoiding many of the adverse effects to power generation and reliability associated with juvenile spill operations analyzed in MO4. The Juvenile Fish Passage Spill Operations in the Preferred Alternative would be implemented through an adaptive management framework that allows the co-lead agencies to adjust operations as new information emerges.

  The 2019–2021 Flexible Spill Agreement was quickly lauded by many including a major regional newspaper who described it as "a landmark agreement supported by states, tribes and federal agencies and is expected to change how water is spilled at Columbia and Lower Snake River dams to boost the survival of young salmon while limiting the financial hit to hydropower." As a February 2019 Council blog post noted, "It's a rare and special event when former litigants find common ground for agreement, particularly on an important biological and power policy issue that has been the subject of divisive court battles for decades."

  As part of the Preferred Alternative, the co-lead agencies would increase planned spill up to 125% total dissolved gas levels at some projects for up to 16 hours per day, which is the new water quality standard for the maximum allowable total dissolved gas limit for Washington and Oregon. Previous state water quality standards limited juvenile fish passage spill to lower amounts. The goal of higher spill is to increase the number of juvenile fish passing through the spillways, in lieu of the powerhouse bypass systems and turbines, which is predicted by the CSS model to result in increased adult fish returns. While flexible spill of up to 120% TDG began in 2019, 2020 was the first year that spill of up to 125% was utilized. This first year of 125% flexible spill operations may provide valuable lessons that can be applied to the implementation of the Preferred Alternative going forward. Also, given the lengthy ocean migration of salmon and steelhead, adults that experienced this first year of 125% flex spill won't return in substantial numbers to the Columbia for at least 3 years. On the whole, the region's new spill experiment is still in the early stages. Many of the most important lessons on the effectiveness of these innovative spill operations won't be learned until multiple generations of adult fish return. Similarly, the role of the spill operation in providing adequate, economical, and reliable power will be a critical area for learning in the future as regional energy policies continue to evolve.

Chinook Salmon

- **Extensive regional collaboration.** The flexible spill for juvenile fish passage included as part of the Preferred Alternative is a result of extensive regional collaboration. Negotiations for the 2019–2021 Flexible Spill Agreement began in the summer of 2018. The parties to the original agreement included Bonneville, the Corps, Reclamation, the states of Oregon and Washington, and the Nez Perce Tribe. The agreement was also explicitly endorsed by the Governors of Idaho and Montana. The Preferred Alternative is intended to build on the collaboration fostered through the agreement and apply those successes to the existing regional coordination processes (Regional Forum).
- **Other changes.** The Preferred Alternative also contains measures to benefit resident fish, as well as lamprey, while providing reliable flood risk management, water supply for irrigation, and flexibility in hydropower generation that would be valuable for integrating wind and solar energy.

Comment: The Preferred Alternative does nothing for endangered salmon and steelhead

The EIS provides analysis of multiple objectives and resources of the Columbia River System including flood risk management, water supply, hydropower generation, fish and wildlife conservation (including a variety of species other than salmon and steelhead), navigation, cultural resources, recreation and other environmental and socioeconomic resources.

The EIS seeks to identify a Preferred Alternative that achieves a reasonable balance of multiple river resource needs and co-lead agency mission requirements. While the purpose of the analysis is not limited to salmon issues, analysis shows that the Preferred Alternative would meet the objectives for improving juvenile salmon, adult salmon, resident fish and lamprey. The analysis found ranges in potential effects due to different assumptions included in each of the fish models used in the study.

Using the Comparative Survival Study (CSS), Snake River Chinook salmon and steelhead are expected to see improvements in smolt-to-adult returns of 35% and 28%, respectively, relative to the No Action Alternative which was based on 2016 operations. Lifecycle models developed by NMFS also predict improvements to SARs if CRS operations can improve ocean survival levels through reduced latent mortality. The smolt-to-adult return ratio (SAR) is the rate at which a group of fish survive from their juvenile, smolt life stage to a defined ending point where they return as adults. While achieving long-term recovery targets will require more than just the efforts of federal agencies, the CSS models indicate the potential for SARs of Snake River Chinook salmon and steelhead to increase to levels that could approach broad-sense regional recovery targets set by the Northwest Power and Conservation Council (i.e., SAR goal range 2–6%). With respect to the Preferred Alternative, the CSS model predicts that average smolt-to-adult return rates would increase for both Snake River spring Chinook and steelhead, and would average well above 2% (the lower end of the Council's recovery targets for the region) as a result of the Preferred Alternative (increasing from 2% to 2.7% for Chinook, a 35% relative increase). NMFS Lifecycle model and COMPASS predict higher levels of risk associated with increased spill levels in the absence of offsets from decreased latent mortality. The Preferred Alternative would be implemented using a robust monitoring plan to help narrow the uncertainty between the two models and to determine how effective increased spill can be toward increasing salmon and steelhead returns to the Columbia Basin.

In addition to making progress toward Council recovery targets, increases in returning adult salmon and steelhead will support goals associated with other regional efforts geared toward restoring salmon and steelhead in the Columbia Basin. NMFS' Marine Fisheries Advisory Committee has established recovery goals of increased natural origin salmon and steelhead production to healthy and harvestable levels, which include up to 3.6 million natural origin adults, and an average increase in total Columbia River runs of natural fish, plus hatchery fish, from 2.3 million to approximately 11.4 million fish. *Source, NOAA*. The potential improvements in SARs for the Preferred Alternative predicted by the CSS model could make a meaningful contribution to meeting these goals while the region works together on additional actions to help achieve long-term salmon recovery and economic sustainability.

As noted above, if latent mortality effects are reduced by passing more juvenile fish through the spillways, the NMFS Lifecycle Model also shows that levels of SARs would increase. However, if latent mortality effects are not reduced, or are different than modeled, the NOAA

models predict that SARs for Snake River spring Chinook salmon may be lower than the No Action Alternative (a range of -7.5% to +28% change relative to the No Action Alternative, depending on the magnitude of latent mortality reduction). This is due to reduced opportunities for fish transportation. While there was not a NMFS lifecycle model for steelhead available for use during the development of this EIS, a similar range of effects could also be assumed for Snake River steelhead based on recent observations of SARs for steelhead that were transported compared to those that migrated in-river.

Results for upper Columbia River stocks are expected to be beneficial based on NMFS LCM estimates as in-river survival and SARs are both anticipated to increase. The CSS models were not developed for upper Columbia fish, so no results specific to the EIS alternatives are available. However, if the same relationships between reduced powerhouse passage and increased SARs apply to upper Columbia stocks, using the CSS approach, the Preferred Alternative would also be expected to show a benefit to upper Columbia stocks because of decreased levels of latent mortality associated with passage at CRS dams.

The Preferred Alternative includes a modification of the John Day Reservoir operations for predator disruption. Reservoir levels would be increased before Caspian tern nesting season to dissuade terns from nesting on islands in the John Day Reservoir, where they are currently nesting and foraging on ESA-listed salmon and steelhead. In early June, after most of the spring juvenile salmon and steelhead have migrated through the reservoir, the John Day Reservoir would be reduced to the minimum irrigation pool range, which mimics the previous operation of the reservoir to benefit juvenile fish migration season.

Comment: The region should continue the discussion and collaboration

While the Preferred Alternative represents a meaningful step forward for salmon that seeks to balance the many purposes of the CRS and statutory obligations of the co-lead agencies, the co-lead agencies recognize that the CRSO EIS will not end the debate about the future of the Columbia River and salmon. We are responding to the voices calling for additional collaborative dialogue across the region about the future of salmon recovery, affordable and reliable clean electricity, and economic and cultural vitality for the tribes and other communities who depend on the Columbia River System for their way of life. The co-lead federal agencies will be active participants in developing solutions for achieving broader recovery objectives that address the effects of the CRS and the other key variables that impact salmon across their life cycle.

Logs clog a streambed awaiting a spring flood to carry them to the Columbia River in the early 1900s. (Courtesy of Oregon Historical Society)

The Preferred Alternative for balanced system operations, maintenance and configuration of the Columbia River System presented in the EIS is based on the current state of technology and markets. It's also important to note that technology is quickly changing, as is the region's dynamic energy market, and the region will need to consider new information as it becomes available and adaptively manage resources.

We identified the Preferred Alternative to best meet statutory obligations, and because of our genuine respect for the people across the spectrum affected by our actions. We recognize that no matter which alternative in the CRSO EIS we choose as the Preferred Alternative, the decision would likely draw criticism. The region includes stakeholders, sovereigns, and other interested parties with diverse and varied opinions on these very important topics, and many are strong in the belief that their perspective is the best path forward.

It is important to keep in mind that factors, both human-caused and natural, that are outside the authority and control of the co-lead federal agencies also contribute to the decline and recovery of fish, and will continue to strongly influence fish and their habitat. Salmon and steelhead have been adversely affected in the Columbia River Basin since the late 1800s, by many activities including human population growth, urbanization, introduction of exotic species, overfishing, development of cities and other land uses in the flood-plains, water diversions for all purposes, dams, mining, farming, ranching, logging, hatchery production, predation, ocean conditions, and loss of habitat. Operation, configuration and maintenance of the Columbia River System clearly requires mitigation for its effects, but the EIS is not intended or required to serve as an overall salmon recovery plan for the region. Other human-caused impacts that have contributed to the decline of fish, and how the region should properly and effectively address

Fish Ladder at Chief Joseph Hatchery

those impacts, should be part of the continued regional discussion. We look forward to participating in that discussion.

Comment: The lower Snake River dams will lead to the extinction of Southern Resident killer whales

Southern Resident killer whales are an icon of the Pacific Northwest's culture and an enduring legacy. The co-lead agencies believe it is essential to find effective solutions to help this endangered population of killer whales on the West Coast that preys on salmon and other fish, but not marine mammals, as many other killer whales do. These whales range from the coasts of California, Oregon, Washington and even as far north as Southeast Alaska. The quantity and quality of prey is one of the limiting factors identified by NMFS in recovery of Southern Resident killer whales, along with vessel traffic and noise, and toxic contaminants. The operation of the Columbia River System directly affects Snake River and Columbia River Chinook salmon, both wild and hatchery origin fish, which migrate past these federal dam and reservoir projects, and the associated effects indirectly affect Southern Resident killer whales.

Southern Resident killer whales are Chinook specialists, but also consume other available prey populations while they move through various areas of their range in search of prey. NMFS and the Washington Department of Fish and Wildlife have developed a prioritized list of Chinook salmon within their range that are important to Southern Resident killer whales to help prioritize actions to increase prey availability for the whales (NOAA and WDFW, 2018). This list includes many Columbia River Basin Chinook salmon stocks including lower Columbia fall-run (tules and brights), upper Columbia and Snake fall-run (upriver brights), lower Columbia River spring-run, middle Columbia River fall-run, and Snake River spring/summer-run. Southern Residents also are known to eat some steelhead, coho, and chum salmon, and halibut, lingcod, and big skate while in coastal waters. The diet is dominated by Chinook salmon both in coastal waters and within the Salish Sea. Southern Resident killer whales are opportunistic feeders that follow the most abundant Chinook salmon runs throughout their range from the west side of Vancouver Island to the central California coast. There is no evidence that Southern Resident killer whales feed or benefit differentially between wild and hatchery Chinook salmon. Snake River spring/summer Chinook salmon comprise a small portion of Southern Resident killer whales' overall diet, but can be an important forage species during late winter and early spring months near the mouth of the Columbia River (Ford, 2016).

The co-lead agencies agree that the quantity and quality of prey is one of the limiting factors identified by NMFS in recovery of Southern Resident killer whales, along with vessel traffic and noise, and toxic contaminants. The operation of the Columbia River System directly affects Chinook salmon, both wild and hatchery origin fish, which migrate past these federal dam and reservoir projects, and the associated effects would indirectly affect Southern Resident killer whales. However, according to NMFS, in terms of the overall abundance of Chinook salmon available to Southern Resident killer whales for prey, numbers of adults from the Snake River Basin (including both hatchery and wild produced fish) are now greater than they were in the 1960s, before three of the four lower Snake River dams were built. In addition, the Preferred Alternative has the potential to further increase the abundance of Snake River Chinook. NMFS maintains that hatcheries funded by the co-lead agencies produce more than enough Chinook salmon in the Columbia River basin to offset losses caused by the dams. So far as researchers can determine, Southern Resident killer whales do not distinguish between or benefit differently from hatchery and wild fish. Hatchery fish today likely make up the majority of fish consumed by Southern Resident killer whales. (NMFS BiOp 2020).

Comment: The four lower Snake River dams are expensive and obsolete

A number of commenters expressed opinions and concerns about the economic viability of the Snake River dams as generation assets. These comments took a number of forms: the Snake River dams have a cost of generation that is above the value of the power that they produce, that the Snake River dams will consume a disproportionately high amount of capital investment, or that customer costs would be lower if the dams were replaced with other resources.

Regional discussions about the future of the lower Snake River dams should be based on the best available factual information. Holistically, the four lower Snake River dams are among the most operationally important and cost effective projects in the Federal Columbia River Power System. From a power value perspective, the four lower Snake River dams provide more in power revenue than they cost to operate and maintain. The average annual cost to operate and maintain all authorized purposes at the four lower Snake River dams is $75 million (Appendix Q, Table 5-1) and the annual-equivalent capital costs are $32 million (Appendix Q, Table 4-1). Hydropower costs funded by Bonneville represent about $50 million of the total annual operations and maintenance costs and nearly all of the annual capital costs, approximately $31 million. This puts the annual-equivalent, power-specific costs at approximately $81 million a year for the projects. These costs are small when compared to the annual value of the power produced by these dams, which ranges between $240 million and $500 million a year (based on replacement value).

The four lower Snake River dams are also among the least costly power generating resources to operate in the FCRPS. Bonneville sells power and recovers costs based on its total system costs. It does not set rates for individual projects. However, a per-project cost basis can be estimated by levelizing the forecasted costs for the four the lower Snake River dams over a 50-year projection. The 50-year cost of generation measures the levelized costs of producing power at the facilities given the capital and expense program forecasts outlined in the Integrated Program Review (IPR). The 2018 IPR, which was the source of the capital and expense forecasts for the EIS, showed a combined cost of generation for the four lower Snake River dams, plus three headwater dams, of $11.41 per MWh. As shown in the most recent IPR meetings in June 2020, the 50-year estimated cost of generation for the four lower Snake River dams is $12.13 per MWh, when updated and separated from the headwater dams. These costs remain competitive even when compared to the short-term, and sometimes volatile, Mid-Columbia spot market energy prices. The Mid-Columbia prices averaged $37/MWh in 2019 and have averaged $18/MWh through May of 2020. Even if the $34 million per year cost of the Lower Snake River Compensation Plan were added to the cost of generation, these costs are below current and projected market prices for the electricity produced at those dams.

Another general comment is that the turbines in the four lower Snake River dams are antiquated, with some almost 60 years old, and will need substantial and expensive upgrades to continue to operate. Although age is a consideration in equipment condition, it is not the determining factor in deciding when to replace or rehabilitate turbines. Existing strategies place the earliest optimal turbine replacement date in the 2030s, with the majority of the turbine replacements falling in the 2040s and 2050s. Additionally, it has not been determined if all six generating units at each plant will be replaced at those times. The expected cost of turbine upgrades is included in the 50-year levelized costs discussed above. Thus, the four lower Snake River Dams have the capability to produce low cost, clean energy for many more years before full turbine overhauls are needed.

Comment: We can breach the four lower Snake River dams now

From the Corps' *Engineering Regulation (ER) 1165-2-119* Water Resources Policies and Authorities, Modifications to Completed Projects (Sept. 20, 1982):

"Significant modifications to completed projects-modifications which involve new federal construction or real estate acquisition in order to serve new purposes, to increase the scope of services to authorized purposes beyond that intended at the time of project construction, or to extend services to new beneficiaries (areas)—require authorization by Congress."

Since breaching one or more of the lower Snake River dams in the state of Washington would result in a major

New high-tech turbines at Ice Harbor Dam improve safety for fish, and produce more power.

Columbia Gorge wind turbines

structural or operational change or could seriously affect authorized purposes, this action is considered a significant modification under the Engineering Regulation requiring congressional authorization. The Corps has not had justification to seek—and currently does not have—the necessary congressional authority through a Water Resources Development Act to breach one or more of the lower Snake River dams.

If MO3 were selected, the Corps could use the CRSO EIS as a basis for seeking congressional authority to breach the four lower Snake River dams. After receiving both authority and appropriations from Congress, the Corps could initiate a detailed construction and design report for the breach measure, identification of disposal areas, real estate acquisition and disposal, permits, and mitigation requirements, including temporary fish hatchery production. Each of these actions are required prior to breaching, and the Corps does not have the authority or appropriations necessary to immediately breach the projects' embankments. More information is available in the Corps' *Engineering Regulation (ER) 1165-2-119* Water Resources Policies and Authorities, Modifications to Completed Projects (Sept. 20, 1982) or ER 1105-2- 100, Appendix G, Section III Post Authorization Changes.

Comment: Replacing power from the four lower Snake River dams is not necessary, or would cost less than stated in the EIS

Many commenters point to data that appears to show the regional power system has surplus energy that could make up for the power that would be lost if the four lower Snake River dams were breached. Several commenters also contend that the lost capability of the four lower Snake River dams could be acquired for much less than the estimates included in the EIS. In particular, commenters point to other studies that indicate the cost of replacement resources for the four lower Snake River dams is below the estimates in the EIS.

Data showing that the region has surplus energy only describe energy supply during average conditions. These data do not show whether power would always be available in time to meet consumer demand when average conditions are not occurring, such as during a heat wave, a cold spell, during multiple generating unit outages, or during a particularly low water year. Consumers expect electricity to be available 24 hours a day, 7 days a week, and 365 days a year. To maintain this high level of reliability, the power system must be robust enough to meet consumer demands for electricity in both above and below average system conditions.

The EIS uses a standard known as the loss-of-load probability, or LOLP, to measure the effects to power system reliability of the MOs on CRS operations. In simple terms, LOLP estimates the likelihood of an energy shortage. The higher the LOLP percentage, the more likely a blackout would occur.

The EIS describes in detail the critical role that the four lower Snake River dams play in keeping the region's LOLP at a very low percentage—currently around 6.6%, or one year in every 15 years would experience one or more blackouts. Breaching the four lower Snake River dams (along with the other operational changes in MO3)

Pacific NW Vineyard

more than doubles the region's risk of a blackout, to roughly one year in every seven years with one or more blackouts. The EIS concludes that, to keep the power system at the reliability levels we now experience, Bonneville (or regional utilities) would need to contract for or build substantial amounts of new resources.

To determine the size of the replacement resources needed in MO3, the EIS uses models and data from the Northwest Power and Conservation Council. The Council has a model—known as GENESYS—that can measure the effectiveness of different resource types at improving the regional LOLP. Using this model, the EIS identifies two representative portfolios that could be used to maintain LOLP at the No Action Alternative levels under MO3. One is a least-cost, conventional portfolio and the other is a least-cost, zero-carbon portfolio. The least-cost conventional portfolio contains 1,120 MW of combined cycle natural gas turbines for a cost of about $250 million a year. The least-cost zero-carbon portfolio is comprised of around 1,960 MW of new solar, coupled with 980 MW of batteries and 600 MW of demand response. The zero-carbon portfolio is larger than the least-cost, conventional portfolio because of the variability of renewable resources. For example, average power generation from solar is much less than the total capacity because the sun is not always shining. This portfolio includes batteries to limit the need to lean on other regional resources for regional reliability. The base cost of the zero-carbon portfolio would be around $400 million a year. Recognizing that there is a range in options for replacement resources, and a range in future costs for the resources, the EIS presents estimated ranges in costs for replacement resources in evaluating the MOs, including MO3.

The cost estimates for almost all of these replacement resource portfolios come from the Northwest Power and Conservation Council's 7th Power Plan (2016) and Mid-Term update (2019). The one exception is the cost of batteries, which is based on more recent utility data from 2018 and 2019 instead of 2013 battery data used in the Council's 7th Power Plan. These cost estimates have been further updated (through a sensitivity analysis) in the final EIS, with more recent data that is being reviewed for the Council's upcoming 8th Power Plan. The data include cost reductions for wind, solar, batteries, and natural gas resources. Presumably, these data are a better basis to forecast future costs, and hence the final EIS includes adjustments to the resource costs for the cost of replacing the power generation from the four lower Snake River dams.

While these cost figures may appear high, they in fact only represent part of the cost picture for replacing power generation from the four lower Snake River dams. The zero-carbon portfolio does not include integration and other costs needed to balance the influx of new variable resources. Including those costs in the zero-carbon portfolio would add another $30 million to $40 million per year to the annual revenue requirement, which would ultimately be recovered by regional rate payers. These costs are captured in the rate sensitivity analysis for MO3.

Additionally, even with considerable additions of renewable resources to restore the reliability of the power system in MO3, the EIS concludes that there would still

be times seasonally or even daily, such as during periods of peak demand, where more flexible fossil fuel generation would be dispatched from existing plants. This would result in an additional 1.3 million metric tons of carbon dioxide emissions in the region annually, an increase in Northwest power sector emissions of about 3.5% compared to the No Action Alternative. This in turn results in additional costs borne by regional ratepayers because some states have passed, or are considering enacting laws and/or policies aimed at reducing, limiting, and eliminating greenhouse gas emissions. For more information, see Washington's Clean Energy Transformation Act (2019); Oregon Governor Executive Order 20-04 (March 2020). The EIS concludes that the increased cost borne by ratepayers to comply with policies to reduce greenhouse gas emissions would be between $43 million and $218 million per year in 2030. These effects are described in Section 3.7 in the other regional cost pressure analysis.

The zero-carbon resource portfolio also replaces only a portion of the lost capability of the four lower Snake River dams. The loss of the other benefits provided by these projects, such as ramping capability and sustained peaking capacity, are not fully returned. The EIS estimates (in the rate sensitivity analysis) that replacing all of these capabilities would roughly double the cost of the zero-carbon resource portfolio per year.

Several comments also cite to a 2018 report commissioned by the NW Energy Coalition (NWEC) that projects a lower cost for replacing the four lower Snake River dams' generation. The EIS analyzed the NWEC study and identified both the similarities and differences between the assumptions and data used in that study, and those in the EIS. As discussed in Section 3.7 and Appendix H, some notable differences include the following:

- The EIS considers lower Snake River dam breaching in combination with multiple other management and operational changes across the system. Thus, the change in power generation under the EIS dam breach alternative (MO3) is not directly comparable with the NWEC analysis. Roughly 90% of the average power generation loss in MO3 is attributable to the four lower Snake River dams, and potentially a larger fraction of the reliability impact due to when the various measures impact power generation.
- The EIS uses a more recent Council load forecast that has roughly 10% higher load.
- The EIS uses a more recent base case dataset from the Western Electricity Coordinating Council that represents more recent load projections, fuel prices, and resources. In particular, the difference in the gas price forecasts between the EIS and the NWEC study is a key driver in the divergent results.

These and other differences described in the EIS explain why the cost estimates in the power replacement analysis in the EIS differ from the NWEC Study. Further differences also make the studies not directly comparable. Importantly, since the NWEC Study and the EIS base case analysis were completed, upwards of 2,500 MW of the region's coal fleet have been slated for retirement in the 2020s. The EIS accounts for this rapid decline in the region's coal fleet, and acknowledges the additional demands that the loss of these resources will place on

the remaining supply of power to maintain reliability. As a result, more zero-carbon resources are needed to return regional reliability to the No Action Alternative level.

Comment: The EIS should have engaged in an IRP to estimate the replacement costs

Another common question in the comments asks why the EIS analysis did not include a competitive resource review, also known as an integrated resource plan (IRP), when selecting the resources to replace power generation from the four lower Snake River dams. The concern of the comments is that without an IRP process, the EIS fails to optimize resource selection and overstates the costs of replacement.

An IRP is a resource planning tool that many retail utilities use to plan for future resource builds and acquisitions to fulfill the utilities' specific retail load serving needs over a certain planning horizon, typically 20 years. Some utilities (investor owned utilities) are required to conduct an IRP for review by their state public utility commissions, while other utilities (consumer owned utilities) do an IRP for review by their local governing officials. Unlike retail utilities, Bonneville is a wholesale marketer of federal power and does not produce an IRP. Instead, Bonneville follows federal statutes (e.g. the Northwest Power Act) in acquiring resources if needed, and is guided by the Council's regional Power Plan, which is far more encompassing than any individual utility's IRP. In concert with the Power Plan, Bonneville performs resource planning to inform its decisions including for this EIS.

The EIS is not comparable to an IRP process because the two processes focus on different scopes and objectives. The scope of the EIS is much broader than an IRP and focuses on measuring the regional impacts of different operations of the CRS. The regional scope of the EIS is necessary because the impacts of the multiple objective alternatives on power system reliability and costs transcend individual utilities and states. Thus, for example, the EIS addresses the cost impacts of replacement resources, regardless of whether Bonneville pays for the replacement resources. If Bonneville does not replace the lost capability caused by a multiple objective alternative, regional reliability would be worse than the No Action Alternative, leaving other regional utilities to acquire the necessary resources. The EIS cannot presume what preferred resources regional utilities would select, (e.g. natural gas over renewables) if they are called to acquire resources to maintain reliability, so it provides a range of resource groups developed from Council data.

The EIS addresses the primary concern from the comments about the lack of IRP-optimization by conducting a form of optimization through the selection of least-cost resources to return regional reliability to the No Action Alternative levels. The EIS employs a rigorous approach for assessing the cost effectiveness of each resource type in reducing (improving) LOLP, placing each resource type on a level playing field, and recognizing the interdependencies between different resource groups. For instance, the EIS replacement analysis addresses the interaction between existing power system resources (such as natural gas) and new resources (such as solar). The final EIS includes an expanded description of how

Lower Granite Dam

the potential replacement resource portfolios were selected for the EIS. (See Chapter 3, Section 3.7.3.1 and Appendix H Section 2.2).

Comment: The four lower Snake River dams are obsolete—not needed for navigation

Access to barge transportation is the most cost effective means of accessing export markets for the majority of grain producers in the Pacific Northwest currently and removing that option would increase transportation costs for grain producers, as the EIS shows. It is true that barge movements on the Snake and Columbia rivers have declined somewhat over the past 20 years. The EIS acknowledges that the decline is mostly attributed to investments in shuttle rail terminals. However, the EIS also acknowledges that shifting traffic to road and rail would increase costs to shippers and would require substantial infrastructure investments. Between 50 and 60 million tons of cargo are transported each year on the Columbia-Snake Navigation System. The river system allows farmers to export grain and other crops grown in interior parts of the United States to overseas markets. Cruise line operators also use the system for tourism, which is a growing business on the Columbia and Snake rivers. More information on navigation can be found in the EIS in Section 3.10.

Without the Snake River dams to provide navigation, the cost to transport goods to market would increase. For example, the cost to transport wheat, which accounted for 87% of the downbound tonnage on the lower Snake River in 2018, is estimated to increase by $0.07–$0.24/bushel. This is equivalent to an increase of 10 to 33% in average transportation costs.

Farmers could also experience increased production costs associated with higher transportation costs for upriver movements (e.g., fertilizer).

There would be additional demands on existing road and rail infrastructure as well as at barging facilities near the Tri-Cities, Washington, increasing traffic and air pollution. Additional capacity and infrastructure improvements would likely be required, borne by public and private entities, and would vary depending on how the rail industry adjusted its rates with reduced competition from the barge industry.

Commercial cruise lines operating on the lower Columbia and lower Snake River provide 18,000 cruise line passengers per year, which bring in associated tourism revenues, jobs, and income. Dam breaching would adversely affect these commercial cruise lines by reducing the number and distance of trips.

Comment: The four lower Snake River dams are obsolete—not needed for irrigation

While the lower Snake River dams are not federally authorized for irrigation, water is pumped for irrigation from their reservoir pools and from nearby groundwater that could drop up to 100 feet without the dams. This water is diverted under natural or live flow water rights issued by the states. Over 48,000 acres are irrigated in this fashion, primarily near Ice Harbor and Lower Monumental dams. These lands include high value-orchards and vineyards.

The social welfare effect associated with these lands is $17 million (annual equivalent). The economic effects in the Ice Harbor and Lower Monumental analysis area stemming from associated crop production equals 4,800 jobs (5.9% of that area's economy), $232 million in labor income, and $460 million in output (sales).

MAJOR CONCLUSIONS

The co-lead agencies developed the Preferred Alternative for the CRSO EIS as part of an iterative process. The Preferred Alternative is a combination of measures included in the No Action Alternative and four multi-objective alternatives, using information learned from evaluating those alternatives, as well as updated measures from the ESA consultation.

Under Section 7 of the Endangered Species Act, the co-lead agencies consulted with National Marine Fisheries Service (NMFS) and the U.S. Fish & Wildlife Service (USFWS) to ensure the action analyzed in both the EIS and ESA consultation documents is not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. NMFS and USFWS determined the actions are not likely to jeopardize the continued existence of the ESA-listed species, (e.g., salmon and steelhead species; Kootenai River white sturgeon and bull trout) or not likely to adversely affect green sturgeon and Southern Resident killer whale. NMFS and USFWS also determined the actions were not likely to destroy or adversely modify designated critical habitat of any ESA-listed species. These determinations resulted in two "no jeopardy" biological opinions issued by NMFS and USFWS.

In the Preferred Alternative for the CRSO EIS, we modified measures in some instances to improve their ability to meet the Purpose and Need Statement or objectives, or refined measures to avoid, reduce or minimize adverse environmental, economic, and social impacts.

We expect that the Preferred Alternative would allow us to meet the EIS intent as expressed in the Purpose and Need Statement and the EIS objectives, including those to benefit ESA-listed species, while also continuing to meet the congressionally authorized purposes of the system.

In conclusion, the Preferred Alternative seeks to balance the multiple purposes of the federal projects, while complying with the applicable federal environmental laws, implementing regulations, and executive orders.

JULY 2020

EXECUTIVE SUMMARY: COLUMBIA RIVER SYSTEM OPERATIONS ENVIRONMENTAL IMPACT STATEMENT

U.S. Army Corps of Engineers Bureau of Reclamation Bonneville Power Administration