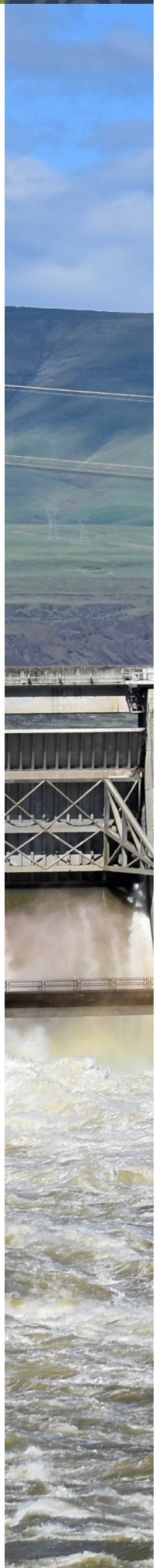
EXECUTIVE SUMMARY

Columbia River System Operations Draft 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 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 not one specific act, but is rather 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 has 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, 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 early versions of this document. We are especially grateful to our tribal partners for helping ensure that the document reflects tribal perspectives on the Columbia River System.

The EIS identifies and evaluates six alternatives for operations, maintenance, and configuration of the CRS. After evaluating the potential effects of the six 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 sought 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 congressionally authorized purposes of the System, 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.

We recognize that the operation and maintenance of the Columbia River System affects threatened and endangered fish populations within the region, and the co-lead agencies are committed to mitigating these effects. Additional regional actions are needed, though, to address other effects that are beyond the co-lead agencies' responsibilities.

It was very important to us to seek input from a wide 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 many communities that depend on the CRS for their livelihoods. 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,

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Brigadier General
U.S. Army
Division Commander

Lorri Gray
Regional Director
Columbia-Pacific Northwest
Bureau of Reclamation
U.S. Department of the Interior

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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 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 within the interior Columbia River basin and its tributaries. 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' approval and funding, numerous dams were built along the Columbia River and its tributaries to provide for flood risk management, navigation, hydropower generation, irrigation, recreation, and 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. Dozens of people lost their lives. 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 barges that can navigate the lower Snake River beginning near Lewiston, Idaho, and Clarkston, Washington, to its 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 the 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 other carbon-emitting resources, like 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 about 1,393,000 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 which 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. After initial construction, the dams restricted the movement

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 2,382 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.

of resident and anadromous fish, contributing to their population declines. These population declines were devastating to many tribes. As noted previously, fish are central to the identity of tribes. In 1994, Donald Sampson, then Chair of the Confederated Tribes of the Umatilla Indian Reservation Board of Trustees, stated:

"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."

Tribal Circumstances and Impacts of the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs and Shoshone Bannock Tribes Meyer Resources, Inc., 1999.

Today, the annual runs of salmon and steelhead average just over two million fish, of which 40 percent 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.

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

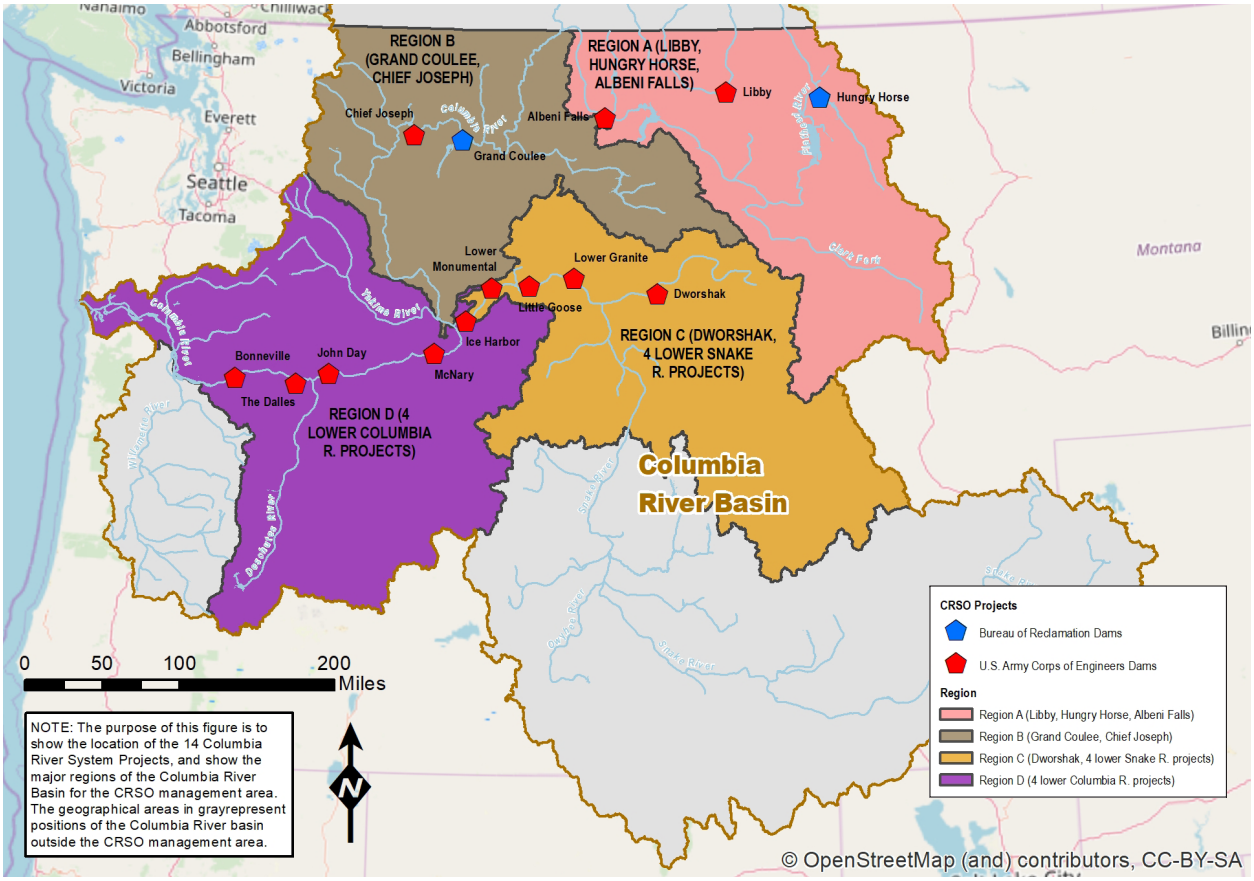
The co-lead agencies have made substantial improvements for resident and anadromous (both adult and juvenile) fish passage at the lower Snake River and lower Columbia River dams. The co-lead agencies have undertaken large-scale efforts to improve fish and wildlife habitat in tributaries and the estuary.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

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 (CRSO) Environmental Impact Statement (EIS) 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 include 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,

Figure ES-1: Columbia River System Projects



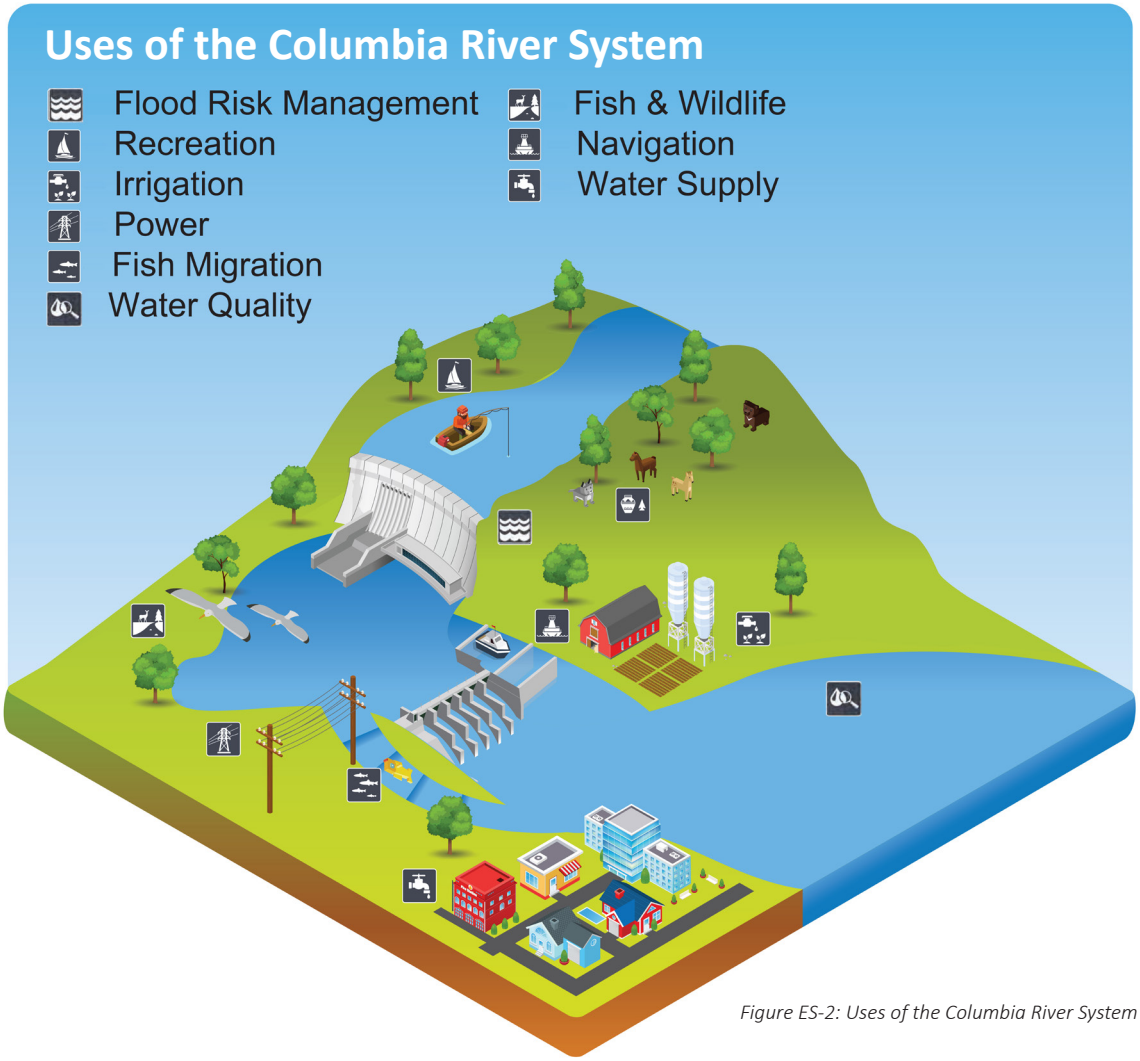


Figure ES-2: Uses of the Columbia River System

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.

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 June 2021 and September 2021 respectively.

This executive summary provides an overview of the draft EIS, which is a much larger document that contains highly detailed analysis 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

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

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. Here is a link to the EIS website: www.crso.info.

Chapter 1	**Introduction**
Chapter 2	**Alternatives**
Chapter 3	**Affected Environment and Environmental Consequences**
Chapter 4	**Climate**
Chapter 5	**Mitigation**
Chapter 6	**Cumulative Effects**
Chapter 7	**Preferred Alternative**
Chapter 8	**Compliance with Environmental Statutes**
Chapter 9	**Coordination and Public Involvement**
Chapter 10	**List of Preparers**
Chapter 11	**References**
Chapter 12	**List of Appendices**

The geographic scope of the EIS encompasses the 14 federal projects on the Columbia River, Snake River, and some of its 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 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 affects considerations, and considerations for how our operations may cause impacts to non-federal projects. However, these were not included in this CRS analysis to scope new measures of how they could operate differently. Non-federal projects are subject to different regulations, and requirements for operations are outlined in FERC licensing. In addition, three projects in the Canadian portion of the basin are partially coordinated with the CRS under the Columbia River Treaty (CRT). These other projects may be included in the cumulative effects analysis, as appropriate.

The temporal scope of the EIS is assumed to be 25 years from the signing of the records of decision (RODs) 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 activities and effects evaluated in this EIS provide the co-lead agencies the ability to learn and adapt to changing conditions and new information over time. Adaptive management will continue to be an important approach to managing the CRS moving forward.

The October 19, 2018 *Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West* directed the co-lead agencies to shorten the timeline to prepare the EIS a year ahead of the original schedule adopted in the Opinion and Order. The schedule was primarily compressed between the completion of the Draft EIS and signing the records of decision. Publication of the Draft EIS represents the noteworthy contributions of numerous entities within the region working to analyze complicated issues.

[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.

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, fishing and commercial fishers; and other public interest groups 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, which can be found at www.crso.info.

2.2 COOPERATING AGENCIES

The co-lead agencies requested federal, state, and local agencies, and tribes 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 retain the right to comment on the Draft and Final EISs 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 Records of Decision. Due to this, the cooperating agencies may or may not agree with or fully support all of the content of these documents.

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
Burns Paiute Tribe
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Shoshone-Paiute Tribes of the Duck Valley Reservation
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

2.3 TRIBAL COORDINATION AND PERSPECTIVE

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. Through treaties, executive orders, judicial decisions, and legislation, the tribes ceded most of their territory to the United States while retaining smaller portions of land for their reservations. Some tribes, through treaties, retained the right to hunt, fish, and gather in their usual and accustomed locations, including areas outside of their reservations. 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 processes, such as the Columbia Basin Fish Accords. The co-lead agencies initiated government-to-government engagement with the tribes in Table ES-2.

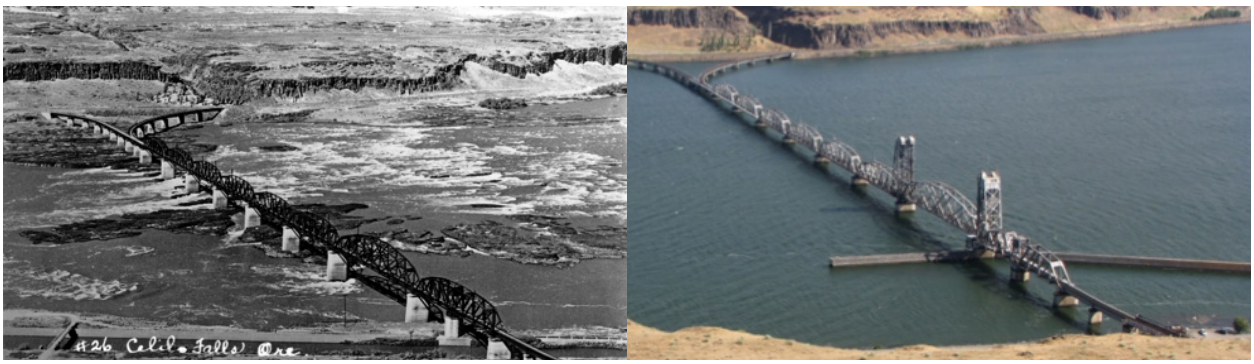
TABLE ES-2 - ENGAGEMENT WITH FEDERALLY RECOGNIZED TRIBES
Burns Paiute Tribe
Coeur D'Alene Tribe of Indians
Confederated Salish and Kootenai Tribes of the Flathead Reservation
Confederated Tribes of the Chehalis Reservation
Confederated Tribes of Grand Ronde
Confederated Tribes of Siletz Indians of Oregon
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 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. The Confederated Tribes of the Colville Reservation (CTCR) stated:

"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."

(See Appendix P)



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.

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

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."

Tribal Circumstances and Impacts of the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs and Shoshone Bannock Tribes, Meyer Resources, Inc., 1999.

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.

2.4 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 the 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, this document can help inform the regional conversation on this complex and often polarizing issue. New congressional authority and associated funding 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 that were developed as part of this EIS will change 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) Life Cycle Model (LCM), which includes the Comparative Passage (COMPASS) model; 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 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 past the dams have a bigger impact on how many adult fish return.

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).

SPILL The co-lead agencies release (or spill) water through the federal dams in the spring and summer to help juvenile salmon and steelhead 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 (see Figure ES-3).

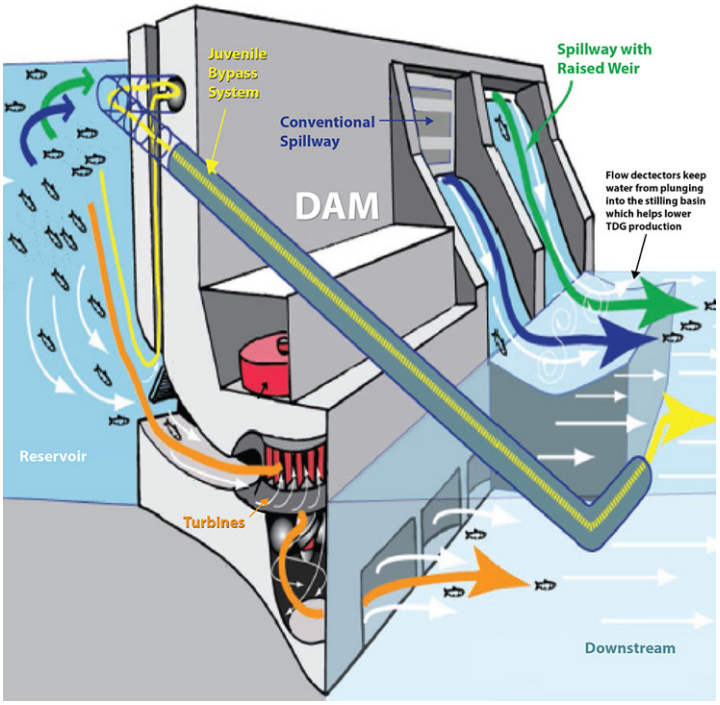


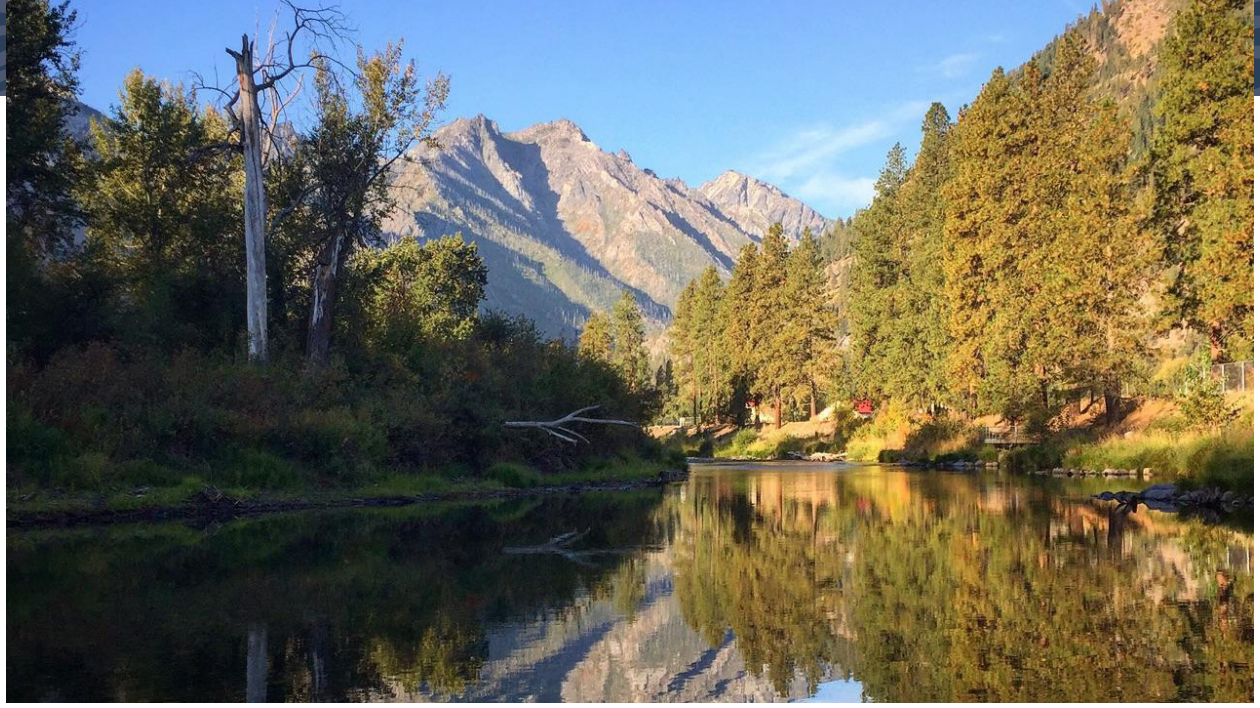
Figure ES-3: Juvenile fish passage routes on Columbia River System dams

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.

Many of the scoping comments expressed a desire to have the EIS include the CSS model. The CSS model is an important part of the broader anadromous fish analysis in the CRSO EIS. Information generated by the CSS model was considered alongside other quantitative and qualitative lines of evidence and 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. 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.

Reintroduction

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. A coordinated approach among water users, tribes, states, multiple federal agencies, and others would be necessary. 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. Nevertheless, the agencies and interested regional sovereigns are developing a framework to address critical information gaps.

Water Quality

The EIS analysis predicted water temperature and total dissolved gas (TDG) 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 controversy 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 depth) 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 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. This approach was used due to the uncertainty of results in the rapidly evolving science of climate change impacts on water temperature and the role of the CRS.

TOTAL DISSOLVED GAS (TDG) is the amount of gas present in water. Supersaturation of gasses 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 gasses (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."

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 project. Preliminary results have been shared across the region, which has led some stakeholders to compare 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.

2.5 ISSUES TO BE RESOLVED

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 percent saturation. Before 2019, the states of Oregon and Washington changed their TDG standards to allow for 120 percent TDG in the tailrace (below the dam) and 115 percent TDG in the forebay (above the dam) in Washington, and 120 percent TDG in the tailrace in Oregon, to enable juvenile fish passage 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 Spill Operation Agreement (Agreement). The second year of flexible spill operations is on track to begin in April 2020. To facilitate higher juvenile fish passage spill in the spring, Oregon and Washington agreed to consider changing their TDG water quality standard. The Agreement called for spring spill up to 120 percent in 2019, a level allowed by Oregon but above the state of Washington's standard at that time. In 2019, Washington temporarily changed their TDG standard to 120 percent TDG in the tailrace and removed the 115 percent 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 requires Oregon and Washington to increase the TDG standard up to 125 percent TDG to allow the Corps to provide 16 hours per day of 125 percent TDG spill in the spring. In Oregon, the Environmental Quality Commission approved a spring TDG standard of 125 percent at its January 2020 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 the 125 percent TDG spring spill for juvenile fish passage as detailed in the Flex Spill Agreement requires approval from the U.S. Environmental Protection Agency. The Washington rule is currently awaiting approval by the U.S. Environmental Protection Agency as of February 14, 2020.

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 EIS contains a "purpose and need" statement to briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action. This discussion, typically one or two paragraphs long, is important for general context and understanding as well as to provide the framework in which reasonable alternatives to the proposed action will be 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 (BPA) 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 on-going 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 insure 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 a reasonable range of alternatives representing alternatives for long-term system operations. The alternatives consist of the No Action Alternative and four Multiple Objective Alternatives (MOs). 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 will allow water managers to react to unanticipated changes in river flow, climate variability, and 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 fulfil 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 consequences 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.

PERFORMANCE STANDARD SPILL Spill levels from the 2008-2010 Federal Columbia River Power System Biological Opinion that were tailored to meet the BiOp standards of 96 percent average per-dam survival for spring migrants and 93 percent for summer migrating fish (see Figure ES-4).

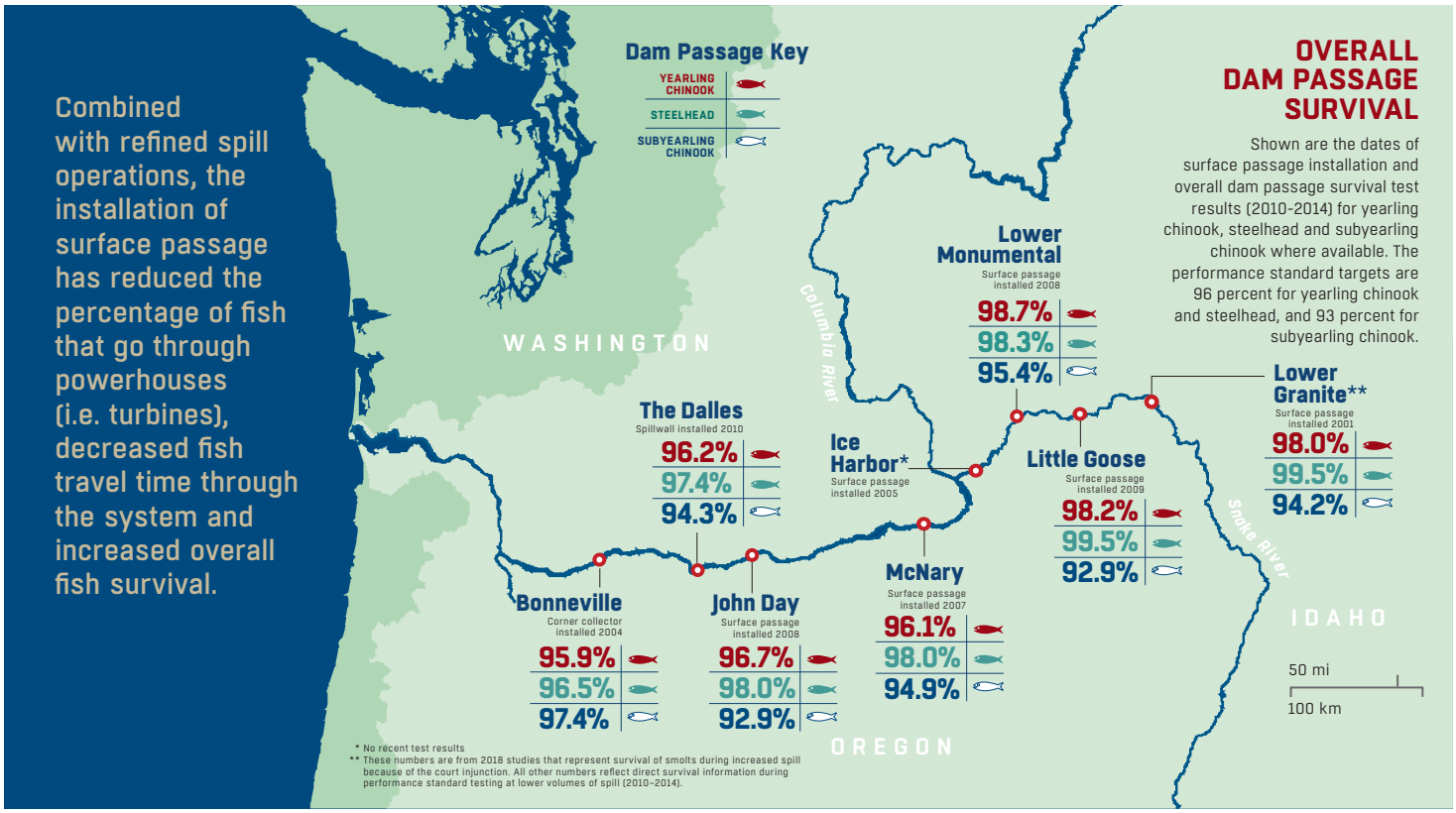


Figure ES-4: Overall Dam Passage Survival

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. Additional measures that could be adopted to improve fish survival to meet these objectives were considered but only resulted in small, incremental improvements and did not meet the EIS objectives for larger, more substantial improvements for fish.

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, it 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 reflect operational restrictions that may be the 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.)

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.

Lamprey

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 percent total dissolved gas (TDG) in the tailrace (below the dam) of projects and 115 percent 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, 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 incorporated 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 varied depending on specific species, location, and the outputs from the two separate models (Fish Passage Center's 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 mitigation for resident fish, as appropriate.

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 under average water conditions, and 300 aMW under low 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 and more than twice the risk compared to the Northwest Power and Conservation Council's target for regional reliability.

To maintain regional reliability at the same level as the No Action Alternative, additional resources would have to be built, at a cost of between $34 million a year (for fossil-fuel based replacement resources) and $161 million a year (for variable renewable resources like wind and solar). For Bonneville's wholesale power rates, MO1 places upward base rate pressure of 4.5 percent to 8.6 percent 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 etail 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. As such, it did not address other potential cost uncertainties under MO1, such as the cost of integrating new renewable resources, potentially shorter financing timeframes, and the costs and availability of firm demand response. These effects (and others) are captured in a rate sensitivity analysis performed on Bonneville's wholesale power rate. As discussed in section 3.7.3, including the rate sensitivities, MO1 could increase the wholesale rate pressure on Bonneville's power rate by up to 14.4 percent. 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.

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

Additional Effects of MO1

Under MO1, there would likely be moderate adverse effects to water quality in the lower Snake River and resident fish in the upper Columbia River basin. 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. 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 a moderate increase in water temperatures in the lower Snake River during August.

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.

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 percent 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 percent relative reduction in in-river survival as well as a 1 percent relative reduction in the smolt-to-adult (SAR) estimate for upper Columbia River spring Chinook. The CSS models were not available for upper Columbia fish.

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).

For Snake River spring Chinook and steelhead, the CSS model generally predicted adverse effects, a 30 percent 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 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.

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 percent 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 percent. 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 1.9 percent 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 4 percent 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 only provided negligible biological benefits for salmon and steelhead. Those same biological benefits could be obtained at much lower costs using alternate measures.

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 results in looting.

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 change 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 percent TDG in the tailrace of the four lower Columbia River projects (McNary, John Day, The Dalles, and Bonneville). This alternative also proposes 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 Purpose and Need and some of the objectives for the EIS to various levels. Additionally, breaching the dams would not allow the co-lead agencies to operate and maintain the dams for their congressionally authorized purposes of navigation, hydropower, envisioned recreational benefits, and water supply for irrigation purposes. It also has the highest adverse impacts to other resources, especially social and economic effects. However, it predicts the highest benefits for several of the ESA-listed juvenile and adult salmon and provides additional riverine type recreational opportunities. It also returns access and opportunities to some of the traditional cultural resources and properties for tribal purposes.

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 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 of Oregon's Opinion and Order, and in response to comments received during public scoping that requested this alternative be evaluated. Breaching the four lower Snake River dams also received substantial interest by several tribes who believe that this alternative is the best option to offset some of the substantial adverse impacts of the CRS. New congressional authority and funding 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 outmigrants from Lower Granite that return to Lower Granite (SARs) would increase by 170 percent relative to the No Action Alternative. The NMFS LCM predicted that SARs from Lower Granite to Bonneville would improve by 14 percent relative to the No Action Alternative. The LCM also assessed SARs under several levels of assumed latent mortality reductions (10, 25, and 50 percent). 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 was not available for use on Snake River steelhead in this EIS.

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 (one percent 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 percent relative increase in abundance).

These changes are primarily due to increased spill levels (120 percent TDG) in the lower Columbia River. The CSS model was not available for use on upper Columbia River species in this EIS.

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 infrastructure at the dams to benefit passage of adult salmon, steelhead, and Pacific lamprey.

Breaching of the lower Snake River projects 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.

MO3 would not meet the objective to **Provide a Reliable and Economic Power Supply**. Under MO3, hydropower generation would decrease by 1,100 aMW 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, and 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 percent risk of a year having power shortages in the No Action Alternative (roughly one year in 15) to 13.9 percent in MO3 (or nearly one year in 7) for the base case (current operation of coal-fired power plants). The loss of power generation at the lower Snake River dams accounts for most of this decrease. 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. As referenced above, without such a resource build-out, the region would face the likelihood of a loss of load event, e.g. a power blackout, nearly one in every seven years in MO3 for the base case including the current fleet of regional coal plants. Two potential resource replacement portfolios were developed for this approach. The first was a conventional least-cost portfolio. Based on co-lead agency analysis (including a review of other publicly available information), the conventional, least-cost resource replacement would include 1,120 megawatts (MW) of combined cycle natural gas turbines at an overall cost of about $200 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 percent and 9.6 percent over the No Action Alternative, depending upon the source of funding for those resources. The second resource portfolio was a zero-carbon replacement portfolio. Understanding the development of the zero-carbon portfolio requires some additional context about the rapidly evolving energy policy environment in the western U.S. as well as how renewable energy resources interact with the broader power system.

Several states in the western U.S. have passed, or are likely to pass, legislation directed at decarbonizing the electric grid. California began implementing an economy-wide cap-and-trade program in 2013. In 2018, the California legislature passed a law seeking to achieve 100 percent carbon-free electricity by 2045 (Senate Bill 100). 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 percent carbon-neutral power by 2030, and 100 percent 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) and New Mexico (Senate Bill 489, 2019) both adopted 100 percent carbon-free goals for the electricity sector. The province of British Columbia has had a carbon tax in place since 2008.

In light of this legislative and policy trend, the co-lead agencies assumed that no new gas-fired generation would be built to replace the lost generation from the lower Snake River dams in developing the least-carbon replacement portfolio; only zero-carbon resources could be selected. At the utility-scale, the current zero-carbon options are solar and wind resources, batteries, and demand response programs. For MO3, the EIS analysis started with an effort to restore the loss of load probability to the No Action Alternative level of 6.6 percent. This analysis identified a potential zero-carbon replacement portfolio consisting of 2,550 MW of solar resources and 600 MW of demand response to restore the LOLP. This portfolio relies on using the existing regional system to help make up for some of the lost capabilities of the lower Snake River projects—primarily by operating thermal plants more frequently to meet regional load.

These initial modeling results were based on assumptions embedded in the No Action Alternative and raised two important additional considerations. First of all, the models used to determine this initial zero-carbon replacement portfolio do not adequately capture the flexibility and dispatchable peaking capabilities that the lower Snake River dams bring to the regional power system. In order to partially reflect the permanent loss of sustained dispatchable hydropower peaking capacity, reserve capability and flexibility at the lower Snake River projects, an additional 1,275 MW of battery storage were added to the zero-carbon portfolio for the base case analysis (in addition to 2,550 MW of solar and 600 MW of demand response). The estimated cost of this base case portfolio was $419 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 9.5 percent and 19.3 percent 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.) While this portfolio with the addition of batteries continues to rely on regional thermal resources to make up for lost energy, capacity and reserves, it lessens that reliance. 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 second issue concerning the base case zero-carbon replacement portfolio is that the composition of the regional power system is undergoing rapid change, and will continue to do so over the coming years with increased coal plant retirements and restrictions on the use of natural gas generation. The base case portfolio implicitly assumes that other regional resources would be used to make up for any deficiencies in the power system's sustained peaking, storage, and dispatchable capability caused by the loss of generation from the lower Snake River dams. As a result, given the expected coal plant retirements and restrictions on natural gas generation, replacing the full flexibility and capability of the lower Snake River dams with zero-carbon resources would require substantially more resources, such as additional dispatchable battery technology, than estimated in the base case analysis. 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 lower Snake River dams would be significant: up to $527 million a year above the resource costs assumed in the base case analysis. Additional variables such as resource financing uncertainties and the uncertainty in the cost and availability of demand response add to this rate

sensitivity. Selecting this portfolio would represent a very large investment in the regional power system, equal to roughly a billion dollars a year or one-third of Bonneville's power revenues. If Bonneville had to replace the lower Snake River projects' full capability with zero-carbon resources, the rate pressure could be up to 50 percent on wholesale power rates. Before making such an investment, Bonneville and its regional partners would need to collaborate on identifying other viable options that could maintain reliability and meet regional carbon objectives, while also ensuring federal power remains competitively priced for Bonneville's power customers.

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 10 percent increase in power-related emissions across the Northwest. However, even assuming the new replacement resources 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. 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 flexible 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, these sources of renewable generation must be used alongside other flexible (dispatchable) resources to maintain system reliability. With less clean hydropower to provide this flexible resource, the region would likely rely more on fossil-fuel-based resources, such as coal and natural gas, to balance renewable generation. This increased reliance on fossil-fuel-based resources is estimated to increase power-related emissions by 2.7 percent (1 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 would 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 percent (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**, but there would be adverse impacts to irrigation in the lower Snake River borne by other public and private entities due to dam breaching. Assuming 47,926 acres were no longer irrigated, the present value of the lost social welfare benefit under the MO3 alternative is $458 million (annual equivalent value is $17 million). Further information can be found in Chapter 3.12.

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, include 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 percent 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 percent 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 increased rail rates are low or non-existent, then significant increased demand on rail infrastructure would occur that would likely exceed current capacities (which could also cause rail rates to increase), as tonnage demand for rail would increase by 86 percent. 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 percent, there would be a 22 percent increase in average transportation costs. With a 25 percent 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 percent following dam breach, average transportation costs would increase by 33 percent. Under this scenario, rail infrastructure demand increases would not be anticipated. Instead, a substantial increase in truck use would occur (an increase of 84 percent 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. For water quality, water temperatures would be warmer in the summer (during the day) that may exceed water quality standards, but spring and fall water temperature improvements are anticipated.

Cultural resources

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 occupation. 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 the removal of the Lower Snake River dams.

Recreation

In terms of economic effects, major long-term adverse effects to lower Snake River barge navigation and reservoir-based recreation in the lower Snake River 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.

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. The region's understanding of the impacts, both beneficial and adverse, of the Columbia River System will improve over time just as the perspectives and values of the people living in the Columbia Basin will continue to change as well. This EIS is not expected to end the regional debate on the future of the four lower Snake River dams. On the contrary, this EIS provides information and analysis to inform that future dialogue.

The co-lead agencies used the analysis in MO3 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.

8 MULTIPLE OBJECTIVE ALTERNATIVE 4 (MO4)

Overview of the Alternative

MO4 was developed with a primary focus on measures 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, operations to help establish riparian vegetation in the Upper Basin, 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 would make improvements to meet project objectives. In MO4, Juvenile fish passage spill is set up to 125 percent TDG during the spring and summer, which is the highest volume and longest duration of spill included in any of the alternatives. This is intended to decrease travel time and improve juvenile downstream fish passage. 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 above). 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 models predicts would reduce latent mortality associated with CRS passage. Snake River spring Chinook and steelhead SARs are predicted to improve by 70 to 75 percent relative to the No Action Alternative.

The LCM predicts minor benefits to Upper Columbia spring Chinook and steelhead, with 2 percent 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 percent (i.e. latent mortality effects are decreased by 10 percent), the net impact to Snake River Chinook salmon would be adverse, a relative decrease in SARs of 12 percent. 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. MO4 also includes structural modifications to infrastructure at the dams to 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 in the lower basin. MO4 proposes mitigation to reduce resident fish adverse effects to negligible, as appropriate, and the objective for **Improving Resident Fish** would be met.

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 reason for the reduced generation is the increase in juvenile fish passage spill, up to 125 percent 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 $156 million (excluding fuel). 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 $350 million. For Bonneville's wholesale power rates, MO4 places upward base rate pressure of 23.5 percent to 25.3 percent 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 41 percent 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 planning changes. Retail rate impacts are also discussed in Chapter 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 percent, or 3.1 MMT of CO_2 increase in power-related emissions across the Pacific Northwest). However, as with MO3, even assuming the new replacement resources are variable renewables (solar with demand response), some increase in fossil-fuel-based generation from existing power plants would occur to maintain system reliability. This seems counter-intuitive, but adding wind and solar, which are variable resources (not always available) requires a base source of dispatchable capacity to maintain reliability when they are not available. The region currently relies on the CRS to provide much of this back-up source of generation. If a significant amount of hydroelectric generation is reduced, given the region's current resource portfolio, additional generation from coal and 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 percent (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.

Additional Effects of MO4

Overall, major adverse economic effects would occur under MO4. For irrigation on the lower Columbia River, particularly at John Day, reservoir levels may be lowered to the point where pumping could no longer be possible. Additionally, in low water years, major adverse effects to water-based recreational access at Lake Pend Oreille could occur.

MO4 would result in major adverse effects to resident fish in the Upper Basin that could require mitigation.

Finally, 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 to minimum navigation pool 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.

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 study 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 CRT Sovereign Review process, the CRT 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. All of 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 averse effects on other resources. As information on how suites of measures from these alternatives preformed 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—Alternative 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, protects valuable 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 salmon protection. Each co-lead agency has different criteria for the outcome of the EIS, but worked together to select one alternative that seeks to balance the multiple purposes of the federal projects, while complying with the relevant environmental laws and regulations.

The five multiple purpose alternatives met the study's Purpose and Need Statement and objectives to varying degrees and with varying levels of beneficial and adverse effects. Because of this, the co-lead agencies selected a combination of suites 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 juvenile spill operations 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 2018 flexible spill agreement have been carried forward in the Preferred Alternative.

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 exceptions are an added measure for lamprey passage (closeable floating orifice gates) and measures identified as part of the associated CRS ESA consultation processes. 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 wherever possible.

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 are a central part of the rationale for selecting fish passage spill measures that have the potential to provide major improvements in SARs. Continued investment in structural improvements for lamprey passage also reflects consistent feedback received from numerous tribes. The affirmation and refinement of the Montana Operation, measures designed to carefully balance resident fish needs with other projects purposes, is the result of close coordination with tribal partners in the Upper Basin.

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. 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 address the potential for access to blocked tributaries for bull trout due to operations at Libby dam. Ongoing programs and operation and maintenance activities would continue from the time this EIS was initiated in 2016 unless otherwise described. Preliminary measures proposed

by the co-lead agencies for compliance with the ESA are also included. These may be modified or added to as the ESA consultation process is still underway. 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 CCS model, Snake River Chinook and steelhead are expected to see relative improvements in SARs of 35 and 28 percent respectively. If latent mortality effects are reduced, the LCM models also predict that levels of 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 percent change relative to the No Action Alternative) due to reduced rates of transportation. 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 will 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, effects to navigation, and other challenges or opportunities 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.

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. Ramp rates at John Day Dam limit the rate of change in reservoir elevations and 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 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 both 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 power-house passage at dams.

The Preferred Alternative would meet the **Provide a Reliable and Economic Power Supply** objective. Hydro-power generation decreases under the Preferred Alternative by 160 aMW assuming average water, and 300 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 percent relative to the No Action Alternative. Additional rate sensitivities not included in the base analysis could lower the rate pressure to 0.4 percent. This rate pressure is within a range that may be offset by cost reductions. 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 U.S. District Court for the District of Oregon. 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.

The Preferred Alternative marginally meets the **Minimize GHG Emissions** objective. 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 0.26 MMT (or 0.70 percent) compared to the No Action Alternative. Other emissions sources (e.g., navigation, construction, fugitive dust) are most likely to have a negligible effect on air quality and greenhouse gas emissions relative to the No Action Alternative across the basin.

The Preferred Alternative also meets the **Maximize Adaptable Water Management** and **Meet Water Obligations** objectives.

Additional Effects of the Preferred Alternative

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 even slightly better than 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. The adverse effects at Libby to archaeological resources resulting from the Preferred Alternative are minor.

As with the other alternatives, and similar to archaeo-logical resources, traditional cultural properties would continue to experience major adverse effects associated with the operations and maintenance of the CRS. These effects that have occurred and would continue to occur under the Preferred Alternative are summarized in Chapter 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 quantitative analysis discussed above 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.

MAJOR CONCLUSIONS

The co-lead agencies developed the Preferred Alternative as part of an iterative process. The Preferred Alternative is a combination of measures included in the five multiple objective alternatives using the information that was learned during their evaluation. In some instances, measures were modified to improve their ability to meet the Purpose and Need or objectives, or refined to avoid, reduce or minimize adverse environmental, economic, and social impacts. The co-lead agencies expect that the Preferred Alternative would allow them to meet the EIS intent as expressed in the Purpose and Need 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. The applicable environmental statutes, regulations, and executive orders are summarized and a status of compliance is detailed in Chapter 8.1.

FEBRUARY 2020

EXECUTIVE SUMMARY: COLUMBIA RIVER SYSTEM OPERATIONS DRAFT ENVIRONMENTAL IMPACT STATEMENT

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