



Lower Snake River Dams Stakeholder Engagement Report

DRAFT Provided for Public Review and Comment

December 20, 2019

Contents

Executive Summary	1	Section 6: Agriculture	44
Background and Context.....	2	Context.....	44
Major Findings and Perspectives.....	2	Perspectives.....	46
Opportunities to Increase Understanding.....	11	Opportunities to Increase Understanding.....	48
Moving Forward.....	12	Section 7: Transportation	49
Section 1: Purpose and Scope of Report	14	Context.....	49
Background.....	14	Perspectives.....	56
The Intent of the Draft Report and Engagement Process.....	14	Opportunities to Increase Understanding.....	58
Methodology.....	15	Section 8: Recreation	59
Review of Draft Report and Public Workshops.....	16	Context.....	59
Report Overview.....	17	Perspectives.....	59
Section 2: Background on Columbia River and Lower Snake River Dams	18	Opportunities to Increase Understanding.....	60
Columbia River Basin Dams.....	18	Section 9: Economics	61
Lower Snake River Dams.....	18	Context.....	61
Section 3: Tribal Connections to the Lower Snake River Dams	21	Perspectives.....	65
Loss of Salmon.....	22	Opportunities to Increase Understanding.....	67
Loss of Access to Land and Cultural Sites.....	23	Section 10: Moving Forward	68
Tribal Engagement Moving Forward.....	24	Careful Framing of Any Subsequent Conversation Is Important.....	68
Section 4: Salmon/Steelhead/Orca/Ecological	25	An Increase in Respect and Understanding is Needed.....	69
Context.....	25	A Desire for Dialogue.....	69
Perspectives.....	33	Appendix A: Annotated Bibliography	71
Opportunities to Increase Understanding.....	36	Appendix B: Relevant State and Federal Studies and Task Forces	89
Section 5: Energy	38	Appendix C: Lower Snake River Dams Stakeholder Engagement Interviewee List	94
Context.....	38	Appendix D: Online Survey Questions	98
Perspectives.....	41	Appendix E: Works Cited	106
Opportunities to Increase Understanding.....	43		

Executive Summary

Salmon, orca, agriculture and energy are fundamental to Washington's past and future. They symbolize who we are as residents of the Pacific Northwest and define our communities and our economy. The lower Snake River dams have touched on all of these issues since they were constructed over 40 years ago. They represent positive gains to the economy and local communities in southeast Washington as well as losses to tribal and fishing communities. The future of the LSRD is inextricably linked to the future of southeast Washington, Washington state and the Pacific Northwest.

There are differing perspectives on how breaching and removing, or retaining, the lower Snake River dams will affect salmon and orcas as well as agricultural, transportation, power and recreation interests. The term *breach* refers to removing river barriers, such as the earth-filled embankments that create reservoirs. *Remove* means that the actual infrastructure of the dams would be taken down. For the purposes of this report, the term breach is used to capture both concepts. Over the past 25 years, multiple studies by different organizations and from different perspectives have evaluated the issues with as yet no clear consensus about impacts of breaching or retaining the LSRD.

At the same time, some themes emerged from the studies and interviews: (1) There are significantly different views of the impacts from breaching the dams on salmon, orca, agriculture, transportation and economics. More information is needed to create opportunities for greater understanding. (2) Energy, transportation, agriculture, salmon and orca are complex issues and decisions about the lower Snake River dams need to consider the broader systems and context for each. Each issue is dynamic, future changes may provide more options as well as more challenges. (3) People across the diversity of interests expressed the desire to have more informed and respectful conversations. Given that issues around the lower Snake River dams have long been in litigation, the ability for shared learning, collaborative problem-solving and a new dialogue has so far been limited. Many of those interviewed are hopeful about the significant benefits a collaborative dialogue could offer to a process that has so far been stuck in a cycle of study, legal actions and court decisions.

The intent of this draft report is to summarize the views of Washingtonians on retaining or breaching the LSRD. It was prepared in response to recommendations of Gov. Jay Inslee's Southern Resident Orca Task Force to further investigate the impacts of breaching the LSRD as a means to provide more salmon for Southern Resident orcas to eat. Gov. Inslee will use this information to inform his perspective on the LSRD and determine if and how to participate in ongoing federal environmental evaluations of the Columbia and Snake River system, including the draft Columbia River System Operations Environmental Impact Statement scheduled to be released in February 2020.

This draft report captures perspectives on the potential positive and negative impacts (social, economic and environmental), as well as opportunities gained and lost, of either retaining the dams or breaching them. Perspectives the consultant team heard repeatedly from stakeholders or found in published documents are summarized into themes supporting retaining or breaching the dams. The consultant team did not try to reconcile divergent perspectives, determine who was "right," or decide which perspectives carry more weight than others. The emphasis is on faithfully capturing what people said and, where possible, why they said it. The final report will be based on four sources of information: review of relevant reports and studies; interviews with stakeholders, jurisdictions and

organizations that would be affected by a decision about the LSRD; an open online public survey; and public review and comment on this draft report. In the final report, as in this draft, the emphasis will be on understanding and summarizing what people think and the context for those ideas; the Governor will consider the diversity of perspectives when he makes his decisions.

Background and Context

The US Army Corps of Engineers operates the four run-of-river dams and locks on the lower Snake River in Washington: Ice Harbor, Lower Monumental, Little Goose and Lower Granite. Together, the LSRD produce 1,000 average megawatts of electricity annually, which is roughly the amount of electricity Seattle City Light consumes annually. They help meet peak power loads and contribute to the reliability of the power transmission grid. They also provide river navigation and transportation between Lewiston, Idaho, and the Tri-Cities, Washington — more than 100 miles — and access to ports on the lower Columbia River.

All species of salmon that use the Snake River are currently listed as threatened or endangered under the Endangered Species Act. The LSRD, along with four other federal dams on the lower Columbia River, are the biggest human-constructed obstacles Snake River fish and other aquatic species encounter on their migration to and from the Pacific Ocean. The LSRD were designed with fish ladders to assist adult fish passage, and juvenile fish passage facilities have been added along with improvements to adult passage facilities.

Five tribal nations are primarily impacted by the LSRD: the Nez Perce Tribe, the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon and the Shoshone-Bannock Tribe. The LSRD are part of a broader set of impacts of European settlement on tribal nations, which include the loss of tribal lands and suppression of tribal cultures. At a practical scale, the dams affect tribal people in two main ways: (1) They affect the abundance and distribution of salmon and reduce salmon fishing opportunities and harvest available to tribal people and (2) They cut off access to tribal fishing, hunting and harvesting of roots, plants and berries and prevent tribal people from holding religious and cultural ceremonies at their usual places. On a cultural and spiritual scale, the impact of the loss of salmon on tribes cannot be overstated. Other tribes in the Columbia Basin and along the West Coast of the Pacific Ocean also are affected by the loss of salmon which has occurred since European settlement.

The Columbia River hydropower system which includes the LSRD is credited with transforming the landscape, economics and local communities in eastern Washington. Dams have provided inexpensive electricity for the Pacific Northwest and irrigation for hundreds of thousands of acres. In addition, the LSRD and lower Columbia river dams allow for river transportation of agricultural and other commodities that support the local communities of central and southeast Washington. The legacy of the dams and their relationship to the local communities is cherished by many citizens in Washington state.

Major Findings and Perspectives

The draft report focuses on six major topics: (1) salmon and Southern Resident orcas, (2) energy, (3) agriculture, (4) transportation, (5) recreation, (6) and economics. Each section provides a summary

of the topic context and presents the perspectives of those who support the current system (people who want to retain the LSRD) and those who support alternatives to the current system (people who want to breach the LSRD).

Salmon and Southern Resident orcas

The lower Snake River is home to five species of anadromous fish: spring/summer Chinook, fall Chinook, coho, sockeye, steelhead and Pacific lamprey. Salmon are critical to the physical, cultural and spiritual wellbeing of Columbia and Snake River basin tribal nations and peoples, and access to salmon for harvest is a right reserved in tribal treaties. Salmon also are important for commercial and recreational harvest by non-tribal people both within and outside the Columbia and Snake River basins, to non-tribal values and cultural identity in the Pacific Northwest, and as a food source for Southern Resident orca whales, which are an endangered species.

Historically the Columbia and Snake river systems were characterized by high flows due to snowmelt and runoff in spring, decreasing summer and fall flows, and lower winter flows. Salmon migration patterns evolved over time to respond to these typical historical flows. Construction of dams in the Columbia and Snake river systems changed river flows. Except for the Hanford Reach and part of the Snake River between Hells Canyon Dam and Lower Granite Reservoir, the lower Snake and the lower Columbia rivers now operate essentially as a series of slow-moving reservoir lakes. Breaching the LSRD would return the flow regime to a pattern closer to that observed before the dams were in place. Sediment and contaminants trapped behind dams would be released — temporarily increasing water turbidity and distributing chemical contamination. Land currently inundated would be exposed as reservoirs are drawn down and removed. Flow velocity would increase, and water temperatures would be more like they were before the dams were built.

Dams on the Columbia and Snake rivers affect fish in three ways: (1) they block or alter fish migration; (2) they change river conditions to cause lower water velocity which increases migration time; and (3) they reduce the overall fitness of fish and decrease their future survival, referred to as “latent mortality.” Fish abundance in the Snake River has declined to a fraction of its historic amount since European settlement in the region and construction of the dams. All species of salmon that use the Snake River are currently listed as threatened or endangered under the Endangered Species Act. Wild Snake River coho went extinct in 1987;¹ the current coho population in the Snake River is produced by hatcheries.

Hatcheries and management efforts have been used over the past decades to increase salmon returns to the Columbia and Snake River systems. Hatcheries have raised and released five species: Chinook, coho, steelhead, sockeye, and chum; most hatchery production has been focused on Chinook. Hatcheries are generally credited with preserving salmon populations in the Snake River and for increasing salmon numbers; however, hatchery releases have declined in recent years due to funding not keeping pace with operational expenses and concerns about interactions between wild and hatchery fish.

Management efforts to support salmon recovery have included improvements to adult fish ladders and increase in spill. Spill is the release of water over a dam to prevent migrating juvenile salmon from passing through turbines. Spill is credited with improving juvenile survival and thereby increasing adult returns. A 2018 agreement on flexible spill brought together the states of Oregon and Washington, the Nez Pierce Tribe and USACE, USBR and BPA with the dual goals of

achieving improved salmon survival through the dams and managing the cost of hydropower generation. This agreement lays out a plan for managing spill to benefit fish as well as complementary measures related to turbine improvements, water cooling and predator management.

There are two main methods of estimating the impact of breaching the LSRD on salmon. The Comparative Survival Study (2017) model developed by the U.S. Fish and Wildlife Service, Columbia River Inter-Tribal Fish Commission, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game and the Fish Passage Center, and the Comprehensive Passage (COMPASS) model developed by NOAA Fisheries, other state, federal and tribal organizations, and the University of Washington. The CSS model estimates a four-fold increase in smolt-to-adult ratios for Snake River salmonids if the LSRD are breached and spill on the four lower Columbia dams is increased significantly above current levels. Published estimates from the COMPASS model will be available when the Columbia River System Operations Environmental Impact Statement is released, scheduled for February 2020.

NOAA identified the Snake River fall and spring/summer Chinook in the top ten most important populations of Chinook for the Southern Resident orca.² However, they have also stated that, for Southern Resident recovery, Columbia and Snake River salmon stocks are a lower priority than North and South Puget Sound salmon stocks because the Southern Residents' foraging patterns do not overlap as much with Columbia and Snake River salmon as they do with the North and South Puget Sound salmon. However, in recent years, Southern Resident foraging patterns have been changing; they are spending less time in the Salish Sea and more time on the outer coast.

People recognize and generally agree on the critical importance of successful salmon recovery to southeast Washington and the Pacific Northwest. However, there are significant differences in how people view the impacts of potential breaching of the LSRD on salmon. Similarly, there is broad support for action to improve conditions for Southern Resident orcas, but disagreement on what salmon from the Columbia and Snake river systems can contribute to that goal — especially in the next 10 to 20 years.

Perspectives of those who support retaining the LSRD and emphasizing other approaches to support salmon and orca recovery

- Actions over the last several decades and the anticipated success of the flex-spill agreement will result in increasing salmon returns to the Snake River and NOAA's assessment of the results for salmon and orca recovery from dam removal.
- Breaching the LSRD is not the most effective, or cost-efficient, way to spend billions of additional dollars.
- There is no certainty that the river would return to conditions supportive of salmon in the short- or long-term, and, at least in the short-term, breaching would adversely impact conditions for salmon by removing riparian cover and increasing water turbidity.
- Rather than focus attention on dam breaching, investment should be made in: continuing improvements to management of the dams in place including flexible spill and more aggressive predator management in the lower Snake River; in increasing hatchery production; in reintroduction of salmon to the upper Columbia; and in investments in salmon recovery of Puget Sound stocks. These efforts would be more effective, and more cost-effective, and would work more quickly to both improve salmon abundance and increase food for orca.

Perspectives of those who support breaching the LSRD to support salmon and orca recovery

- Dam breaching is the only action that has not been already tried which could make a significant difference in the trend line for salmon populations. The Fish Passage Center analysis of potential increases in salmon returns if the dams are to be breached is accurate.
- There has been a \$17 billion investment in making improvements in the structure and management of the current system to support salmon recovery without reversing the downward population trend.
- Breaching the dams will take time, and the resulting improvements in salmon populations also will take time, but this approach is overall the best way to increase resiliency in the system, especially considering climate change, and provides the greatest opportunity to prevent extinction and move toward sustainable salmon runs.
- Flexible spill efforts are helpful but insufficient to support long-term salmon recovery.
- Hatchery production is not a viable long-term strategy particularly for Southern Resident orca since hatchery fish tend to be smaller and contain less fat than wild fish, making them a less substantial food source. Hatcheries may support harvest, but they depress the genetic diversity of wild salmon.

Energy

The LSRD are part of the broader integrated system of hydroelectric facilities that make up the Federal Columbia River Power System, the largest source of renewable electricity in the Pacific Northwest. The energy that is produced from the dams is sold and marketed by the Bonneville Power Administration to a variety of customers. BPA also is responsible for covering the costs of Columbia River Basin fish and wildlife mitigation.

Each year the LSRD produce an average of 1,024 average megawatts of electricity annually, which is about 4% of BPA's annual energy portfolio. The LSRD have the ability to produce 3,033 megawatts of electricity at peak capacity for a short period of time if there is both high water storage and high river flows.³

Most of the year, energy produced by the LSRD is not directly used to meet energy demands but instead acts as reserves to ensure BPA has enough capacity to provide power reliability for customers. Typically, the LSRD supply BPA with one-fourth of its operating reserves.⁴ BPA uses energy from the LSRD during peak demands, most often in the winter months when energy loads are high due to individuals heating their homes and wind and solar power generation are at their lowest levels. In addition to power generation, the LSRD provide transmission stability and capacity. Power from the LSRD flows into 500-kilovolt transmission lines that integrate the LSRD into the power grid. Due to their location, the LSRD are an important transmission system link between the east- and west-sides of the Cascades.

The LSRD help to maintain the reliability of the Northwest power grid by providing key reserves of energy to the system that can be quickly accessed when other energy sources become unavailable. The dams are connected to the Automatic Generation Control System which allows the power grid to meet constantly fluctuating electricity demand, often referred to as "load." Replacing the power provided by the LSRD would require finding renewable locations within BPA's geographic range that have both high generation potential and are not so remote that the cost of distribution is prohibitive. Replacing the reliability of the LSRD would require that other energy resources be

steadily performing under a range of conditions and quickly responsive (scaled up or down) to demand.

Since 2013 the energy market has gone through a large-scale transformation due to a variety of factors such as wide-scale development of renewable resources; improvements in energy efficiency and demand response; the proliferation of low-cost natural gas generation; and periods of oversaturated wholesale markets that dampened sales of surplus energy. BPA's contracts with its preferred customers are set to expire in 2028. Many local utilities that have BPA contracts have seen substantial rate increases due to a variety of factors, like the recent changes to the energy market and costs associated with Columbia River Basin fish and wildlife mitigation.

Perspective of those who support the current energy system (retain dams)

- Losing the energy generated by the LSRD would complicate achieving the state's clean energy goal of being carbon free by 2045. Future population growth; the loss of coal plants; resistance to expanding the use of nuclear energy; and climate change are all reasons the LSRD are needed for the state to become a carbon-free system.
- While on average Washington state has a surplus of energy, averages are not the most important measure when energy is operating close to the current maximum capacity. Reserves like those provided by the LSRD increase the reliability of meeting load demand and reduce the likelihood of more drastic measures like brownouts or blackouts.
- Ice Harbor Dam is fundamental to meeting the energy needs of the Tri-Cities during summer peak periods. It also is a key link between the energy grids on the East and West sides of the Cascades.
- Many communities in southeastern Washington were built and have prospered because of the inexpensive energy provided by the dams. The dams are a part of the history, legacy and heritage of the people who live there.

Perspective of those who support alternatives to the current energy system (breach dams)

- The Pacific Northwest has a surplus of power, and the LSRD are not ultimately needed to meet energy needs or to successfully transition to a clean energy grid by 2045. Increases in solar and wind generation coupled with technology improvements for energy storage will support Washington state in meeting the 2045 goal.
- Dam breaching would take time, and this time would allow for alternative renewable energy generating plants to be built, and potentially for improvements in energy storage technology to be realized.
- Based upon findings from the NW Energy Coalition, supporters of breaching the dams believe the energy provided by the dams can be replaced with energy from other renewable sources and improvements in energy efficiency and demand response, without losing any system reliability and at only small cost increases to BPA ratepayers.
- A transition away from using power generated by the LSRD will cost less over time than maintaining energy production from the LSRD, especially when considering increasing maintenance and repair costs for the LSRD.

Agriculture

There are approximately 5 million total acres of farmland within the eight counties surrounding the lower Snake River (Adams, Asotin, Benton, Columbia, Franklin, Garfield, Walla Walla and Whitman) in southeast Washington, which is approximately 33% of the total farmland in the state.⁵ Agricultural production in the areas surrounding the LSRD includes both dryland and irrigated farming.

In southeast Washington non-irrigated, or dryland, agriculture is dominated by grain production. In 2017, over one million acres of dryland wheat were harvested in the eight counties surrounding the Snake River.⁶ The local grain economy relies on a complex set of relationships between grain producers (farmers), cooperatives, transporters, exporters and customers, all of whom are all also part of an equally complex and competitive global market.

If the LSRD are breached, it would eliminate barging down the Snake River because the lower river depth would not be sufficient for barge transportation. This would be a significant change for dryland farmers, many of whom rely at least in part on barge transportation for their crops. Barge transportation is the least expensive and most reliable transportation method for those producers close to the reservoirs when compared to truck and rail transportation.

The LSRD currently support approximately 47,000 acres of irrigated farmland drawn from Lake Sacajawea, the reservoir created by Ice Harbor Dam. Lake Sacajawea is the only reservoir of the four LSRD that provides direct irrigation.⁷ Fruit orchards are the predominate irrigated crop within one mile of the river; vegetables, like onions, potatoes or sweet corn are more common within five miles.⁸ Irrigated farming requires significant resources and staffing. Irrigated farmland also is more profitable than dryland.

If the LSRD are breached, specifically Ice Harbor Dam, impacts to irrigated agriculture — for both farms that draw directly from the reservoir and ground water users that rely on the groundwater table created by the dams — would need to be addressed. Mitigating these changes would involve lowering intake structures, creating additional pumping capacity, digging deeper wells and other operational changes. Other options if water availability were to change due to breaching the dams could include changing crops to accommodate new water supply or fallowing fields during periods of water interruption.

Perspective of those who support the current barge and irrigation system (retain dams)

- Breaching the dams would lead to increased shipping costs and a downturn in the overall grain economy due to the loss of barging. This could lead to the loss of family farms, local community economic viability and the overall way of life that the dams have supported in the region through lower grain transportation costs and the ability to irrigate farmland.
- Water levels would not be stable enough to provide reliable irrigation if the dams are breached, which would lead to increased costs, uncertain infrastructure upgrades, uncertainty of water supply and shifts in the type of agriculture that is viable.
- The reduction in certainty of water availability would increase capital costs for farmers due to increases in infrastructure and energy needs.

- Breaching the dams would make the current irrigation infrastructure obsolete and would require significant investment in lowering water intake infrastructure, more pumping stations and drilling deeper wells to reach the lowered water table.
- Local farmers are skeptical that current irrigated agriculture like orchards and vineyards would be able to easily transition to other crops or move to other areas down river if they are displaced from their current farms. The costs of these transitions can be significant, and the disruption to farming families, farm businesses and communities that rely on them also is significant.

Perspective of those who support alternatives to the LSRD (breach dams)

- It is important to make agriculture “whole,” so farmers do not suffer significant economic losses if the dams are breached. Suggestions included paying for the infrastructure to lower irrigation pumps and wells; subsidizing the increased cost of energy required to pump water; subsidizing farmers for their increased transportation costs; and building or upgrading infrastructure for storage and transportation.
- The costs to implement the suggestions above and make agriculture whole would be less than the cost of ongoing maintenance and repair of the dams and locks.
- Approximately 5,000 acres of the 14,000 acres currently underneath the LSRD reservoirs could potentially be used for farming if the dams are breached.

Transportation

The transportation that serves the region surrounding the LSRD is a multi-modal network of barge, rail lines and trucks. The LSRD and their associated locks allow local agricultural producers and shippers to market and transport agricultural products downstream and move other materials by barge up and down the Lower Snake River between the Tri-Cities and Lewiston/Clarkston. In the area surrounding the LSRD, there are both mainline and shortline railroads. While some of the shortline rail infrastructure that existed before the LSRD were constructed remains, much of it is in disrepair and would require improvements to be relied on in the future.⁹ Trucks are the most expensive and carbon intensive form of transportation within the network¹⁰; their main purpose is to move grain or produce from farms to nearby ports, cooperative elevators or processing facilities. Compared to rail or trucks, barging is the safest method of moving cargo. There are lower numbers of injuries, fatalities and spill rates from barge transportation than from rail and trucks.

Over the past 20 years, the transportation infrastructure in southeast Washington around the LSRD has evolved. Investments have been made in capacity for shortline rail, mainline rail, port terminals and barging. Local agricultural producers, cooperatives and shippers take a number of factors into account when determining which modes of transportation to use. Barge transport is generally less expensive than the other options, and the timing of delivery is more predictable.¹¹ Transport of commodities by barge has trended downward in recent years on the entire Columbia and Snake river system. However, a 2017 report prepared for the Washington Public Ports Association estimates continuation of current levels or modest growth in the amount of overall grain transport by barge.

Exporters, producers and shippers report that having access to both rail and barge transportation helps them create the most cost effective, cost competitive and reliable transportation combination tailored to the specifics of each shipment. If the LSRD are breached, it would no longer be feasible

to transport materials by barge on the lower Snake River; this would create the need to improve road, rail and other infrastructure to provide for transportation.

Perspective of those who support the current transportation system (retain dams)

- A multimodal shipment system (i.e., barge, rail and truck) is necessary for competition and capacity, and the removal of one major mode (i.e., barge) would have disastrous ramifications for farmers and the local economy. Removal of barge transportation would put farmers at the mercy of the railroads who would have the freedom to increase shipping prices due to the lack of competition.
- Barges are more efficient, cleaner and safer for the public than other modes of transport like rail or trucks. Supporters of the current transportation system questioned why there would be a push to shift from what they see as a cost-effective, safe, low carbon mode of transport to higher carbon modes like trucks and rail.
- Some question the ability to sufficiently expand the rail and roadway system both in the LSRD region and on the main lines. Even if the rail improvements in the LSRD region could be addressed, some question the capacity to increase transportation on the main lines, especially downstream along the Columbia River.

Perspective of those who support alternatives to the current transportation system (breach dams)

- If the dams are breached actions should be taken to improve the rail and road transportation system as alternatives to the existing barge transportation system. Rather than maintaining the lock systems at the LSRD, these investments in rail line and road and highway improvements will be more cost effective in the long run.
- Rather than using federal dollars to support continuation of the barge system and continued investment in salmon recovery and restoration efforts which have not so far succeeded, investment in transportation upgrades could make better economic sense and be coupled with increased salmon abundance.
- Current investments into multi-car loading facilities in the LSRD region show a trend within the system towards rail and away from the barge system for the transport of grain.

Recreation

The reservoirs, dams and shorelines on the lower Snake River provide land- and water-based recreational opportunities and access. Land-based recreation activities include hiking, camping and hunting; water-based activities include fishing, swimming and boating. If the LSRD are breached the Snake River will be a free-flowing river instead of a series of reservoirs. The shift to a free-flowing river system would result in the loss of some existing recreational opportunities and create the potential for growth of new recreational opportunities. For example, if the dams are breached, many current swimming beaches and river access points would close, and a free-flowing river could provide new whitewater recreation opportunities.

Salmon recovery efforts afforded by dam removal are also likely to increase recreational and sportfishing opportunities. Some of the existing activities that currently occur on reservoirs, like certain fishing, boating and wildlife opportunities, could continue with a free-flowing river.

Perspective of those who support the current recreational system (retain dams)

- The existing parks and other recreational facilities that would be closed or modified by dam removal are seen as vital parts of the local communities and would cause disruptions to many people's way of life.
- Local communities may not receive the same levels of revenue from tourists visiting their communities for whitewater rafting as they currently do from flat water recreators.

Perspective of those who support alternatives to the current system (breach dams)

- Breaching the LSRD would open new trails, campgrounds and other recreation-based infrastructure that could connect the communities surrounding the LSRD.
- A wild river recreation economy may also provide increased public access and the growth of a tourism industry in the Lewiston/Clarkston region.

Economics

Breaching the LSRD would have economic impacts on communities surrounding the dams as well as the state and region more broadly due to shifts in salmon abundance, agriculture, transportation, recreation usage, employment and energy production. The primary economic analyses referenced by participants in this effort were the 2002 "Lower Snake River Juvenile Salmon Migration FS/EIS," completed by the USACE, and the June 2019 "Lower Snake River Dams: Economic Tradeoffs of Removal" report, prepared by ECONorthwest for Vulcan, Inc. The draft Columbia River System Operations EIS (due to be released in February 2020) will include a new economic analysis of the Columbia River operating system, including retaining and breaching the LSRD.

The FS/EIS and ECONorthwest reports reached different conclusions. The FS/EIS recommended major system improvements to improve salmon migration; breaching the LSRD was not seen as necessary to avoid jeopardizing the ESA-listed species. The ECONorthwest report concluded that the public benefits of breaching the LSRD exceeds the costs of retaining them. Comparison of the conclusions of the FS/EIS and ECONorthwest reports is difficult because they analyzed different study areas, study periods, and reported values in 1998 dollars versus 2018 dollars, respectively.

Perspective of those who support LSRD (retain dams)

- The ECONorthwest report did not adequately consider the impacts of dam breaching on the people, communities and industries throughout the Northwest, especially those in the vicinity of the LSRD.
- There will be drastic economic consequences if the LSRD are lost, including loss of tax revenues, jobs, businesses and property values, especially for rural and agricultural communities and users of the current barge system.
- The positive benefit-cost analysis in the ECONorthwest report is driven by the estimated non-use value (which economists define as the willingness of the public to pay their own money to protect or enhance an environmental resource, regardless of whether they ever plan on visiting or directly utilizing that resource) associated with salmon; supporters of the LSRD question the validity of the methods used to determine non-use values.
- Millions, if not billions, of dollars would be needed to improve road and rail transportation infrastructure for agriculture, provide annual subsidies for increased costs of transportation and electricity and other costs. Supporters of the LSRD do not believe there would be

political support to fund the needs of farmers and the agricultural community now and for years into the future.

- If the LSRD are breached the political focus will next shift to removal of other Columbia River system dams and the economic consequences will increase exponentially across the region.
- Efforts to breach the LSRD are a distraction when time and resources would be better spent optimizing the system we have for multiple benefits including salmon recovery.

Perspective of those who support LSRD alternatives (breach dams)

- The cost of retaining the dams will continue to increase, some are not cost effective now, and more will become cost-ineffective over time.
- While there may be short-term loss of jobs and disruption to local communities, these impacts can be mitigated through thoughtful transition strategies and investments, and, in the long term, it is realistic to expect a new, more robust economy to be achieved.
- New federal subsidies could be identified to cover the costs of rail and road infrastructure improvements and surface water and groundwater infrastructure upgrades for irrigators and other water users. In the long term, these investments could provide more benefits to farmers, businesses and communities than the current LSRD transportation and agriculture system does.
- BPA is already operating at a deficit and technology improvements continue to accelerate for things like intermittent renewable battery storage. Energy production lost through breaching the LSRD can be replaced with little to no increase in carbon emissions.
- BPA's investments to date in fish passage, salmon restoration and hatcheries are seen as insufficient (and ineffective) to truly restore Snake River salmon and support Southern Resident orca recovery.

Opportunities to Increase Understanding

Although differences remain deep, for each issue there also are clear opportunities to increase understanding. Major opportunities and questions include the following.

- Explore differences in interpretation of salmon, orca and ecological studies and data to clarify areas of agreement, areas of disagreement and data gaps.
 - What is known about how the Snake River might respond to breaching of the dams?
 - What are the impacts of current dam management on salmon returns?
 - What are key differences around conclusions regarding latent mortality?
- Further examine ways to meet energy demand in the near- and long-term with a decarbonized power generation system.
 - Will there be certainty that the state can meet its energy needs with a decarbonized power generation system as the population grows and the climate changes?
 - Determine if energy efficiency, demand response, wind and solar, or other carbon-free energy sources can replace the flexibility and reliability currently provided by the LSRD?
 - Are BPA ratepayers willing to pay more and, if they are, how much more and under what circumstances?

- Define what it would mean to make agriculture “whole” if river transportation is not available through the LSRD.
 - What are the costs and timing of implementing surface water and groundwater infrastructure improvements?
 - Who would finance or subsidize this work and compensate for impacts?
 - Can farmers be certain they will be able to pull the same levels of water they are currently using without the dams?
- Conduct more detailed analyses to determine the viability and costs associated with main- and shortline rail and highway infrastructure improvements to accommodate the loss of the barge system if the LSRD are to be breached.
 - What are the source(s) for funds and compensation provided to farmers, cooperatives, ports, and potentially private companies for the improvements to infrastructure, lost capital and increased cost of shipping?
- Identify the total cost and funding sources for potential replacement and modification of parks and other recreational amenities.

Moving Forward

The consultant team was not tasked with making recommendations for future steps to address the issues and interests of the different communities affected by the LSRD if they are retained or breached. However, interviewees were asked what would help make forward progress. Debate over the dams has gone on for several decades and the issues are complex. Despite some recent improvements in collaboration, many people remain wary of the cycle of study, lawsuits and court decisions. There is both hope and despair about what comes next and the potential for progress.

The upcoming Columbia River Systems Operation Environmental Impact Statement will provide the next detailed analysis of the environmental and social impacts of the operations, maintenance and configurations for 14 federal dams in the Columbia River system including the four lower Snake River dams. Although we heard from several people that they believe the federal process is necessary and helpful because the updated information will provide an analysis of alternatives, they do not hold high hopes that it is likely to build consensus or end debate.

Careful and sensitive framing of any subsequent conversation would be needed to lay a foundation for productive engagement. People told us that the manner in which the issue of dam removal is raised contributes to the overall frustration and negative reaction of those who live in southeastern Washington and are closest to the dams. Dam supporters feel the “coast” is telling eastern Washington communities what to do in a way that lacks respect and understanding of local values and priorities and minimizes how changes to the dams would significantly affect their communities. The need for greater respect and understanding extends to the tribal communities as well. The tribes point out the harm that was inflicted on their communities and the suffering and challenges they have faced for well over a century. People interviewed recognize the need to respectfully engage the tribes by acknowledging their losses and the responsibility to address the issues of the dams on salmon, other species and tribal culture.

People across the diversity of interests expressed the desire to have more informed and respectful conversations. Given that issues around the LSRD have long been in litigation, the ability for shared learning, collaborative problem-solving and a new dialogue has so far been limited. Many of those interviewed are hopeful about the significant benefits a well-structured collaborative dialogue could offer to a process so far stuck on its challenging issues. People point to the NOAA Columbia Basin Partnership Task Force and 2019-2021 Spill Operation Agreement as causes for optimism.

Section 1: Purpose and Scope of Report

Background

In fall 2018 the Gov. Jay Inslee’s Southern Resident Orca Task Force recommended further investigation of the impacts of breaching the lower Snake River dams as a means to provide more salmon for Southern Resident orcas to eat. The task force received hundreds of public comments about breaching the LSRD. It did not have adequate time to fully consider all the issues raised by commenters, so it recommended a separate engagement process.

In response to the task force recommendation, the Washington State Legislature provided funding in the 2019–21 operating budget:

... to contract with a neutral third party to establish a process for local, state, tribal and federal leaders and stakeholders to address issues associated with the possible breaching or removal of the lower Snake River dams in order to recover the Chinook salmon populations that serve as a vital food source for Southern Resident orcas.

To conduct the engagement process funded by the Legislature, the Washington state Governor’s Office contracted with the project team of Ross Strategic, Kramer Consulting and White Bluffs Consulting to provide neutral facilitation, research and report development.

The Intent of the Draft Report and Engagement Process

The intent of this process, and the draft report, is to faithfully capture the views of Washingtonians on potential positive and negative impacts (social, economic and environmental) and opportunities gained and lost from breaching or removing, the LSRD, as well as from retaining the dams. The term *breach* refers to removing river barriers, such as the earth-filled embankments that create reservoirs. *Remove* means that the actual infrastructure of the dams would be taken down. For the purposes of this report, the term breach is used to capture both concepts.

Gov. Inslee will use this information to inform his perspective on the LSRD and determine if and how to participate in ongoing federal environmental evaluations of the system, including the draft Columbia River System Operations Environmental Impact Statement scheduled to be released in February 2020. Perspectives the consultant team heard repeatedly from stakeholders or found in published documents are summarized into themes supporting retaining or breaching the dams. The consultant team was not asked to adjudicate between perspectives or to determine which perspective is “right.” The emphasis is on summarizing available information and on documenting what people think and, wherever possible, why they think it.

When completed, the engagement process and report will:

- Provide a Washington state-focused summary of the effects of both retaining and breaching the LSRD.
- Allow stakeholders, tribes and citizens an opportunity to express their opinions in a structured, neutral facilitated process.

- Help inform the state of Washington position on the federal court-ordered EIS on Columbia River system operations.

The engagement process and report will not:

- Not recommend whether the LSRD should be retained or breached.
- Not develop new or prioritize potential mitigation options, although it will reflect a range of stakeholder thoughts and existing information on this subject.
- Not provide recommendations on the best way to address costs and benefits from breaching or retaining the LSRD.
- Not use a stakeholder board to review and approve the draft or final report.
- Not provide a summary of the effects on retaining or breaching the LSRD in Oregon, Idaho or Montana.

Methodology

For the draft report, information was gathered through a combination of literature/document review and telephone and in-person interviews. The final report also will consider results from an online questionnaire and public comments submitted in response to the draft.

In the literature review, the project team assembled and reviewed publicly available information and analyses related to LSRD operations and potential retention or breaching. The goal of the literature review was to understand information and cost estimates on impacts of LSRD retention and breaching, fact-check statements from interviews and provide high-level context. Sources examined are summarized in an annotated bibliography in Appendix A. In addition, Appendix B provides a summary of major state and federal studies and task forces directly related to the LSRD.

Interviews were carried out in two phases. First, the project team conducted 25 “framing interviews” with individuals who have experience and expertise with the different issues surrounding the effects, concerns and issues with retaining or breaching the LSRD. The framing interviews provided an overall sense of the range of perspectives and helped identify information resources and additional individuals and groups to be contacted. Phase two included 70 telephone and in-person interviews with representatives of the organizations identified in the framing interviews. Most of the interviews were conducted with a two-member team. The questions included:

- What do you see as the major benefits if the dams stay in place? What are the major impacts that need to be addressed if the dams stay in place?
- What do you see as the major benefits if the dams are breached? What are the major impacts that need to be addressed if the dams are breached?
- Who are the impacts most important to? What are the challenges or barriers to addressing impacts?
- How might these challenges or barriers be overcome? Do you have suggestions for approaches or processes that would be most useful in addressing the above topics and why?
- What scientific studies or information should we review and consider so we can understand perspectives on the Lower Snake River Dams? What economic studies or information? Other studies or information?

- Is there anyone else you think we should be interviewing? Why is it important to talk with them?

Interviewees were selected based on the following criteria: (1) broadly representative of the interests affecting and affected by the retention or removal of the LSRD; (2) organizational and/or subject matter expertise and/or leaders; (3) geographic diversity; and (4) representative of the diverse perspectives and views regarding the retention or removal of the LSRD. The goal of the report is for people to feel confident their perspectives are represented, whether they themselves were interviewed or not.

To encourage interviewees to be as candid as possible, this report does not attribute specific statements to individual interviewees. There is a list of interviewees (who agreed to have their name included) in Appendix C.

To complement the interviews, an online survey was distributed to the individuals and organizations that participated in interviews or expressed interest in being informed about the stakeholder engagement process. At the time of the draft report, 4,051 responses have been received. The online survey will stay open through Jan. 24, 2020, the end of the public comment period on the draft report. The final report will include an analysis and summary of the themes from the online survey. A copy of the online survey questions is included in Appendix D.

In addition to the literature review, interviews and online survey carried out by the consultant team, the Governor's Office led an engagement process with impacted tribes and tribal organizations including the Columbia River Inter-Tribal Fish Commission and Upper Columbia United Tribes. The Governor's Office also sent a letter to 39 tribal chairs to invite them to participate in the process.

Review of Draft Report and Public Workshops

This draft report is available for public review from Dec. 20, 2019 through Jan. 24, 2020. The consultant team will host three public workshops on the draft report: (1) January 7 in Clarkston, (2) January 9 in Vancouver, Wash., and (3) January 13 in the Tri-Cities. The workshops are designed to help people prepare their written input on the draft report. Oral comments and testimony will not be taken during the workshops, but written comments will be accepted. Detailed information on the workshops is available on the project website: <http://lsrdstakeholderprocess.org/>.

Comments on the draft report can be provided via email, through the project website or by mail. All public comments must be submitted by 5 p.m., PST, on Jan. 24, 2020.

- Emailed comments can be sent to info@lsrdstakeholderprocess.org with email subject line "LSRD Report."
- Online comments can be submitted through the project website: <http://lsrdstakeholderprocess.org/>.
- Written comments can be sent via mail to:

LSRD Stakeholder Engagement Draft Report
c/o Tess Wendel

1325 Fourth Ave., Suite 1600
Seattle, WA 98101

Report Overview

The rest of this draft report is divided into the following sections:

- Section 2 provides an overview of the Columbia River system and history of the LSRD and their intended purposes.
- Section 3 provides a summary of the effects of the LSRD on tribal resources and culture.
- Sections 4–9 discuss social, economic and environmental issues related to retaining or breaching the LSRD. Each section includes a summary of the context, perspectives in support of retaining the dams or breaching them, and a summary of the opportunities to increase understanding. The sections are:
 - Section 4: Salmon/Steelhead/Orca/Ecological
 - Section 5: Energy
 - Section 6: Agricultural
 - Section 7: Transportation
 - Section 8: Recreation
 - Section 9: Economics
- Section 10 provides a summary of the perspectives on factors to consider in moving forward.

Section 2: Background on Columbia River and Lower Snake River Dams

The first nation people who lived along the shores of the Snake River in southeast Idaho would mark their territory with sticks that showed an image of a snake and would greet traders with snake-like hand motions which was meant to represent swimming salmon. These tribes were noted as the “Snake Indians” by Lewis and Clark, but were actually the Shoshone tribe who called the river Ki-moo-e-nim or Yam-Pah-pa for the herbs that grew along the banks.¹²

Columbia River Basin Dams

The Columbia River is the predominant river in the Pacific Northwest. From its headwaters in British Columbia’s Rocky Mountains to its mouth on the Pacific Ocean at Astoria, the river and its tributaries drain parts of seven states.¹³ The U.S. Army Corps of Engineers, Bureau of Reclamation, and Bonneville Power Administration planned, designed, constructed and currently own and operate 14 federal multi-purpose dams and related facilities throughout the Columbia River Basin, including nine on the Columbia River, one on the Clearwater River, and four on the Lower Snake River. Figure 1 shows the location of the 14 federal dams in the Columbia River Basin.

The first federal dam constructed in the Columbia River Basin, Bonneville Dam, was completed in 1938. Since then, 13 more dams have been constructed, the most recent being Lower Granite Dam on the Snake River in 1984. The dams fall into two major categories: (1) storage reservoirs, which adjust the river’s natural flow patterns to meet water and energy demand and (2) run-of-river projects, which primarily aid in navigation and generate hydropower. Because of their limited storage capacity, run-of-river dams do not control floods.

The 14 Columbia River system dams are a part of the Federal Columbia River Power System, one of the largest hydroelectric systems in the world. This power system generates more than 40% of the total hydroelectric capacity in the United States and is the foundation of the Pacific Northwest’s power supply. Through interconnected transmission grids, it serves utility customers as far away as Los Angeles, CA. BPA markets and distributes the power produced by the Columbia River Power System.

Lower Snake River Dams

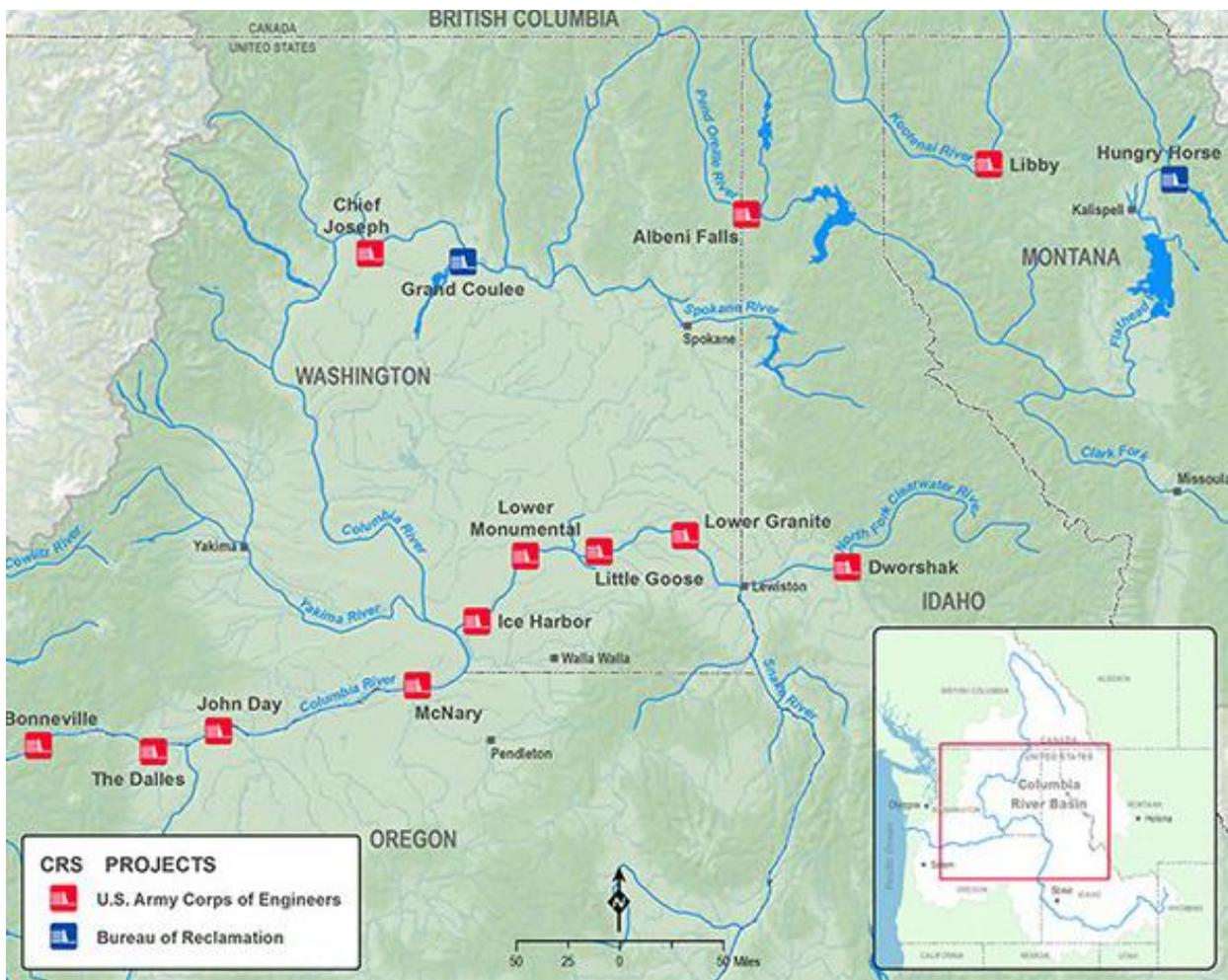
The Snake River is the largest of the Columbia River tributaries in both length and volume. It flows over 1,000 miles from its headwaters in Western Wyoming through Idaho and Oregon before converging with the Columbia at Lake Wallula (the reservoir formed by the McNary Dam) in the Tri-Cities, Washington.

The USACE operate four run-of-river dams and locks on the Lower Snake River in Washington state: Ice Harbor, Lower Monumental, Little Goose and Lower Granite. Table 1 provides more details about each LSRD. Together, the LSRD produce 1,000 average megawatts of electricity annually, which is roughly the amount of electricity that Seattle City Light consumes annually. They help meet peak power loads and contribute to the reliability of the transmission grid. They also

provide river navigation from Lewiston to the Tri-Cities — more than 100 miles — and ultimately to ports on the lower Columbia through additional dams. The capacity of the LSRD is 3,000 megawatts, which is the amount of electricity that can be generated at full output.

The LSRD, along with four federal dams on the lower Columbia River, are the biggest human constructed obstacles Snake River fish and other aquatic species encounter on their migration to and from the Pacific Ocean. The LSRD were designed with fish ladders to assist adult fish passage. As the USACE learned more about juvenile and adult fish migration, it updated the LSRD to add fish passage facilities, including installing spillway weirs and flow deflectors, making turbine improvements, investing in surface bypass systems, and other improvements. In recent decades, the adult fish ladders have been improved and updated with features such as metal plating to assist Pacific lamprey migration.

Figure 1: Map of 14 Federal Columbia River Basin Dams¹⁴



Source: US Bureau of Reclamation

Table 1: Summary of Lower Snake River Dams

	Ice Harbor ¹⁵	Lower Monumental ¹⁶	Little Goose ¹⁷	Lower Granite ¹⁸
Location	River mile 10	River mile 42	River mile 70	River mile 107
Construction	1956–76	1961–81	1963–78	1965–84
Reservoir	Lake Sacajawea	Lake Herbert G. West	Lake Bryan	Lower Granite Lake
Type	Concrete gravity-type dam with earth fill abutment embankments	Concrete gravity-type dam with earth fill abutment embankments	Concrete gravity-type dam with earth fill abutment embankments	Concrete gravity-type dam with earth fill abutment embankments
Maximum power capacity	603MW	810MW	810MW	810MW
Infrastructure	<ul style="list-style-type: none"> • One single-lift lock • Six generators • 10-bay spillway 	<ul style="list-style-type: none"> • One single-lift lock • Six generators 	<ul style="list-style-type: none"> • One single-lift lock • Six generators • Eight-bay spillway 	<ul style="list-style-type: none"> • One single-lift lock • Six generators • Eight-bay spillway • Eight miles of levees around Lewiston
Fish passage infrastructure	<ul style="list-style-type: none"> • Two fish ladders • Spillway weir • Lamprey passage structures 	<ul style="list-style-type: none"> • Two fish ladders • Juvenile fish facility • Spillway weir • Lamprey passage structures • Juvenile Fish Collection and Bypass System 	<ul style="list-style-type: none"> • One fish ladder • Juvenile fish facility • Spillway weir • Lamprey passage structures • Passive integrated transponder-tag monitoring system 	<ul style="list-style-type: none"> • One fish ladder • Spillway weir • Lamprey passage structures • Juvenile fish collection and bypass system • Two intake chimneys to pump cool water
Project Footprint	<ul style="list-style-type: none"> • 3,576 acres • Four habitat management areas 	8,335 acres	5,398 acres	13,000 acres
Recreation and visitation	<ul style="list-style-type: none"> • 345,000+ visits in 2015 • Four developed recreation areas • Three public access areas • Seven public boat launch sites 	<ul style="list-style-type: none"> • 115,000+ visits in 2015 • Seven day-use areas • Five camping areas • Five boat launch sites • One swimming beach 	<ul style="list-style-type: none"> • 166,000+ visits in 2015 • Seven day-use areas • Five camping areas • Five boat launch sites • Two swimming areas 	<ul style="list-style-type: none"> • 1.9+ million visits in 2015 • 12 boat launch sites
2015 Annual expenditures	\$11.5 million	\$9.5 million	\$10.2 million	\$23.6 million

Section 3: Tribal Connections to the Lower Snake River Dams

“Fish provide us with both physical and spiritual sustenance. Other cultures seem unable to recognize how those two concepts go hand in hand. Instead, they see them as separate, traditional beliefs on one side, science on the other. For Indian people those concepts have never been separate. Our fate and the fate of the fish are linked.” —Jaime Pinkham quote from Salmon and His People (Landeem and Pinkham, 1999).

Five tribal nations are primarily impacted by the construction and ongoing operation of the LSRD: the Nez Perce Tribe, the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon and the Shoshone-Bannock Tribe. The upper Snake tribes are primarily impacted by Hells Canyon Dam where there is no fish passage. Table 2 summarizes tribal nations in the United States and First Nations in Canada that have management authorities and responsibilities affected by the Columbia River treaty.¹⁹ These tribal nations and First Nations are affected to varying degrees by decisions that impact the Columbia Basin, including any decisions on the LSRD. The LSRD are part of a broader set of impacts European settlement has had on tribal nations, which include the loss of tribal lands and suppression of tribal cultures. The dams affect tribal people in two main ways: (1) They affect the abundance and distribution of salmon and reduce salmon fishing opportunities and harvest available to tribal people and (2) they cut off access to tribal fishing, hunting, and harvesting of roots, plants and berries and prevent tribal people from holding religious and cultural ceremonies at their usual and accustomed places. Other tribes in the Columbia Basin and along the West Coast of the Pacific Ocean are also affected by the loss of salmon, which has occurred since European settlement.

Table 2: Tribal Nations and First Nations Affected by Decisions that Impact the Columbia Basin

Tribal Nations in the United States	First Nations in Canada
Burns Paiute Tribe	Lower Kootenay Indian Band
Coeur d’Alene Tribe	Tobacco Plains Indian Band
Confederated Salish and Kootenai Tribes of the Flathead Nation	Columbia Lake Indian Band
Confederated Tribes and Bands of the Yakama Nation	St. Mary’s Indian Band
Confederated Tribes of the Colville Reservation	Upper Similkameen Indian Band
Confederated Tribes of the Umatilla Indian Reservation	Lower Similkameen Indian Band
Confederated Tribes of the Warm Springs Reservation of Oregon	Penticton Indian Band
Cowlitz Indian Tribe	Westbank First Nation
Fort McDermitt Paiute Shoshone Tribes	Okanagan Indian Band

Tribal Nations in the United States	First Nations in Canada
Kalispel Tribe of Indians	Osoyoos Indian Band
Kootenai Tribe of Idaho	Shuswap Indian Band
Nez Perce Tribe	Upper Nicola Band
Shoshone Paiute Tribe of the Duck Valley Indian Reservation	Little Shuswap Indian Band
Shoshone-Bannock Tribes of the Fort Hall Reservation	Adams Lake Indian Band
Spokane Tribe of Indians	Simpco First Nation
	Neskonlith Indian Band
	Splatsin First Nation

Loss of Salmon

The importance of salmon to the physical, cultural and spiritual well-being of Columbia and Snake River tribes cannot be overstated. Historically, the typical tribal member ate almost a pound of salmon every day, and salmon fishing and harvest shaped tribal peoples’ lives. Tribal creation stories throughout the Columbia Basin feature the importance of salmon in tribal culture. According to information compiled by the Columbia River Inter-Tribal Fish Commission:

From a tribal legend, we learn that when the Creator was preparing to bring forth people onto the earth, He called a grand council of all creation. From them, He asked for a gift for these new creatures—a gift to help the people survive, since they would be quite helpless and require much assistance from them all. The very first to come forward was Salmon, who offered his body to feed the people. The second to come forward was Water, who promised to be the home to the salmon. In turn, everyone else gathered at the council gave the coming humans a gift, but it is significant that the very first two were Salmon and Water. In accordance with their sacrifice, these two receive a place of honor at traditional feasts throughout the Columbia Basin. These ceremonies always begin with a blessing on and the drinking of water, followed by a prayer of thanksgiving on and the serving of wiykan-usb, the salmon. This ceremony reinforces the central role that salmon and water play in the health of Indian people and their culture.²⁰

Tribes took care to protect their rights to harvest salmon and other resources during treaty negotiations. In treaties with the Nez Perce, Yakama, Umatilla and Warm Springs, the U.S. government agreed that “the exclusive right of taking fish in all streams, where running through or bordering said reservations is further secured to said confederated tribes and bands of Indians, as also the right of taking fish at usual and accustomed places in common with the citizens of the Territory, and of erecting temporary buildings for curing them; together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed lands.”²¹

Current tribal harvest of salmon is a fraction of what it was before European settlement and before construction of the LSRD. Table 3 summarizes estimated historic harvest amounts of the five tribes most affected by the LSRD compared to current harvest.

Table 3: Comparison of Estimated Tribal Harvests from the Columbia/Snake System Contact Times to 1999²²

Benchmark	Annual Harvest in Thousands of Pounds				
	Nez Perce	Shoshone/ Bannock	Yakama	Umatilla	Warm Springs
Estimated Pre-Contact Harvest	2,800	2,500	5,600	3,500	3,400
Estimated Harvest in mid-1800s	1,600	1,300	2,400	1,600	1,000
Tribal harvest in 1999*	160	1	1,100	77	
Present vs. Pre-Contact Harvests					
Above lower Snake River Dams	0.6%	0.04%	–	–	
Below lower Snake River Dams	5.1%	–	9.4% for three mid-Columbia tribes		

* Shoshone Bannock estimates include harvests by Sho-Pai Duck Valley peoples.

Not all losses of salmon are attributed to the LSRD. Initially, the losses of salmon were principally caused by preemption by competing non-Indian harvesters and obstruction or denial of access to usual and accustomed fishing places — sometimes fenced off by non-Indian property owners. Over time, as tribal access to usual and accustomed sites has been restored, loss of salmon numbers and salmon harvesting areas for these five tribes is more related to the LSRD.

Loss of Access to Land and Cultural Sites

The reservoirs behind the LSRD inundated approximately 140 river miles and 34,000 acres of land,²³ important to tribes and 600–700 sites where tribal people historically lived; fished and hunted; harvested plants, roots and berries; and conducted cultural and religious ceremonies. Numerous tribal gravesites were inundated, making it impossible for tribal people to care for these graves in their normal ways. Table 4 describes the loss of access to land and cultural sites for these five tribes in the LSRD by tribal organization.²⁴

In addition to the effects to the tribes summarized in Table 3, tribes from outside the region who historically visited the lower Snake River area for hunting, gathering, fishing and trading are similarly affected. If a decision is made to breach the LSRD, now-inundated tribal cultural resources will be exposed and accessible to tribes but require protection. Reservoir drawdowns cause erosion of tribal cultural sites and expose them to vandalism. When the Wanapum Lake was drawn down for repairs to Wanapum Dam, Grant County Public Utility District spent over \$1 million for enforcement to protect tribal archeological sites.

Table 4: The Relationship Between Present Tribal Treaty-Based Entities and Pre-Treaty Tribal Groups in the Lower Snake Reservoir Area

Tribal Organization	Original Tribal Groups in Lower Snake Territory	Associated Inundation by Lower Snake Reservoirs
Nez Perce Tribe	Nez Perce Indians living along the Clearwater River and downstream along the lower Snake River to Palouse River (north side) and Tucannon River (south side).	Lower Granite Little Goose Lower Monumental
Yakama Indian Nation	Palouse peoples living at the confluence of the Snake and Palouse rivers and downstream along the north riverbank. Possibly other bands near the mouth of the Snake.	Lower Monumental Ice Harbor
Confederated Tribes of the Umatilla Indian Reservation	Palouse peoples living at the confluence of the Snake and Palouse rivers, and downstream along the north riverbank. Walla Walla peoples living from the mouth of the Tucannon River downstream along the south bank of the Snake River.	Lower Monumental Ice Harbor

Tribal Engagement Moving Forward

Decisions about the LSRD need to take into account the state and federal government’s responsibilities to comply with tribal treaties and government-to-government protocols for engagement and consultation with the tribes. The Governor’s Office is engaging with impacted tribes and tribal consortia including the Columbia River Inter-Tribal Fish Commission and Upper Columbia United Tribes.

Section 4: Salmon/Steelhead/Orca/Ecological

Context

Concern over the impacts of the LSRD on salmon abundance in the Columbia and Snake river systems and the relationship between Columbia and Snake river salmon and Southern Resident orca recovery stimulated this engagement process. As described in the introduction to this report, in fall 2018 Gov. Inslee's Southern Resident Orca Task Force recommended further investigation of the impacts of breaching the lower Snake River dams as a way to provide more salmon for Southern Resident orcas to eat. In response to the task force recommendation, the Washington State Legislature provided funding in the 2019-21 operating budget for this effort.

The lower Snake River is home to four Endangered Species Act-listed species of anadromous fish: spring/summer Chinook, fall Chinook, sockeye and steelhead. It is also home to non-listed populations of anadromous coho (which were extirpated and reintroduced) and Pacific lamprey, as well as resident species including white sturgeon and ESA-listed bull trout. Historically, salmon spawning and rearing occurred in both the main river (fall Chinook) and in tributaries. There are five principal salmon-producing tributaries to the lower Snake River. Three of the five, the Clearwater, Grande Ronde, and Salmon rivers, are large, complex systems composed of several smaller tributaries which are further composed of many small streams. The two others, the Tucannon and Imnaha rivers, are smaller and most salmon spawning and rearing occurs in the main rivers. There also are three smaller streams, Asotin, Granite and Sheep creeks, that enter the Snake River between Hells Canyon and Lower Granite dams and provide additional spawning and rearing areas.²⁵ Currently, salmon spawning and rearing occurs almost exclusively in tributaries, except for fall Chinook which spawn in the free-flowing stretch of the Snake River between Hells Canyon Dam and the Lower Granite Dam's reservoir, as well as in the lower tributaries such as the Clearwater and Grande Ronde.

Historically, fall Chinook and steelhead spawned in the Snake River as far inland as Shoshone Falls, 600 miles upstream of the confluence of the Snake and the Columbia. The LSRD inundated the lower 140 miles of the lower Snake River, some of which served as fall Chinook spawning habitat. Other wildlife was also affected by the dams. Before the dams, this section of the river had 48 islands and supported an estimated 1,800 deer, 120,000 upland game birds and animals, 13,000 fur bearers as well as waterfowl and nongame species.²⁶ Currently, less than 50% of the portion of the mainstem Snake River once used by salmon remains accessible. Fish are limited to the lower 247 miles of the Snake River because there is not fish passage beyond Hells Canyon Dam, the lowermost of three dams that are part of the Hells Canyon dam complex.²⁷ However, as noted above, Snake River salmon and steelhead retain access to several large tributaries of the lower Snake River, including largely pristine salmon habitat including Idaho's Middle Fork Salmon and Selway rivers.

Changes in Wild Salmon Abundance in the Snake River and Columbia Basin

Salmon decreased significantly in the Columbia and Snake river system following European settlement. When Europeans first arrived in the basin in the 1800s, the runs of salmon were substantial. An early European settler wrote, "the number of fish who reached these beds was so

great the receding waters would leave missions of dead salmon strewn along the banks, emitting a stench that could be smelled miles off, and which never failed to attract a great number of bears.”²⁸

In the years that followed, salmon runs declined significantly. As early as 1894, the Oregon Fish and Game Protector warned that Chinook populations were “threatened with annihilation.”²⁹ With the falling numbers of Chinook, fishermen moved onto the other salmon species in the region like sockeye and coho; these species also saw a pronounced fall in the 1920s. In 1911, 46 million pounds of canned salmon were produced from the Columbia and Snake river systems; by 1938 the annual catch had decreased to 20 million pounds.³⁰

Salmon populations decreased further with the construction of dams on the Columbia and Snake rivers. Based on estimates compiled by the Washington Department of Fish and Wildlife and the Oregon Department of Fish and Game in the Columbia River Fish Runs and Fisheries Status report, salmon runs in the Columbia and Snake river system have declined by over 90% during the last century.³¹

Table 5 shows the current abundance levels for the ESA-listed salmonids within the Snake River detected at the Lower Granite Dam as well as the historic abundance levels.

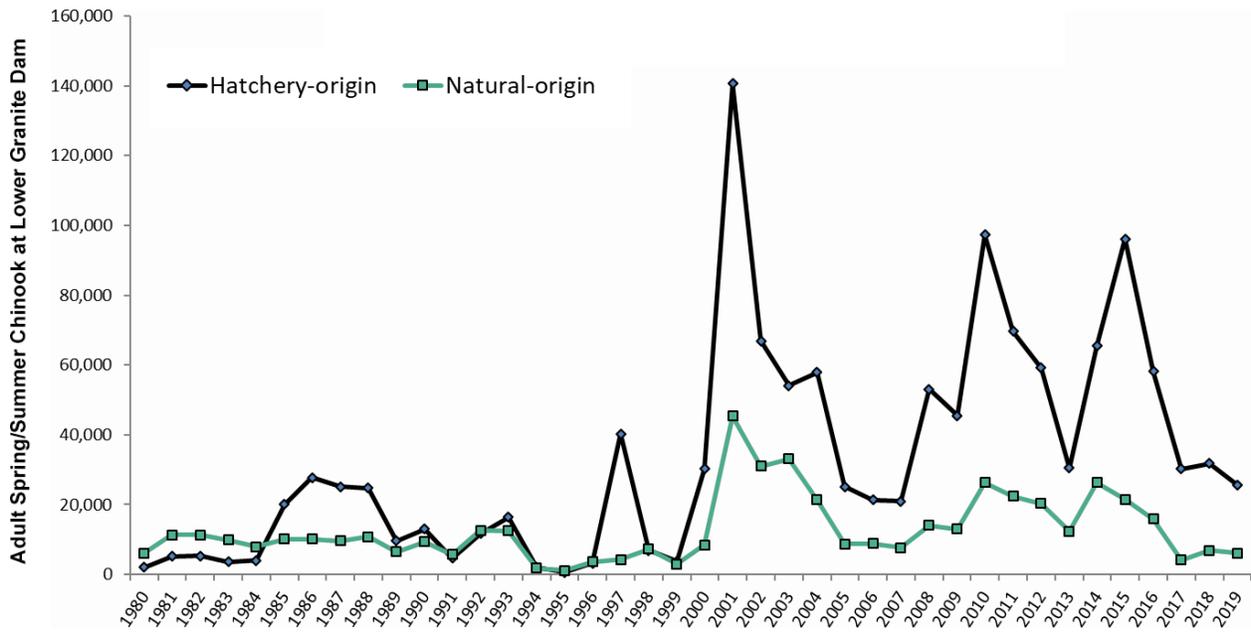
Table 5: LSRD ESA-Listed Salmonids Historic and Current Abundances

Species	Historic Abundance ³²	2019 Wild Abundance ³³	2019 Total Abundance (Wild & Hatchery Origin) ³⁴
Spring/summer Chinook	1,000,000	6,130	31,831
Fall Chinook	500,000	5,435	15,451
Sockeye	84,000	43	129
Steelhead	114,800	17,614	60,700

All species of salmon that use the Snake River are currently listed as threatened or endangered under the Endangered Species Act. Wild Snake River coho went extinct in 1987;³⁵ and the current reintroduced coho population in the Snake River basin is supported by hatcheries.

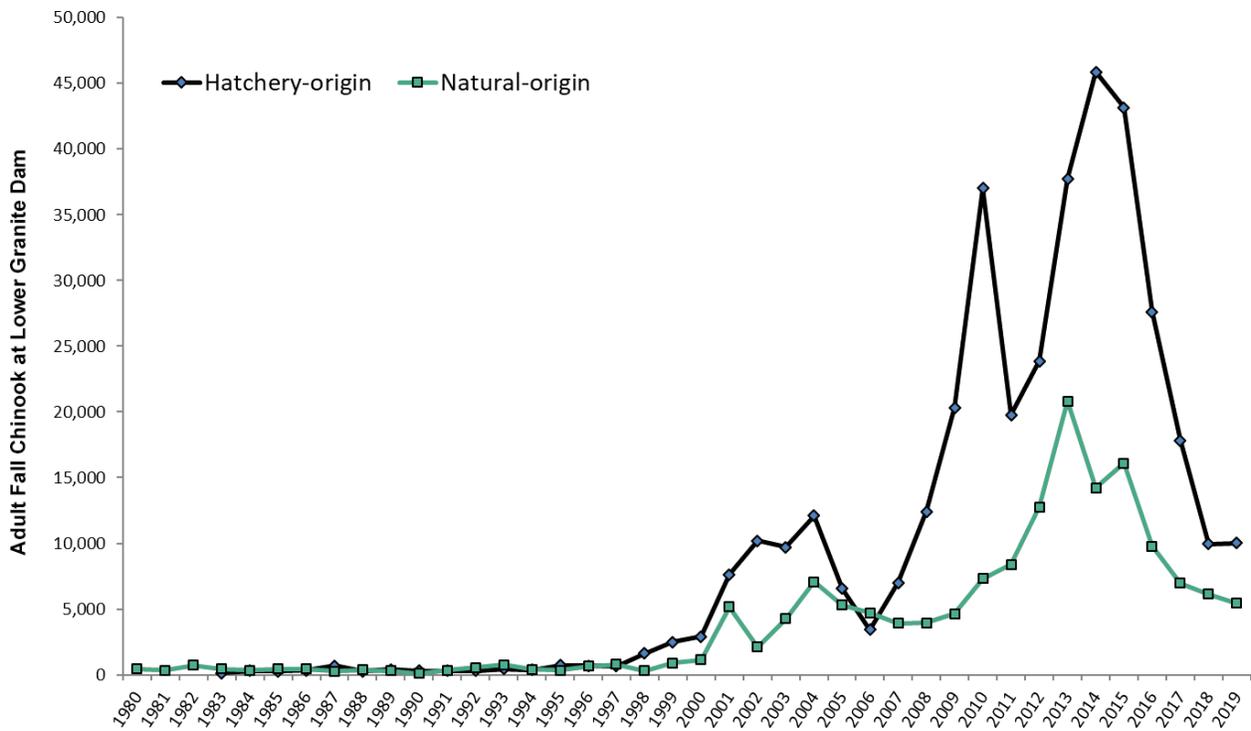
Year over year, salmon abundance fluctuates based on many factors including weather and climate, ocean conditions and prey availability. Figures 2–5 show the natural and hatchery origin annual returns of salmon to the Snake River at Lower Granite Dam from 1980 through the present. Returns for 2019 are projected because fish counts have not been finalized. Recent returns to the Snake River are higher than their historic lows, but lower than a bump in returns in the earlier part of this century, and much lower than historic abundance.

Figure 2: Snake River Spring/Summer Chinook Abundance at Lower Granite Dam Over Time³⁶



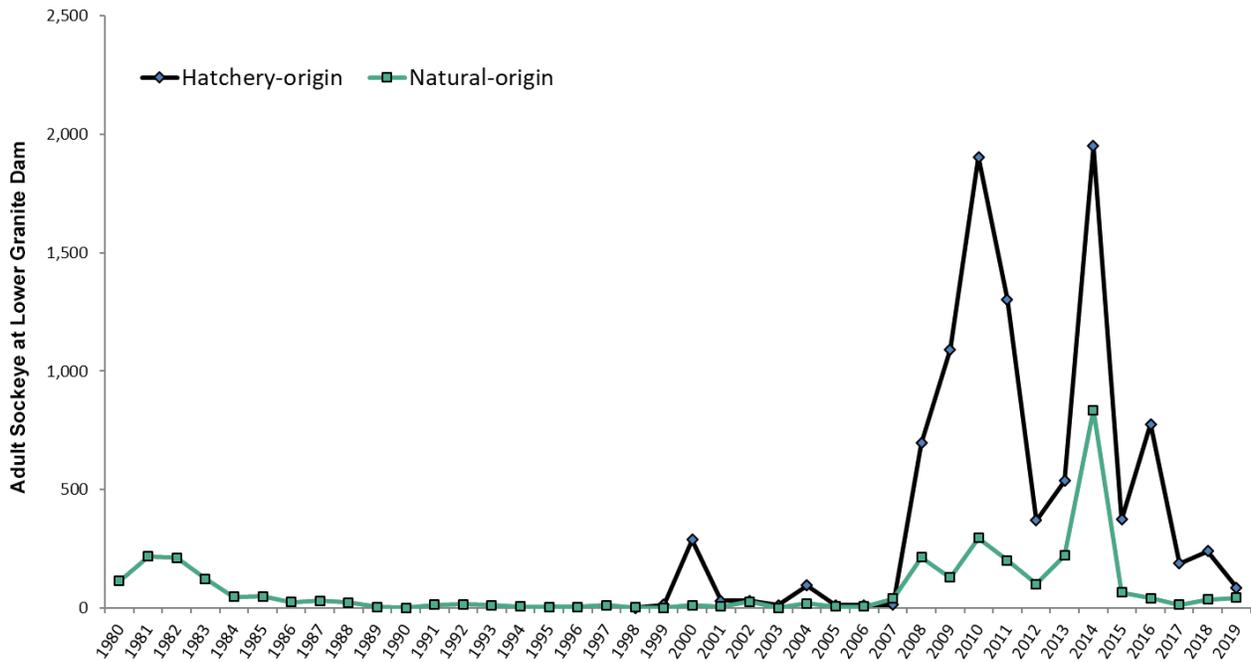
Source: Northwest Power and Conservation Council

Figure 3: Snake River Fall Chinook Abundance Counted at Lower Granite Dam Over Time³⁷



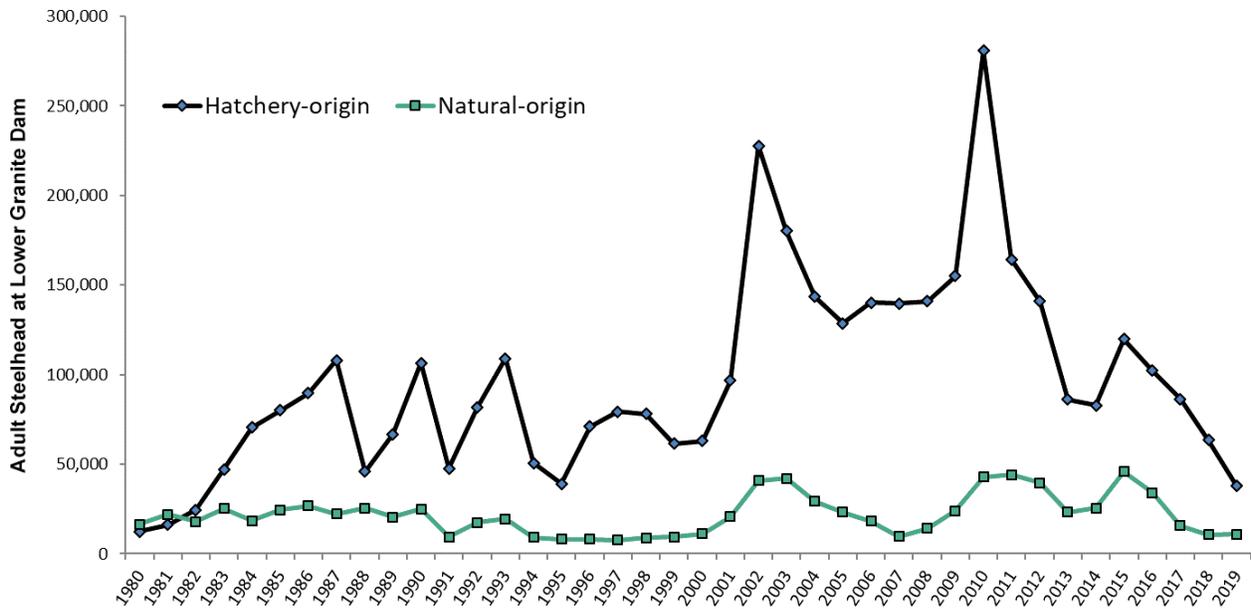
Source: Northwest Power and Conservation Council

Figure 4: Snake River Sockeye Abundance Counted at Lower Granite Dam Over Time³⁸



Source: Northwest Power and Conservation Council

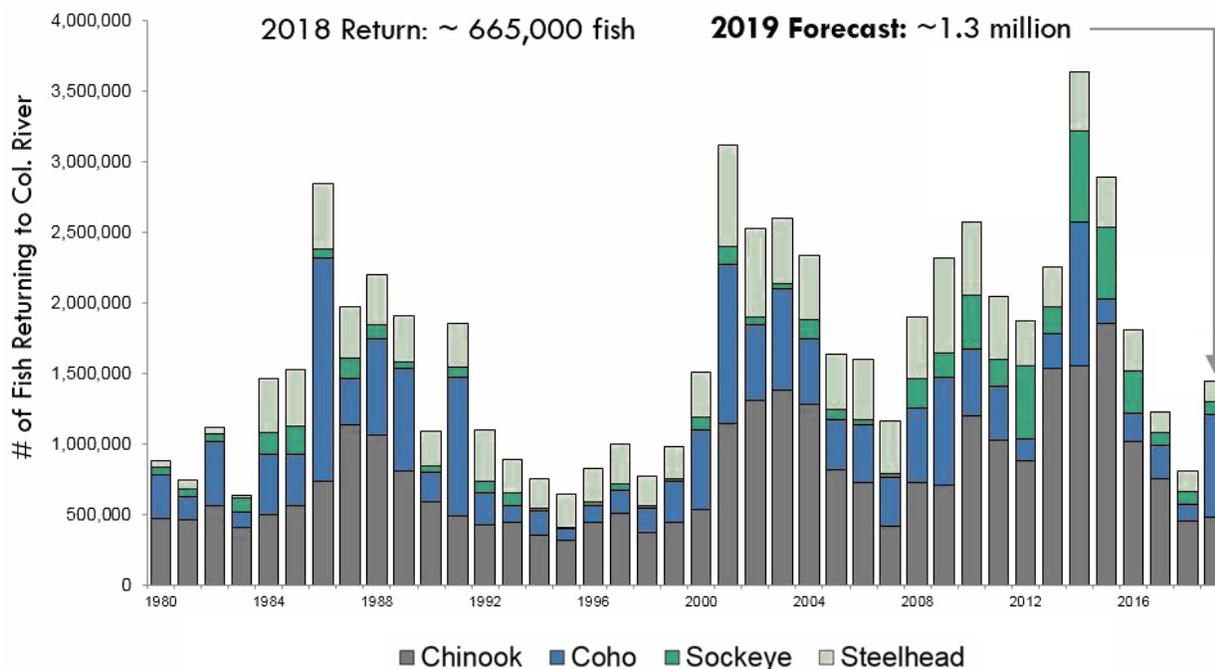
Figure 5: Snake River Steelhead Abundance Counted at Lower Granite Dam Over Time³⁹



Source: Northwest Power and Conservation Council

Figure 6 below shows the annual returns of all (natural and hatchery origin) adult salmonids to the Columbia River as detected at the Bonneville Dam with the current 2019 counts forecasted because they have not been finalized yet.

Figure 6: Total Returns of All Columbia and Snake Rivers Salmonid Returns Counted at Bonneville Dam Over Time⁴⁰



Source: Northwest Power and Conservation Council

Columbia and Snake River Hydrology and Effects of Dams

Historically the Columbia and Snake river systems were characterized by high flows due to snowmelt and runoff in spring, decreasing summer and fall flows and lower winter flows. Salmon migration patterns evolved over time to respond to these typical historical flows. Construction of dams in the Columbia and Snake River systems changed these historical flows. Except for the Hanford Reach and a section of the Snake River between Hells Canyon Dam and Lower Granite Reservoir, the lower Snake and the lower Columbia rivers now operate as a series of slow-moving reservoir lakes. The new flow regime has more moderate spring flows and increased water levels during the late-summer when irrigation occurs. Sediment, which formerly moved down river and formed sand bars, beaches and other habitat, is now largely impounded behind dams.

Breaching the LSRD would significantly alter the current hydrology and flow regime in the lower Snake River, returning it to a pattern closer to that observed before the dams were in place. Sediment and contaminants trapped behind dams would be released, temporarily increasing water turbidity and distributing chemical contamination in the form of DDT, manganese, dioxin, and un-ionized ammonia⁴¹ Approximately 50 to 70 million cubic yards of sediment could be released.⁴² The 2002 USACE FS/EIS estimated that water quality would be poor for up to three years following breaching the LSRD.⁴³

If the dams were breached, land currently inundated by reservoirs would be exposed as the river returns to its historic channel. Flow velocity would increase, and water temperatures would be more like they were before the dams were built. This could include higher daily fluctuations in water temperatures, although overall water temperatures would be cooler. Spillway flows from dams increase total dissolved gas concentrations; if the dams were breached, these concentrations would decrease. High levels of TDG have been found to cause gas bubble disease (GBD) in salmonids. GBD causes loss of equilibrium, abnormal buoyancy and hemorrhaging of the gills, fins, skin and muscles, which can lead to death.⁴⁴

There are several municipal waste discharges into the Snake River above Lower Granite Dam. If Lower Granite Dam is breached, the permit requirements for the discharges will need to be reviewed to address the change in the receiving body water volume and capacity for dissolution of water pollution.

Salmon Life Cycle and Effects of Dams

Salmon are a migratory fish. They hatch in freshwater systems, spend most of their adult lives in the ocean, and then return to the freshwater systems in which they were hatched to spawn and die. Dams impede salmon migration by blocking or limiting migratory routes, reducing in river water velocity, reducing access to tributaries and, even where there is fish passage provided by ladders, increasing the time it takes for migration. This increased time for juvenile migration affects their fitness for survival once they enter the ocean estuary. The increased time for adult migration back upstream can affect their success in spawning. Dams can also increase river temperatures by absorbing more of the sun's rays in their reservoirs, which increases rates of disease, reduces reproductive viability in salmonids, and increases predation because the warmer, slow waters support more predators and predators can easily access fish at dams and in slower moving, deeper reservoirs.⁴⁵

The current survival rate of juvenile Spring/Summer Chinook and steelhead salmon through the dams from Lewiston, Idaho, on the Snake River to Bonneville Dam on the Columbia River is approximately 50%.⁴⁶ For returning adult fish, once they are back in the river the average survival rate of Snake River salmonids is about 90% through the eight dams from 2008 - 17.⁴⁷ While these survival rates are improved from previous years⁴⁸, the listed species of salmonids that inhabit the river still are not meeting regional recovery goals that the NWPCC has laid out of 2-6% smolt-to-adult ratio (SAR) with an average of 4% SAR.⁴⁹

SAR is a measure of survival of salmonids from their beginning point as a smolt to an ending point as an adult.⁵⁰ For Snake River salmon it is a measure of salmon passing Lower Granite Dam as a smolt and returning back over the same dam as an adult. The average SAR for natural origin spring/summer Chinook in the Snake River from 1997 - 2015 is 1.07% while the average SAR for natural origin steelhead over the same period is 1.74%.⁵¹ Spring/summer Chinook only met the NWPCC SAR goal of at least 2% SAR twice during that period, while steelhead on average were better reaching the goal in eight of the years.⁵² Part of the reason for this low overall survival rate can be caused by the effect passage through the dams and reservoirs has on the fitness of salmon once they pass Bonneville dam.⁵³ Latent mortality refers to this reduced fitness and increased likelihood of death for fish in their first year in the ocean from the effects of a highly altered and managed river system.⁵⁴

Hatcheries

Since the late 1800s fish hatcheries have been used in the Columbia River Basin to mitigate the impacts of harvest and habitat alteration to salmon populations.⁵⁵ Fish hatcheries collect returning adult fish, harvest their eggs and produce juvenile fish in controlled conditions. The juvenile fish are then returned to the river to migrate to the ocean. Hatcheries are generally credited with bolstering total current salmon returns to the Snake River and for increasing salmon numbers to support limited harvest. In 1976, Congress authorized the creation of the Lower Snake River Compensation Plan to construct fish hatcheries to compensate for the impacts of the dams on salmon and steelhead populations. The goals of the program are to return 55,100 adult steelhead, 58,700 adult spring/summer Chinook, and 18,300 fall Chinook to the Snake River.

Hatcheries in the Columbia and Snake river systems have raised and released five salmonids (Chinook, coho, chum, sockeye and steelhead) but most hatchery production has been focused on Chinook. Ten hatcheries in Oregon, Washington and Idaho supplied a total of 16.8 million juvenile fish to the lower Snake River in 2002.⁵⁶ Fall Chinook returns boosted by hatchery supplementation increased from less than 1,000 adults at Lower Granite Dam in the mid-1990s to a record (post-dam construction) of more than 41,000 in 2010. The natural-origin adult returns at Lower Granite Dam in 2010 was just under 10,000 fish, which was also a record since the initial construction of Lower Granite Dam in 1975. While hatchery fish have boosted returns, total Snake River fall Chinook returns remain a fraction of the historical estimate of over 500,000 fish⁵⁷ before either the lower Snake River dams or the Hells Canyon dams inundated and blocked, respectively, the vast majority of historic Snake River fall Chinook habitat.

Separate from the Compensation Plan, there are also hatcheries for the endangered Snake River sockeye conducted in collaboration with NOAA, the Idaho Department of Fish and Game, the Shoshone-Bannock Tribes and BPA. In 1991, only 16 Redfish lake sockeye returned to spawn. From the genetic material of those last surviving fish, the hatchery program has produced over 4,300 adult sockeye. Without the hatchery program, it is likely that Snake River sockeye would now be extinct.⁵⁸

Hatchery production in the Columbia River system (including the Snake River) has declined in recent years due to a variety of factors, including increasing costs and concerns about biological interactions between hatchery and wild fish. In 1998 the combined Chinook and coho hatchery releases in the Columbia River system (including the Snake River) was 216 million fish; in 2015 it was 139 million fish, a decrease of 36%.

Spill to Improve Juvenile Salmon Passage and Survival

In the spring and summer, water is routed over the tops of the LSRD dams to help juvenile salmon and steelhead migrate to the ocean. This is referred to as “spill”. During spill periods, juvenile fish can migrate past the dams in water that flows over the spillways rather than traveling through the turbines or bypass systems.⁵⁹ Spill is credited with improving juvenile Snake River spring/summer Chinook survival and thereby increasing adult returns. The effectiveness of spill to increase fish survival varies and depends on the configuration at each dam and how spill is managed. Too much spill can create back-eddies where fish become trapped and are more vulnerable to predators; increased dissolved gases caused by water agitation during spill can cause GBD in fish.⁶⁰

A 2018 agreement on flexible spill has brought together the states of Oregon and Washington, the Nez Pierce Tribe and USACE, USBR and BPA with the dual goals of achieving improved salmon survival through the dams and maintaining hydropower revenues at, at least, 2018 levels. In 2018, per a court injunction, the lower Snake and lower Columbia River dams spilled 24 hours, seven days a week to 115% total dissolved gas levels in the forebays and 120% as measured in the tailrace. The flexible spill agreement called for spill to a 120% tailrace-only standard in 2019 and is calling for spilling to a 125% TDG standard in 2020. But rather than spill to those levels 24 hours per day, the flexible spill agreement allows spill to be reduced to lower 2014 BiOp levels (lower than 2018 levels) for eight hours a day to allow BPA to take advantage of times with higher energy demand that fetch higher prices per unit of power produced. On balance, preliminary data indicated that 2019 flexible spill operations were roughly on par with 2018 in terms of overall fish survival and power revenue. 2020 operations are expected to provide for improved fish survival relative to 2018 (and 2019), and at least equal power revenue.

Differing Methods to Estimate the Impacts of Breaching the LSRD

There are two main modeling efforts to characterize survival of Snake River salmonids: (1) The Comparative Survival Study (CSS) model, which was developed by research scientists from U.S Fish and Wildlife, Columbia River Inter-Tribal Fish Commission, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game and Fish Passage Center. (2) The comprehensive passage (COMPASS) model which was developed by NOAA Fisheries along with federal, state, and tribal agencies and the University of Washington. While both models are used to characterize survival through the system, they are methodologically quite different

The CSS is a statistical modelling approach based on retrospective analysis of a long series of data sets from the Columbia and Snake River system. It estimates that if the LSRD were breached, and there was a significant increase in spill above current BiOp spill levels (24-hour 125% total dissolved gas (TDG)) at the four lower Columbia dams, there would be a four-fold increase in SARs for Snake River salmonids.⁶¹

The COMPASS model is a mechanistic modeling approach composed of four main components: dam passage and survival, reservoir survival, fish travel time, and hydrological processes.⁶² Published estimates from the COMPASS model will be available when the Columbia River System Operations Environmental Impact Statement is released, scheduled for February 2020.

Southern Resident Orcas

The Southern Resident orca population is comprised of three family groups: J Pod, K Pod and L Pod. The pods traditionally spend most of the year in the Salish Sea and in the Pacific Ocean between the mouth of the Columbia River and off the west coast of Vancouver Island. They feed primarily on Pacific salmon, especially Chinook salmon. Historically, the Southern Resident orcas had a population as high as 140 individuals; today there are 73 remaining.⁶³ The population was listed as endangered in 2004.⁶⁴

Multiple factors contribute to the Southern Residents' population decline: bioaccumulation of contamination; disturbance from vessels and the noise they create; and reduced food sources—which links the Southern Resident orcas to the question of the management and future existence of

the LSRD. NOAA has found a positive correlation between Chinook abundance and Southern Resident birth rates; however, it has not been able to quantify this relationship because of confounding factors.

NOAA Fisheries assessed the operation of the four lower Snake River dams and their effects on listed salmon and steelhead in their Biological Opinion issued in 2008. In 2014, their supplemental Biological Opinion re-examined the issues, including consequences for Southern Resident orcas. Neither opinion, nor the recovery plans NOAA Fisheries has developed for individual salmon species and stocks, concluded that breaching the dams is necessary for recovery of Snake River salmon or Southern Resident orcas.⁶⁵

In its Southern Resident Killer Whale Priority Chinook Stocks Report, NOAA and the Washington Department of Fish and Wildlife stated that, for Southern Resident recovery, Columbia and Snake river salmon stocks are a lower priority than North and South Puget Sound salmon stocks because the Southern Residents' foraging patterns do not overlap as much with Columbia and Snake River salmon as they do with the North and South Puget Sound salmon.⁶⁶ At the same time, Columbia and Snake river fall Chinook were ranked as the fifth most important salmon stock for Southern Resident orcas, and Snake River spring/summer Chinook as the ninth most important. And orca scientists have acknowledged that Southern Resident orcas are shifting their foraging patterns in response to the lower salmon abundance levels within the Salish Sea, spending less time in the Sea and more time on the Western shore of Vancouver Island to intercept salmon migrating from Alaska to return to the Columbia and Snake river systems. Other scientists note that the Southern Residents still gather along the Washington coast and at the mouth of the Columbia River between January and April to feed on Columbia and Snake spring/summer Chinook, which they argue is a critical time for the orcas to find nourishment and put on weight.⁶⁷ An average adult orca must consume between 28 and 34 adult salmon daily as adults and 15–17 daily as juveniles.⁶⁸

As part of the ongoing Columbia River System Operations environmental impact statement, USACE, USBR and BPA are evaluating different operations and maintenance options for the dams on the lower Columbia and Snake rivers, including breaching one or more dams. The EIS will conclude with a decision in 2021. After the process is complete, if dam breaching is recommended, then those three agencies would need to seek Congressional authorization to do so. NOAA fisheries cannot order dam breaching, but it does consult with the agencies about the impacts of the dams on salmon runs.⁶⁹

Perspectives

People recognize and generally agree on the critical importance of successful salmon recovery to the LSRD region and to the Pacific Northwest. However, there are significant differences in how people view the impacts of potential breaching of the LSRD on salmon. Similarly, there is broad support for action to improve conditions for Southern Resident orcas, but disagreement on what level salmon stocks from the Columbia and Snake river systems can contribute to that goal — especially in the near-term of the next 10 to 20 years.

Support for retaining the LSRD and optimizing current efforts for salmon and orca recovery

People who support retaining the LSRD point to the positive impact of salmon recovery actions over the last several decades and the further anticipated benefits of the flex-spill agreement in

increasing salmon returns to the Snake River. Some agree more with NOAA's assessment of the potential impact of dam removal on salmon returns and may believe that removal of the LSRD is not the most effective, or cost-efficient, way to spend billions of additional dollars on salmon recovery. They would like to see investment made, instead, in continuing improvements to management of the dams in place and investing in salmon recovery efforts and dam mitigation efforts in other places. They make some or all of following points:

- Recent increases in returns show that salmon recovery efforts are on the right track with flex spill and other improvements to system management. Rather than start over, we should increase investment in the things that are already working. These actions are working; for example, their results have been significant enough to allow harvest on Snake River salmon.
- Removing the dams will dramatically disrupt river hydrology by releasing tons of sediment; this may have short-term adverse effects on salmon in both the Snake and the Columbia River systems, it could cause problems for the dissolution of pollutions from municipal waste discharges and other sources
- Removing the dams will, at least temporarily, reduce riparian cover by moving the river channel in, away from existing banks; in the short term this may decrease fish access to cooler water.
- Predators are a large problem for returning salmon to the Columbia River, especially pinnipeds like sea lions and seals, we should try to control this source of mortality before taking more drastic steps like breaching the dams.
- The upper Columbia once provided upwards of 40% of the returning adult salmon to the Columbia River system, reintroduction of the salmon to the upper Columbia could have an equal and more immediate benefit to orca and overall salmon recovery
- Decline in hatchery production in the Snake and Columbia River systems as well as in Puget Sound plays a significant role in decreasing salmon returns; increasing hatchery production is a faster and more reliable way to increase salmon abundance overall and increase food for Southern Resident orcas than a large-scale dam removal process which would take years to accomplish and even longer for any increase in salmon populations to be realized. Removal of the dams could end the funding from BPA for hatchery production, creating a significant gap in both salmon available for harvest and in food supply for Southern Resident orcas in the short, and potentially, the long term.
- Other factors are more important for Southern Resident orca recovery than Columbia and Snake River salmon abundance including pollution, vessel noise and Puget Sound/Salish Sea salmon abundance.
- Ocean conditions are one of the most significant factors affecting the cyclical returns of salmon. Poor ocean conditions are the reason for the recent decline in returns.

People who support retaining the LSRD and addressing salmon recovery needs through new and ongoing management changes criticize the Fish Passage Center, one of many organizations that developed the CSS model, as a biased entity that advocates for specific policy positions rather than an unbiased provider of scientific and technical information. They do not see the CSS model estimate of a four-fold increase in salmon as accurate.

Support for breaching the LSRD to support salmon and orca recovery

People who support breaching the LSRD see it as the only action that has not been already tried which could make a significant difference in the trend line for salmon populations. Some emphasize that the results from the \$17 billion investment in making improvements in the structure and management of the current system to support salmon recovery can be built upon with dam removal; others emphasize that a \$17 billion investment has not reversed the downward population trend. They make the following points:

- Although breaching the dams will take time, and the resulting improvements in salmon populations also will take time, this approach is overall the best way to increase resiliency in the system, especially considering climate change, and provides the greatest opportunity to prevent extinction and move toward sustainable, harvestable salmon runs.
- Fish ladders are a fragile system prone to disruption; these disruptions will increase as the dam infrastructure continues to age. Two of the four LSRD have only one fish ladder. If the ladder is “out” due to mechanical or other difficulty it will have significant impacts on fish migration.
- Flexible spill, including in the lower Columbia River, represents progress but alone is not enough to bring populations back. Additional spill can be put in place while dam breaching is planned and flex spill on the lower Columbia will be necessary to achieve full benefits if the LSRD are breached.
- There is significant, high-quality spawning habitat in the Snake River basin, particularly in large tributaries like the Salmon, Grande Ronde, and Clearwater rivers. Even with the improvements made to fish passage over the years, there are still not enough adult salmon getting over the dams to return to the upper watershed to spawn. Breaching the dams is the most reliable and effective way to ensure fish can access and use upstream habitat and increase overall productivity.
- Dam breaching will result in cooler river temperatures by returning the river back to a free-flowing river. Cooler temperatures will benefit the species in the future, as climate change is expected to increase water temperatures in the region.
- Hatchery production is not a viable long-term strategy for increasing Southern Resident orcas’ food. Hatchery fish are smaller contain less fat than wild fish, making them a less substantial food source, and hatcheries can depress the genetic diversity of wild salmon.
- Increasing the food base for the Southern Residents is a critical action to their recovery and it can be accomplished more quickly than other actions such as cleaning up pollution and addressing bioaccumulation of chemicals.
- Breaching the dams is the only remaining action to try to reverse the downward trend in wild salmon populations; and abundant, healthy, wild, salmon populations are critical to recovery of the Southern Residents.

People who support breaching the LSRD do not agree with the NOAA estimates about the impact of breaching the LSRD on salmon populations or to Southern Resident orca recovery. They believe NOAA may be overly influenced by political forces that are in favor of retaining the LSRD. They see the Biological Opinions as a negotiation between the federal agencies responsible for the LSRD (USACE, USBR and BPA) and NOAA, which is also a federal agency, and believe NOAA is susceptible to pressure from the other federal agencies to maintain the status quo. They support the

CSS model results as a more accurate representation of potential benefits for salmon if the LSRD were to be breached.

Different perspectives on how the Snake River would respond if dams are breached

In part, differences in perspective about how breaching the LSRD would affect salmon stem from differences in perspective about what the river would become if dams were to be breached. Supporters of breaching believe the river would relatively quickly return to what it once was — with sandy beaches, swimming holes and riparian areas of cottonwoods supporting abundant wildlife and waterfowl. In contrast, supporters of retaining the dams believe the river will become a mud filled, unstable floodplain with invasive species and high sediment loads and turbidity as the sediment currently impounded behind the dams are eroded. These two very different visions for how the river might respond to dam breaching distill people’s different ideas about what is best for the region, and color people’s ideas and responses to virtually all subsequent questions.

Supporters of breaching the LSRD point to the Conduit Dam removal on the White Salmon River and the Elwha Dam removal on the Elwha River as examples where a river recovered relatively quickly after dam removal and salmon returned. Supporters of retaining the LSRD believe that the Conduit and Elwha projects are not relevant examples because the scale is so different from the lower Snake River.

Opportunities to Increase Understanding

The impacts of the LSRD on salmon and the factors contributing to the Southern Resident orcas’ decline have been extensively studied. If there is continued interest in exploring the potential to breach the LSRD, the main opportunities to increase understanding around salmon and the Southern Residents relate to: exploring differences in interpretation of data to clarify areas of agreement; areas of disagreement; and data gaps (if any). In particular:

- What is known and can be reasonably predicted about how the Snake River might respond to breaching of the dams? What steps could be taken to influence how and the speed at which the river responds?
- What are the current impacts of management (e.g., spill or hatcheries) on salmon returns? How durable are those management efforts in terms of maintaining and increasing salmon populations?
- What are the key differences around conclusions regarding latent mortality and is there an opportunity to develop agreement around a quantitative estimate?
- What are the current foraging patterns of the Southern Residents and where are increases in salmon production (from hatcheries and restoration of wild stocks) accomplished most quickly, most cost-effectively and with most impact?

The current differing estimates of the impact of dam breaching on salmon populations and the lack of trust in the organizations providing the estimates is seen as a significant challenge to progress.

There also are opportunities to explore differences in perspective about the role of hatchery production relative to restoration of wild stocks, particularly in light of climate change and Southern Resident prey needs. Questions to explore could include: What should be the approach to balancing

between hatchery production and wild stocks to increase confidence in overall species survival and to meet interests around tribal and non-tribal harvest and Southern Resident prey needs? What is the role of hatcheries (if any) if dams are breached and how would any ongoing hatchery production be funded?

Section 5: Energy

Context

The four Lower Snake River dams are part of the broader integrated system of hydroelectric facilities that make up the Federal Columbia River Power System, the largest source of renewable electricity in the Pacific Northwest. BPA markets and delivers the energy generated by the FCRPS through the transmission system.

Each year the LSRD produce an average of 1,024 average megawatts (aMW) of carbon-free power (aMW is the total amount of energy produced by a plant divided by the 8,760 hours of the year) and have the ability to produce up to 3,033 MW of power at peak capacity. Table 6 provides more detail on the LSRD's power generating capacity. Because the LSRD are run-of-river dams and the total water flow of the river varies throughout the year, the dams do not always have significant water storage built up behind them. Therefore, the dams are only able to produce energy at peak capacity for a few hours at a time when there is both high water storage and high river flows.⁷⁰

Table 6: LSRD Power Generating Capacity⁷¹

Plant	Peak MW Capacity	aMW Energy
Ice Harbor	603	272
Lower Monumental	810	263
Little Goose	810	278
Lower Granite	810	211
Total	3,033	1,024

Reliability and Flexibility of LSRD

The entire BPA energy system operates on a second-to-second basis to match the demand for electricity throughout the regional system (referred to by power managers as “load”) which fluctuates throughout a day, week and season. The LSRD produce approximately 4% of BPA's annual energy portfolio. Most of the year, energy produced by the LSRD is not directly used to meet load demands but acts as reserves to ensure BPA has enough capacity to provide power reliability for utility customers. Typically, the LSRD supply BPA with one-fourth of its operating reserves.⁷² BPA uses energy from the LSRD during peak demands, most often in the winter months when energy loads are high due to individuals heating their homes and wind and solar power generation are at their lowest levels. During cold snaps or during emergency situations when energy production from other forms of generation may be negligible or unavailable, the LSRD can produce 10% of BPA's total capacity for 10 hours a day over a five-day period provided there is adequate river flow.

Depending on river flow, energy produced by the LSRD can quickly come online in the event another power generation source goes offline and address peak loads and unexpected increases in demand. Hydroelectric dams like the LSRD are responsive to fluctuations in the energy grid in that

they can come online and reach peak production more quickly than other forms of power generation.

In addition to power generation, the LSRD provide transmission stability and capacity. Power from the LSRD flows into 500-kilovolt transmission lines that integrate the LSRD into the power grid. Due to their location, the LSRD are an important transmission system link between the east- and west-sides of the Cascades. Ice Harbor Dam is the most important of the LSRD from a transmission point of view, because it provides power and voltage to the Tri-Cities, especially during peak demand in the summer and when food processing plants are operating at full capacity.⁷³

Current and Future Power Grid Stability

In June of 2019, hydropower accounted for approximately 76.2% of Washington's energy, with 10.2% from Natural Gas; 9.4% other renewables (biomass, wind, solar); 2.6% nuclear; and 1.6% coal.⁷⁴ The Washington Clean Energy Transformation Act requires all utilities in Washington to provide carbon-neutral electricity by 2030, with all coal to be phased out of the Washington energy grid by 2025. The Act calls for 100% clean energy by 2045.⁷⁵

The Pacific Northwest's total consumption of energy in 2013 was 19,400 aMW. Annual consumption is expected to grow by 0.5% to 1% a year, adding an additional 2,200-4,800 aMW by 2035. Because of relatively cool summers and low rates of air conditioning, the Pacific Northwest has historically had higher peak demand in the winter, when more people are using heat. This is shifting due to increases in air conditioning use and the gap between winter and summer peak usage is expected to shrink over time. The winter peak is expected to grow from 30,500 to 33,600 MW by 2035, at an average annual growth rate of 0.6%. The summer peak is expected to grow from 27,500 to 32,100 MW, at an average annual growth rate of 0.85%.⁷⁶

With the phase out of coal energy, BPA's ability to meet peak load demands becomes less certain. By 2024, there are 1,746 MW of coal planned to be retired, most of which comes from the Centralia and Boardman coal power plants. Additional coal power plant retirements are expected after 2024. While the amount of energy generated from Centralia and Boardman coal power plants is estimated to be entirely met by energy efficiency savings and demand response, the probability of a loss of load event, i.e., a large-scale blackout, occurring is expected to increase and exceed the NWPCC's reliability threshold if no other resources are added to the system.

The probability of a loss of load event occurring within the grid is called loss of load probability. Currently, the NWPCC uses a 5% LOLP standard as the measure of reliability for the region's electric grid. At the present time, the region's LOLP falls below the 5% threshold, but the NWPCC's present-day forecasts indicate the region's LOLP is expected to rise to 8.2% in 2024. Such loss of load events are more likely to occur in the winter and could last longer than in prior periods. It is during these winter periods that the LSRD are most valuable (or vital) for system balancing and reliability. Importantly, the NWPCC's current projections have been made assuming the LSRD energy production will be available to serve the system. The NWPCC's analytical work is ongoing in preparation for its 2021 Power Plan, including its forecast of the region's short- and long-term LOLP.⁷⁷

Role of Intermittent Renewable Energy Sources

In 2005 three Pacific Northwest states (Montana, Oregon and Washington) enacted renewable energy portfolio standards to encourage development of renewable energy resources. Since then approximately 8,500 MW of wind energy and approximately 540 MW of solar power have been added to the Pacific Northwest power grid. In 2012 the development of renewable energy resources slowed due to uncertainty over whether Congress would renew federal tax incentives. More recently, renewable energy development is on the rise again due to a variety of factors including Oregon developing a more aggressive renewable portfolio standard in 2016; large corporations like Apple and Microsoft developing renewable resources on their own; and the falling costs of wind and solar development. A NWPCC energy analyst stated, “Renewable energy costs have fallen so substantially that a renewable energy project could be constructed to deliver energy at a lower cost than an existing gas plant.”⁷⁸

The LSRD provide more reliability and flexibility than wind and solar can with current battery storage and energy distribution technologies and capabilities.⁷⁹ There is significant research and development occurring into energy distribution technologies and capabilities such as the Automatic Generation Control system that BPA uses on 10 of its 31 dams and intermittent sources. The Automatic Generation Control system allows energy operators to adjust energy generation from connected facilities on a real-time basis to meet the load. This system was updated in 2019 to allow BPA to optimize grid operation and improve flexibility for balancing reserves or secondary sales.⁸⁰

Replacing power provided by the LSRD would require finding renewable locations within BPA’s geographic range that have both high generation potential and are not so remote that the cost of distribution is prohibitive. A Northwest Energy Coalition report identified locations in Montana for wind power that already have power lines that could be available after local coal power plants shut down. Locations near existing power infrastructure were identified in Idaho and eastern Oregon that would be suitable for solar projects.⁸¹

Changing Energy Markets and BPA

Since 2013 the energy market has gone through a large-scale transformation due to a variety of factors such as wide-scale development of renewable resources; improvements in energy efficiency and demand response; the proliferation of low-cost natural gas generation; and periods of oversaturated wholesale markets that dampened sales of surplus energy. Before large volumes of renewable sources of energy entered the surplus energy market, BPA could sell their surplus energy on the open market for \$60–\$100 per megawatt-hour. As of 2019, the price has dropped to \$20–\$43 per megawatt-hour.⁸² Recently, when the energy market was oversaturated with solar energy from California, BPA had to sell its surplus energy at a net loss after taking the costs of fish and wildlife mitigation into account.⁸³

BPA recently began a process to join the Western Energy Imbalance Market, which connects most of the utilities west of the Rocky Mountains to support real-time energy trading.⁸⁴ Participation in the Energy Imbalance Market should lead to better market prices for BPA, especially for hydropower. For example, because California has a cap-and-trade program, energy providers in California want Washington hydroelectricity to supplement their portfolios because it is a renewable source that can generate electricity at night when solar is not generating. In addition, the flexible spill agreement was negotiated in part to position BPA for current opportunities in the energy market, it

aims to increase spill for most of the day to benefit fish, while also ramping down spill to increase energy generation during windows of higher energy demand and higher prices (e.g., evenings when solar generation decreases). In this way, flexible spill may help BPA compensate and adapt to changes in the energy market.

BPA is a self-financing federal power marketing agency that receives its revenue from the sale of electricity to its primary utility customers, not from taxpayers, and from sales of surplus power on the open market. BPA had to raise rates in recent years to maintain revenue due to increasing fish and wildlife costs and the changes in the surplus energy sales market.⁸⁵ However, for the past 35 years BPA has made all its payments to the U.S. Treasury on time and in-full. In fiscal years 2020–21, BPA projects to have sufficient annual revenue to pay of its annual debt payments.⁸⁶

BPA's recent fiscal challenges have led them to be more strategic with capital investments (such as major improvements to turbines) within its system of 31 dams. In its 2017–30 Hydro Asset Strategy, BPA laid out their preferred \$300 million annual plan for capital investments into hydropower generation assets from its ratepayers but were only granted a \$200 million annual plan.⁸⁷ BPA proposed total capital investments of \$425 million for the LSRD in the \$200 million annual plan and \$666 million for the LSRD in the \$300 million annual plan. In contrast, the Grand Coulee and McNary dams, which are much larger than the LSRD from an energy production standpoint, are scheduled to receive \$2 billion in capital investments through 2035.⁸⁸ These capital improvements are in addition to the \$50 million annually that it costs to operate and maintain the LSRD.⁸⁹

BPA's contracts with its preferred customers are set to expire in 2028. Many local utilities that have BPA contracts have seen substantial rate increases due to a variety of factors, like the recent changes to the energy market and costs associated with Columbia River Basin fish and wildlife mitigation.

Perspectives

Support for Retaining Lower Snake River Dam Energy Production

Stakeholders supportive of retaining the LSRD energy system believe that losing the energy generated by the LSRD would complicate achieving the state's clean energy goal of being carbon free by 2045. They see future population growth, the loss of coal plants, resistance to expanding the use of nuclear energy and climate change as reasons the LSRD are needed for the state to become a carbon-free system.

Supporters of retaining the LSRD note that, while on average Washington state has a surplus of energy, averages are not the most important measure when energy is operating close to the current maximum capacity. Reserves provide the flexibility to meet load demand with local or regional resources rather than add to the risk of brownouts or blackouts. LSRD energy reserves provide balance to the intermittency of demand needs. Supporters also noted that the power system may be over supplied with energy in the future, but the capacity for flexible distribution of power is decreasing, which is energy that can quickly be generated within the system in the case where other sources are not available.

Other energy sources, especially renewable sources like wind and solar, are not seen as providing the same level of flexibility or reliability that the LSRD provide. While the LSRD do not generate a significant portion of energy compared to the entire grid, the dams can be called upon quickly,

which is important to the reliability of the broader energy system. Supporters of retaining the LSRD believe the state's energy grid will not have the same level of power that can be quickly dispatched to the system when other non-hydropower renewable energy sources are not available, such as during extreme cold events in the winter when the dams are used most often.

In addition to the importance of the LSRD to the energy portfolio and grid overall, energy produced by Ice Harbor Dam is seen as fundamental to the energy needs of the Tri-Cities. Ice Harbor Dam provides 30–40% of the energy needs of the Tri-Cities during summer peak load and when food processing plants are operating at full capacity. Supporters of retaining the LSRD also brought up an equity dimension for BPA ratepayers: BPA's service area covers Washington, Oregon, Idaho and Montana, and it serves many small communities and customers who do not have the economic capacity to absorb the rate increases that removal of the LSRD could cause.

Supporters of retaining the LSRD believe the communities surrounding the Columbia and Snake river dams in eastern Washington were built and prospered because of the dams and depend on the inexpensive electricity provided by the dams. They believe that if the LSRD or other major electricity producing dams are breached, the surrounding communities will be devastated. Electricity provided by the dams is a major reason why large corporations like Microsoft and others have located facilities in eastern Washington. The electricity is central to the jobs that have been created.

Supporters of retaining the LSRD are concerned if the LSRD are breached there will be an increased focus to breach other dams on the Columbia River. The direct jobs provided by the Columbia and Snake river dams and the electricity they generate create economic benefits across the state and region. Aluminum manufacturing, which is supported by the low-cost electricity, supports the aerospace industries which total tens of thousands of jobs. Over decades, many of these jobs have become legacy jobs, meaning that multiple generations have been employed. The dams are not just an economic issue, they are seen by dam supporters as part of the history, legacy and heritage of people and communities across Washington. Dam supporters also questioned the logic of losing the electricity from the dams when there is a priority on achieving the goal of clean electricity by 2045. The closure process for the TransAlta coal plant is acknowledged as an example of the long transition necessary for the loss of a community's economic assets and the challenges for making a community whole in the process.

Supporters of retaining the LSRD do not agree with the assessment that the dams are in an extreme state of disrepair that is not conducive to positive operations of the system. They see the dams as being cost effective and being taken good care of by the USACE.

Support for Alternatives to the Lower Snake River Dams Energy Production

Supporters of alternatives to the LSRD believe the Pacific Northwest has a surplus of power, and the LSRD are not ultimately needed to meet energy needs or to successfully transition to a clean energy grid by 2045. They acknowledge that a transition strategy for energy would be needed but believe such a strategy can be successful and cost-effective, especially when weighed against the substantial benefits to salmon and Southern Resident orca recovery, which they believe would be a result of breaching the LSRD.

Supporters of breaching the LSRD believe that increases in solar and wind generation coupled with technology improvements for energy storage will support Washington state in meeting the 2045

clean energy goal without relying on the LSRD. They note that dam breaching would take time, and this time would allow for alternative renewable energy generating plants to be built, enhanced energy conservation to be implemented and improvements in energy storage technology to be realized.

Supporters of breaching the LSRD believe increasingly lower costs for renewable power generation from wind and solar will become more cost-effective than hydropower generation over the next 20 years, in addition to improvements in energy efficiency and demand response. Many referenced findings in a report from the NW Energy Coalition, who investigated the feasibility of replacing power and energy services provided by the LSRD with a portfolio of clean and renewable resources that support a reliable and adequate regional power system while minimizing increases to greenhouse gas emissions.⁹⁰

Supporters of breaching the LSRD believe a transition away from using power generated by the LSRD will cost less over time than maintaining energy production from the LSRD, especially when considering increasing maintenance costs and repair for the LSRD. Based upon findings from the NW Energy Coalition report on replacing LSRD energy, they believe it is possible to have increased reliability and flexibility now and more so in the future. They also referenced the NW Energy Coalition report's findings that increases to BPA ratepayers would only be 2–3% if LSRD energy were to be replaced.

Opportunities to Increase Understanding

There are three primary ideas related to energy-production that would need to be addressed in any continuing conversation about the future of the LSRD.

First, how to meet load demand in the near- and long-term with a decarbonized power generation system. Given the region's goal is to continue to decarbonize, this would include examination of questions such as:

- Will the state be able to rely on technologies improving for battery storage for wind and solar?
- Will there be certainty that the state can meet its energy needs with a decarbonized power generation system as the population grows and the climate changes?
- Will it be physically possible to replace the power portfolio of the LSRD?

Second, to determine if energy efficiency, demand response, wind and solar, or other carbon-free energy sources can replace the flexibility and reliability currently provided by the LSRD.

Third, any long-term discussion needs to acknowledge whether BPA ratepayers are willing to pay more and, if they are, how much more and under what circumstances. Utilities would likely object to paying for costs that are not directly related to the cost of producing energy, e.g., improving rail for agriculture would not be an appropriate expense.

Section 6: Agriculture

Context

There are approximately five million total acres of farmland within the eight counties surrounding the lower Snake River (Adams, Asotin, Benton, Columbia, Franklin, Garfield, Walla Walla and Whitman) in southeast Washington, which is approximately 33% of the total farmland in the state.⁹¹ Agricultural production in the areas surrounding the LSRD includes both dryland and irrigated farming.

The area surrounding the LSRD is part of the Palouse region. The Palouse region has a combination of deep, fertile soil and temperate weather that supports dryland crops like wheat, lentils and dry peas, and the lower Snake River near Burbank, Washington, supports irrigated farming like potatoes, onions, grapes, peaches and apples. Over the last several decades, farmers in southeast Washington have significantly increased productivity of the food grown per acre. Average production of wheat per acre in southeast Washington has increased from approximately 25 bushels per acre to as high as 90 bushels per acre. During the same period, soil erosion has decreased by over 85%. By reducing soil erosion and retaining crop residue on the land after harvest, farm families have made major progress preserving soils and helping to keep streams cleaner.⁹²

Dryland Agriculture

In southeast Washington non-irrigated, or dryland, agriculture is dominated by grain production. The primary crop is soft white wheat, which is highly desirable in Asian countries due to its low moisture content and is used to make noodles, steam breads and cakes.⁹³ In 2017, over one million acres of dryland wheat were harvested in the eight counties surrounding the Snake River.⁹⁴ The local grain economy relies on a complex set of relationships between grain producers (farmers), cooperatives, transporters, exporters and customers, who are all also part of an equally complex and competitive global market.

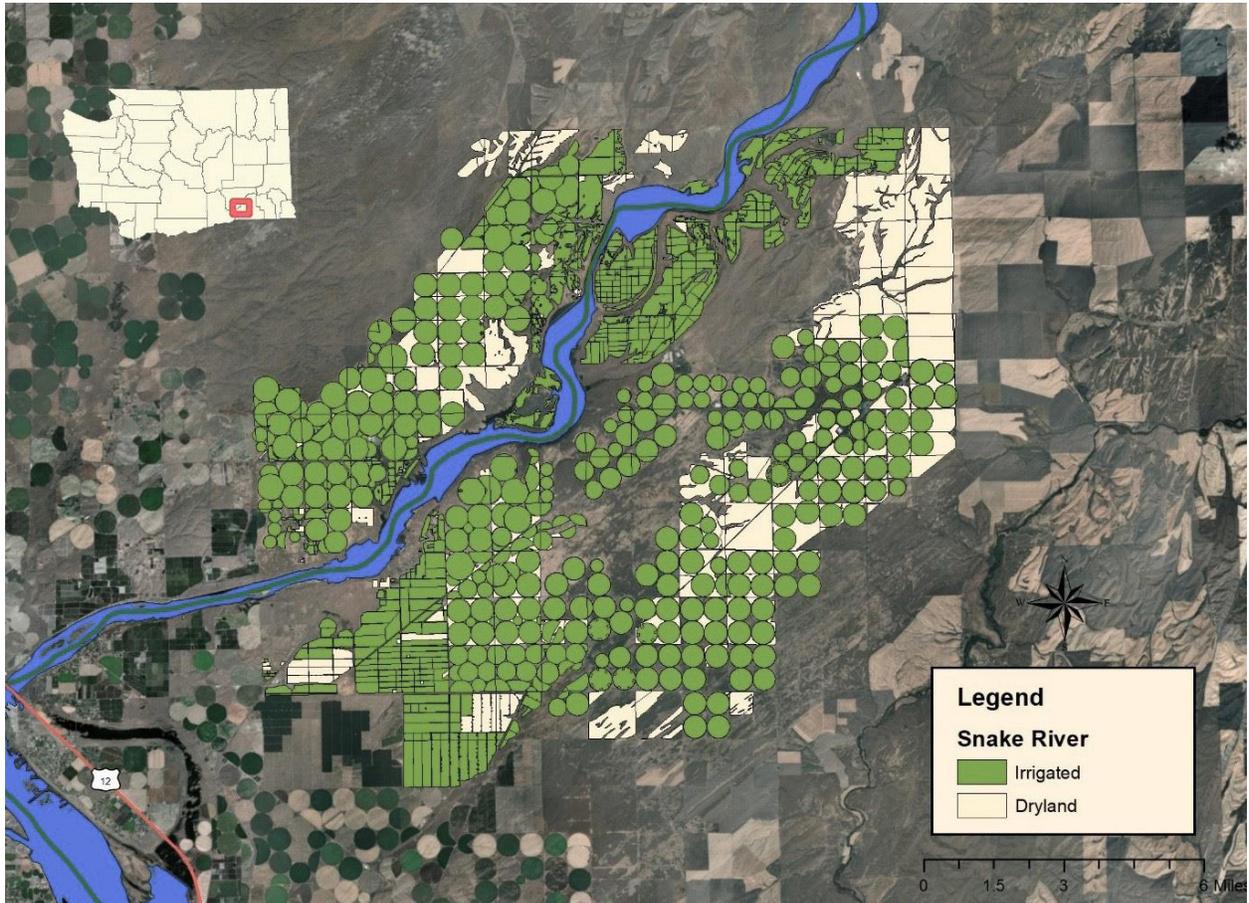
Most grain producers in eastern Washington, including in the areas around the LSRD, are part of grain cooperatives.⁹⁵ Cooperative sizes range from several hundred members to up to 15,000.⁹⁶ In areas around the LSRD local farmers truck their product to nearby “up country” grain elevators owned by the cooperatives. At the time of sale, the cooperatives move the product either to a barge terminal on the river or to a rail unit loading facility for transport to one of the exporters on the lower Columbia. Exporters load the grain onto a ship for transport to customers.

Eighty to 90% of the grain grown in the area around the LSRD is shipped overseas.⁹⁷ Shippers and exporters noted most of the grain is purchased by overseas buyers who actively track and respond to activities in the global marketplace. Pacific Northwest wheat growers compete with producers in Canada, Russia and Ukraine.⁹⁸ They currently have a slight competitive advantage due to high product quality and a low price point. The ability to transport wheat downriver by barge contributes to the price advantage because it is the least expensive means of transport for cooperatives close to the Snake River.

If the LSRD are breached, it would eliminate barging down the Snake River because the lower river depth would not be sufficient for barge transportation. This would be a significant change for

dryland farmers, many of whom rely at least in part on barge transportation for their crops. See Section 7: Transportation for more discussion of the relationship between dryland agriculture and transportation. Figure 7 shows irrigated and non-irrigated land near Ice Harbor Dam.

Figure 7: Map of Irrigated and Dryland Agriculture Near Ice Harbor Dam⁹⁹



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Irrigated Agriculture

The LSRD currently support approximately 47,000 acres of irrigated farmland through water drawn from Lake Sacajawea, the reservoir created by Ice Harbor Dam. Lake Sacajawea is the only reservoir of the four LSRD that provides direct irrigation.¹⁰⁰ Farmers in this area draw water directly from Lake Sacajawea (approximately 37,000 acres) and take advantage of the higher groundwater table created by the dams (approximately 10,000 acres). Fruit orchards are the predominate irrigated crop within one mile of the river, and vegetables, like onions, potatoes or sweet corn are more common within five miles.¹⁰¹

Irrigated farming requires significant resources and staffing. For example, a 16,000-acre farm near Eureka has 45 full-time employees as well as hundreds of temporary farm laborers that work on the farm during harvest and planting seasons. Interviewees suggested a farm of comparable size on dryland would only require approximately three full-time staff.

Irrigated farmland also is more profitable than dryland. Several interviewees estimated that an irrigated acre generates \$3,000–\$5,000/acre annually and dryland wheat production generates approximately \$100–\$240/acre annually. The 2019 ECONorthwest economic analysis cited USDA Agricultural Census data, which found “on average farmland values in Washington state show a \$7,400 premium for irrigated over non-irrigated acres. This Washington state premium for irrigated farmland is greater than the premium in Oregon (\$2,900) or Idaho (\$3,850).”

In 2018, approximately 10,000 acres of land irrigated by Lake Sacajawea produced 6.3 million pounds of potatoes which the producer sold for \$49.6 million, supporting over 2,000 jobs. The indirect value of these potatoes was \$467.2 million and hundreds more jobs. In the same year, 8,000 irrigated acres produced 316.8 million pounds of apples for a farm market value of \$108.6 million.¹⁰²

If the LSRD are breached, specifically Ice Harbor Dam, impacts to irrigated agriculture — for both farms that draw directly from the reservoir and groundwater users that rely on the groundwater table created by the dams would need to be addressed. The Department of Ecology Water Rights Tracking System lists 41 total surface water diversions and 84 wells within one mile of the lower Snake River that would be impacted by water level changes if the LSRD are breached.¹⁰³ Irrigators and out-of-stream users rely on the LSRD; removing Ice Harbor Dam would significantly disrupt these systems and change the water supply. Mitigating these changes would require the cost of lowering intake structures, creating additional pumping capacity, digging deeper wells and other operational changes. Other options to address water constraints could include changing crops to accommodate new water supply, fallow during periods of water interruption or selling water rights to other users. There also is a question about the change in certainty for farms drawing water from a free-flowing river compared to the current water withdrawals from the reservoir.

Perspectives

Support for the Current Barge Transportation and Irrigation Systems

Stakeholders reliant on and supportive of the current dryland agricultural system believe if the dams are breached it would lead to increased shipping costs and a downturn in the overall grain economy due to the loss of barging. (See Section 7: Transportation for more discussion). Breaching the dams could lead to the loss of family farms, local community economic viability and the overall way of life that they see the dams and barge system as having supported through lower grain transportation costs and the ability to irrigate farmland. They see the growth of agriculture in the Palouse region over the past several decades as one of the biggest gains in productivity and stewardship of any generation, and the loss of barge and transportation is seen as a threat to these gains.

The grain economy relies on very tight profit margins, and the dams provide an efficient and reliable way to get a large portion of their product to market by barge. Some farmers projected that in the next 20 years there will be approximately 25% more grain produced in the area surrounding the LSRD and feel that this increased production is not being taken into consideration by those who think grain shipping can easily move to other modes.

Supporters of the current agricultural system suggest that if the LSRD were breached, the new water levels would not be stable enough to provide reliable irrigation which would lead to increased costs, uncertain infrastructure upgrades, uncertainty of water supply and shifts in the type of agriculture that is viable. Without irrigation, they anticipate widespread job losses for those working in the irrigated farm economy, causing a negative effect on the broader local economy and surrounding communities.

The reduction in certainty of water availability would increase capital costs for farmers due to increases in infrastructure and energy needs. Anecdotal information from interviews suggests that if pumps are lowered to reach lower water levels, the energy costs for irrigation would increase by approximately 20% or more. Energy expenses are one of the highest costs for irrigated agriculture drawing water from Lake Sacajawea.

Some farmers are skeptical of the feasibility of moving to other areas down river if they are displaced from their current farms because of lack of access to water. Irrigated farms like orchards or vineyards do not have the flexibility to quickly shift their operations given that trees and vines are a significant sunk cost that are impossible to move and would require large-scale capital investments to replicate elsewhere. In addition, producers do not see that there are options for moving to new areas based on soils, geography and current land use.

Concerns about the potential impacts of breaching the lower Snake River dams on irrigation water supply extend to farmers well downstream of the dams. There is concern that sediment released from behind dams would settle in downstream reservoirs and reduce access to (or significantly increase costs of) irrigation water.

Support for Alternatives to the Lower Snake River Dams

Many of the people interviewed who support alternatives to the LSRD believe it is important to make agriculture “whole,” so local farmers do not suffer significant economic losses if the dams are breached. Some mentioned that if farmers cannot be made whole, their support for breaching the dams would change. What is meant by “making agriculture whole” is so far not defined. Suggestions included paying for the infrastructure to lower irrigation pumps and wells; subsidizing the increased cost of energy required to pump water; subsidizing farmers for their increased transportation costs; and building or upgrading infrastructure for storage and transportation. Supporters of breaching the dams believe these costs would be less than the cost of ongoing maintenance and repair of the dams and locks. These issues are discussed in more detail in the transportation and economic sections of this report. In addition, it is estimated approximately 5,000 acres of the 14,000 acres currently underneath the LSRD reservoirs could potentially be used for farming if the dams are breached. Some also questioned if growing wheat, and specifically the type of wheat grown on the fertile soils of the Palouse, is the best use of those rich soils.

Opportunities to Increase Understanding

If the LSRD remain in place, significant changes to the current agricultural system are not likely beyond whatever shifts in production and farming costs the domestic and global marketplaces dictate. If there is continued interest to understand the implications of breaching the LSRD, what it would mean to make agriculture “whole” if river transportation is not available through the LSRD needs to be defined specifically. This includes clearly identifying the costs and timing to implement surface water and groundwater infrastructure improvements if the dams are breached, including intake facility modifications into a lowered surface elevation and free-flowing river pump modification costs for municipal and other industrial water users and irrigation well modifications. More research is needed to identify how to provide certainty that farmers can pull the same levels of water they are currently using, especially in the event of a low flow year or with a changing climate. Defining who would finance or subsidize this work and compensate for impacts would also be needed.

Section 7: Transportation

Context

The transportation network that serves the region surrounding the LSRD is a multi-modal network of rail lines, barge and trucks on the Columbia-Snake River lock system. The transport of grain is an example of the use of the multi-modal network: Farmers use trucks to move their grain to nearby storage facilities. Rail and barges are used to move the product to exporters on the lower Columbia River. Of all the grain exported through the lower Columbia River, approximately 40% is by barge and 60% is by rail, with a high percentage of the rail volume coming from the Midwest.¹⁰⁴ How far away farmers are from the river affects their choice for how their product moves to market. In the Pacific Northwest, farmers in eastern Oregon, northern Idaho, and southern Washington move approximately 90% of their grain by barge, while farmers in northern Washington or southern Idaho only move an average of 18% of their grain by barge along the Columbia and Snake river navigation system.¹⁰⁵

Barge Transport

The LSRD and their associated locks allow local agricultural producers and shippers to market and transport agricultural products downstream and move other materials by barge up and down the Lower Snake River between the Tri-Cities and Lewiston/Clarkston, with most downstream movement of products destined for the Port of Portland. A similar system of locks and dams on the Columbia River provides access to OR Pacific Ocean ports (Portland and Astoria, OR) making Lewiston, Idaho the farthest inland water port on the West Coast.

Figure 8 displays the Columbia and Snake river navigation systems. As can be seen, the width of the river progressively grows larger to express the additional amount of food and farm products that enter the system downriver.

Figure 8: Downriver Food and Farm Products Flows (KTons) Between April 2017 and March 2018¹⁰⁶

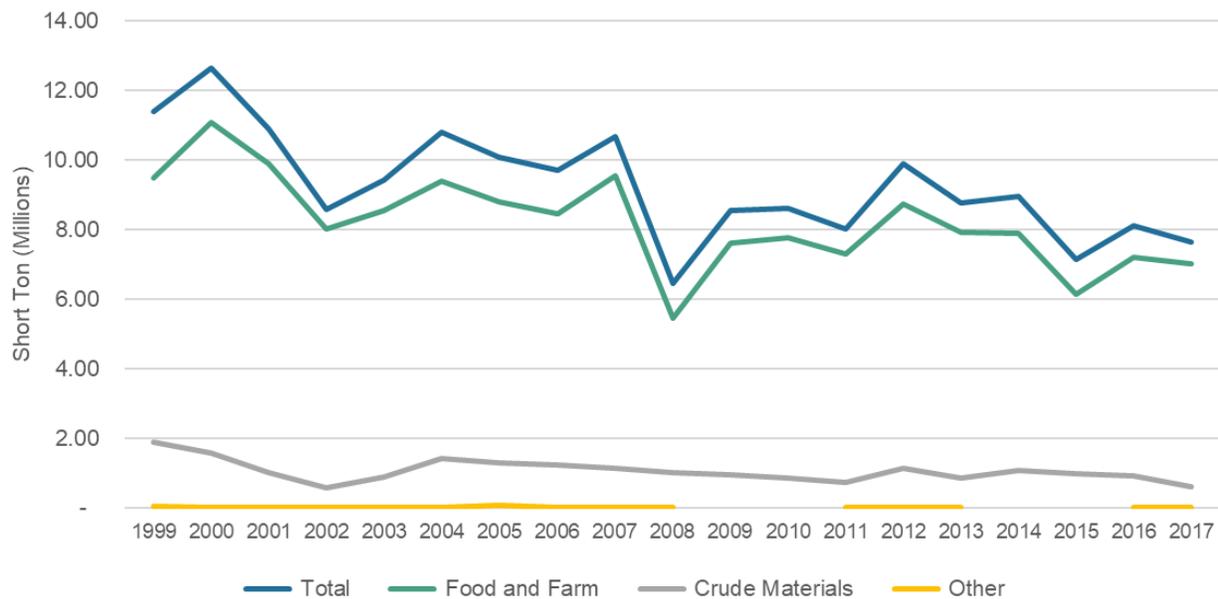


Source: ECONorthwest with data from U.S. Army Corps of Engineers Lock Performance Monitoring System

Washington is the fourth-largest wheat producing and wheat exporting state in the nation.¹⁰⁷ Whitman County has been the nation's top wheat producing county in the nation since 1978. Eighty to 90% of the grain grown around the LSRD is ultimately shipped overseas,¹⁰⁸ approximately 90% of the tonnage shipped downstream on the Snake River is grain and other food products produced in southeast Washington.¹⁰⁹ ¹¹⁰ Approximately 45% of all barged grain (primarily wheat) coming out of the Columbia River system is from the area around the LSRD, with the remaining 55% of grain entering the system below Ice Harbor Dam. Other commodities like agriculture supplies, logs and sawdust, fuel and chemicals, municipal waste, manufacturing equipment and machinery travel upstream from ports on the Columbia into the LSRD region. Figure 9 displays the downriver tonnage by major commodity for the Snake River between 1999 and 2017. The transport of grain has a widespread effect for agricultural producers throughout southeast Washington and the transport of other materials by barge provides flexibility and reliability for other products and industries both in and beyond the LSRD region.¹¹¹

One reason for the decrease in barge transportation in recent years is the loss of container shipping from the Port of Portland which ended in 2015. However, the port recently announced the return of container shipping.¹¹² This could encourage an increase in barge shipping through the LSRD in the future.

Figure 9: Downriver Commodity Flows on the Snake (1999-2017)



Source: U.S. Army Corps of Engineers

The system of locks and navigation aids in the lower Snake River is federally supported by a tax on commercial barge diesel fuel. This funding source is known as the Inland Waterways Trust Fund. The IWTF provides ongoing federal investments in maintenance and operations and major rehabilitation and construction for lock and navigation aid repairs.¹¹³ In recent years, construction, operations and maintenance costs nationwide, including for the LSRD, have exceeded the tax revenue in the IWTF. Stopgap funding was provided under the American Recovery and Reinvestment Act of 2009; however, given the age of the dams, future significant investments will be required to maintain their viability (such as rewinding turbines).

Rail Line Transport

Railroads are used for multiple purposes throughout Washington, including moving freight between cities or states and moving people commuting for work or to cities in other states. In 2007, nearly half (41%) of all interstate freight was hauled by rail and a quarter (27%) of all wheat produced in the state is transported by rail at some point.¹¹⁴ In the area surrounding the lower Snake River, there are both mainline and shortline railroads. Mainlines are larger rail lines which provide higher freight capacity and more frequent trips over longer distances between destinations. Shortline rail lines are shorter in distance, usually less than 100 miles, with fewer trips and less freight capacity. The mainline rail companies near the lower Snake River are BNSF and Union Pacific.¹¹⁵ Shortline railroads include Camas Prairie Railnet, Port of Columbia Railroad, Blue Mountain Railroad, Columbia Basin Railroad and the Palouse River & Coulee City Railroad.¹¹⁶ In Washington there are 1,346 total miles of shortline rail, 600 miles of which are privately owned and the remaining 746 miles are publicly owned. The longest of these is the Palouse River & Coulee City Railroad, which is owned by the Washington Department of Transportation.¹¹⁷ While a lot of the rail infrastructure that existed before the LSRD were constructed remains, much of it is in disrepair and would require improvements to be relied on in the future.¹¹⁸

Truck Transport

Trucks are the most expensive and carbon intensive form of transportation within the system.¹¹⁹ The main purpose that trucks serve in transporting agricultural products in the region is to move the grain from farms to nearby ports if the farm is located within 50 miles of the river, or to the grain cooperative elevators if the farm is located further away. Trucks are also used to move perishable produce like apples or potatoes to either processing or distribution facilities.

Safety and Emissions

Compared to rail or trucks, barging is the safest method of moving cargo. There are lower numbers of injuries, fatalities and spill rates from barge than both rail and trucks. For every one injury on the Inland marine navigation system, there are 125.2 injuries on rail and 2,171.5 injuries on highways.¹²⁰ If the LSRD are breached, there would likely be increased greenhouse gas and other air pollutant emissions due to the increases in truck transport to other rail services or barges downriver.¹²¹ A 2017 Texas Transportation Institute study found that barge towing emits 15.6 grams of CO₂ per ton-mile, rail emits 21.2 grams of CO₂ per ton-mile, and trucks emit 154.1 grams of CO₂ per ton-mile.¹²²

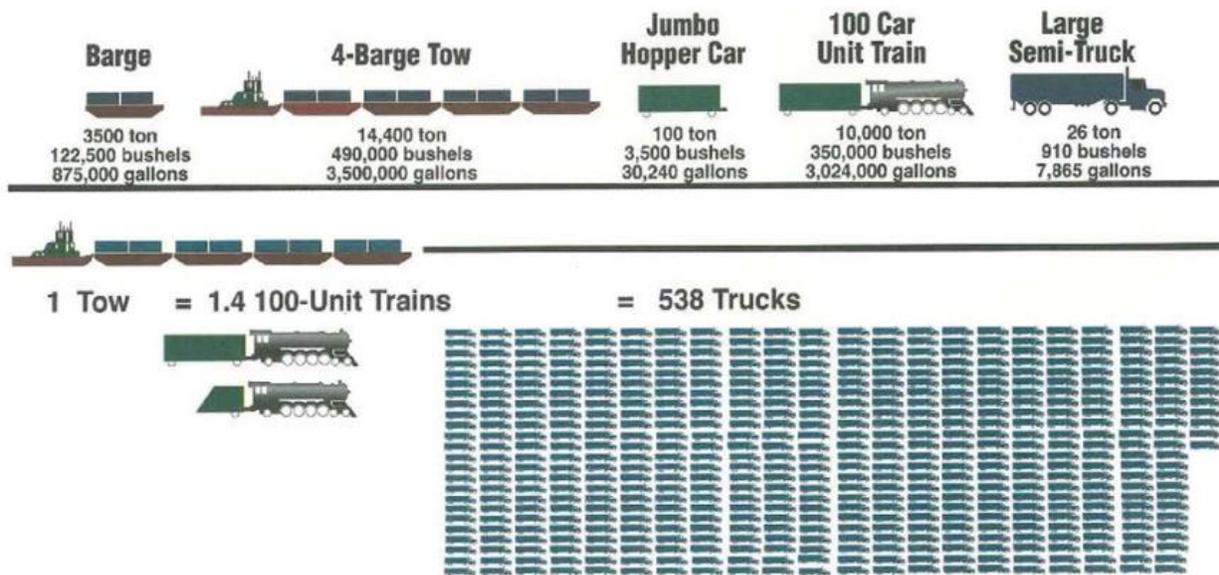
The Transportation Network

Local agricultural producers, cooperatives and shippers take numerous factors into account when determining which modes of transportation to use. As discussed above, trucks are used to transport grain from the field to the local cooperative. Depending on the location of the cooperative in southwest Washington, they transport their grain by rail, barge or, in some cases, have the option to choose either.

The exporters on the lower Columbia receive orders from customers for grain and a timeframe for delivery. The exporter arranges for transport from their facility on the lower Columbia to the overseas customer. They solicit supply from cooperatives in the LSRD region and producers in other regions. These solicitations often specify the amount of grain they want from rail and water transport. Exporters report that having two modes of transportation for the exporter to choose from is important for reliability, flexibility and cost. While it generally costs more to transport grain by rail, rail is generally faster to unload and transfer to ships. Barge transport is generally less expensive, and the timing of delivery is more predictable.¹²³

Exporters, producers and shippers report that having access to both rail and barge transportation helps them create the most cost effective, cost competitive and reliable transportation combination tailored to the specifics of each shipment. Figure 10 shows that for every four-barge tow that is used to move product along the navigation channel the equivalent amount of freight would take 1.4 100-car unit-trains or 538 semi-trucks. Barging is more fuel efficient than the other two methods of transportation and for every single injury that occurs due to barge transportation, 125.2 injuries occur on rail and 2171.5 injuries occur on highways.¹²⁴

Figure 10: Freight Comparison of Barges, Trains, and Trucks¹²⁵



Source: Pacific Northwest Waterways Association

Transportation Trends

Over the past 20 years, the transportation infrastructure in southeast Washington around the LSRD has evolved. Investments in capacity of shortline rail, mainline rail, port terminal capacity and barging capacity have occurred. For example, a number of facilities, such as Wallula, Endicott¹²⁶ and McCoy Terminal¹²⁷ have built relatively new facilities to increase the transport of grain from both the Snake River and Midwest, and in the last 20 years there have been 10 new grain barges built for transport of grain on Columbia River.

Rail Loading Facilities and Shortline Rail

Over the last several years, grain cooperatives have constructed multi-unit railcar loading facilities in the area around the LSRD. The shift to multi-unit railcar loading facilities was in response to mainline rail companies, including BNSF and Union Pacific, no longer being willing to pick up a few railcars from more dispersed storage facilities. These multi-car facilities load 100 or more railcars at a time. There are currently five multi-car loading facilities in southeast Washington with another being built in Dusty, Washington. Some of the loading facilities are located where it is not cost effective to ship by barge and several are located where both modes are possible.

Shortline rail is used to transport grain from a local storage facility (upcountry) to either a multi-unit railcar loading facility or to a port on the Columbia for shipping downstream by barge. These shortline rail systems are owned and operated by a combination of state and private entities. The Washington Grain Train currently serves over 2,500 cooperative members in southeast Washington; this rail line is unique in that the railcars are publicly owned by the state, but the tracks are operated by BNSF and Union Pacific and move grain to facilities on the Snake River. This shortline rail operation is composed of 118 hopper cars, operates without any taxpayer subsidies, and helps to preserve shortline railroads in the region by generating revenue that can be used to upgrade existing infrastructure. The state of Washington purchased the cars because there was a national shortage of

railcars, which made it hard for Washington farmers to get their grain to market in the early 1990s. Washington State Department of Transportation used federal funds to purchase railcars to assist in the movement of grain from elevators in the east to export facilities in the West.¹²⁸

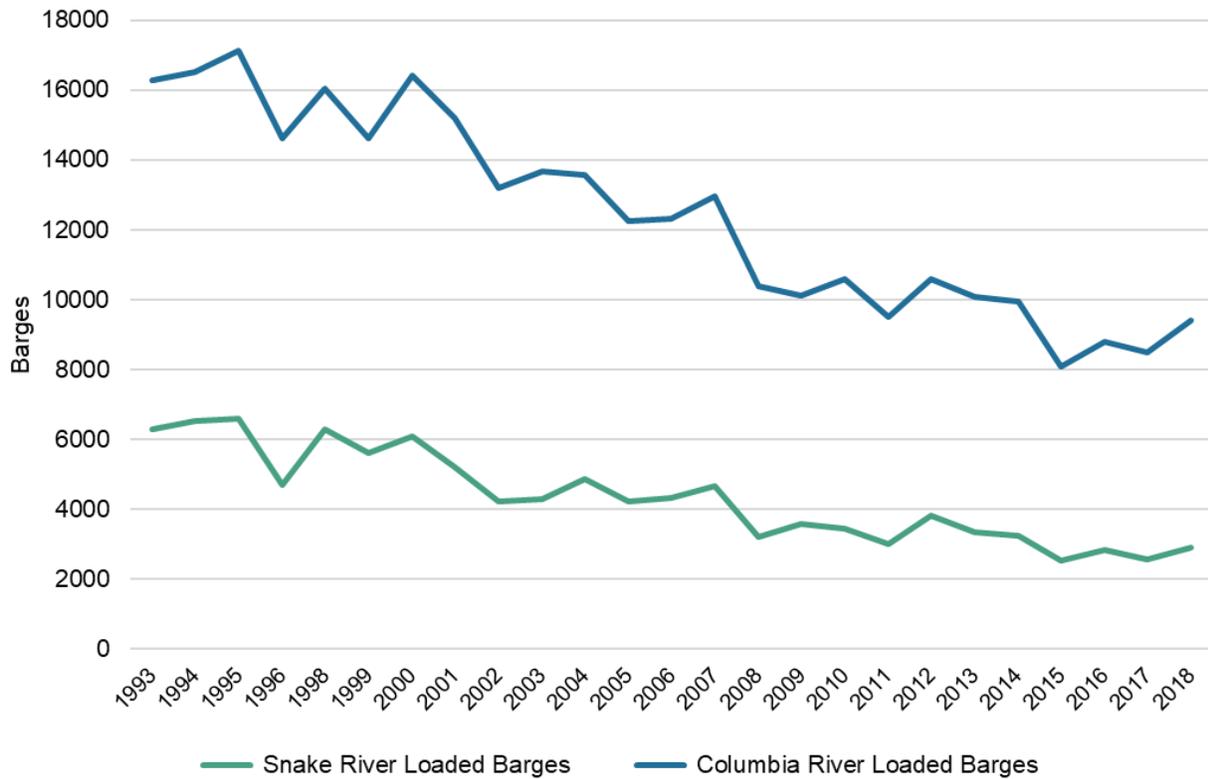
Mainline Rail

Improvements have been made over the past several years to the infrastructure and operation of the mainline railroads to increase the capacity to transport materials from southeast Washington. During the Bakken Oil Boom in winter 2013, large volumes of oil were exported from North Dakota. There were system capacity constraints because the weather conditions prevented freight from being moved quickly, which led to issues with moving grain out of eastern Washington because trains were tied up moving oil. Since 2013, BNSF has made significant investments in infrastructure improvements between Chicago and Seattle to reduce the possibility of a situation like this occurring in the future.¹²⁹ With the refurbishment of Stampede Pass to allow double-stack trains to pass through, the overall efficiency of the Pasco to Portland rail network has increased. Trains are loaded at multi-car loading facilities in eastern Washington and travel along the Columbia River to export facilities in Portland. The empty trains then travel north to Auburn and are routed east over Stampede Pass to then be reloaded; creating a highly efficient loop. There has also been a recent expansion in rail improvements from Spokane to Portland.¹³⁰

Barging Capacity

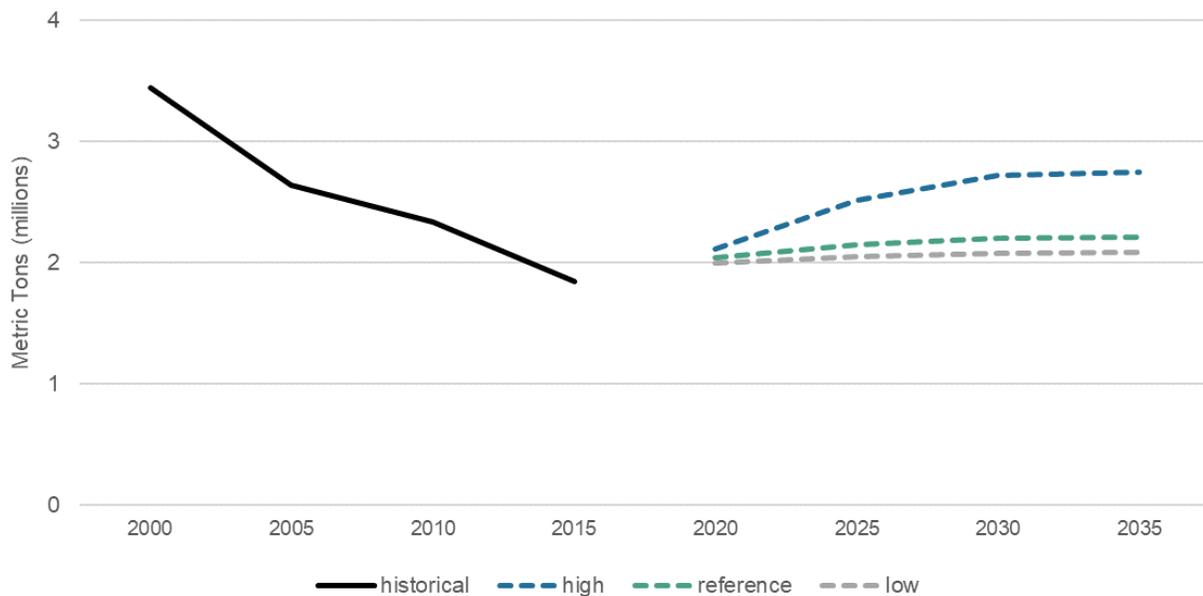
Transport of commodities by barge has trended downward in recent years on the entire Columbia and Snake river system. In 2000, a total of 13.8 million tons on 6,071 barges was transported versus 7.8 million tons on 2,554 barges in 2017.¹³¹ Figure 11 below summarizes lockage data along the Columbia and Snake rivers from 1993-2018. This downward trend is largely due to restrictions on the shipment of hazardous materials by barge on the Snake River and declines in markets like pulp and paper and manufactured goods. The downward trend can also be attributed in part to the end of container shipping at the Port of Portland in recent years, which was used to move pulp and paper products as well as hay and lentils. These commodities are now trucked up to Tacoma or Seattle to be exported from those ports by container. In the past five years, there also have been investments in two new upstream fertilizer facilities at the Port of Wilma across the river from Clarkston, one built by the McGregor Company and the other by Cenex Harvest States.¹³² These relatively new facilities are expected to increase the amount of upstream movement of commodities by barge. A 2017 report prepared for the Washington Public Ports Association estimates continuation of current levels or modest growth in the amount of overall grain transport by barge (see Figure 12). The gap from 2015–20 in Figure 12 is because historical data was only available up to 2015 and projections begin in 2020.

Figure 11: Lockage data along the Columbia and Snake rivers from (1993-2018)¹³³



Source: US Army Corps of Engineers

Figure 12: Snake River Waterborne traffic above Ice Harbor Lock Current Trend and Future Projections¹³⁴



Source: BTS Associates (2017)

If the LSRD are breached, it would no longer be feasible to transport materials by barge on the lower Snake River. Barge transportation would still occur between Tri-Cities, Washington, and the lower Columbia. The Tri-Cities is approximately 100 miles downriver from Lewiston, Idaho. Grain cooperatives that currently transport by barge on the lower Snake River would have to truck to Tri-Cities to load on barges, to an existing unit rail-loading facility or construct new unit rail-loading facilities. These changes would create the need to improve road, rail and other infrastructure and result in an increased cost for transport of grain.

Perspectives

Support for the Current Transportation System

People reliant on and supportive of the current transportation system believe that a multimodal shipment system (i.e., barge, rail and truck) is necessary for competition and capacity, and the removal of one major mode (i.e., barge) would have disastrous ramifications on farmers and the local economy (see Section 7: Agriculture). They equate the loss of barges with a loss in cost advantages and reliability and worry that dam removal would create a de facto monopoly for the rail companies. Supporters of the current transportation system do not see the 2010-11 and 2016-17 lock outages as a meaningful example of a potential shift to a rail-centric system. They noted that these outages were part of broader lock navigation management plans and they received upwards of a one-year notice which allowed for extensive preplanning.

If rail is the only viable transportation option, supporters of the current transportation system worry that farmers would be at the mercy of private rail lines to set prices because competition would be eliminated. Having barge cargo capacity as an alternative is seen as keeping trucking and rail rates competitive.

Barges are considered more efficient, cleaner and safer for the public than other modes of transport like rail or trucks. Supporters of the current transportation system questioned why there would be a push to shift from what they see as a cost-effective, safe, low-carbon mode of transport to higher carbon emission modes of transport like trucks and rail. They cited a 2017 report regarding greenhouse gas emissions from freight transport that found that barge produces 15.6 grams of CO₂ per ton-mile, 21.2 grams of CO₂ per ton-mile for Freight, and 154.1 grams of CO₂ per ton-mile for trucks.¹³⁵ Barges use less fuel per ton of cargo and are seen as supportive of the state's efforts to reduce carbon emissions and allow for safer roadways without the increase in trucks.

Barge transport is seen as a more service-oriented transportation provider and more responsive to customers' needs to move product. Supporters of the current transportation system note that this responsiveness is especially important when engaging in a complex global wheat market. The global market for wheat is highly competitive; producers in southeast Washington compete with other wheat growers in the world. Price, quality and reliability are key factors for customers in choosing who they buy from. The customers have a sophisticated understanding of the market and frequently ask questions about issues of transportation capacity and reliability to ensure they can trust their suppliers.

Supporters of the current transportation system also question the ability to sufficiently expand the rail and roadway system both in the LSRD region and on the main lines. Some see existing rail congestion in Lewiston as an issue and are skeptical of the economic feasibility and practicality of

adding what could amount to 300 miles of shortline rail improvements. They also question the feasibility of purchasing a significant amount of right-of-way, which could include the condemning property and relocating residents to implement rail improvements.

Even if the rail improvements in the LSRD region could be addressed, they question the capacity to increase transportation on the main lines, especially downstream along the Columbia River. Finally, supporters of the current transportation system note that the recent investments in barge facilities by grain cooperatives, local ports and private facilities, some of which have recently invested millions of dollars in support of water transportation by barge, would all be lost, along with significant job losses.

Supporters of Alternatives to the Barge Transportation System

Many of the people interviewed that support breaching the LSRD believe that if the dams are breached actions should be taken to improve the rail and road transportation system as alternatives to the existing barge transportation system. Rather than retaining the lock systems at the LSRD, they see investments in rail line and road/highway improvements as more cost effective in the long run.

Supporters for breaching the dams often cite the ECONorthwest 2019 economic analysis findings regarding the shipping cost increases: “The net annual increase in shipping costs to the region as a result of LSRD removal is \$6.2 million. The evaluation of the full suite of benefits and costs indicates that there are numerous costs that are not incorporated in the transportation of products via barge. Significant federal appropriations are dedicated to operating transportation infrastructure on the LSRD that are not recovered via the USACE fuel surcharge and are borne by the federal government. A comparison of solely the transportation costs and the federal appropriations indicates that barge transportation along the lower Snake River would not be viable without this subsidy. There are, however, additional public costs that need to be accounted for should the volume of products currently projected to ship via barge switch to another alternative.”

There is acknowledgement that barge shipping is less expensive for transporting grain to lower river facilities than truck or rail, but supporters of alternatives to barge transportation system cite the significant amount of federally appropriated funds dedicated to maintaining the locks that allow barges to travel up and down the river, as well as the fact that most of the product transported by barge is shipped overseas. Rather than using these federal subsidies to continue the barge system, and with salmon recovery and restoration efforts funded by BPA seen as less effective, those who support breaching say investment in transportation upgrades could make better economic sense and be coupled with increased salmon abundance.

The growth in multi-car loading facilities is cited as an example of a trend toward more use of rail for transport of grain even with barging options still in place. Supporters of breaching the LSRD believe this trend could be built on with additional investments in rail and highway transport if the LSRD are breached.

The recent lock closures in 2010–11 and 2016–17 were also cited as examples of what a new rail-centric transportation system could look like around the Snake River. A Freight Policy Institute study found that during the 2010–11 closure over 90% of the grain by volume was shipped by rail, and there was an increase in shipping and storage cost shipments of almost 40% for shippers. There

were also increases in shipping in the months leading up to the outages, as shippers made coordinated efforts with overseas buyers to ensure there were no major changes in the supply chain.

Supporters of breaching the LSRD see a future where the transportation needs of local farmers are still met. They acknowledge that the resulting shift in the transportation system would require investment in infrastructure and potential subsidies for farmers and cooperatives, and that there may be emission increases due to the increased use of trucks and rail but believe the benefits of breaching the dams would outweigh these impacts.

Opportunities to Increase Understanding

If the LSRD remain in place, significant changes to the current transportation system are not likely beyond whatever shifts in rail and handling capacity are already underway, or other shifts in the domestic and global grain marketplace. If improvements needed for operations and management of the lock system continue to be delayed and unfunded, there could also be more frequent lock outages or disruptions to the current barge system. Otherwise, the existing transportation system is apt to operate in a similar fashion to the way it has in recent years.

There are two primary issues that need to be addressed if there is continued interest to understand the implications of potentially breaching the LSRD and the full effect of losing the barge transportation system: First, more detailed analyses are required to determine the viability and costs associated with the necessary main-line rail, short-line rail and road and highway network improvements to accommodate the loss of the barge system. The question of when the improvements would occur in relation to the dams being breached would also need to be determined to ensure agricultural producers and shippers do not face a significant loss if/when the dams came down. Second, the source(s) would need to be determined for funds and compensation provided to farmers, cooperatives, ports and potential private companies for the improvements to infrastructure, lost capital and increased cost of shipping.

Section 8: Recreation

Context

The reservoirs, dams and shorelines on the lower Snake River provide land- and water-based recreational opportunities and access. Land-based recreation includes hiking, camping and hunting; water-based activities include fishing, swimming and boating. The USACE operates and supports 58 parks and recreational facilities along the lower Snake River.¹³⁶ There are four state parks and three recreation areas managed by Washington State Department of Fish and Wildlife. In addition, there are numerous parks and recreational sites operated by local cities, counties and ports. The current reservoir system also allows for large river cruise boats that bring tourists up the Snake River to Clarkston, IDAHO. The biggest draw for cruise boat tourists is to visit Hells Canyon Recreation Area on jet boats.

If the LSRD are breached the river will shift from a series of flat-water reservoirs to free-flowing. The shift to a free-flowing river would result in the loss of some existing recreational opportunities and create the potential for growth of new recreational opportunities. The 2002 EIS evaluated 33 recreational areas that would be affected if the LSRD are breached, and found that 11 would close entirely, two would be closed to river access and 18 would require modifications for river access. Nine marinas would no longer exist, and all current swimming beaches would be impacted by changes in water surface elevations. Recreation that relies on motorized boats is likely to experience an economic loss from dam breaching while non-motorized boaters will likely experience an economic benefit.¹³⁷

New whitewater recreation opportunities may be realized if the LSRD are breached. Before the LSRD were constructed, the USACE identified 63 rapids between Lewiston, Idaho, and the confluence with the Columbia River.¹³⁸ Salmon recovery efforts afforded by dam removal also may increase recreational and sportfishing opportunities. Some of the existing activities that currently occur on reservoirs, like certain fishing, boating and wildlife opportunities, could continue with a free-flowing river.¹³⁹

Perspectives

Support for the Current Recreational System

Supporters of the LSRD and its associated reservoirs want to maintain the significant use of parks that already exists and preserve the value of investment in boats and other equipment for the lake environment. They see the existing parks and other recreational facilities that would be closed or modified by dam breaching as vital parts of the local communities and losing these parks or recreational facilities would cause disruptions to many people's way of life.

Supporters of the LSRD are skeptical that the local communities will receive the same levels of revenue from tourists visiting for whitewater rafting as they currently do from flat-water recreators. They assume the USACE would not manage the existing park system in place if the dams were breached, which would have a significant impact on the federal as well as state and local recreational facilities. State and local funding sources are limited and may not have the capacity to address the

costs of revamping facilities and the ongoing operation and maintenance of alternative recreation facilities. There also are uncertainties about whether the current river cruise and tour boat industry would be viable in a free-flowing river.

Support for Alternatives to the Current Recreational System

Supporters of restoring the lower Snake to a free-flowing river argue that the river is currently underused for recreation, citing national and regional research findings that a river environment is preferred over lake recreation.¹⁴⁰ Breaching the LSRD would open new opportunities for trails, campgrounds and other recreation-based infrastructure that could connect the communities surrounding the LSRD. Recreational, sportfishing and hunting opportunities would also have the potential to grow significantly with a free-flowing river.

The transition from a flat-water recreation economy to a wild river recreation economy could enable growth of the local rafting industry and associated tourism, and the possibility of multi-day rafting trips within the 60-plus rapids that would be accessible if the dams were breached. Interviewees noted that many people are willing to travel great distances for high quality rafting, with people waiting up to 10 years for permits to raft the Grand Canyon. Breaching the LSRD may also provide for increased public access and the growth of a tourism industry in the Lewiston-Clarkston region.

Supporters of breaching the LSRD believe that there will be more river access in and near Lewiston-Clarkston if the river is returned to free-flowing. Prior to the dams, they pointed out that the sand bars and beaches were a popular attraction for local residents, as they currently are upriver of Lower Granite reservoir and along the lower Salmon River.

Opportunities to Increase Understanding

The primary issue that would need to be addressed regarding recreation in any continuing conversation about the LSRD is to identify the total need, cost and funding sources for potential replacement, modification and expansion of trails, parks and other recreational amenities if the dams were breached.

Section 9: Economics

Context

This chapter summarizes information from previous studies about the economic impacts that breaching of the LSRD would have on local communities surrounding the dams as well as the state and region more broadly due to shifts in recreation usage, salmon abundance, agriculture, transportation, employment and energy production. The consultant team does not attempt to validate the accuracy of these perspectives but does aim to capture the range of viewpoints.

The primary economic analyses referenced by participants in this effort were the 2002 “Lower Snake River Juvenile Salmon Migration FS/EIS,” completed by the USACE, and the June 2019 “Lower Snake River Dams: Economic Tradeoffs of Removal” report, prepared by ECONorthwest for Vulcan, Inc. An additional study, “Washington State Travel Impacts & Visitor Volume 2010-18,” prepared by Dean Runyan Associates for the Washington Tourism Alliance, focused on the economics of tourism across Washington state with specific information for the counties adjacent to the lower Snake River. The draft CRSO EIS due to be released in February 2020 will include a new economic analysis of the Columbia River operating system, including retaining and breaching the LSRD.

Note that the 2002 FS/EIS and 2019 ECONorthwest report cost estimates referenced below are not an “apples-to-apples” comparison. All 2002 FS/EIS values reported are in 1998 dollars and reflect a 100-year study period, and the study area generally encompasses the 140-mile long lower Snake River reach between Lewiston and the Tri-Cities. All 2019 ECONorthwest report values reported are in 2018 dollars and reflect a 20-year study period (2026–45), and the study area is based upon a geographic boundary for spending in the eight counties in Washington that surround the LSRD and one county in Idaho (Nez Perce County).

The 2002 FS/EIS included an economic analysis of breaching the LSRD. The study found that uncertainties remained that prevented the USACE from concluding whether it would be cost-effective to breach the LSRD. The USACE noted that further work was needed to “(1) more precisely quantify the recreational benefits of the lower Snake River if the dams are breached; (2) more thoroughly assess the effect of dam removal on future anadromous fish stocks, and; (3) further specify the configuration of the future power supply system if the dams are breached.”¹⁴¹

The 2019 ECONorthwest report is the most recent comprehensive economic analysis of retaining or breaching the LSRD. The ECONorthwest report concluded that the public benefits of breaching the LSRD exceed the costs of retaining them. The report found that while breaching the LSRD would result in increased power and transportation costs, benefits in recreational uses (including a calculation of the “non-use” value for salmon recovery) more than offset costs of removing the dams. Economists define non-use values as the willingness of the public to pay their own money to protect natural resources, regardless of if they plan on directly using that resource.¹⁴²

The ECONorthwest report summarizes their analysis of the costs and benefits of removing the LSRD by major category, including grid services, dam removal, irrigation, transportation, use value and potential non-use value. Without the inclusion of non-use values the costs of dam removal

exceed the benefits by \$2.32 billion. With the inclusion of non-use values the benefits of dam removal exceed the costs by \$8.65 billion.

Recreation and Non-Use Values

Both the 2002 FS/EIS and ECONorthwest report estimated the shift from a flat-water reservoir system to a free-flowing river system would create economic benefits in the form of increased high-value recreation activities, like whitewater rafting and river related tourism. The reports both predict dam breaching would also lead to increases in recreation and sportfishing from salmon population gains. These recreational changes would benefit river system users and tourism-based businesses in Clarkston and Lewiston.^{143 144}

The ECONorthwest report included non-use values for salmon in their economic analyses. The ECONorthwest study found that “on a per-household basis... there is a willingness to increase electricity bills by an average of \$39.89 per year to help protect wild salmon, but the cost of removal is estimated at only \$8.44 per year.”¹⁴⁵ In the ECONorthwest report these non-use values were applied to the populations of Oregon, Washington, Idaho, Montana and California (over 18 million households). These non-use values are the determining factor to the ECONorthwest report’s overall finding that benefits significantly offset the costs of dam removal. The 2002 FS/EIS did not include non-use values for salmon in its economic analyses. The USACE is one of the only federal agencies that does not consider non-use evaluations in economic analyses.

Cruise boats tours have also become popular along the river in the last ten years. In 2017 over 18,000 passengers visited in 2017 and contributed over \$15 million to the communities along the Columbia and Snake rivers, with almost \$3 million contributed to Lewiston and Clarkston.¹⁴⁶

Transportation

The 2002 FS/EIS found that if the LSRD are breached commercial barge transportation would be eliminated and the use of more trucks and trains would increase some emissions. The cost per bushel of grain was estimated to increase from 6 cents in Oregon to 21 cents in Montana and costs for transportation other commodities was expected to increase by approximately 5%. The average annual cost over the 100-year study period associated with transportation would be approximately \$38 million. Rail improvements were estimated to cost \$50 million to \$89 million and highway improvements were estimated to cost \$84 million to \$101 million. In addition, grain elevator improvements were estimated to cost \$60 million to \$352 million. The FS/EIS also noted the potential increase of highway and rail safety concerns due to additional traffic from the increased transportation of goods.¹⁴⁷

The ECONorthwest report estimated that if the LSRD are breached it could result in: (1) potentially higher shipping costs for local growers and shippers; (2) the need for additional rail and road infrastructure improvements; and (3) increases in emissions from the increased use of truck and rail due to the loss of barge. The ECONorthwest report identified several transportation-related costs if the LSRD were breached, summarized below:

- Reservoir drawdown mitigation and damage costs (\$205 million-\$551 million)
- Additional rail infrastructure (\$113 million-\$136 million)
- Additional road infrastructure (\$14 million-\$17 million)

- Road wear and tear costs (\$13 million–\$15 million)
- Net change in transportation costs for shippers (\$41 million–\$78 million)
- Net change in emissions costs (CO₂ equivalent, PM_{2.5}, NO_x, VOC) (\$18 million–\$20 million)
- Net present value change in accident costs (crash fatality costs, crash injury costs and crash property damage costs) (\$43 million–\$49 million)

In addition to the transportation-related costs identified above, the ECONorthwest report identified that during the 20-year study period (2026-45) the net change in appropriated spending for USACE operation and maintenance costs of the LSRD to be \$239 million–\$248 million and USACE Columbia River Fish Mitigation costs are \$9 million–\$23 million. When taking the entire ECONorthwest report's variables into account, the report ultimately concluded that federal appropriations dedicated to operating and maintaining the lock system on the Lower Snake River are more costly than the economic benefits of maintaining the barge system. Even without breaching the LSRD, the continued operation of the lock system was deemed unjustified by the ECONorthwest report.

Agriculture

The 2002 FS/EIS found pump modifications for irrigators and other water users would be required if the LSRD are breached. If irrigated water from the Snake River was no longer available, the impact on lowered farmland value was estimated at \$134.2 million. Implementing pump modifications for both municipal and other industrial water users was estimated to cost \$11 million–\$55 million. In addition, irrigators within one mile of the reservoirs would require further modifications estimated at \$56.4 million. These costs resulted in an annual average cost of \$15.4 million over the 100-year period of analysis used for this study. The FS/EIS also anticipated job losses because of projected reductions in irrigated farmland, reductions in spending by the Corps and the loss of barge transportation and cruise ship operations.¹⁴⁸

The ECONorthwest report acknowledged that the loss of irrigation could create significant economic challenges to some reliant on irrigation around the LSRD. If currently irrigated acres within five miles of the lower Snake River are converted to non-irrigated land, the ECONorthwest report estimates a loss of value of \$390 million. However, the report assumed that water withdrawals for irrigation could continue, even without the LSRD, through surface water and groundwater infrastructure upgrades estimated to cost \$146 million–\$183 million.¹⁴⁹ Overall, impacts to the agricultural industry were assumed to potentially negatively affect current users of Lower Snake River waters, but the overall regional impacts were expected to remain constant.

Energy

The 2002 FS/EIS acknowledged that hydropower generation could not continue if the LSRD are breached. The FS/EIS found the net economic costs of losing hydropower generation to be \$271 million, not including implementation or avoided costs. The FS/EIS assumed non-polluting resources could replace the lost hydropower energy generated and would result in no net changes in air pollution from existing conditions. However, the study noted that using this conservation strategy would require government subsidies and implementation to occur before the dams are breached.¹⁵⁰

The ECONorthwest report assumed that the region could meet power needs without LSRD energy production, though there could be some higher carbon emissions and a need for low-cost adjustments to BPA's grid operations. If the LSRD were breached, BPA would also pay less for operations and maintenance, capital replacement, overhead, and fish mitigation.¹⁵¹ The "Lower Snake River Dams Power Replacement Study," developed by Energy Strategies for the Northwest Energy Coalition, found that energy grid services from the LSRD could be replaced at a cost of \$400 million to \$1.2 billion per year, depending on the mix of replacement resources and other assumptions, which could result in zero to \$1–\$2/month increases in monthly utility bills.

LSRD Operations & Maintenance Needs

BPA is responsible for paying the USACE to staff and perform operations and maintenance for the LSRD. BPA's total O&M expenses for the 2019 fiscal year were \$2.137 billion, a 2% increase from the previous fiscal year.¹⁵² These O&M costs reflect the core funding for maintenance, operation, and minor equipment replacements of the entire BPA energy system. Of this total, the LSRD's O&M costs are \$50 million annually, most of which goes towards general O&M costs stated previously and workers compensation. In addition, 15% of total O&M costs are fish and wildlife costs for fish screens, hatcheries, fish bypass facilities, and transport of smolts.¹⁵³ Into the future, O&M costs are less certain due to factors like the ongoing environmental costs of the fish and wildlife program, the uncertainty around annual weather and water supply available to use for power generation, the aging infrastructure of the FCRPS that will require investments to preserve the value of the system, and changing attitudes towards hydropower plants.¹⁵⁴

Commercial and Recreational Fishing

A 2017 study prepared for the Pacific Salmon Commission of the economic impacts of commercial and recreational salmon fisheries in the Pacific Northwest region of Oregon, Washington, British Columbia and southeast Alaska found that from 2012-2015, the contribution of the commercial and recreational sectors combined averaged:

- \$3.4 billion in output; \$1.9 billion in Gross Domestic Product; \$1.2 billion in Labor Income and 26,700 Full-time Equivalent jobs to the US economy
- \$1.3 billion in Output; \$850 million in Gross Domestic Product; \$485 million in Labor Income and 12,400 Full-time Equivalent jobs to the Canadian economy

Both the commercial and recreational salmon fishing sectors are major contributors to these economic impacts.¹⁵⁵

The overall effect of hatchery fish on the survival of certain wild anadromous species led NOAA to place a ceiling on the total hatchery releases in the Columbia River System. A 1999 report developed to inform the 2002 FS/EIS found that "the economic impact on the Pacific Northwest region from eliminating most hatchery programs and thereby most harvesting of salmon produced in the Columbia River Basin may be as high as \$213 million per year. The burden of these reductions would be felt all along the Pacific West Coast and inland throughout the Columbia River Basin. Projecting over 100 years for what is at stake from all production, the net-present-value at the current Corps discount rate may be as high as \$2.0 billion." (Values reported in 1999 dollars.)¹⁵⁶

Commercial fishing fleets along the Washington coast are a fraction of what they were, and their communities, once known for their abundant natural resources and food production, are suffering from increased poverty and food insecurity.¹⁵⁷

Perspectives

Support for the Lower Snake River Dams

Supporters of retaining the LSRD believe that the ECONorthwest report did not adequately consider the impacts of dam breaching on the people, communities and industries throughout the Northwest, especially those in the vicinity of the LSRD. They believe there will be drastic economic consequences if the LSRD are lost, including loss of tax revenues, jobs, businesses and property values, especially for rural and agricultural communities and users of the current barge system. While the ECONorthwest report recognizes societal costs from LSRD removal and the loss of energy production, supporters of the LSRD disagreed with the notion that surrounding communities in aggregate would “experience gains in employment, incomes, and economic output.”¹⁵⁸

For recreation, supporters of the LSRD did not agree that a new whitewater rafting industry will be created, or if it was that it would have a significant economic benefit, noting that the actual river conditions may not be conducive for whitewater rafting after dam removal. They believe the assumption about more economic benefit for river-based tourism is based on national data and the benefit would not necessarily be to the local communities. Supporters of the LSRD believe the existing benefits from recreation on the reservoirs, boating, fishing and camping have significantly more economic benefit than the recreation on a free-flowing Snake River. The local cruise boat industry is also cited as a significant economic benefit that was not included in ECONorthwest’s analyses and that could be lost through breaching the LSRD.

The positive benefit-cost analysis in the ECONorthwest report is driven by the estimated non-use value. Supporters of the LSRD question the validity of the survey that is the basis for the non-use value. They believe the wording in the survey was biased and then calculated with the assumption that people as far away as California would actually pay more on their utility bills for Snake River salmon. They view BPA’s investments in fish passage, salmon restoration, and hatcheries as already achieving significant long-term progress and not being sufficiently valued. Finally, they see retaining the dams and increasing hatchery production as an approach to achieve significant economic benefits for the Pacific Northwest recreational and commercial fishing industries.

For transportation, they disagreed with ECONorthwest’s assessment that the costs of losing barge transport and switching to trucking/rail are less valuable than the current federal appropriations that support the locks. Supporters of the LSRD did not think the report recognized the importance of maintaining a multi-modal transportation network and overestimated the ease and costs of implementing rail and road infrastructure improvements. They also believe the report inadequately recognized the carbon benefits of the dams, both in terms of energy production and the increased carbon emissions that could result from the loss of barging and increased rail and truck usage.

For agriculture, they believe the ECONorthwest report’s assumption that the costs to replace irrigation infrastructure will be less than \$200 million is too low. And even if this number were accurate, supporters of the LSRD questioned the viability of finding a funding source to pay for these improvements. They also challenged the ECONorthwest report’s assumption that farmers

could find new jobs, switch crops, relocate or access other water sources, noting that the “human element” is inherently missing in economic analyses and broader considerations of LSRD breaching. Supporters of the LSRD do not see how it would be possible that farmers and the general agricultural community would be made “whole” if the LSRD were breached. Millions, if not billions, of dollars would be needed to improve road and rail transportation infrastructure, provide annual subsidies for increased costs of transportation and electricity, and other costs. Supporters of the LSRD do not believe there would be political support to fund the needs of farmers and the agricultural community. They also question the willingness to subsidize farmers and farm cooperatives for their infrastructure losses and ongoing increased cost of transportation. Finally, if water volumes in the Snake River are decreased significantly, municipalities and private businesses releasing effluent into the river will have difficulty satisfying increasingly stringent water quality standards and incur significant costs.

For energy, they believe the loss of low-cost, low-carbon energy production and the jobs associated with the management and maintenance of the dams would be significant. There would be a ripple effect throughout the local communities and across parts of the region by losing the energy provided by the dams. Supporters of the LSRD believe that if the dams are breached the political focus will shift to removal of other Columbia River system dams and the economic consequences will increase exponentially across the region.

Lastly, supporters of the LSRD are skeptical that the federal government will make the capital and long-term investments assumed in the ECONorthwest report for economic development in the communities affected by the loss of the LSRD.

Support for Alternatives to the Lower Snake River Dams

Supporters of alternatives to the LSRD believe the cost of retaining the dams and its associated subsidies will continue to increase, some are not cost effective now, and more will become cost-ineffective over time. They acknowledge there needs to be a transition plan for local communities that would be impacted, recognizing there is a likelihood of job loss and disruption, but believe that the transition to a new, more robust economy can be realistically achieved.

For recreation, supporters of alternatives to the LSRD are confident that LSRD breaching would generate widespread growth in fishing and whitewater rafting, and lead to a thriving tourism industry and economic development opportunities in the Lewiston/Clarkston area and other surrounding counties. The ECONorthwest report uses national data as the basis for their analysis that river recreation will generate more economic benefit than the current reservoir recreation. Supporters of breaching the LSRD believe this assumption is accurate and perceive that Clarkston and Lewiston could be a recreational magnet for people across the country to visit and add to the economic vitality of the community.

While some supporters of alternatives to the LSRD understand concerns raised about the non-use value estimates in the ECONorthwest report, they do believe non-use values are a valid component of any technically sound economic analysis. They are concerned the CSRO FS/EIS will not include non-use values, similar to the 2002 USACE FR/FS/EIS; if the CRSO FS/EIS does not include non-use values, they worry the FS/EIS will conclude that removing the LSRD does not have a positive benefit-cost ratio. Supporters of breaching the LSRD also noted that the ECONorthwest report did not include benefits provided by restored salmon populations in the Columbia River

basin and along the coast as well as in farther upstream Idaho. They see breaching the LSRD as an approach to achieve significant economic benefits for the Pacific Northwest recreational and commercial fishing industries.

For transportation and agriculture, supporters of alternatives to the LSRD believe that if a plan was in place to breach the LSRD, new federal subsidies could be identified to cover the costs of rail and road infrastructure improvements and surface water and groundwater infrastructure upgrades for irrigators and other water users. In the long term, these investments could provide more benefits to farmers, businesses and communities than the current LSRD transportation and agriculture system does.

For energy, supporters of alternatives to the LSRD believe that BPA is already operating at a deficit and technology improvements continue to accelerate for things like intermittent renewable battery storage. Ultimately, they believe that energy production lost through breaching the LSRD can be replaced with little to no increases in carbon emissions. They note that while the ECONorthwest study contains an accounting for the cost of power replacement should the dams be breached, it does not reflect the potential benefits from corresponding investment of those funds in the build-out of new renewable resources to replace the power. Finally, BPA's investments to date in fish passage, salmon restoration and hatcheries are seen as insufficient to truly restore Snake River salmon and support Southern Resident orca recovery.

A number of supporters of alternatives to the LSRD see the need for a coalition of Northwest congressional representatives and governors to convene a process involving tribes, state and federal governments and stakeholders to identify the needs and potential solutions for energy, salmon, transportation and economic challenges presented by retaining or breaching the LSRD.

Opportunities to Increase Understanding

To determine the full economic impacts of retaining or breaching the LSRD, more detailed analyses are required to determine (1) the viability and costs of retaining the LSRD (and viability and costs of LSRD breaching); (2) viability and costs of implementing needed infrastructure improvements; and (3) identify potential funding sources, if the LSRD are breached.

Section 10: Moving Forward

The consultant team was not tasked with making recommendations for future steps to address the issues and interests of the different communities affected by the lower Snake River dams if they are retained or breached. However, we did ask people interviewed what would help make forward progress. This section summarizes the ideas we heard. As noted in the preceding sections, debate over the dams has gone on for several decades and the issues are complex. Despite some recent improvements in collaboration, many of the participants remain wary of the cycle of study, lawsuits and court decisions. There is both hope and despair about what comes next and the potential for progress.

The upcoming Columbia River Systems Operation Environmental Impact Statement in response to the 2016 Judge Simon decision will provide the next detailed analysis of the environmental and social impacts of the operations, maintenance and configurations for 14 federal dams in the Columbia River system including the four lower Snake River dams. It will assess several alternatives and may include a preferred alternative from the perspective of the three federal agencies associated with the dams: Bonneville Power Administration, Army Corps of Engineers and Bureau of Reclamation. There will likely be thousands of comments on the draft and potentially litigation. Although we heard from several people that they believe the federal process is necessary and helpful because the updated information will provide an analysis of alternatives, they do not hold high hopes that it is likely to build consensus or end debate.

Careful Framing of Any Subsequent Conversation Is Important

Careful and sensitive framing of any subsequent conversation would be needed to lay a foundation for productive engagement. We heard a strong desire from some parties for the issues surrounding the dams to be discussed and decided in a larger context. By “larger context” people mean a number of things depending on their interests and perspectives. Some emphasize the larger context around the changing supply and demand for energy across the Pacific Northwest. People focused on the larger context for energy feel decisions and conversations solely about whether energy production from the lower Snake River dams should continue or can be alternatively produced would not be fruitful. They want any future discussions to also address the future role of BPA and the financial issues facing BPA and its customers especially in the context of the BPA contracts that will be up for renewal by 2028.

For others, the larger context is centered around deepening understanding of the role of retaining or breaching the LSRD relative to the many other actions underway to support recovery of salmon and orca. People focused on this part of the larger context believe it is critical to consider the future of the LSRD as part of the overall efforts to recover these complex species and not as a discrete, stand-alone choice.

Still others see the larger context as including the effects of retaining or removing the dams on the broader economic future of southeast Washington considering fisheries, agriculture, industry, recreation and other economic drivers. They see the large context as including a conversation about the vision for the future of the southeastern Washington communities that have grown up around the LSRD.

While many see framing a decision about the LSRD within the “larger context” of each of the major issues as necessary to make the best decisions, there also is the fear that adding more complexity to an already complicated decision process would be a distraction and result in no decision, or additional delays. Bridging the gap between those that want to broaden the focus and those that fear inaction is part of what people feel needs to be addressed to make progress.

People identified the need to consider that decisions about solutions will need to be implemented over a ten year or longer timeframe. The energy, economic and environmental fields are dynamic. Significant changes are occurring, and more are anticipated. By considering solutions that may not be possible today, but could become possible over a longer timeframe, people see the potential for solutions that can more fully address the interests and concerns of people and their communities.

An Increase in Respect and Understanding is Needed

People told us that the manner in which the issue of dam breaching is raised contributes to the overall frustration and negative reaction of those who live in eastern Washington and benefit from the dams. Dam supporters feel the “coast” is telling eastern Washington communities what to do in a way that lacks respect and understanding of local values and priorities and minimizes how changes to the dams would significantly affect their communities. The Southern Resident Orca Task Force recommendations and the ECONorthwest economic report are cited as examples of this kind of “outsider” perspective being imposed on eastern Washington. Pushing for breaching the LSRD affects other issues that leaders in eastern Washington are trying to address. Some leaders noted that the pressure and negativity from proponents of dam breaching make it more challenging to make progress on issues like clean energy, worker’s rights and other concerns that might be held in common. They question the seriousness of the “coast’s” commitment to addressing salmon and orca recovery when the focus of energy from western Washington is on the LSRD instead of fully committing to the level of change needed in their own communities with their own sacrifices.

The need for greater respect and understanding extends to the tribal communities as well. The tribes point out the harm that was inflicted on their communities and the suffering and challenges they have faced for well over a century. Tribes have essentially lost the salmon they protected in their treaties with the United States. Above the LSRD, tribal harvest is a small percentage of pre-contact levels. As each dam was constructed, the tribes objected, calling on the government to reconsider - pointing out that these actions were contrary to the treaties the United States had signed with them, and predicting adverse consequences for the salmon and for tribal peoples. The four reservoirs inundate 140 miles of treaty-protected tribal fishing; hunting; and harvesting of roots, plants and berries at usual and accustomed stream side locations. People interviewed recognize the need to respectfully engage the tribes by acknowledging their losses and the responsibility they have to address the issues of the dams on salmon, other species and tribal culture.

A Desire for Dialogue

People across the diversity of interests expressed the desire to have more informed and respectful conversations. Given that issues around the LSRD have long been in litigation, the ability for shared learning, collaborative problem-solving and a new dialogue has so far been limited. Many of those interviewed are hopeful of the significant benefits a collaborative dialogue could offer to a process

stuck on its challenging issues. Participants point to two recent examples that give cause for optimism.

First, the NOAA Columbia Basin Partnership Task Force was mentioned as an example of the type of collaboration that has been successful in building relationships between diverse interests and creating momentum. The task force is a collaboration of different interests from across the basin landscape including: environmental, fishing, agricultural, utility, and river-user groups; local recovery groups; the states of Idaho, Montana, Washington and Oregon; and federally recognized tribes. A report from Phase 1 (January 2017–March 2019) of this collaboration reflects consensus around a shared vision, qualitative goals and provisional quantitative goals for 24 stocks of Columbia Basin salmon and steelhead. This is the first time a comprehensive set of goals for salmon recovery has been agreed to by any group of diverse interests in the Columbia basin. The task force is now focused on defining the actions needed to achieve their near and long-term goals.

Second, is the 2019–21 Spill Operation Agreement (flexible spill agreement). Federal, State and Tribal partners came together to develop an agreement on a key component of operating federal dams in the Columbia River Basin. Parties to the agreement have aligned on a flexible spring spill operation premised on achieving improved salmon survival while also managing costs for BPA and testing the promise of increased hydropower generation and energy marketing during daily windows of high energy demand that have been created by increasing deployment of solar energy in the western U.S. This is one of the first agreements amongst the parties for action that was not in response to a federal court decision. It happened because leaders of the different organizations and interests agreed to discuss concerns and collaboratively seek actions.

Appendix A: Annotated Bibliography

“2018 Columbia River Basin Fish and Wildlife Program Costs Report.” *Northwest Power and Conservation Council*, Mar. 2019, www.nwcouncil.org/sites/default/files/2019-5_0.pdf.

Since 2001, the Northwest Power and Conservation Council has reported annually on all costs related to fish and wildlife incurred by BPA. This includes the cost of implementing the Council’s Columbia River Basin Fish and Wildlife Program. In this 18th annual report, the Council provides an update of Bonneville’s fish and wildlife costs in fiscal year 2018 (October 1, 2017 – September 30, 2018). The information in this report was provided by Bonneville in response to requests from the Council staff. The Council prepares this report solely for informational purposes, not as a requirement of the Northwest Power Act. BPA reported spending \$480.9 million total for fish and wildlife costs – 19.6% of Bonneville's entire Power Business Line costs. The Council also tracks progress of fish and wildlife efforts in the Columbia River Basin using three high-level indicators: abundance/health of fish species, whether the operations are meeting fish-passage survival objectives, and what is being accomplished by the fish and wildlife programs.

American Waterways Operators. “Economic Contribution of the US Tugboat, Towboat and Barge Industry.” U.S. Department of Transportation, 2014. <http://www.americanwaterways.com/sites/default/files/Econ%20Impact%20of%20US%20Tugboat%20Towboat%20and%20Barge%20Industry%20lh%206-22-17.pdf>

Nearly 5,500 US-flag tugboats and towboats and more than 31,000 barges move an average of 763 million tons of cargo on the nation’s waterways each year, including raw materials and commodities as well as finished consumer products. This report considers three separate channels -- the direct impact, the indirect impact and the induced impact – that, in aggregate, provide a measure of the total economic impact of the US tugboat, towboat and barge industry.

American Waterways Operators. “The Tugboat, Towboat and Barge Industry: A Leader in Marine Safety and Environmental Stewardship.” U.S. Department of Transportation, 2017. <https://www.americanwaterways.com/sites/default/files/AWO-PWC%20press%20kit%20--%20Safety%20and%20Environmental%20Stewardship.pdf>

This one-pager from the American Waterways Operators is about how the tugboat, towboat and barge industry has been a leader in marine safety and environmental stewardship. In 1994, AWO developed the Responsible Carrier Program as a code of best practices for member companies which has been used to develop company-specific safety programs meet or exceed applicable laws and regulations, while being practical enough to reflect a company's unique needs. In 2015 AWO implemented a web-based Safety Statistics Reporting Program to help member companies foster a culture of safety and strive toward continuous improvement.

“A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams Fact Sheet.” *Bonneville Power Administration*, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.

This fact sheet was designed to inform users of the LSRD's functionality, current impact on fish migration/habitat relative to other dams in the Columbia River system, and the costs/uncertainties of breaching the dams. It highlights that LSRD have some of the most advanced and successful fish passage systems in the world; that they're on track to achieve up to 96% survival rates; wind and solar generators are not reliable replacements for the dams, which produce over 1000MW of reliable, carbon-free energy.

“A Vision for Salmon and Steelhead: Goals to Restore Thriving Salmon and Steelhead to the Columbia River Basin.” *NOAA Fisheries*, U.S. Department of Commerce, 11 July 2019, www.fisheries.noaa.gov/vision-salmon-and-steelhead-goals-restore-thriving-salmon-and-steelhead-columbia-river-basin.

This is the Phase 1 (Jan. 2017-March 2019) report of the Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee (MAFAC). It reflects consensus around a shared vision of a healthy Columbia River and outlines qualitative and provisional quantitative goals for the salmon and steelhead stocks of the Columbia River Basin. The task force's vision is, "A healthy Columbia River Basin ecosystem with thriving salmon and steelhead that are indicators of clean and abundant water, reliable and clean energy, a robust regional economy, and vibrant cultural and spiritual traditions, all interdependent and existing in harmony." In June 2018, MAFAC approved continuation of this effort to further test and refine the provisional quantitative goals. The Phase 2 report is expected in June 2020.

Arthur, Bill, and Julia Reitan. “Best Chance to Save Wild Salmon in Columbia Basin: Remove Four Dams on Lower Snake River.” *Sierra Club*, 8 Feb. 2017, www.sierraclub.org/washington/best-chance-save-wild-salmon-columbia-basin-remove-four-dams-lower-snake-river.

This online article is pro-breaching of the LSRD; it was posted within the Washington chapter of the Sierra Club on February 8, 2017. It describes the general history of the dam system, with a perspective towards opposing the dams, as well as where the removal process has come through 2017. There are references to specific facts about the dam system, but the report does not provide any specific sources or citations for their statements.

Bilby, Robert. “Latent Mortality Report.” *Independent Scientific Advisory Board*, Northwest Power and Conservation Council, 6 Apr. 2007, app.nwcouncil.org/media/31244/isab2007_1.pdf.
https://www.nwcouncil.org/sites/default/files/isab2007_1.pdf

This report reviews a number of hypotheses about causative factors that contribute to latent mortality. The ISAB concludes that the hydrosystem causes some fish to experience latent mortality, but strongly advises against continuing to try to measure absolute latent mortality. Latent mortality relative to a damless reference is not measurable. Instead, the focus should be on the total mortality of in-river migrants and transported fish, which is the critical issue for recovery of listed salmonids. Efforts would be better expended on estimation of processes, such as in-river versus transport mortality that can be measured directly. Future monitoring and research is needed to further quantify biological factors that contribute to variability in estimated post-Bonneville mortality. In particular, the ISAB recommends that acoustic tags continue to be developed and used to assess and partition mortality in the lower river, the estuary and the Pacific Ocean shelf. In addition, the ISAB recommends the

continuation of PIT tagging with a monitoring and evaluation program designed to reduce the current levels of uncertainty.

Bogaard, Joseph. “Why Remove The 4 Lower Snake River Dams?” *Save Our Wild Salmon*, 2019, www.wildsalmon.org/facts-and-information/why-remove-the-4-lower-snake-river-dams.html.

This online article is pro-breaching the LSRD; it was posted on the website of the NGO Save Our Wild Salmon in 2019. It is a list of short essays that goes through common questions and arguments that people have about the LSRDs. All of the essays have a strong anti-dam perspective since the NGO is focused on restoring river systems to their natural state for the benefit of salmon. There are many facts that appear to be either direct quotes from the literature or are summarizations of the literature but there are no citations or linked research.

“Bonneville Power Administration Response to Public Comments on the BPA Resource Program.” *Bonneville Power Administration*, U.S. Department of Energy, 2018, www.bpa.gov/p/Power-Contracts/Resource-Program/Documents/BPA%202018%20Resource%20Program%20Reponse%20to%20Public%20Comments.pdf.

This document is a list of BPA's responses to public comments that were collected as part of the public review of Bonneville's updated Resource Program in 2018. The comments don't go into specifics of the lower Snake River dams as the review pertained to how Bonneville forecasted their future needs in terms of power supply obligations while focusing on potentially optimal resource choices absent of evaluating existing sources of supply in isolation. The questions that were brought forward that had to do with the lower Snake River dams were referred to the ongoing environmental impact statement as an answer source.

“Bonneville Power Administration’s Summary of Energy and Capacity Values and Energy Production Costs of Lower Snake River Dams.” Bonneville Power Administration, 12 Sept. 2019.

This memo from the Bonneville Power Administration is about the energy and capacity values and energy production costs of the lower Snake River dams. The dams annually produce around 1,000 average megawatts (aMW) of power which is roughly equivalent to the annual consumption by the businesses, households and industries served by Seattle City Light (SCL). It brings up that the power generated by the LSRD is significant during Washington's high winter power loads as well as during extreme weather events during the entire year. The dams also provide valuable capacity that can be used for integrating renewables as well as meeting peak energy periods.

“BPA Invests in Fish and Wildlife Fact Sheet.” *Bonneville Power Administration*, U.S. Department of Energy, Jan. 2019, www.bpa.gov/news/pubs/FactSheets/fs-201901-BPA-invests-in-fish-and-wildlife.pdf.

Under its Northwest Power Act authorities and responsibilities, BPA mitigates the effects of the federal hydropower system on fish and wildlife in the Columbia River Basin. BPA partners with other federal agencies, states, tribes, conservation organizations, and others to enhance habitat, improve hatchery practices and protect lands and streams. BPA funds fish

and wildlife projects in the Basin, directly pays USACE for fish passage improvements at the dams, purchases extra power when the dams cannot meet energy demands due to additional spillage requirements and considers foregone revenue in the event water is spilled (rather than passing through the dams). Since 2007, BPA has restored or protected over 13,500 acres of estuary floodplain and over 50 miles of tidal channels.

“Citizen's Guide to the 2016 Comprehensive Evaluation: Protecting Salmon and Steelhead in the Columbia Basin.” *Bonneville Power Administration*, U.S. Department of Energy, Feb. 2017, www.bpa.gov/news/pubs/GeneralPublications/fish-Citizens-Guide-to-the-2016-Comprehensive-Evaluation.pdf.

This report is a more accessible version of the information that is outlined in the 2016 Comprehensive Evaluation (a progress report on the work done to protect ESA-listed salmon and steelhead within the Columbia River Basin by the U.S. Army Corps of Engineers, Bureau of Reclamation and Bonneville Power Administration). The report describes how the listed stocks within the system have been trending upwards in terms of abundance even with poor ocean conditions; the improvements to fish passage at the hydro projects which lead to better survival rates; investments made towards habitat restoration; the hatchery programs that have made improvements to abundance; predator management; and what still needs to be done in the future for the benefit of the stocks. This report has graphics and pictures to give the reader an understanding of what the on the ground projects look like and how they benefit salmon.

“Columbia Basin Salmon and Steelhead Fact Sheet: Many Routes to the Ocean.” *Bonneville Power Administration*, U.S. Department of Energy, June 2017, www.bpa.gov/news/pubs/FactSheets/fs-201306-Columbia-Basin-salmon-and-steelhead-many-routes-to-the-ocean.pdf.

This fact sheet was published by the Bonneville Power Administration in 2013. It goes over various methods juvenile salmonids use to pass dams as they migrate down the Columbia River. The main ways in which juveniles make their way down the river are through spill, the juvenile bypass system which diverts juvenile salmon to then be transported down river by truck or barge, and turbines. With improvements to spillway weirs, bypass systems and increases in spill during the months the juveniles are migrating downriver, the current survival rate through each dam is between 95% - 98%. The amount of capture and transportation has been reduced to about 35% (depending on the species) in recent years due to improvements made to passage infrastructure.

“Columbia River System Operation Review Final Environmental Impact Statement.” *Bonneville Power Administration*, U.S. Department of Energy, Nov. 1995, www.bpa.gov/efw/Analysis/NEPADocuments/nepa/System_Operation_Review/pdf/FinalEISSummary.pdf.

The goals of the System Operation Review are to 1) develop a system operating strategy and a regional forum for allowing interested parties (other than USACE, USBR and BPA) a long-term role in system planning and 2) provide the environmental analysis needed for the federal agencies to sign new agreements for coordinating power generation. The preferred alternative for a system operating strategy is adaptive management, where operations can be modified to meet changes in the natural environment, as well as other arenas. Means to achieve the preferred alternative include a combination of in-river migration and barge

transportation of smolts; a combination of different spill rates; operate John Day Dam and the LSRD at minimum operating pools (drawdown) throughout the year and during spring/summer; maintain sliding scale targets for flow augmentation; and limit the elevation to which the reservoirs are drafted.

Connolly, Kieran P. “2018 Pacific Northwest Loads and Resources Study.” *Bonneville Power Administration*, U.S. Department of Energy, Apr. 2019, www.bpa.gov/p/Generation/White-Book/wb/2018-WBK-Loads-and-Resources-Summary-20190403.pdf.

The Pacific Northwest Loads and Resources Study (commonly referred to as the “White Book”) is a planning document produced by the Bonneville Power Administration that presents its projection of load and resource conditions for the upcoming 10-year period (OY 2020 through 2029). The White Book includes analysis of Bonneville’s forecasts of expected power obligations and resource generation for both the Federal system and the Pacific Northwest region as a whole. The information contained in the White Book is used for: 1) long-term planning throughout Bonneville; 2) in planning studies for the Columbia River Treaty; and 3) as a published record of information and data for customers and other regional planning entities. The White Book is not used to guide day-to-day operations of the Federal Columbia River Power System.

Dauble, D. D., and D. R. Geist. “Impacts of the Snake River Drawdown Experiment on Fisheries Resources in Little Goose and Lower Granite Reservoirs, 1992.” *Impacts of the Snake River Drawdown Experiment on Fisheries Resources in Little Goose and Lower Granite Reservoirs, 1992 (Technical Report)* | OSTI.GOV, U.S. Department of Energy, 1 Sept. 1992, www.osti.gov/servlets/purl/7148129.

In March 1992, USACE initiated a test to help evaluate physical and environmental impacts resulting from the proposed future drawdown of Snake River reservoirs. Drawdown would reduce water levels in Snake River reservoirs and was proposed as a solution to decrease the time it takes for salmon and steelhead smolts to migrate to the ocean. The Pacific Northwest Laboratory evaluated impacts to specific fisheries resources during the drawdown experiment by surveying Lower Granite Reservoir to determine if fall Chinook salmon spawning areas and steelhead access to tributary creeks were affected. In addition, shoreline areas of Little Goose Reservoir were monitored to evaluate the suitability of these areas for spawning by fall Chinook salmon. Surveys and observations made during the drawdown indicated that known fall Chinook salmon spawning areas upstream of Lower Granite Reservoir were not influenced by the experiment. However, lower pool elevations would prohibit adult steelhead passage to Alpowa Creek.

Dehart, Michele. “Comparative Survival Study of PIT-Tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye 2017 Annual Report.” *Fish Passage Center*, Bonneville Power Administration, Dec. 2017, www.fpc.org/documents/CSS/2017%20CSS%20Annual%20Report%20ver1-1.pdf.

This report updates the historical time series life-cycle monitoring data and includes enhancements to analyses based upon review comments and recommendations from the fishery management agencies, tribes and the Northwest Power and Conservation Council’s Independent Scientific Advisory Board. The long-term objective of the CSS is to link stages of the salmon life cycle, the factors influencing survival at each life stage, and understanding how each factor affects survival at later life stages, resulting in smolt-to adult return rates. If

the lower four Snake River dams are breached and the remaining four lower Columbia dams operate at BioP spill levels, FPC predicts approximately a two- to threefold increase in abundance above that predicted at BiOp spill levels in an impounded system, and up to a fourfold increase if spill is increased to the 125% TDG limit. This analysis predicts that higher SARs and long-term abundances can be achieved by reducing powerhouse passage and water transit time, both of which are reduced by increasing spill.

DeHart, Michele. “Comparative Survival Study Of PIT-Tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye 2018 Annual Report.” *Fish Passage Center*, Dec. 2018, <http://www.fpc.org/documents/CSS/2018%20CSS%20Annual%20Report.pdf>

This Comparative Survival an annual report from the Fish Passage Center in collaboration with US Fish and Wildlife, the Columbia River Inter-Tribal Fish Commission and the Fish and Wildlife Departments of Idaho, Oregon and Washington; it has been ongoing since the mid-1990s. The long-term objective of the CSS is to link stages of the salmon life cycle, the factors influencing survival at each life stage and understanding how each factor affects survival at later life stages, resulting in smolt-to-adult return rates. This report has new analysis compared to previous reports by including life cycle analysis of upper Columbia Chinook, with an analysis of PIT tag and coded wire tag effects on SARs, and new methods of estimation of detection probability at Bonneville Dam for juvenile migrants.

Dehart, Michele. “Delayed/Latent Mortality and Dam Passage, Fish Passage Operations Implications.” Received by Ed Bowles, 6 Oct. 2010. <http://www.fpc.org/documents/memos/135-10.pdf>

This is a memo from Michele DeHart of the Fish Passage Center to Ed Bowles of the Oregon Department of Fish and Wildlife on delayed and latent mortality associated with dam passage as well as the implications that the FPC findings have on fish passage operation in the Columbia and Snake river systems. The FPC concludes there is a broad range and scope of evidence that indicates powerhouse passage and the transportation/collection/bypass system at dams result in significant delayed and latent mortality of juvenile salmonids. It cites findings from a variety of studies, including one that found that bypassed and transported fish have similar experiences in passing through powerhouses, and concludes these two types of dam passage result in similar levels of delayed and latent mortality. It also cites studies that find individual project acoustic tag estimates of bypass survival at a single dam do not capture latent mortality as a result of the juvenile bypass passage.

DeHart, Michele. “Review of Paulsen and Fisher Draft Entitled, ‘Bypass Effects and Smolt-to-Adult Survival: A Re-Analysis of CSS and Transport Study Yearling Chinook and Steelhead Smolts’, Dated July 1, 2016.” Received by Tom Lorz, et. al, 847 NE 19th Ave., Suite 250, 15 Nov. 2016, Portland, OR. <http://www.fpc.org/documents/memos/63-16.pdf>

This memo from Michele Dehart of the Fish Passage Center to the writers of a draft report from the USACE Study Review Work Group indicates the FPC does not agree with the overall conclusions of the report due to a variety of factors and feels that the report doesn't raise valid concerns regarding the Comparative Survival Study analytical results and the management applications of those results. The draft report proposes that smaller fish are more likely to enter juvenile bypass and collection systems, but FPC reviewed the findings and states, if this was actually occurring, the bypass systems would be disproportionately

affecting wild stocks of salmon and steelhead than on larger hatchery produced fish. FPC also found that the draft report was fraught with contradictions and conflicting findings which raise serious questions and concerns about the validity and conclusions of the report.

Domanski, Adam. "Lower Snake River Dams Economic Tradeoffs of Removal." *ECONorthwest*, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.

This report by the firm ECONorthwest, funded by Vulcan Inc., explores the economic implications of removing the lower Snake River dams. It was published on July 29, 2019. It estimates the removal of the lower Snake River dams would provide the region with \$12.1 billion in benefits and would cost the region \$3.46 billion for a net benefit of \$8.65 billion. The majority of these benefits would come from what the report states are "Potential Non-Use" benefits which are described as how much the average household is willing to pay out of pocket to protect salmon and steelhead. Through public surveys, it determined that the average household would be willing to pay an additional \$39.89 on their electric bill in order to protect salmon and steelhead populations as well as restoring the habitat to a natural state. In terms of transportation costs, it estimates that the current amount spent by federal appropriations to subsidize barging as well as lock and dam maintenance is enough to offset any costs to transportation that would result with the removal of the dams.

"ESA Recovery Plan for Snake River Spring/Summer Chinook Salmon (*Oncorhynchus Tshawytscha*) & Snake River Basin Steelhead (*Oncorhynchus Mykiss*)." *Nation Marine Fisheries Service*, National Oceanic and Atmospheric Administration, Nov. 2017, www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/Final%20Snake%20Recovery%20Plan%20Docs/final_snake_river_spring-summer_chinook_salmon_and_snake_river_basin_steelhead_recovery_plan.pdf.

This document includes the components of the ESA Recovery Plan for Snake River spring/summer Chinook and steelhead. The goal of the Plan is to improve the viability of Snake River spring/summer Chinook salmon and steelhead, and the ecosystems upon which they depend, to the point that the fish populations are self-sustaining in the wild and no longer require ESA protection. The Plan provides a roadmap that builds on past and current efforts to recover the species. It includes a summary of threats, strategies and actions, an adaptive management framework (which includes research, monitoring, and evaluation), time and cost estimates, and an implementation framework. NMFS intends to use the recovery plan to organize and coordinate recovery of the species in partnership with state, tribal, and federal resource managers.

Filardo, Margaret, et al. "Science-Based Solutions Are Needed to Address Increasingly Lethal Water Temperatures in the Lower Snake River." Received by Northwest Policymakers - Governors and Members of Congress, 22 Oct. 2019. <https://static1.squarespace.com/static/55a5773ae4b081289a66090b/t/5db0886bbf234954c1932976/1571850347966/2019.Sci.Letter.Snake.climate.final.pdf>

This is a letter from a group of 55 fisheries and natural resources scientists to Gov. Inslee about how the current Federal Columbia River Power System reservoirs on the lower Snake River have been increasingly warming the river above critical levels during the late summer

months. The warming has been found to have multiple negative effects on salmon at all life stages, like direct mortality, migration delay, reduced gamete viability and increased rates of disease. The letter states that cold-water resources to protect migrating salmonids in the existing hydrosystem are extremely limited and there are no additional resources available that can significantly cool the river.

“Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Summary.pdf?ver=2019-05-03-131237-337.

This Feasibility Study/EIS focused on the relationship between the four dams on the lower Snake River and their effects on juvenile fish traveling toward the ocean. It was generated as a response to the alternatives presented in NMFS's 1995 Biological Opinion (which was updated in 2000). The Final FR/EIS incorporates evaluation of additional data, comments and other information gathered since release of the draft document. The Final FR/EIS also provides river managers, users and the general public with the information and evaluation processes that were used to select a preferred alternative: Major System Improvements, with increased focus on adaptive migration capabilities. This alternative provides the maximum operational flexibility for juvenile fish passage; it optimizes in river passage when river conditions are best for fish and optimizes the juvenile transportation program when that operation is best for fish.

“Fish Passage & Reintroduction into the U.S. & Canadian Upper Columbia Basin.” *Canadian Columbia River Inter-Tribal Fisheries Commission*, July 2015, ccrffc.org/cms/wp-content/uploads/2015/10/Fish_Passage_and_Reintroduction_into_the_US_And_Canadian_Upper_Columbia_River4.pdf.

The Columbia Basin tribes and First Nations jointly developed this paper to inform the U.S. and Canadian Entities, federal governments, and other regional sovereigns and stakeholders on how anadromous salmon and resident fish can be reintroduced into the upper Columbia River Basin. Reintroduction and restoration of fish passage could be achieved through a variety of mechanisms, including the current effort to modernize the Columbia River Treaty. Restoring fish passage and reintroducing anadromous fish should be investigated and implemented as a key element of integrating ecosystem-based function into the Treaty.

“Fish Passage and Reintroduction Phase 1 Report: Investigations Upstream of Chief Joseph and Grand Coulee Dams.” *Upper Columbia United Tribes*, 2 May 2019, seureservercdn.net/104.238.71.140/b63.d34.myftpupload.com/wp-content/uploads/2019/05/Fish-Passage-and-Reintroduction-Phase-1-Report.pdf.

This analysis determines whether the reintroduction of salmon to the United States portion of the upper Columbia River upstream of Chief Joseph Dam is likely to achieve identified goals given current dam operations, riverine and reservoir habitat condition, donor stock availability, reintroduction risk to native species and effectiveness of state-of-the-art juvenile and adult passage technology. The Joint Paper identifies four initial goals for reintroducing anadromous salmon to habitat located upstream of Chief Joseph and Grand Coulee dams. The goals will be achieved by providing salmon access to the hundreds of miles of stream habitat in areas of the upper Columbia River basin currently blocked by Chief Joseph and

Grand Coulee dams. Ideally, this will be accomplished by providing adult and juvenile fish passage at all anthropogenic barriers that currently prevent Chinook, sockeye, coho and steelhead access to historical habitat.

Ford, Richard. "Statewide Rail Capacity and System Needs Study." *Washington State Transportation Commission*, Dec. 2006, wstc.wa.gov/Rail/RailFinalReport.pdf.

The Washington Rail Capacity and System Needs Study was requested by the Washington State Legislature to assess rail needs in the state, determine the state's interest in rail, develop policies to govern the state's participation in rail and develop a plan for managing the rail lines, railcars and service rights owned by the state. The economic vitality of Washington requires a robust rail system capable of providing its businesses, ports and farms with competitive access to North American and overseas international markets. The benefits that Washington can obtain from a robust rail system are threatened because the system is nearing capacity. Service quality is strained and rail rates are going up for many Washington businesses. The pressure on the rail system will increase in the next decades. The state should participate in the rail system through a mix of direct investment, financial incentives to private parties and advocacy on behalf of Washington businesses and communities. However, the state should do so only when the projects or actions can be demonstrated to deliver public benefits to the citizens and businesses, and when it has been demonstrated that there is a low likelihood of obtaining these benefits without public involvement.

Giles, Deborah A, et al. "Orca Scientists Letter." Received by Stephanie Solien, and Les Purce, *Orca Scientists Letter*, 15 Oct. 2018, <https://www.documentcloud.org/documents/5002547-Orca-Scientists-Letter-10-15-18-Final.html>

This letter was sent to Gov. Inslee and the chairs of the Southern Resident Orca Recovery Task Force from a group of scientists who are advocates for the Southern Resident orcas; it describes key considerations that the scientists believe should be brought up within the task force's process. The scientists state that the abundance of Chinook salmon needs to increase on a year-round basis; the task force needs to fully appreciate the role that spring Chinook play in the life history of the orcas; that stocks of spring Chinook within the Columbia Basin warrant special attention; and they recommend that spill be increased to 125% TDG. They also assert that breaching the LSRD is the way to restore the lower Snake River. The scientists include individuals we are considering interviewing as a part of our stakeholder engagement process as experts on Southern Resident orcas.

Grace, Sharon. "Policy & Factual Points for Breaching the Four Lower Snake River Dams." *Dam Sense*, 2018, damsense.org/policy-factual-points-breaching-four-lower-snake-river-dams/.

This is an online list of facts and policy points listed by Dam Sense, a community that advocates for the removal of the Lower Snake River Dams. The general format of each point includes a quote or excerpt from a research report and commentary on how the excerpt shows why the lower Snake River dams should be breached. Due to the nature of the sources of this list, it is useful to show the perspectives and where those perspectives are rooted from the breaching side of the argument, but the sources need to be researched further to show what the reports are stating as fact.

Hammond, Paula J. “Washington State 2010-2030 Freight Rail Plan.” *Washington State Department of Transportation*, Washington State, Dec. 2009, www.wsdot.wa.gov/NR/rdonlyres/AFF740F6-20F2-4C85-8569-F107E5B649D8/0/StateFreightRailPlan.pdf.

Washington’s economy needs a vibrant, competitive rail network. This network must provide a reliable, accessible and cost-effective freight service to shippers and customers across the state. An assessment of the freight needs was completed as part of this plan. The assessment is based on data provided directly by the state’s freight railroads, ports, public agencies and other key stakeholders. In total, this needs assessment identifies 109 short- and long-term capital improvement projects and other initiatives. The total cost for the requested projects, where cost estimates are available, is \$2 billion. Other issues that need to be considered in the development of this plan are: proposed rail abandonments and at-risk lines, port access, intermodal connectors and emerging issues that face freight rail in this state. The state needs to develop a comprehensive system to prioritize these projects, using a cost benefit approach, to obtain the maximum benefit for the public’s investment into any private infrastructure that is clearly measurable.

Harkema, Peter. “Columbia River Basin Salmon and Steelhead Long-Term Recovery Situation Assessment.” *The William D. Ruckelshaus Center*, The University of Washington Evans School, 7 June 2013, <https://s3.wp.wsu.edu/uploads/sites/2180/2013/06/ColumbiaRiverBasinSalmonandSteelheadLong-TermRecoverySituationAssessment-FinalReport.pdf>

This report was written by the William D. Ruckelshaus Center in 2013 in collaboration with the Oregon Consensus Center at the request of NOAA Fisheries. It provides a neutral third-party situation analysis of the regional views around lower Snake River dams and recommends an approach to comprehensive, long-term salmon and steelhead recovery in the region. Some key takeaways from the report are: all parties are committed to the recovery of salmon and steelhead; there is general sentiment among a majority of the parties that any process needs a strong leadership body charged with overseeing the salmon recovery process; and there should be a neutral science board that is the arbiter of what is considered "good" science. Some groups believe that more should be invested in the monitoring and evaluation of recovery actions, as well as greater efficiency, certainty, transparency, and predictability; improved relationships; and more durable solutions for salmon and steelhead recovery in the Basin.

Jones, Anthony. “Lower Snake River Dam Navigation Study.” *Rocky Mountain Econometrics*, Save Our Wild Salmon, 30 Sept. 2015, static1.squarespace.com/static/55a5773ae4b081289a66090b/t/563be13be4b0678da1393b9d/1446764859083/LSD+Navigation+Study+2015.Final.pdf.

This report emphasizes the decline/reduced need of shipping/barging on the Snake River; its thesis is the benefits of navigation are decreasing, the costs of maintaining the LSRD are increasing and the benefit-cost ratio indicates the dams should be shut down. The only product still being shipped regularly is barley/wheat, and Jones argues that farmers are interested in exploring higher-value crops (e.g., chickpeas/rapeseed) that don't fit well into shipping containers. He points out that rail is a better alternative to barge for shipping crops.

Jones, Anthony, and Linwood Laughy. “Bonneville Power Administration and the Lower Snake River Dams: The Folly of Conventional Wisdom.” *Rocky Mountain Econometrics*, June 2018, www.rmecon.com/examples/BPA%20&%20LSRDs%206-5-18.pdf.

This report was written by the firm Rocky Mountain Econometrics, an economic analysis firm that performs economic analysis for a variety of private and public organizations primarily within the Columbia Basin. It deals with the economic implications of the current operating conditions of the lower Snake River dams. It describes the level of power generation the dams currently operate and how surplus power generated from the dams is sold on the open market, often at either no profit or even at a negative price. The analysis is limited to hydropower production; it does not address the economic benefits from recreation, tourism, commercial fishing or the biological implications of breaching the dams.

“Juvenile Salmon Survival in 2018 and River Conditions.” Fish Passage Center. Received by Michele DeHart, 6 Mar. 2019. <http://www.fpc.org/documents/memos/9-19.pdf>

This is a memo from the Fish Passage Center (FPC) to Michele Dehart about the findings from the 2018 Comparative Survival Study on juvenile salmon survival rates on a per reach basis and compares that year’s results with the previous twelve years of results. The 2018 juvenile spring/summer Chinook survival rate was 0.64 which was slightly higher than the 2006 - 17 average of 0.63, while steelhead had a survival rate of 0.68 which was above the average rate of 0.60. It also compared their survival estimates with those of NOAA and found that NOAA estimates of survival were lower in 2018 and in general, were lower from 2006 - 17. Differences in estimates of reach survival between FPC and NOAA may indicate the effect of the bypasses since the NOAA estimates are generally lower than FPC estimates.

Lewison, Pam. “Study Suggests Dry Land Farming, New Lives to Southeastern WA Farmers.” Washington Policy Center, 12 Aug. 2019, www.washingtonpolicy.org/publications/detail/study-suggests-dry-land-farming-new-lives-to-southeastern-wa-farmers.

This article is a rebuttal to ECONW's *Lower Snake River Dams: Economic Tradeoffs of Removal* report. Lewison takes issue with two of the report's assertions:

1. *Non-irrigated farming is a reasonable choice for farmers who currently grow irrigated crops.* Lewison points out that each area of southeastern Washington faces unique challenges and a one-size-fits-all approach to agriculture is not appropriate; irrigated crops are more valuable than non-irrigated crops; different areas lend themselves well to specific types of farming; and it's not easy or efficient for farmers to move from one product to another, especially as agriculture is a business of relationships built over time.

2. *The cost to change irrigation infrastructure is relatively minor.* Lewison points out that ECONW used data from 1999 to estimate infrastructure changes would cost ~\$165 million.

“Lower Snake River Dams Power Replacement Study.” *Energy Strategies*, NW Energy Coalition, Mar. 2018, rossstrategic365.sharepoint.com/BD/BidTracking/https://nwenergy.org/featured/lsrcstudy/

This NW Energy Coalition report from 2018 shows it is possible to replace the power generated by the Lower Snake River Dams with a variety of different energy portfolios, some of which could increase the reliability of the system with only minor rate and emission

increases. This report used data from Bonneville Power Administration, grid constraints laid out by the Northwest Grid Council, and models used by the National Reliability Council for their analysis. While this analysis shows that it is possible to compensate for the energy production lost from breaching the dam, the proposed portfolios would need to be optimized by the NWPCC and BPA to fit with their energy goals.

Mainzer, Elliot. “Greenwire Article Response.” Received by Cyril T. Zaneski, 5 Sept. 2019 <https://www.bpa.gov/news/newsroom/Pages/BPA-responds-to-deeply-flawed-article-on-agencys-financial-health.aspx>

This is a letter from Elliot Mainzer the current CEO of Bonneville Power Administration in response to an article E&E News. The letter outlines areas of the article that BPA took issue with and provides context as well as additional information to back up their claims. One instance is on BPA’s debt which as BPA states is not paid for with taxpayer dollars and they are on track to pay their annual debt payments for the next three years.

Matthews, Gene M, and Robin S Waples. “Status Review for Snake River Spring and Summer Chinook Salmon.” *NOAA Tech Memo NMFS F/NWC-200: Status Review for Snake River Spring and Summer Chinook Salmon*, June 1991, www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm200/tm200.htm.

The National Marine Fisheries Service Species Definition Paper (Waples 1991) provides a guide for evaluating the petitions for the three forms (spring-, summer-, and fall-run) of Snake River Chinook salmon. NMFS considers fall Chinook separately and spring and summer Chinook in ESA evaluations. This report summarizes the review of the status of Snake River spring and summer Chinook conducted by the NMFS Northwest Region Biological Review Team. Collectively, the data indicate that spring and summer Chinook in the Snake River are in jeopardy: Present abundance is a small fraction of historical abundance, the Dennis model provides evidence that the ESU is at risk, threats to individual subpopulations may be greater still, and the short-term projections indicate a continuation of the downward trend in abundance. NMFS does not feel the evidence suggests that the ESU is in imminent danger of extinction throughout a significant portion of its range; however, it is likely to become endangered in the near future if corrective measures are not taken.

Mojica, J., Cousins, K., Briceno, T., 2016. National Economic Analysis of the Four Lower Snake River Dams: A Review of the 2002 Lower Snake Feasibility Report/Environmental Impact Statement. Economic Appendix (I). Earth Economics, Tacoma, WA. <http://www.damsense.org/wp-content/uploads/2014/12/National-Economic-Analysis-of-the-Four-Lower-Snake-River-Dams-2.16.pdf>

This report presents a thorough analysis of the benefits and costs of the four lower Snake River dams in both “keep dam” and “breach dam” scenarios. It concludes the benefits created by the four dams are outweighed by the costs of keeping them. Furthermore, with the possible exception of navigation and irrigation water supply, the current benefits would not be lost, but rather increased, if the dams were breached. Due to subsidies and unclear rail and barge cost data, the verdict is still out on whether there is an economic benefit to shipping by barge over rail. The report says the four lower Snake River dams in southeast Washington do not provide a net benefit to the nation, and they may never have.

Myers, Todd. *The Environmental Tradeoffs of Removing Snake River Dams*, 53 Idaho L. REV. 209 (2017) <https://www.washingtonpolicy.org/library/doclib/Todd-Myers-1--1.pdf>

This analysis examines the cost of replacing the energy generated by the LSRD and fully mitigating the carbon emissions associated with replacement. It concludes that the cost of removing the dams is very high for both the economy and the climate; it would eliminate carbon-free energy greater than the entire stock of wind and solar energy in Washington and oblige utilities to replace a relatively low-cost source of energy with high-cost alternatives. The report acknowledges that this conclusion is not entirely objective, given how one might value different aspects of the dams; it does "not claim to be a mathematical calculation of the overall benefits and costs of removing the dams." It is meant to serve as a data source to narrow and refine the debate over the dams.

“NOAA Fisheries 2019 CRS Biological Opinion.” *NOAA Fisheries West Coast Region*, National Oceanic and Atmospheric Administration, 29 Mar. 2019, www.westcoast.fisheries.noaa.gov/publications/hydropower/fcrps/master_2019_crs_biological_opinion_1.pdf.

This report was released by NOAA Marine Fisheries Services as their most recent Biological Opinion in 2019 for how the operations within the Columbia River system are affecting the ESA-listed stocks within the system. This Biological Opinion is broken down by the various reaches that the ESA-listed stocks inhabit, including the four listed Snake River stocks. The BiOp describes the stock's current status, range, environmental baseline, the effects the action would have on the stocks and their conclusion for moving forward for recovery on the stocks. One of the main actions considered in this Biological Opinion is the shift towards 125% TDG Flex Spill plans at the dams to increase juvenile survival through the dams. For all the stocks, this proposed action would not have detrimental effects on recovery or survival of the stocks.

Peterson, Lynn. “Washington State Rail Plan Integrated Freight and Passenger Rail Plan 2013-2035.” *Washington State Department of Transportation*, Mar. 2014, www.wsdot.wa.gov/sites/default/files/2019/03/08/Rail-Plan-20132035.pdf.

The purpose of the Washington State Rail Plan is to outline strategies for addressing changes and provide a blueprint for ensuring the continued movement of people and goods on the rail system in support of a healthy economy. It sets a course for state action and investment to ensure that these vital services continue to meet transportation needs now and through 2035. This plan melds the state-level policy direction with feedback from stakeholders, Tribes and the public to guide identification of needs and development of recommendations. Public actions to improve the rail system are identified, and policies for state action are recommended.

Purce, Les, and Stephanie Solien. “Southern Resident Orca Task Force Report and Recommendations.” *Washington Governor Jay Inslee*, Washington State, 16 Nov. 2018, www.governor.wa.gov/sites/default/files/OrcaTaskForce_reportandrecommendations_11.16.18.pdf.

This report was produced by Gov. Jay Inslee's Southern Resident Orca Task Force, a collaborative process that brought together stakeholders from around the state to discuss a plan on how to restore the Southern Resident orca populations in Puget Sound. The report

highlights four goals for restoring the Southern Resident orca population and 36 recommendations. Recommendations eight and nine refer to this current stakeholder engagement process. The four goals are 1) increase chinook salmon abundance, 2) decrease disturbance of and risk to Southern Resident orcas from vessels and noise and increase their access to prey, 3) reduce the exposure of Southern Resident orcas and their prey to contaminants, and 4) to ensure funding, information and accountability mechanisms are in place to support effective implementation. The report includes public comments, responses to those public comments and minority reports that include views and perspectives that can be captured within our process.

“Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*).” National Marine Fisheries Service, Northwest Region, Seattle, Washington, 2008, https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/esa_status/srkw-recov-plan.pdf

This is NMFS's recovery plan for Southern Resident orcas, as required by the Endangered Species Act. Southern Resident orcas were ESA-listed in 2005; this document outlines the process NMFS went through to develop a recovery plan, the recovery strategy and its goals/objectives, and estimates the cost of recovery. The recovery strategy acknowledges the considerable uncertainty as to which threats are responsible for the declining orca population and provides an adaptive management approach that addresses each of the potential threats based on the best available science.

Resources, Meyer. “Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes.” *Columbia River Intertribal Fisheries Commission*, Apr. 1999, www.critfc.org/wp-content/uploads/2014/11/circum_exec.pdf.

This report considers impacts on the Nez Perce Tribe, the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation and the Confederated Tribes of the Warm Springs Reservation of Oregon. Today, the tribes have lost the greatest part of the salmon protected in their treaties with the United States. The further up-river one goes, the greater the losses that have occurred. Above the four lower Snake River dams, tribal salmon are presently harvested at less than 1% of pre-contact levels. The four lower Snake River dams evaluated in this report have significant, but not sole responsibility for the desperate present circumstances of tribes. Construction of these dams transformed the production function of the lower Snake River – taking substantial Treaty-protected wealth in salmon away from the tribes, as evidenced by the miniscule tribal harvests currently taken above the dams.

“Revenue Stream: An Economic Analysis of the Costs and Benefits of Removing the Four Dams on the Lower Snake River.” *Save Our Wild Salmon*, 2005, docs.streamnetlibrary.org/revenuestream8.pdf

This BCA answers two questions: 1) What are the costs of restoring salmon with and without the dams, and 2) What are the economic benefits with and without the dams? Ultimately, it demonstrates that removing the four lower Snake River dams in Washington state as the centerpiece of a Columbia River salmon protection plan will return significant economic dividends to the Northwest and the nation, creating a “revenue stream” of both cost savings and economic benefits from new and restored industries.

“Review of the 2014 Columbia River Basin Fish and Wildlife Program.” *Independent Science Advisory Board*, Northwest Power and Conservation Council, 23 Mar. 2018, www.nwcouncil.org/sites/default/files/isab-2018-3-review2014fwp23march.pdf.

This report is by the Independent Science Advisory Board; it was commissioned by the Northwest Power and Conservation Council to evaluate the scientific merits of the Council's 2014 Columbia River Basin Fish and Wildlife Program so that NWPCC could amend the program in 2018. Overall, the ISAB found that most sections of the 2014 Program provide sound scientific guidance for actions to mitigate hydrosystem impacts and move toward recovery of fish and wildlife resources in the Columbia River Basin. Program strengths include Mainstem Hydrosystem research, the Protected Areas, strategies such as the Stronghold Habitat and Anadromous Fish Mitigation in Blocked Areas, and Public Engagement. Weaknesses include the fact that the majority of Program goals do not have corresponding objectives, key program strategies do not have monitoring and evaluation plans or funding, and the Program provides limited guidance and use of adaptive management. In addition to specific recommendations for weaknesses listed above, the ISAB's review contains additional points of emphasis for the Council's consideration.

“Review of the SOS Revenue Stream Report.” *Northwest Power and Conservation Council*, Independent Economic Analysis Board, 25 Feb. 2007, www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-economic-advisory-board/review-of-the-sos-revenue-stream-report.

The Independent Economic Analysis Board reviewed SOS's Revenue Stream BCA and found: (1) The Revenue Stream report underestimates hydropower replacement costs by enough to invalidate its main conclusion that the region could save money by removing the dams. (2) The Revenue Stream report is not a peer reviewed analysis, the work was not conducted by an open public process, and many of the sources that the report relied on came from reports that were also not products of an open, public peer-reviewed process. (3) The Revenue Stream report does not discount future benefits and costs of dam removal, which could drastically affect conclusions. (4) The reported recreational fishery benefits rely heavily on a study by Don Reading (2004), which the IEAB reviewed in December 2005. The IEAB concluded that Reading had made a number of methodological errors which seriously biased his benefit estimates upward. The non-fishery recreational benefits are derived from a study by John Loomis (1999) which the IEAB reviewed during its overall review of the Corps' EIS in 2001. The IEAB had significant concerns about some of Loomis' results as well, and the numbers actually used in the final Corps EIS differed substantially from those presented in the original Loomis study. Hence, the Revenue Stream's reported benefits from salmon recovery in the Snake River appear unreliable.

“Seventh Northwest Conservation and Electric Power Plan.” *Northwest Power and Conservation Council*, 25 Feb. 2016, www.nwcouncil.org/sites/default/files/7thplanfinal_allchapters_1.pdf.

The Council's seventh NW Conservation and Electric Power Plan addresses the uncertainties faced by the Pacific Northwest's power system (e.g., compliance with federal carbon dioxide emissions regulations, future fuel prices, or renewable resources and technology) and provides guidance on which resources can help ensure a reliable and economical regional power system over the next 20 years. Acquiring energy efficiency is the primary action for the next six years. The Plan's second priority is to develop the capability

to deploy demand-response resources or rely on increased market imports to meet system capacity needs under critical water and weather conditions. After energy efficiency and demand response, new natural gas-fired generation is the most cost-effective resource option for the region in the near-term. The Plan encourages research in advanced technologies to improve the efficiency and reliability of the power system. For example, emerging smart-grid technologies could make it possible for consumers to help balance supply and demand.

Simmons, Sara, and Ken Casavant. “The Economic and Environmental Impacts of The Columbia-Snake River Extended Lock Outage.” *Freight Policy Transportation Institute*, Washington State University, Aug. 2011, ses.wsu.edu/wp-content/uploads/2015/07/FPTI-12.pdf.
<http://ses.wsu.edu/wp-content/uploads/2015/07/FPTI-12.pdf>

This report’s main objectives are to 1) analyze the change in rates and modal costs for shippers, commodity industries and ports prior to, during and after the 15-week lock outage and 2) determine the impacts on the environment in the form of energy consumption and emissions production prior to, during and after the lock outage in winter 2010-11. During a transportation disruption, such as the extended lock outage, alternative modes are used more frequently and heavily as barge transportation is unavailable. The lock outage on the Columbia-Snake River forced commodities that regularly travel by barge to shift to rail and truck. As a result, transportation costs incurred a 37.4% increase. Along with energy consumption, emissions production also increased due to the lock outage. The total change in emissions due to the loss of barge during the lock outage caused a 9% increase in overall emissions from the transportation commodities.

“Southern Resident Killer Whales: 10 Years of Research and Conservation.” *Northwest Fisheries Science Center*, National Oceanic and Atmospheric Administration, June 2014,
www.nwfsc.noaa.gov/news/features/killer_whale_report/pdfs/bigreport62514.pdf.

This report by NOAA Fisheries in 2014 covers the past 10 years of conservation efforts for the benefit of the Southern Resident orcas and what needs to happen for the recovery of the species over the next 10 years. It summarizes the current recovery plans for the orcas, the current major threats to the species, what critical information gaps were filled over the past ten years and what ongoing recovery measures are in place for the orcas. The report brings up the fact that the Southern Residents are altering their behavior in the presence of vessel noise and that even though PCBs have been phased out by humans, are still being bioaccumulated within the tissues of the Southern Residents due to the high prevalence of the toxins within their food and habitat.

“Southern Resident Killer Whale Priority Chinook Stocks Report.” *National Marine Fisheries Service*, National Oceanic and Atmospheric Administration, 22 June 2018,
www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/recovery/srkw_priority_chinook_stocks_conceptual_model_report_list_22june2018.pdf.

This 2018 report describes the current status of the key fish stocks identified as being the highest priority for recovery due to their prevalence within the Southern Resident orca whale's diet. The report was the basis of the shorter summary in the Fact Sheet and shows how NOAA concluded that the northern and southern Puget Sound stocks of fall Chinook salmon are the most important to recover for the benefit of the orcas. NOAA evaluated each stock based upon the amount that the stock contributes to the diet of the orcas, the

amount that the particular stock is consumed when other stocks are less abundant, and the amount of spatial and temporal overlap with the range of the stock and the orcas. The Snake River spring/summer Chinook stocks come in fifth due to the lower levels of spatio-temporal overlap with the Southern Resident orcas compared to other higher priority stocks like Puget Sound fall or lower Columbia spring Chinook.

“Sothern Resident Killer Whales and Snake River Dams Fact Sheet.” *NOAA Fisheries West Coast Region*, National Oceanic and Atmospheric Administration, 2016, www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/killerwhales_snakeriverdams.pdf.

This fact sheet was released by NOAA Fisheries Service in 2016. It presents a high-level overview of how the dams along the lower Snake river affect the Southern Resident orcas. It explicitly states that NOAA has not concluded that breaching the dams is necessary to the recovery of Snake River salmonids or Southern Resident orcas. It addresses other factors affecting the Southern Residents, such as vessel traffic and pollution within the Salish Sea, and states that saving the Southern Residents will take a variety of mitigation and recovery efforts over the course of many years and that the recovery effort of one salmon species in one river won't bring about recovery of the Southern Residents on its own.

“Southern Resident Killer Whales and West Coast Chinook Salmon.” *NOAA*, National Oceanic and Atmospheric Administration, 2018, www.nww.usace.army.mil/Portals/28/docs/V2N/FactSheets%20not%20508/10.4.2018_S_RKW_salmon_sources_factsheet%206PM.pdf?ver=2018-10-22-181659-907.

This fact sheet that NOAA Fisheries released in 2018 shows the link between the Southern Resident orcas and Chinook salmon on the West Coast. It shows the key threats the Southern Residents currently face, the key stocks NOAA identified as priority stocks for the Southern Residents, the current abundance of these key Chinook stocks, and the trends for the different stocks in Washington. The fact sheet states that dam breaching is a long-term proposition that takes congressional authorization and recovery results will not be apparent until several generations after the breaching. NOAA perceives that northern and southern Puget Sound stocks of fall Chinook salmon are the highest priority for recovery, with Snake River spring/summer Chinook being the 5th highest priority, and these stocks aren't showing the increases in returns that the Snake River stocks is currently experiencing.

Tweit, Bill, et al. “State of Washington November 2018 Comprehensive Evaluation of the Columbia River Basin Salmon Management Policy C-3620, 2013-2017.” *Comprehensive Evaluation of the Columbia River Basin Salmon Management Policy C-3620, 2013-2017*, Washington Department of Fish and Wildlife, Nov. 2018, wdfw.wa.gov/sites/default/files/publications/02029/wdfw02029.pdf

This report by the Washington Fish and Wildlife Commission in 2018 that is a comprehensive review of the previous five years of the Columbia River Salmon Management Policy, which was first adopted in 2013. The evaluation assesses the success the policy was having toward stated objectives, areas where the policy was not working well, and to provide information on why areas were either doing well or poorly. It concluded the large economic benefits expected for both commercial and recreational fisheries were not observed, that commercial area enhancements and alternative gear development had not replaced mainstem

fisheries, recreational fisheries only had marginal benefits due to changes in allocations and that the overall expectations in the development of the Policy were not met.

Widener, D. L., J. R. Faulkner, S. G. Smith, T. M. Marsh, and R. W. Zabel. 2018. Survival Estimates for the Passage of Spring-Migrating Juvenile Salmonids through Snake and Columbia River Dams and Reservoirs, 2017. Draft report of the National Marine Fisheries Service to the Bonneville Power Administration, Portland, Oregon, 2/1/2018.
https://www.nwfsc.noaa.gov/assets/26/9359_02262018_135356_Widener.et.al.2018-Spring-Survival-2017.pdf

In 2017, NOAA completed the 25th year of a study to estimate survival and travel time of juvenile Pacific salmon passing dams and reservoirs on the Snake and Columbia rivers. All estimates were derived from detections of fish tagged with passive integrated transponder (PIT) tags. In light of planned operations that will reduce detection probabilities below the current low levels, the need is now more urgent than ever before to develop PIT-tag detection capability through passage routes other than the juvenile bypass systems.

Ziegler, Brian. "2017 Marine Cargo Forecast and Rail Capacity Analysis Final Report." *Freight Mobility Strategic Investment Board*, Washington Public Ports Association, Aug. 2017, static1.squarespace.com/static/5a8499e518b27dc83c2403ce/t/5af0ba816d2a73731f8d1faa/1525725867212/Marine-Cargo-Forecast-2017-Final-10-2017.pdf.

This report assesses the expected flow of waterborne cargo through Washington's port system and evaluates the distribution of cargo through the state's transportation network, including waterways, rail lines, roads and pipelines. The study includes forecasts of trade by commodity and cargo type from 2015 through 2035. Of the Snake River, the report says the Columbia-Snake River navigation system allows Washington-grown agricultural products to move from farm to market and creates price competition between modes of transportation. There is a steady demand for barge transportation on the Snake River. The report says Washington's public ports are vital and investing in transportation infrastructure – beginning with an efficient, cost-effective rail system - is the best way to maintain and expand the state's place in the global economy.

Ziegler, Brian. "2017 Marine Cargo Forecast and Rail Capacity Analysis Appendix A Rail Capacity Analysis." *Freight Mobility Strategic Investment Board*, Washington Public Ports Association, Aug. 2017, static1.squarespace.com/static/5a8499e518b27dc83c2403ce/t/5b5631f370a6ad58609ec92f/1532375542016/MCF-2017-Appendix-A.pdf.

This analysis uses a rail model simulation for the greater rail network within Washington state (essentially the BNSF Railway network). The model simulation program used was the Rail Traffic Controller (RTC) simulation suite, which is used by all Class I North American railroads and is accepted as the standard analysis program for analyzing rail operations and capacity under various operating protocols, train volumes and infrastructure design. The Base Case conditions indicate that BNSF does not currently have capacity issues on most of their line segments in the PNW.

The following link includes additional letters, fact sheets, opinion pieces, resolutions and other information sources related to the LSRD provided by interviewees and other interested parties:
<https://app.box.com/s/smdi3sx4nz8z1pmps5osteimlohv61e>

Appendix B: Relevant State and Federal Studies and Task Forces

In recent decades, the LSRD have been the subject of numerous scientific, economic and environmental analyses and task forces. Listed below are the significant state and federal actions and organizations that informed the draft report.

Endangered Species Act Listings for Anadromous Fish in the Lower Snake River & NOAA National Marine Fisheries Service Biological Opinions

Four anadromous fish species in the lower Snake River are currently listed under the Endangered Species Act. Table 4 summarizes the species, status and year of listing. Under Section 7 of the ESA, federal agencies must consult with NOAA Fisheries on activities that may affect ESA-listed species. These inter-agency consultations are designed to help federal agencies in fulfilling their duty to ensure that their actions do not jeopardize the continued existence of a species or destroy or adversely modify designated critical habitat. NOAA Fisheries' Office of Protected Resources issues Biological Opinions to document its Opinions on how federal agencies' actions affect ESA-listed species and critical habitat.¹⁵⁹ Table 5 (below) summarizes the findings of NOAA National Marine Fisheries Service BiOps issued since 1992 on operation and maintenance of the Columbia River System Operations, including the LSRD.

NOAA has adopted three recovery plans for the four ESA-listed Snake River basin species – steelhead, spring/summer Chinook salmon, fall Chinook salmon and sockeye. NOAA's intent is to optimize recovery plan implementation through stakeholder involvement to prioritize and implement recovery actions; particularly through NOAA Fisheries' Snake River Coordination Group.¹⁶⁰

Table 7: Endangered Species Act Listings for Anadromous Fish in the Lower Snake River¹⁶¹

Species	Status	Listing Year
Snake River fall Chinook	Threatened	1992
Snake River spring/summer Chinook	Threatened	1992
Snake River sockeye	Threatened	1991
Snake River steelhead	Endangered	1997

Table 8: NOAA National Marine Fisheries Service Biological Opinion Findings ¹⁶²

Year	Findings	Litigation
1992 FCRPS BiOp	Two BiOps were issued this year. The first found that the federal power system’s operations did not jeopardize the continued existence of listed fish or detrimentally alter their critical habitat. The second found no jeopardy to protected salmonids in the basin as a result of ocean fisheries and in-river fisheries.	Several users of the FCRPS energy filed suit challenging these BiOps claiming restricted operations would lead to increased rate, but the case was dismissed in the U.S. District Court of Oregon and an appeal was rejected by the Ninth Circuit Court of Appeals.
1993 FCRPS BiOp	Found that the federal power system’s operations did not jeopardize the continued existence of listed fish or detrimentally alter its critical habitat.	This BiOp was challenged in the U.S. District Court of Oregon in the case <i>Idaho Department of Fish & Game v. National Marine Fisheries Service</i> and remanded to be rewritten by Judge Malcom Marsh.
1994 FCRPS BiOp	Found that the federal power system’s operations did not jeopardize the continued existence of listed fish or detrimentally alter its critical habitat.	This BiOp was challenged in the case <i>American Rivers v. National Marine Fisheries Services</i> but the court stayed the case while NMFS revised the BiOp to comply with the previous ruling.
1995 FCRPS BiOp	Found that the federal power system’s operations did jeopardize the continued existence of listed fish and adversely modified critical habitat, proposed Reasonable Prudent Alternatives (RPAs).	This BiOp was challenged in two cases, one by American Rivers and the other by a group of users of the FCRPS energy. The former suit was dismissed in the Ninth Circuit and the later suit was also dismissed by the same court.
2000 FCRPS BiOp	Found that the federal system’s operations would jeopardize protected salmonids and proposed RPAs to alleviate the effects of operation on salmonids, but even with the implementation of these RPAs jeopardy would not be avoided so they proposed offsite activities unrelated to system operations to avoid jeopardy in tandem with the RPAs.	This BiOp was challenged in the case <i>Wildlife Federation v. National Marine Fisheries Service</i> where it was remanded to be rewritten in the U.S. District Court of Oregon by Judge James Redden due to his conclusion that the offsite activities were not reasonably certain to occur.
2004 FCRPS BiOp	NMFS took a different approach to BiOps and excluded the effects of each of the dams that already exists (i.e., included the dams in the environmental baseline) and found that the discretionary elements of the system’s operations would not jeopardize the salmonids.	This BiOp was found incompatible with the Endangered Species Act by Judge James Redden and was remanded to be rewritten after the Ninth Circuit affirmed Judge Redden’s decision.
2005 Upper Snake River BiOp	Found that the effects of BOR-proposed operations on the Snake River would not jeopardize the salmonids or detrimentally alter critical habitat.	This BiOp was challenged in the U.S. District Court of Oregon before Judge James Redden who remanded it to be rewritten because it utilized the same methodology of the 2004 BiOp that the court held to be flawed.
2008 BiOp	Found that the federal power system’s operations did jeopardize the continued existence of listed fish or detrimentally alter its critical habitat through 2018 with the use of RPAs they could mitigate the effects of the FCRPS.	This BiOp was challenged by the same group of litigants from the 2000 BiOp, Judge James Redden ruled that parts of the BiOp did comply with the ESA but ultimately remanded it to be rewritten.

Year	Findings	Litigation
2010 Supplemental BiOp	Incorporated the measures that were agreed upon in the “Fish Accords” to avoid jeopardizing the listed salmonids as well as their critical habitat	This BiOp was collectively ruled upon with the 2008 BiOp.
2014 Supplement BiOp	Supplemented the 2008 BiOp and found that the implementation of RPAs could be utilized to mitigate jeopardy caused by the operation of the federal power system	This BiOp was challenged by the same group of litigants of recent previous BiOps, in the U.S. District Court of Oregon where Judge Michael Simon remanded it to be rewritten and a new EIS was required because the proposed RPAs violated NEPA since an EIS was not prepared in connection with the RPAs and the relied upon EISs were no longer satisfactory.
2019 CRS BiOp	Found that actions proposed in the Flexible Spill Agreement would not jeopardize listed salmonids or detrimentally alter critical habitat	As of the writing of this report there has not been litigation regarding this BiOp

Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (2002)

The 2002 federal Feasibility Report/Environmental Impact Statement led by the US Army Corps of Engineers was a seven-year analysis under the National Environmental Policy Act that examined alternatives for improving salmon migration through the four LSRD. It evaluated the effects of the operation and configuration of the dams on the status of ESA-listed salmon, water quality, commercial navigation and other resources.

The FR/EIS considered four alternatives and their technical, environmental and economic effects: (1) maintain the status quo (continue existing conditions); (2) maximize juvenile fish transportation; (3) make major system improvements (an adaptive migration approach); and (4) breach the dams. The FR/EIS incorporated input from federal agencies, including US Fish and Wildlife and National Marine Fisheries Service, state agencies, regional entities, tribes and the public. The USACE identified alternatives 3 and 4 (adaptive migration and breach the LSRD, respectively) as the environmentally-preferred alternatives, although both had negative short- and long-term effects on key environmental resources and economic factors. Elements of alternatives 3 and 4 in the FR/EIS are being evaluated in a Columbia River System Operations environmental impact statement that will soon be released in draft form for public review and is described later in this section.

Ultimately, the Corps recommended a modified version of alternative 3 (major system improvements [adaptive migration]), that combined a series of structural and operational measures intended to improve fish passage through the lower Snake River. The adaptive management alternative was meant to complement regional actions and processes that already address salmon recovery. This recommendation was, in part, due to the conclusion in the NMFS 2000 Biological Opinion that breaching was not necessary at that time to avoid jeopardizing ESA-listed species, although that BiOp did include contingency measures that would, under certain circumstances, trigger additional analysis of breaching and whether congressional authorization for breaching should be considered.

Columbia Basin Partnership Task Force

The Columbia Basin Partnership Task Force was convened in 2017 by NOAA Fisheries' Marine Fisheries Advisory Committee to develop shared goals and a comprehensive vision for the future of Columbia Basin anadromous fish, including lower Snake River salmon and steelhead. The task force includes many groups with different interests from across the Basin, including federally-recognized tribes, fishing groups, environmental groups, energy, freight transportation, agricultural representatives and northwest states.

The Phase 1 task force report (January 2017–March 2019) reflects consensus around a shared vision for a healthy Columbia River and provisional goals for the 24 stocks of Columbia Basin salmon and steelhead. The goal-setting process reflected and considered the full range of social, cultural, economic and ecosystem values and diversity in the Basin. In Phase 2 the task force is exploring scenarios for how the goals from Phase 1 might be achieved and their potential impacts on stakeholder and reserved right-holder interests and consider if any of the provisional goals developed in Phase 1 should be adjusted based on Phase 2 work. Phase 2 will be complete in June 2020.

Southern Resident Orca Task Force

In March 2018, Gov. Inslee's Southern Resident Orca Task Force was created by executive order to develop recommendations for orca recovery and future sustainability. The task force was comprised of 47 members from many organizations, including the Washington State Legislature; Washington state agencies; the Government of Canada; tribal, federal, local and other state governments; and the private and nonprofit sectors.

The task force released a final report in November 2018 that identified four overarching goals: (1) increase chinook abundance and access to other prey; (2) decrease disturbance and risk from vessels and noise; (3) reduce the exposure of Southern Resident orcas and their prey to contaminants; and (4) ensure funding, information and accountability mechanisms are in place to support effective implementation. The report included a package of 36 recommendations designed to support the four goals. Each recommendation identified a lead agency and key partners for execution and identified whether the recommendation required federal, state or local actions or decisions. Recommendations 8 and 9 directly relate to LSRD: immediately increase total dissolved gas allowances to facilitate increased volumes of water spilled over the federal dams on the lower Snake and lower Columbia rivers, and establish a stakeholder process to discuss potential breaching LSRD.

Columbia River System Operations Environmental Impact Statement

Unrelated to the Southern Resident Orca Task Force process and recommendations, since 2016 USACE, USBR and BPA have been preparing, pursuant to a federal court order, an environmental impact statement to determine whether any changes should be made to the coordinated long-term operations, maintenance and configuration of the 14 federal dams in the Columbia River System, including the LSRD. The EIS will present a range of alternatives for long-term system operations and evaluate potential environmental and socioeconomic impacts of each. Alternatives include maintain the status quo (no change from 2016 actions) and four multiple-objective alternatives. The following five measures are in most of all of the four multiple-objective alternatives: (1) updating flood risk management operations at Libby and Grand Coulee dams; (2) providing for authorized

irrigation water supply; (3) providing structural measures for fish passage; (4) modifying operations to smooth triggers for summer draft as some upstream projects; and (5) providing more flexibility during fish passage season to shape flows within the day. One of the four multiple-objectives alternatives being evaluated in the EIS includes breaching the LSRD.

The draft CRSO EIS is scheduled to be released in February 2020, with a public comment period to follow. The final EIS is scheduled to be released in June 2020. If the EIS determines that significant modifications to the dams are advisable and it is approved by the USACE's Administration, the EIS recommendations can be implemented (in the case of additional spill) or submitted to Congress for authorization and appropriation (in the case of breaching the LSRD).

Appendix C: Lower Snake River Dams Stakeholder Engagement Interviewee List

Below is the list of people interviewed during the process. Each interview was approximately 90 minutes and most of the interviews were in person. The interviewees were asked a series of questions focused on the impacts (positive and negative) from retaining or breaching the LSRD. The consultant team greatly appreciates the time provided by the interviewees and this report benefits from their insights. The interviewees did not review this draft report before it was released and may have different perspectives on the report content.

Name	Organization
Blaine Meek	Irrigated farmer, AgReserves Inc.
Wendy McDermott	American Rivers
Brian Shinn	Asotin County
Chad Bartram	Benton Public Utility District
Elliot Mainzer	Bonneville Power Administration
Liz Klumpp	Bonneville Power Administration
Greg Guthrie	Burlington Northern Santa Fe Railway
Butch Smith	Coho Charters and Port of Ilwaco
Mike Talbott	Columbia County
Amy Grondin	Commercial Fisher
Joel Kawahara	Commercial Fisher and Coastal Trollers Association
Jim Waddell	Dam Sense
Robb Kriehbel	Defenders of Wildlife
Tom Tebb	Department of Ecology
Todd True	Earth Justice
Adam Domanski	ECONorthwest
Michelle DeHart	Fish Passage Center
Deb Bone-Harris	Franklin Public Utility District
Holly Dohrman	Franklin Public Utility District
Roger Wright	Franklin Public Utility District
Scott Rhees	Franklin Public Utility District
Justin Dixon	Garfield County

Name	Organization
Katie Nelson	Gordon Bros. Winery
Marc Nelson	Gordon Bros. Winery
Tom Dresser	Grant County Public Utility District
Dustin Aherin	Idaho River Adventures
Travis Swayze	International Brotherhood of Electrical Workers Local 112
Matthew Hepner	International Brotherhood of Electrical Workers of WA
Mike Bosse	International Union of Operating Engineers, Local 302
Scott Zuger	Lewiston-Clarkston Terminal Inc
Jacques White	Long Live the Kings
Barry Thom	National Oceanic and Atmospheric Administration
Ritchie Graves	National Oceanic and Atmospheric Administration
Dave Johnson	Nez Perce, Department of Fisheries
Jay Hesse	Nez Perce, Department of Fisheries
Nakia Williamson-Cloud	Nez Perce, Department of Natural Resources
Dave Cummings	Nez Perce, Office of Legal Counsel
Nancy Hirsh	Northwest Energy Coalition
Chris Peha	Northwest Grain Growers
Guy Norman	Northwest Power and Conservation Council
Austin Rohr	Northwest RiverPartners
Kurt Miller	Northwest RiverPartners
Liz Hamilton	Northwest Sport Fishing Industry Association
Ed Bowles	Oregon Department of Fish and Wildlife
Glen Spain	Pacific Coast Federation of Fishermen's Associations
Kristin Meira	Pacific Northwest Waterways Association
Roy Keck	Port of Benton
Wanda Keefer	Port of Clarkston
Jennie Dickinson	Port of Columbia
David Doeringsfeld	Port of Lewiston
Randy Hayden	Port of Pasco
Marla Harrison	Port of Portland

Name	Organization
Patrick Reay	Port of Walla Walla
Brenda Stav	Port of Whitman County
Joe Poire	Port of Whitman County
Tom Kammerzell	Port of Whitman County
Mark Pinch	Private Development/Real Estate
Bill Hector	Retired Irrigation Farmer
Bryan Jones	Dusty Wheat Farmer
Joseph Bogaard	Save our Wild Salmon
Sam Mace	Save Our Wild Salmon
Lynn Best	Seattle City Light
Rob Rich	Shaver Transportation
Bill Arthur	Sierra Club
BJ Kieffer	Spokane Tribe Natural Resource
Chris Casserino	Spokane Tribe, Cultural Resources
Brent Nichols	Spokane Tribe, Natural Resources
Alex McGregor	The McGregor Company
Leslie Druffel	The McGregor Company
Brian Fletcher	Tidewater Barge lines
Craig Nelson	Tidewater Barge Lines
David Konz	Tidewater Barge lines
Jennifer Riddell	Tidewater Barge lines
David Reeploeg	Tri City Development Council
Rob Masonis	Trout Unlimited
Dan Wilson	United Steelworkers Local 338
Todd Kimball	Walla Walla County
Mark Riker	Washington Building Trades
Derek Sandison	Washington Department of Agriculture
Michael Garrity	Washington Department of Fish & Wildlife
Glen Squires	Washington Grain Commission
Bill Newbury	Washington Grain Growers Association

Name	Organization
Chris Herman	Washington Ports Association
Gerry O'Keefe	Washington Ports Association
Matt Harris	Washington Potato Commission
Larry Brown	Washington State Labor Council
Ken Casavant	Washington State University
Greg Mueller	Washington Trollers Association
Michelle Hennings	Washington Wheat Growers
Michael Largent	Whitman County
Deborah Giles	Wild Orca Center
Buzz Ramsey	Yakima Bait
Dan McDonald	Yakima Bait

Appendix D: Online Survey Questions

This questionnaire is part of a process to gather and summarize the perspectives of Washingtonians on the impacts, both positive and negative, of retaining or breaching/removing the four lower Snake River dams (LSRD). The results of the questionnaire will be summarized into themes.

Governor Inslee supports this process to understand the full range and diversity of views in Washington state in regard to the LSRD. He plans to use this information to help craft his recommendations on the Columbia River Systems Operations Environmental Impact Statement being developed by U.S. Army Corps of Engineers, Bureau of Reclamation, and Bonneville Power Administration anticipated in February 2020 regarding the operations, maintenance and configurations for 14 federal projects in the Columbia River System in the interior Columbia River Basin.

Responses to the questionnaire will be treated confidentially. Please email twendel@rossstrategic.com with the subject line "LSRD Distribution List" if you would like to be added to a contact list for updates.

1. Please select the option(s) that best represent your affiliation. You may select more than one option, and if you like you can identify your primary affiliation in the next question.

- Conservation
- Business
- Sport or Commercial Fishing Industry
- Recreation
- Agriculture
- Not-for-Profit Organization
- For-profit Company
- Federal Government
- Tribe
- State Government
- Local Government
- Interested Citizen
- Other (please specify)

2. Which is your primary affiliation?

3. What is your primary interest(s)? You may select more than one.

- Retaining the dams
- Breaching or removing the dams
- Prosperity of agriculture
- Economic viability of communities supported by the dams
- Recovery of salmon and steelhead
- Economic viability of communities supported by salmon and steelhead
- Transportation
- Cultural
- Heritage
- Energy supply and transmission
- Environmental/ecosystem function

4. Your Zip Code

The next questions are meant to gather your perspectives on various social, economic, and environmental categories that could be impacted by retaining or breaching/removing the four lower Snake River dams (LSRD). You do not need to answer every question. For those questions that you do answer under each category, a short (600 characters, with spaces) text box is included to give you space to describe why you answered the way you did.

5. Agriculture

In 2017, over 1 million acres of wheat were harvested in the 7 counties adjacent to the Snake River. In addition, the LSRD currently support approximately 37,000 acres of irrigated farmland drawn from the Ice Harbor Reservoir and allow for the transport of wheat and other commodities, generally at a reduced cost relative to other modes of transportation.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/Leaving the dams will:

- Have a significant benefit for agriculture in the region
- Have a small benefit for agriculture in the region
- Have no benefit for agriculture in the region
- Slightly harm agriculture in the region
- Significantly harm agriculture in the region
- Not sure/NA

Breaching/removing the dams will:

- Have a significant benefit for agriculture in the region
- Have a small benefit for agriculture in the region
- Have no benefit for agriculture in the region
- Slightly harm agriculture in the region
- Significantly harm agriculture in the region
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

6. Transportation

The LSRD currently allow for barge and tourism navigation up and down the lower Snake River that supports shipments of agricultural products and other materials used or produced by local communities. Transport of materials by barge are less than their historical levels in 2000. Some forecasts include continuation of current levels or increases in the amount of barge transportation.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/Leaving the dams will:

- Have a significant negative impact on the transport of materials upstream and downstream
- Have a small negative impact on the transport of materials upstream and downstream
- Have no impact on the transport of materials upstream and downstream
- Slightly improve transport of materials upstream and downstream
- Significantly improve transport of materials upstream and downstream
- Not sure/NA

Breaching/Removing the dams will:

- Have a significant negative impact on the transport of materials upstream and downstream
- Have a small negative impact on the transport of materials upstream and downstream
- Have no impact on the transport of materials upstream and downstream
- Slightly improve transport of materials upstream and downstream
- Significantly improve transport of materials upstream and downstream
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

7. Energy

The LSRD are a carbon free energy source, produce an average of 1,000 average megawatts of electricity annually, and currently support the reliability of the energy system regionally. Energy supply and markets are changing rapidly which may increase or decrease the role of energy provided by the LSRD.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/ Leaving the dams will:

- Have a significant positive impact on the region's energy system
- Have a small positive impact on the region's energy system
- Have no impact on the region's energy system
- Slightly harm the region's energy system
- Significantly harm the region's energy system
- Not sure/NA

Breaching/ Removing the dams will:

- Have a significant positive impact on the region's energy system
- Have a small positive impact on the region's energy system
- Have no impact on the region's energy system
- Slightly harm the region's energy system
- Significantly harm the region's energy system
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

8. Salmon and Steelhead

There are significantly different predictions of the benefits of breaching/removing the LSRD on Snake River salmon and steelhead returning adults that range from a fourfold increase in returning Snake River salmon/steelhead to a smaller percent increase.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/ Leaving the dams will:

- Have a significant negative impact on the abundance of Snake River salmon and steelhead

- Have a small negative impact on the abundance of Snake River salmon and steelhead
- Have no impact on the abundance of Snake River salmon and steelhead
- Slightly improve the abundance of Snake River salmon and steelhead
- Significantly improve the abundance of Snake River salmon and steelhead
- Not sure/NA

Breaching or Removing the dams will:

- Have a significant negative impact on the abundance of Snake River salmon and steelhead
- Have a small negative impact on the abundance of Snake River salmon and steelhead
- Have no impact on the abundance of Snake River salmon and steelhead
- Slightly improve the abundance of Snake River salmon and steelhead
- Significantly improve the abundance of Snake River salmon and steelhead
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

9. Ecological

There are differing interpretations of what the river will look like if the dams were to be breached, how long it will take the river to fully provide anticipated benefits, and what the impacts on water quality will be from sediment and turbidity.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/ Leaving the dams will:

- Have a significant positive impact on the ecology of the river system
- Have a small positive impact on the ecology of the river system
- Have no impact on the ecology of the river system
- Slightly harm the ecology of the river system
- Significantly harm the ecology of the river system
- Not sure/NA

Breaching/ Removing the dams will:

- Have a significant positive impact on the ecology of the river system
- Have a small positive impact on the ecology of the river system
- Have no impact on the ecology of the river system
- Slightly harm the ecology of the river system

- Significantly harm the ecology of the river system
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

10. Recreation

There are differing interpretations of what the recreational shift will be in the river system if the dams were to be breached/removed, causing the river to shift from a flat water/slack water system to a more natural system featuring riffles, pools, and whitewater rapids.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/Leaving the dams will:

- Have a significant positive impact on the recreational use of the Snake River system
- Have a small positive impact on the recreational use of the Snake River system
- Have no impact on the recreational use of the Snake River system
- Slightly harm recreational use of the Snake River system
- Significantly harm recreational use of the Snake River system
- Not sure/NA

Breaching/Removing the dams will:

- Have a significant positive impact on the recreational use of the Snake River system
- Have a small positive impact on the recreational use of the Snake River system
- Have no impact on the recreational use of the Snake River system
- Slightly harm recreational use of the Snake River system
- Significantly harm recreational use of the Snake River system
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

11. Tribal Cultural Resources

When the dams and reservoirs were created, tribal communities' sites were lost as well as sites for fishing, hunting, and gathering.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/ Leaving the dams will:

- Have a significant positive impact on tribal cultural resources in the basin
- Have a small positive impact on tribal cultural resources in the basin
- Have no impact on tribal cultural resources in the basin
- Slightly harm tribal cultural resources in the basin
- Significantly harm tribal cultural resources in the basin
- Not sure/NA

Breaching/ Removing the dams will:

- Have a significant positive impact on tribal cultural resources in the basin
- Have a small positive impact on tribal cultural resources in the basin
- Have no impact on tribal cultural resources in the basin
- Slightly harm tribal cultural resources in the basin
- Significantly harm tribal cultural resources in the basin
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

12. Economics

There are differing estimates and perspectives on what the impacts will be on the local economy of the communities surrounding the LSRD as well as the state and region more broadly, due to shifts in recreation usage, shifts in employment, shifts in shipping, and shifts in energy and water supply.

Description of the statement above:

- I agree with how the statement is framed
- I disagree with how the statement is framed

Retaining/ Leaving the dams will:

- Have a significant positive economic impact to local communities and the region
- Have a small positive economic impact to local communities and the region

- Have no economic impact to local communities and the region
- Slightly harm the economy of local communities and the region
- Significantly harm the economy of local communities and the region
- Not sure/NA

Breaching/Removing the dams will:

- Have a significant positive economic impact to local communities and the region
- Have a small positive economic impact to local communities and the region
- Have no economic impact to local communities and the region
- Slightly harm the economy of local communities and the region
- Significantly harm the economy of local communities and the region
- Not sure/NA

Why? (If you'd like, please provide a short (600 characters, with spaces) answer on why you answered the way you did for the questions under this category.)

Appendix E: Works Cited

- 1 Harrison, John. “Extinction.” Northwest Power and Conservation Council, 2019, www.nwcouncil.org/reports/columbia-river-history/extinction.
- 2 “Southern Resident Killer Whales and West Coast Chinook Salmon,” NOAA Fact Sheet, 2018.
- 3 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” *Bonneville Power Administration*, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 4 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” Bonneville Power Administration, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 5 “Census of Agriculture - 2017 Census Publications - State and County Profiles - Washington.” National Agricultural Statistics Service, United States Department of Agriculture, 25 Mar. 2019, www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/index.php. & “2018 State Agriculture Overview.” National Agricultural Statistics Service, United States Department of Agriculture, 9 Dec. 2019, www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=WASHINGTON.
- 6 “Census of Agriculture - 2017 Census Publications - State and County Profiles - Washington.” National Agricultural Statistics Service, United States Department of Agriculture, 25 Mar. 2019, www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/index.php
- 7 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 8 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 9 Sage, Jeremy, et al. “Washington State Short Line Rail Inventory and Needs Assessment.” Freight Policy Transportation Institute, Washington State University, June 2015, ses.wsu.edu/wp-content/uploads/2015/07/FPTI-19.pdf.
- 10 Simmons, Sara, and Ken Casavant. “Economic and Environmental Impacts of The Columbia-Snake River Extended Lock Outage.” Freight Policy Transportation Institute, Washington State University, Aug. 2011, ses.wsu.edu/wp-content/uploads/2015/07/FPTI-12.pdf.
- 11 Peterson, Lynn. “Washington State Rail Plan Integrated Freight and Passenger Rail Plan 2013-2035.” Washington State Department of Transportation, Mar. 2014, www.wsdot.wa.gov/sites/default/files/2019/03/08/Rail-Plan-20132035.pdf.
- 12 Harrison, John. “Snake River.” Northwest Power and Conservation Council, 2019, www.nwcouncil.org/reports/columbia-river-history/SnakeRiver.
- 13 BPA, “The Columbia River System Inside Story.” Bonneville Power Administration, U.S. Department of Energy, Apr. 2001, www.bpa.gov/news/pubs/GeneralPublications/edu-The-Federal-Columbia-River-Power-System-Inside-Story 2001.pdf.
- 14 Bureau of Reclamation. “Pacific Northwest Region.” FCRPS Hydrosystem, PN Region, Bureau of Reclamation, 5 Apr. 19AD, www.usbr.gov/pn/fcrps/hydro/index.html.
- 15 “Ice Harbor Lock and Dam.” Walla Walla District, U.S. Army Corps of Engineers, 2019, www.nww.usace.army.mil/Locations/District-Locks-and-Dams/Ice-Harbor-Lock-and-Dam/.
- 16 “Lower Monumental Lock and Dam.” *Walla Walla District, U.S. Army Corps of Engineers*, 2019, www.nww.usace.army.mil/Locations/District-Locks-and-Dams/Lower-Monumental-Lock-and-Dam/.
- 17 “Little Goose Lock and Dam.” Walla Walla District, U.S. Army Corps of Engineers, 2019, www.nww.usace.army.mil/Locations/District-Locks-and-Dams/Little-Goose-Lock-and-Dam/.
- 18 “Lower Granite Lock and Dam.” Walla Walla District, U.S. Army Corps of Engineers, 2019, www.nww.usace.army.mil/Locations/District-Locks-and-Dams/Lower-Granite-Lock-and-Dam/.
- 19 “Columbia Basin Passage Barriers,” Columbia River Inter-Tribal Fish Commission, 2019, <https://www.critfc.org/tribal-treaty-fishing-rights/policy-support/columbia-river-treaty/area-blocked-salmon-columbia-basin/>
- 20 “We Are All Salmon People.” Columbia River Inter-Tribal Fish Commission, 2019, www.critfc.org/salmon-culture/we-are-all-salmon-people/.

- 21 Meyer Resources, Inc. “Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes.” Canadian Columbia River Inter-Tribal Fisheries Commission, Apr. 1999, www.critfc.org/wp-content/uploads/2014/11/circum.pdf.
- 22 Meyer Resources, Inc. “Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes.” Canadian Columbia River Inter-Tribal Fisheries Commission, Apr. 1999, www.critfc.org/wp-content/uploads/2014/11/circum.pdf.
- 23 Meyer Resources, Inc. “Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes.” Canadian Columbia River Inter-Tribal Fisheries Commission, Apr. 1999, www.critfc.org/wp-content/uploads/2014/11/circum.pdf.
- 24 Meyer Resources, Inc. “Tribal Circumstances & Impacts from the Lower Snake River Project on the Nez Perce, Yakama, Umatilla, Warm Springs, and Shoshone Bannock Tribes.” Canadian Columbia River Inter-Tribal Fisheries Commission, Apr. 1999, www.critfc.org/wp-content/uploads/2014/11/circum.pdf.
- 25 “Snake River Mainstem.” Columbia River Inter-Tribal Fish Commission, 2019, plan.critfc.org/vol2/subbasin-plans/snake-river-mainstem/.
- 26 John Rosholt, “Irrigation and Politics” Idaho Yesterdays (Boise), Spring 1986 p 22.
- 27 Harrison, John. “Hells Canyon.” Northwest Power and Conservation Council, 2019, www.nwcouncil.org/reports/columbia-river-history/hellscanyon.
- 28 “Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement APPENDIX R Historical Perspectives.” US Army Corps of Engineers Walla Walla District, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Appendix_R.pdf.
- 29 “Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement APPENDIX R Historical Perspectives.” US Army Corps of Engineers Walla Walla District, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Appendix_R.pdf.
- 30 “Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement APPENDIX R Historical Perspectives.” US Army Corps of Engineers Walla Walla District, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Appendix_R.pdf.
- 31 “Status Report Columbia River Fish Runs and Fisheries 1938-2000.” Washington Department of Fish and Wildlife, Aug. 2002, wdfw.wa.gov/sites/default/files/publications/00935/wdfw00935.pdf.
- 32 “A Vision for Salmon and Steelhead: Goals to Restore Thriving Salmon and Steelhead to the Columbia River Basin.” NOAA Fisheries West Coast Region, U.S. Department of Commerce, 11 July 2019, www.fisheries.noaa.gov/vision-salmon-and-steelhead-goals-restore-thriving-salmon-and-steelhead-columbia-river-basin.
- 33 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 34 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 35 Harrison, John. “Extinction.” Northwest Power and Conservation Council, 2019, www.nwcouncil.org/reports/columbia-river-history/extinction.
- 36 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 37 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 38 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 39 Idaho Department of Fish and Game. “Snake River Salmon and Steelhead Returns.” Northwest Power and Conservation Council, Mar. 2019, nwcouncil.app.box.com/s/2ip90cycwqsonssqt0ejl5zbtpkw1d4g.
- 40 Harrison, John. “2019 Columbia River Basin Salmon and Steelhead Runs Should Be Better Than 2018, Agencies Predict.” Northwest Power and Conservation Council, 15 Mar. 2019, www.nwcouncil.org/news/2019-columbia-river-salmon-and-steelhead-runs-should-be-better-2018.
- 41 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Summary.pdf?ver=2019-05-03-131237-337.
- 42 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, www.nww.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Summary.pdf?ver=2019-05-03-131237-337.

- 43 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, www.nw.usace.army.mil/Portals/28/docs/library/2002%20LSR%20study/Summary.pdf?ver=2019-05-03-131237-337.
- 44 “Gas Bubble Disease (GBD).” Alaska Department of Fish and Game, July 2019, www.adfg.alaska.gov/static/species/disease/pdfs/fishdiseases/gas_bubble_disease.pdf.
- 45 Cannamela, David. *Science-Based Solutions Are Needed to Address Increasingly Lethal Water Temperatures in the Lower Snake River*. 22 Oct. 2019, static1.squarespace.com/static/55a5773ae4b081289a66090b/t/5db0886bbf234954c1932976/1571850347966/2019.Sci.Letter.Snake.climate.final.pdf.
- 46 Widener, D. L., J. R. Faulkner, S. G. Smith, T. M. Marsh, and R. W. Zabel. 2018. Survival Estimates for the Passage of Spring-Migrating Juvenile Salmonids through Snake and Columbia River Dams and Reservoirs, 2017.
- 47 “NOAA Fisheries 2019 CRS Biological Opinion.” *NOAA Fisheries West Coast Region*, U.S. Department of Commerce, 29 Mar. 2019, www.westcoast.fisheries.noaa.gov/publications/hydropower/fcrps/master_2019_crs_biological_opinion_1.pdf
- 48 “High Level Indicators Report | Hydrosystem Survival and Passage.” *Northwest Power and Conservation Council*, 2019, app.nwcouncil.org/ext/hli/level1.php?q=hydrosystem.
- 49 Bradbury, Bill. “Program Goals and Quantitative Objectives.” *Northwest Power and Conservation Council*, 30 Dec. 2014, www.nwcouncil.org/reports/2014-columbia-river-basin-fish-and-wildlife-program/program-goals-and-quantitative-objectives
- 50 Smith, Brad. “Smolt-to-Adult Returns: A Critical Measure of Salmon and Steelhead Recovery (or Lack Thereof).” *Idaho Conservation*, 27 Mar. 2019, www.idahoconservation.org/blog/smolt-to-adult-returns-a-critical-measure-of-salmon-and-steelhead-recovery-or-lack-thereof/.
- 51 “High Level Indicators Report | Smolt Returns.” *Northwest Power and Conservation Council*, 2019, app.nwcouncil.org/ext/hli/chart.php?q=smolt_returns.
- 52 “High Level Indicators Report | Smolt Returns.” *Northwest Power and Conservation Council*, 2019, app.nwcouncil.org/ext/hli/chart.php?q=smolt_returns.
- 53 Bilby, Robert. “Latent Mortality Report.” *Independent Scientific Advisory Board*, Northwest Power and Conservation Council, 6 Apr. 2007, app.nwcouncil.org/media/31244/isab2007_1.pdf.
- 54 Bilby, Robert. “Latent Mortality Report.” *Independent Scientific Advisory Board*, Northwest Power and Conservation Council, 6 Apr. 2007, app.nwcouncil.org/media/31244/isab2007_1.pdf.
- 55 Harrison, John. “Hatcheries.” Northwest Power and Conservation Council, 2019, www.nwcouncil.org/reports/columbia-river-history/hatcheries.
- 56 U.S. Fish & Wildlife Service. (2015). Lower Snake River Compensation Plan Office. Retrieved from <https://www.fws.gov/pacific/fisheries/Documents/LSRCP%20Fact%20Sheet%202015.pdf>
- 57 “A Vision for Salmon and Steelhead: Goals to Restore Thriving Salmon and Steelhead to the Columbia River Basin.” NOAA Fisheries West Coast Region, U.S. Department of Commerce, 11 July 2019, www.fisheries.noaa.gov/vision-salmon-and-steelhead-goals-restore-thriving-salmon-and-steelhead-columbia-river-basin.
- 58 Northwest Fisheries Science Center. (2015). Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. Retrieved from https://www.nw.fsc.noaa.gov/assets/11/8623_03072016_124156_Ford-NWSalmonBioStatusReviewUpdate-Dec%2021-2015%20v2.pdf
- 59 “Federal Columbia River Power System Dam Improvements and Spill Information.” NOAA Fisheries, U.S. Department of Commerce, 27 Sept. 2019, www.fisheries.noaa.gov/west-coast/endangered-species-conservation/federal-columbia-river-power-system-dam-improvements-and.
- 60 Maynard, Chris. “Evaluation of Total Dissolved Gas Criteria (TDG) Biological Effects Research.” *Washington State Department of Ecology*, July 2008, fortress.wa.gov/ecy/publications/publications/0810059.pdf.
- 61 Dehart, Michele. “Comparative Survival Study of PIT-Tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye 2017 Annual Report.” Fish Passage Center, Dec. 2017
- 62 Zabel, Richard W. “Comprehensive Passage (COMPASS) Model: A Model of Downstream Migration and Survival of Juvenile salmonids through a Hydropower System.” *NOAA Fisheries*, U.S. Department of Commerce, 2008, swfsc.noaa.gov/uploadedFiles/Events/Meetings/Fish_2015/Document/5.0_Zabel_etal_2008_COMPASS.pdf.
- 63 “POPULATION.” *Center for Whale Research*, 1 July 2019, www.whaleresearch.com/orca-population.
- 64 NOAA. “Killer Whale.” *NOAA*, U.S. Department of Commerce, 2019, www.fisheries.noaa.gov/species/killer-whale.
- 65 “Sothern Resident Killer Whales and Snake River Dams.” *NOAA Fisheries West Coast Region*, U.S. Department of Commerce, 2016, www.westcoast.fisheries.noaa.gov/publications/protected-species/marine-mammals/killer-whales/killerwhales-snakeriverdams.pdf.

- 66 NOAA. “Southern Resident Killer Whale Priority Chinook Stocks Report.” NOAA Fisheries West Coast Region, U.S. Department of Commerce, 22 June 2018, archive.fisheries.noaa.gov/wcr/publications/protected_species/marine_mammals/killer_whales/recovery/srkw_priority_chinook_stocks_conceptual_model_report___list_22june2018.pdf.
- 67 Giles, Deborah A, et al. “Orca Scientists Letter.” Received by Stephanie Solien, and Les Purce, Orca Scientists Letter, 15 Oct. 2018, <https://www.documentcloud.org/documents/5002547-Orca-Scientists-Letter-10-15-18-Final.html>
- 68 National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington, https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/esa_status/srkw-recov-plan.pdf
- 69 “Southern Resident Killer Whale: Questions and Answers on J50 Emergency Response.” NOAA Fisheries, 18 December 2019, <https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/southern-resident-killer-whale-questions-and-answers-j50>
- 70 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” *Bonneville Power Administration*, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 71 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 72 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” Bonneville Power Administration, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 73 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” Bonneville Power Administration, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 74 “Washington - State Energy Profile Overview.” U.S. Energy Information Administration (EIA), U.S. Department of Energy, Jun. 2019, www.eia.gov/state/?sid=WA#tabs-4.
- 75 “Clean Energy Transformation Act (CETA).” Washington State Department of Commerce, 2019, www.commerce.wa.gov/growing-the-economy/energy/ceta/.
- 76 “Seventh Northwest Conservation and Electric Power Plan” Northwest Power and Conservation Council, 25 Feb. 2016, www.nwccouncil.org/sites/default/files/7thplanfinal_allchapters_1.pdf.
- 77 Fazio, John. “2024 Resource Adequacy Assessment.” Northwest Power and Conservation Council, 10 Sept. 2019, www.nwccouncil.org/sites/default/files/2019_0917_p4.pdf.
- 78 Winkel, Carol. “Renewable Energy Gets Its Second Wind.” Northwest Power and Conservation Council, 22 Aug. 2018, www.nwccouncil.org/news/renewable-energy-gets-its-second-wind.
- 79 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” Bonneville Power Administration, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 80 “Grid Mod: BPA Makes Most Significant Update in a Decade to Its Automatic Generation Control Tool.” Bonneville Power Administration, 23 Aug. 2019, www.bpa.gov/news/newroom/Pages/Grid-Mod-BPA-makes-most-significant-update-in-a-decade-to-its-Automatic-Generation-Control-tool.aspx.
- 81 “The Lower Snake River Dams Power Replacement Study Fact Sheet.” NW Energy Coalition, 4 Apr. 2018, nwenergy.org/wp-content/uploads/2018/04/LSRD-Study-Fact-Sheet.pdf. & “The Lower Snake River Dams Power Replacement Study 4 Page Overview.” NW Energy Coalition, Apr. 2018, nwenergy.org/wp-content/uploads/2018/04/LSRDS-study-4-page-overview.pdf.
- 82 Jacobs, Jeremy P. “Energy Transitions: Anatomy of a 'Bloodbath.'” E&E News, Environment & Energy Publishing, LLC, 16 Sept. 2019, www.eenews.net/stories/1061125873.
- 83 Jacobs, Jeremy P. “Energy Transitions: Anatomy of a 'Bloodbath.'” E&E News, Environment & Energy Publishing, LLC, 16 Sept. 2019, www.eenews.net/stories/1061125873.
- 84 “About.” Western Energy Imbalance Market, California Independent System Operator, 2019, www.westerneim.com/Pages/About/default.aspx.
- 85 “BPA Adopts New Wholesale Power and Transmission Rates.” Bonneville Power Administration, 24 July 2014, www.bpa.gov/news/newroom/Pages/BPA-adopts-new-wholesale-power-and-transmission-rates-.aspx.

- 86 Mainzer, Elliot. “Greenwire Article Response.” Received by Cyril T. Zaneski, 5 Sept. 2019 <https://www.bpa.gov/news/newsroom/Pages/BPA-responds-to-deeplly-flawed-article-on-agencys-financial-health.aspx>
- 87 “2017-2030 Hydro Asset Strategy.” Bonneville Power Administration, June 2016, www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf.
- 88 Jacobs, Jeremy P. “Energy Transitions: The New Weapon in the Push to Remove Dams: Economics.” E&E News, Environment & Energy Publishing, LLC, 23 Oct. 2019, www.eenews.net/stories/1061355907.
- 89 “2017-2030 Hydro Asset Strategy.” Bonneville Power Administration, June 2016, www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf.
- 90 “The Lower Snake River Dams Power Replacement Study 4 Page Overview.” NW Energy Coalition, Apr. 2018, nwenergy.org/wp-content/uploads/2018/04/LSRDS-study-4-page-overview.pdf.
- 91 “Census of Agriculture - 2017 Census Publications - State and County Profiles - Washington.” National Agricultural Statistics Service, United States Department of Agriculture, 25 Mar. 2019, www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/index.php. & “2018 State Agriculture Overview.” National Agricultural Statistics Service, United States Department of Agriculture, 9 Dec. 2019, www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=WASHINGTON.
- 92 “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” Bonneville Power Administration, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf, & “A Northwest Energy Solution: Regional Power Benefits of the Lower Snake River Dams.” *Bonneville Power Administration*, U.S. Department of Energy, Mar. 2016, www.bpa.gov/news/pubs/FactSheets/fs-201603-A-Northwest-energy-solution-Regional-power-benefits-of-the-lower-Snake-River-dams.pdf.
- 93 “2019 Crop Quality Report.” U.S. Wheat Associates, 24 Oct. 2019, www.uswheat.org/market-and-crop-information/crop-quality/.
- 94 “Census of Agriculture - 2017 Census Publications - State and County Profiles - Washington.” National Agricultural Statistics Service, United States Department of Agriculture, 25 Mar. 2019, www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/index.php
- 95 Monson, Jason, et al. “The Changing Dynamics of Grain Cooperatives in Eastern Washington.” *AgriBusiness Management Reports*, Washington State University, 2002, agribusiness-mgmt.wsu.edu/AgbusResearch/docs/eb1985e.pdf.
- 96 “Join the Co-Op!” Central Co-Op, 2019, www.centralcoop.coop/join.php.
- 97 “Buyers & Processors.” Washington Grain Commission, 8 Oct. 2016, wagrains.org/buyers-processors/.
- 98 “Who Buys Wheat.” Washington Grain Commission, 30 Oct. 2019, wagrains.org/all-about-wheat/varieties-of-wheat/who-buys-wheat/.
- 99 “*Public Lock Commodity Report Calendar Years 1999-2017*.” IWR Libraries, US Army Corps of Engineers, 1 Apr. 2018, publibrary.planusace.us/#/document/a746bb97-a3b6-4ccf-a750-840145b7e6e1.
- 100 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 101 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 102 Calculated using “Galinato, S.P., and P.R. Tozer. “1 The Economic Contribution of the Potato Industry in Washington State.” S.P. Galinato and P.R. Tozer.” *Washington State University*, Pullman, WA, January 2016, ses.wsu.edu/wp-content/uploads/2017/06/Economic-Contribution-of-WA-Potato-Industry-Jan-2016.pdf.
- 103 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 104 “Columbia Snake River System Facts.” Pacific Northwest Waterways Association, 2018, www.pnwa.net/factsheets/CSRS.pdf.
- 105 Simmons, Sara, and Ken Casavant. “Economic and Environmental Impacts of The Columbia-Snake River Extended Lock Outage.” Freight Policy Transportation Institute, Washington State University, Aug. 2011, ses.wsu.edu/wp-content/uploads/2015/07/FPTI-12.pdf
- 106 *ECONorthwest with data from U.S. Army Corps of Engineers Lock Performance Monitoring System*, Domanski, Adam. “LOWER SNAKE RIVER DAMS ECONOMIC TRADEOFFS OF REMOVAL.” *ECONorthwest*, Vulcan, Inc, 29 July 2019,

- static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf. & http://corpslocks.usace.army.mil/lpwb/?p=121:1:0
- 107 “Wheat.” Washington Grain Commission, 15 July 2019, wagrains.org/all-about-wheat/varieties-of-wheat/.
- 108 “Who Buys Wheat.” Washington Grain Commission, 30 Oct. 2019, wagrains.org/all-about-wheat/varieties-of-wheat/who-buys-wheat/.
- 109 Kelly, Bruce E. “BNSF Testing Double-Length Grain Trains.” *Railway Age*, Simmons-Boardman Publishing Inc., 14 Mar. 2019, www.railwayage.com/freight/bnsf-testing-double-length-grain-trains/.
- 110 “Public Lock Commodity Report Calendar Years 1999-2017.” IWR Libraries, US Army Corps of Engineers, 1 Apr. 2018, publibrary.planusace.us/#/document/a746bb97-a3b6-4ccf-a750-840145b7c6e1.
- 111 Peterson, Lynn. “Washington State Rail Plan Integrated Freight and Passenger Rail Plan 2013-2035.” Washington State Department of Transportation, Mar. 2014, www.wsdot.wa.gov/sites/default/files/2019/03/08/Rail-Plan-20132035.pdf.
- 112 Simonds, Kama. “SM Line Brings Weekly Container Service to the Port of Portland's Terminal 6.” *Port of Portland*, 19 Nov. 2019, portofportland.com/Newsroom/SM-Line-Brings-Weekly-Container-Service-to-the-Port-of-Portland%E2%80%99s-Terminal-6
- 113 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 114 Peterson, Lynn. “Washington State Rail Plan Integrated Freight and Passenger Rail Plan 2013-2035.” Washington State Department of Transportation, Mar. 2014, www.wsdot.wa.gov/sites/default/files/2019/03/08/Rail-Plan-20132035.pdf.
- 115 “Freight Rail.” WSDOT, 7 Aug. 2019, www.wsdot.wa.gov/Freight/Rail/.
- 116 “PCC Rail System.” WSDOT, 17 Oct. 2019, www.wsdot.wa.gov/freight/pcc.
- 117 Sage, Jeremy, et al. “Washington State Short Line Rail Inventory and Needs Assessment.” Freight Policy Transportation Institute, Washington State University, June 2015, ses.wsu.edu/wp-content/uploads/2015/07/FPIT-19.pdf.
- 118 Sage, Jeremy, et al. “Washington State Short Line Rail Inventory and Needs Assessment.” Freight Policy Transportation Institute, Washington State University, June 2015, ses.wsu.edu/wp-content/uploads/2015/07/FPIT-19.pdf.
- 119 Simmons, Sara, and Ken Casavant. “Economic and Environmental Impacts of The Columbia-Snake River Extended Lock Outage.” Freight Policy Transportation Institute, Washington State University, Aug. 2011, ses.wsu.edu/wp-content/uploads/2015/07/FPIT-12.pdf.
- 120 “Columbia Snake River System Facts.” Pacific Northwest Waterways Association, 2018, www.pnwa.net/factsheets/CSRS.pdf.
- 121 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 122 “Columbia Snake River System Facts.” Pacific Northwest Waterways Association, 2018, www.pnwa.net/factsheets/CSRS.pdf.
- 123 Peterson, Lynn. “Washington State Rail Plan Integrated Freight and Passenger Rail Plan 2013-2035.” Washington State Department of Transportation, Mar. 2014, www.wsdot.wa.gov/sites/default/files/2019/03/08/Rail-Plan-20132035.pdf.
- 124 “Columbia Snake River System Facts.” Pacific Northwest Waterways Association, 2018, www.pnwa.net/factsheets/CSRS.pdf.
- 125 “Columbia Snake River System Facts.” Pacific Northwest Waterways Association, 2018, www.pnwa.net/factsheets/CSRS.pdf.
- 126 Davidson, Kara. “Big Endicott Area Projects Wrapping up for Winter.” *Whitman County Gazette*, Gazette Publishing, LLC, 22 Nov. 2018, www.wcgazette.com/story/2018/11/22/news/big-endicott-area-projects-wrapping-up-for-winter/27473.html.
- 127 Lind, Treva. “Spokane Journal of Business.” *Spokane Journal of Business*, Journal of Business, 10 Oct. 2013, www.spokanejournal.com/local-news/17-million-grain-elevator-complex-gears-up-south-of-spokane/.
- 128 “Washington Grain Train.” WSDOT, 5 Dec. 2017, www.wsdot.wa.gov/Freight/Rail/GrainTrain.html.
- 129 “BNSF Invests Across Its Regions to Expand Capacity and Maintain Vast Network.” BNSF Railway, BNSF Railway Company, 15 Jan. 2015, www.bnsf.com/news-media/news-releases/bnsf-invests-to-expand-capacity-and-maintain-2015.html. & Staff. “BNSF Promising Faster Intermodal on Northern Corridor.” *Fleet Management - Trucking Info*, Heavy Duty Trucking, Bobit Business Media, 11 June 2015, www.truckinginfo.com/129920/bnsf-promising-faster-intermodal-on-northern-corridor.
- 130 Kelly, Bruce E. “BNSF Testing Double-Length Grain Trains.” *Railway Age*, Simmons-Boardman Publishing Inc., 14 Mar. 2019, www.railwayage.com/freight/bnsf-testing-double-length-grain-trains/.

- 131 “Public Lock Commodity Report Calendar Years 1999-2017.” IWR Libraries, US Army Corps of Engineers, 1 Apr. 2018, publibrary.planusace.us/#/document/a746bb97-a3b6-4ccf-a750-840145b7e6e1.
- 132 Port of Whitman County. “Port of Wilma.” *Port of Whitman County*, 2019, www.portwhitman.com/doingbusiness/portwilma.
- 133 “Public Lock Commodity Report Calendar Years 1999-2017.” IWR Libraries, US Army Corps of Engineers, 1 Apr. 2018, publibrary.planusace.us/#/document/a746bb97-a3b6-4ccf-a750-840145b7e6e1.
- 134 Ziegler, Brian. “2017 Marine Cargo Forecast and Rail Capacity Analysis Final Report.” *FREIGHT MOBILITY STRATEGIC INVESTMENT BOARD*, Washington Public Ports Association, Aug. 2017, static1.squarespace.com/static/5a8499e518b27dc83c2403ce/t/5af0ba816d2a73731f8d1faa/1525725867212/Marine-Cargo-Forecast-2017-Final-10-2017.pdf.
- 135 Texas Transportation Institute, “A Modal Comparison of Domestic Freight Transportation Effects of the General Public: 2001-2014,” January 2017
- 136 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 137 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 138 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 139 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 140 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 141 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, <https://www.nww.usace.army.mil/Library/2002-LSR-Study/>
- 142 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 143 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 144 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, <https://www.nww.usace.army.mil/Library/2002-LSR-Study>
- 145 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 146 “Columbia Snake River System Facts.” *Pacific Northwest Waterways Association*, 2019, www.pnwa.net/factsheets/CSRS.pdf.
- 147 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, <https://www.nww.usace.army.mil/Library/2002-LSR-Study>
- 148 “Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, <https://www.nww.usace.army.mil/Library/2002-LSR-Study>
- 149 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 150 “FINAL Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement.” *US Army Corps of Engineers Walla Walla District*, U.S. Department of Defense, Feb. 2002, <https://www.nww.usace.army.mil/Library/2002-LSR-Study>

- 151 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 152 “2019 BPA Annual Report.” Bonneville Power Administration, 2019, www.bpa.gov/Finance/FinancialInformation/AnnualReports/Documents/AR2019.pdf.
- 153 “2017-2030 Hydro Asset Strategy.” Bonneville Power Administration, June 2016, www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDdocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf.
- 154 June 2016, www.bpa.gov/Finance/FinancialPublicProcesses/IPR/2016IPRDdocuments/2016-IPR-CIR-Hydro-Draft-Asset-Strategy.pdf.
- 155 Pacific Salmon Commission, “Economic Impacts of Pacific Salmon Fisheries,” July 2017.
- 156 Radtke, Hans & Davis, Shannon, “Anadromous Fish Economic Analysis, Lower Snake River Juvenile Salmon Migration Feasibility Study,” June 1999.
- 157 “Roundtable Fishes for Salmon Solutions: Fishermen, Scientists, Researchers Convene to Address Reeling Coastal Communities, Fisheries.” Chinook Observer, October 10, 2018.
- 158 Domanski, Adam. “Lower Snake River Dams Economic Tradeoffs of Removal.” ECONorthwest, Vulcan, Inc, 29 July 2019, static1.squarespace.com/static/597fb96acd39c34098e8d423/t/5d41bbf522405f0001c67068/1564589261882/LSRD_Economic_Tradeoffs_Report.pdf.
- 159 “Biological Opinions: Endangered Species Act Section 7 Consultations.” NOAA Fisheries, U.S. Department of Commerce, 15 Nov. 2019, www.fisheries.noaa.gov/national/endangered-species-conservation/biological-opinions.
- 160 “Current Snake River Recovery Plan Documents,” NOAA Fisheries, U.S. Department of Commerce, 15 Nov. 2019, https://archive.fisheries.noaa.gov/wcr/protected_species/salmon_steelhead/recovery_planning_and_implementation/snake_river/snake_river_salmon_recovery_subdomain.html
- 161 Adapted from NOAA. “2016 5- Year Review: Summary & Evaluation of Snake River Sockeye Snake River Spring-Summer Chinook Snake River Fall-Run Chinook Snake River Basin Steelhead.” Nation Marine Fisheries Service, U.S. Department of Commerce, 2016, archive.fisheries.noaa.gov/wcr/publications/status_reviews/salmon_steelhead/multiple_species/final_2016_5-yr_review_snake_river_species.pdf. & NOAA. “Green Sturgeon.” NOAA Fisheries, U.S. Department of Commerce, 2019, www.fisheries.noaa.gov/species/green-sturgeon.
- 162 Adapted from “NOAA Fisheries Biological Opinion for Operation and Maintenance of the Columbia River System Operations.” Federal Caucus, 2019, www.salmonrecovery.gov/BiologicalOpinions/FCRPSBiOp.aspx. & Mulligan, Stephen P, and Harold F Upton. “Endangered Species Act Litigation Regarding Columbia Basin Salmon and Steelhead.” EveryCRSReport.com, Congressional Research Service, 8 Aug. 2016, www.everycrsreport.com/reports/R40169.html#_Toc458603444.