



CRITFC Overview of Columbia River USACE Fish Budget Needs



**Columbia River Inter-Tribal
Fish Commission**



CRITFC Overview of Columbia River USACE Fish Budget Needs

OVERVIEW

The spreadsheets in this document were compiled by CRITFC staff to help better understand the budgetary needs and shortcomings of both the U.S. Army Corps of Engineers (USACE) Columbia River Fish Mitigation budget (CRFM) and the USACE Operational and Maintenance budget (O&M). The costs are compiled over an 8-year time frame so projects can be both one-time costs as well as reoccurring costs. The majority of the items in the budget are ones that the USACE has highlighted at the regional System Configuration meetings (SCT), and the unfunded items from the O&M budget that were presented at the Fish Passage Operations and Maintenance regional meetings.

The other items and projects that are compiled in the spreadsheet are items identified in the Proposed Action from the Action Agencies as well as the NOAA's recent Hydro Biological Opinion. Additional items such as lamprey passage improvements and river mouth sedimentation work reflect needs that have been identified by staff working with regional sovereigns and stakeholders. Total 8-year costs are specified in attached spreadsheets and were broken into the 10 separate work element categories discussed below.

The Columbia River is no longer a free-flowing river but rather a series of impoundments whose slow-moving reservoirs create as many problems for salmon as the concrete structures of the dams. The USACE has recognized this problem

and has expended CRFM funding for estuary restoration projects and "offsite" actions like avian predator management in the past.

If the Simpson Amendment moves forward, an estimated \$104.3M that is projected to be spent in this budget would no longer be needed with the removal of the Snake River dams. This is only for items included in this budget. Additional savings would be realized, such as the elimination of the required dredging in the Snake River and the replacement of the aging turbines at Snake River dams.

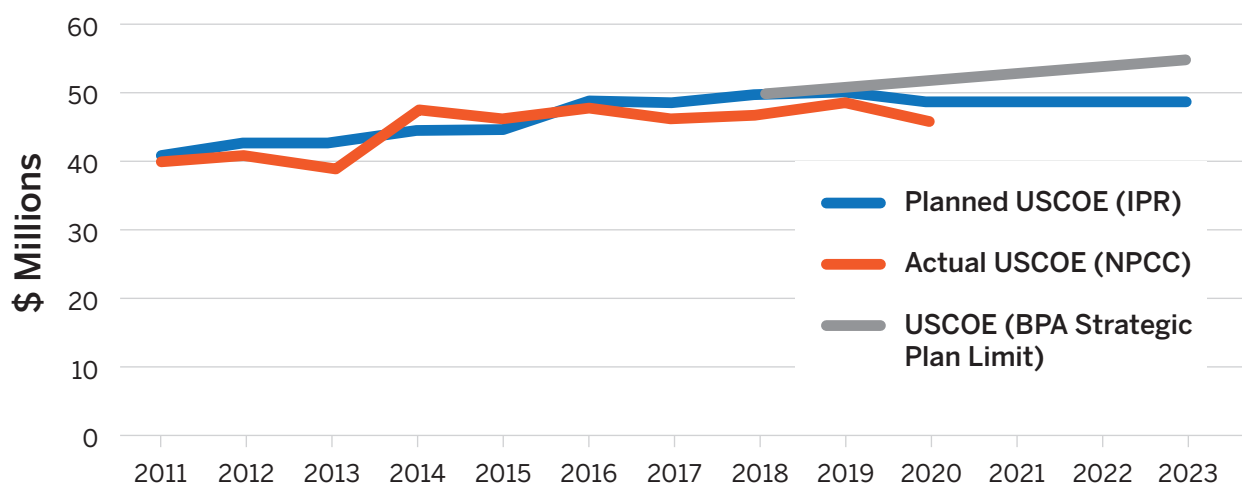
Part of the reason this is needed is the current level of funding for both CRFM and O&M is not keeping pace with the needs of the basin. As an example, in 2022 the President's Budget that

the COE submitted was \$42M of capability, but the President's Budget only allocated \$3.5M total for Columbia River. This represents the lowest amount ever received over the past nearly 30 years. However, returns in 2021 for species such as steelhead also represent some of the lowest returns over the past 30 years.

As for the O&M Budget, which is funded by both the USACE and BPA, the level of funding has stayed constant. But when one takes into

account inflation, increases in salaries, and not to mention the increasing needs as these dams approach nearly 70 years of age, the funding is actually in a negative trajectory. It is no wonder that critical maintenance is being delayed for years. To make matters worse, BPA with the adoption of the new strategic plan, the level of O&M funding has been decreased. As the graphs show, this trend is only worsening and will continue to get worse into the future.

U.S. Corps of Engineers Annual O&M Funding



Fish Ladder Repairs and Improvements (Cooling Structures included)

Fish ladders are necessary to pass adult salmon upstream past the hydroelectric dams on the Lower Columbia and Snake Rivers. The ladder technology at most of the dams is 50 to 80 years old and in need of repairs, some extensive, to keep the ladders in service. Diffusers and Auxiliary Water Supply systems (AWS) are key components to supplying water throughout the fish ladder.

A ladder failure during the peak of salmon runs would be disastrous since most dams only have one or two ladders. If a ladder fails, there are no other adequate means for adult salmon to get past the dam to reach their spawning gravels. A whole year class of salmon could be lost. The water supplied to the ladders for operation is provided either from fish turbines or pumps. Many of these pumps and turbines are aging and have failed. John Day and McNary dams, for example, are operating with less than the needed number of pumps. If one of the current pumps fails, the ladders would not be able to operate and would require most of the entrances to be closed. This would require any adult salmon trying to pass the dam to find only a small entrance across the entire dam with little or no attraction water.

Climate change will increase not just absolute river temperatures, but the length of time the river is at temperatures that stress salmon and impacts their survival. To help combat this, cooling water structures are needed at several of the adult ladders to ensure adult salmon continue to migrate, and thermal barriers are not created at the dams.

The total cost of ladder repairs and improvements identified in the following spreadsheets is \$160.9M

Spillway Repairs and Improvements

The spillways at the dams are critical passage routes for juvenile salmon as they migrate to the oceans. The spillways also provide an important means for moving water during high-flow events to aid in flood control. Modifications to spillway have been ongoing for 20 years to improve the efficiency and safety of the route.

However, at several of the projects, most notably Bonneville Dam, erosion and safety concerns about the operation of the spillway have arisen starting in early 2000. At Bonneville Dam, spill is limited to reduce the potential to draw rocks into the stilling basin and cause additional erosion and damage that could take the spillway out of commission. Modifications to the spillway, such as notched spillway weirs that use less water, can help reduce the cost of spill for salmon as outlined in the recent NOAA Biological Opinion where spill is now required during times of the year where it previously was not provided.

The spill program detailed in the Proposed Action (PA) and Settlement agreement has increased spill programs to maximize juvenile passage over the spillway. Tailrace modifications may be needed to ensure continued high survival through the spillway. This will be informed by data collected by the system monitoring program and site-specific studies.

The total cost of spillway repairs and improvements identified in the following spreadsheets is \$200.7M

Fish Screen and Juvenile Bypass System (JBS) Maintenance

The fish screens are part of Juvenile Bypass Systems (JBS) that provide juvenile salmon and lamprey an alternative passage route to that of turbines. The screens divert juveniles away from the turbines and then force them up into a gate well where they are in turn passed through dewatering orifices and piped around the dam or to raceways where they are held for transportation.

Current data indicates that while survival upon release is comparable to a spillway, there is a reduction in long-term fitness and thus lower survival for those that use many of the JBS systems on the Columbia and Snake rivers. However, it is likely that JBS's are better than passage through turbines. It is important to note that there will be powerhouse operations during juvenile migration times and protection for migrants will be needed. While JBS's are not a perfect solution, they provide a safer route than most turbines.

The screens need annual maintenance and the current design for the extended screens were not intended for juvenile lamprey. Juvenile lamprey are found to get impinged on the extended screens which lead to mortality. Many of the JBS's are aging and need to be rebuilt and upgraded. The standard length screens (STS) at several of the projects have met their life expectancy and will need to be replaced within the next eight to ten years. Many of the JBS's were retrofitted to the dams and were built before there were guidelines and knowledge about what would be the best design for juvenile migrants that they would encounter.

The total cost of repairs and improvements to the Fish Screens and JBS's identified in the following spreadsheets is \$132.7M

Survival Studies (System and Settlement Spill Operations, Turbine Improvements, Reach Survivals and Pit Tag Recoveries and Detection Improvements)

Over the past 20 years, project operations at the dams have changed as knowledge and litigation have progressed. Part of what drives these changes is knowledge gained through studies and monitoring. As new systems are put in place, it is wise to study them to determine that they are operating as intended and are providing the benefit that was intended, since the science and knowledge for what is best for adult and juvenile salmon is continuing to progress.

The new settlement and Proposed Action (PA) spill operations that were implemented two



Courtesy US Army Corps of Engineers

years ago are an example of a new operation that is quite different than what has been done previously, and it is imperative that monitoring and studies are conducted to ensure the planned benefits are being realized.

However, most studies and monitoring are based on using information gained as juveniles pass the powerhouses at the dams. The new PA and Settlement spill program has the goal of reducing powerhouse passage and passing the majority of migrants through the spillway. The new spill program appears to be working, but with the majority of juvenile migrants going over the spillway, there is not enough data being collected to get very accurate or precise reach survivals, as well as other important information to help inform managers if this new spill program is producing benefits over past years' operations. Without accurate reach and sub-reach survivals, it is impossible to determine if and where survival impacts are occurring. This information would allow regional parties to apply management actions, if available, to improve survival. Further, it would inform the action agencies on future budget priorities and needs to improve survival and ensure the PA was meeting its BiOp goals.

To aid in this, additional means to collect data need to be pursued and advanced. There has been success with new monitoring structures such as the Lower Granite Spillway Pit Tag detection system. However, there have not been adequate funds to implement additional and other promising technology to help gather this critical information.

The total cost of studies and improvements for monitoring identified in the following spreadsheets is \$59.4M

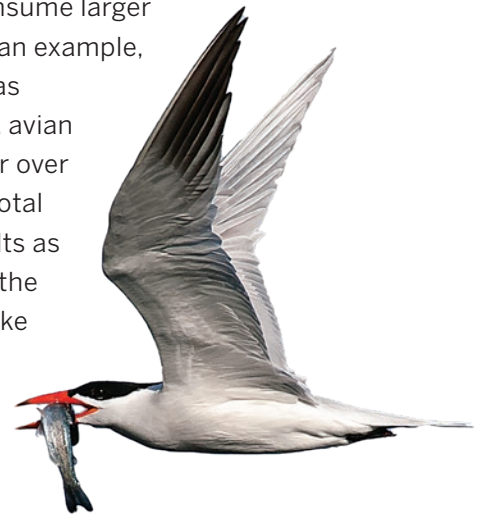
Predator Management

The USACE historically has funded extensive avian predator management programs in the mainstem and estuary. These programs have been vital to improving the survival of juvenile migrants. However, the USACE is proposing to reduce the level of effort aimed at predator management. At the same time, invasive fish species (such as Northern pike, bass, walleye, etc.) are beginning to consume larger numbers of juveniles. As an example, for certain species such as steelhead, in some years, avian predation can account for over half to two-thirds of the total mortality of juvenile smolts as they travel from through the Upper Columbia and Snake River to Bonneville Dam.

The USACE needs to increase funding for predator management and coordinate their predator management programs through a central forum to ensure that funding is targeting the worst offenders and that we are not merely switching the consumers rather than reducing the consumption of juvenile migrating fish.

We are proposing \$3.2M for monitoring predator management programs and \$8M for implementing predator management in the Columbia River. We strongly encourage strong coordination between the USACE predator management programs and those funded through BPA and the mid-Columbia PUDs.

The total cost of predator management and predator deterrence structures identified in the following spreadsheets is \$31.2M



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Sediment Management and Cold Water Refuges

Sediment management has been an overlooked problem since the construction of the dams. Some dredging has occurred to assist with inland navigation, but the accumulated sediments at tributary deltas and other areas within the reservoirs due to the low flow in the mainstem continue to have a negative impact on salmon survival.

The Zone 6 and the lower Columbia tributary mouths provide critical sources of cold water for salmon holding while on their migration route (adults upstream and for the late season juvenile downstream migrants). The tributary mouths are shallow, slow-moving, and now provide ideal conditions for warm-water piscivorous fish and avian predators that benefit from the shallow sand bar habitats with no habitat complexity. The tribes are proposing to implement sustainable actions which can result in restoration and conservation of key fish habitat in potential cold-water areas. These actions include dredging tributary river mouths and reconfiguring habitat in these areas to support native vegetation and safer resting areas for fish. This will improve connectivity between cold water areas and the main river.

It is estimated that \$500K per year will be needed for hydrographic assessments and monitoring and approximately per year is needed for restoring these river mouths and creating and maintaining important cold water refuges.

The total cost of Sediment Management and Cold Water Refugee as identified in the following spreadsheets is \$12M

Estuary Restoration

All migrating fish in the Columbia River must pass through the estuary twice in their life cycle. It was not until the early 2000s that USACE recognized the importance of habitat restoration in the estuary and began funding work to restore important habitat to support food webs and water quality improvements.

Considerable work has been funded through the USACE and BPA to restore priority areas, but significant work remains. Due to the damming of the Columbia River, the active channel and sediment transport through the plume no longer provide the necessary diversity to support robust food webs and refuge from water quality and predators needed for the transitioning salmon.

The total cost for continued estuary studies and actions as identified in the following spreadsheets is \$6.5M

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Hatchery Modernization, Upgrades, and Maintenance

Hatchery programs were instituted in the Columbia Basin to mitigate losses to fisheries associated with hydro system development and associated habitat loss and degradation. Artificially propagated juvenile salmon are released from the programs as a substitute for the juveniles previously produced by natural reproduction in the tributary streams throughout the basin. Some hatchery programs have been instituted with a conservation role—to rebuild return numbers of wild populations, and to conserve their natural productivity and genetic diversity levels. The need for conservation efforts was made more apparent with the recent listing of many of the basin's salmon populations as threatened or endangered under the Endangered Species Act (ESA).

A majority of the Columbia and Snake River basin hatcheries are aging structures that need major rehabilitation and improvements to their water systems, raceways, and other structural

components. It is becoming increasingly difficult to operate these projects to meet the fish mitigation requirements that were assured with their construction. The hatchery needs identified in the spreadsheet associated with this budget planning document only identify the Corps of Engineers' portion of hatchery modernization needed in the Columbia Basin.

A much bigger infusion of capital is needed to meet the total needs of the hatcheries Basin that were developed by other entities, such as NOAA Fisheries (Mitchell Act), U.S. Fish and Wildlife Service (Lower Snake River Compensation Plan), and Bureau of Reclamation (Grand Coulee Mitigation).

The total cost for USACE hatchery improvements and rehabilitations is \$240M to \$360M. The need is presented as a range because the processes for the final selection of John Day Mitigation (\$25M–\$175M) production measures have yet to be concluded.

Lamprey

Pacific lamprey (“eels”) hold great significance to the CRB tribes for their subsistence, ceremonial, traditional, and medicinal purposes and ecological contributions. The goal of the CRITFC and member tribes for Pacific lamprey restoration is to immediately halt the decline of Pacific lamprey and to restore lamprey throughout their range to self-sustaining numbers that support cultural, harvest, and ecological value. Pacific lamprey populations in the Columbia River Basin have declined drastically in the past half-century due to several factors including passage obstacles, entrainment, habitat degradation, poor water quality, contaminants, dredging, predation, poor ocean conditions, and climate change.

Blocked and delayed passage due to dams has severely impacted the ability of lamprey to reach

their historic spawning habitat and has led to extirpation in the upper reaches of their range. Dams have altered the system for lamprey in all life stages and throughout their range. Ladders constructed for salmon are not suitable for lamprey due to differences in swimming style and ability. Lamprey use anguilliform swimming and use their sucking disc mouths to help propel them up surfaces. They are unable to maintain suction on 90-degree angles. Lamprey are not strong swimmers in comparison to salmon. As such, lamprey needs must be considered when constructing new passage or improving upon older structures at the dams.

Passage improvements for lamprey have been made at the mainstem dams, however, more work is required. Roughly only 50% of lamprey pass each consecutive dam during the upstream migration. Downstream passage is also problematic, lamprey are impinged on screens at the dams, inadvertently diverted and barged downstream with salmon, preyed upon, endure poor water quality, and other threats.

The tribes and the Corps have developed an implementation plan to enact these actions to improve passage for Pacific lamprey. The costs of many of these improvements are significant and require multiple years of stable funding in order to be successful. The implementation plan identifies work to be done with the remaining \$17.8M Accord committed capability and \$147.2M of additional project needs.

Passage studies are required to monitor passage improvements and adjust or overhaul systems if the results of the studies suggest additional improvements are needed. A specialized miniaturized juvenile lamprey acoustic tag (JLAT) just for the small juvenile phase of lamprey has recently been developed for passage studies to understand the downstream migration.



These passage studies ideally would span multiple years and multiple dams, reservoirs, and tributaries. This is a significant cost that could take approximately \$10M to \$20M to complete a robust study. Additionally, the JLAT tag needs to be commercialized in order to put it to work more easily.

The total cost for lamprey improvements and studies as identified in the following spreadsheets is \$165.1M. The items below are a summation of the items in the spreadsheet.

- Adult migration behavior and fate studies (timing, magnitude, production, distribution, survival) (PIT, acoustic, radio tag) to identify bottlenecks and priorities, including a focus on adult passage issues in the Snake River basin, and in the pools between dams.
- Implement passage fixes at each of the mainstem dams as identified to get passage success to greater than 95%.
- Development of new types of passage designs/ approaches (wetted climbing walls, etc.).
- Implement juvenile RM&E passage and survival studies through the system, including a focus on downstream migration survival and the fate of Upper Columbia ammocoetes and macrophthalmia in the mainstem.
- JLAT tag procurement.
- Develop a strategic, coordinated approach to understanding migration behavior timing, magnitude, distribution/production, and passage and survival.
- Implement fixes in a timely manner to improve passage and survival.
- Support for supplementation efforts (translocation and artificial propagation).

- Provide support for the translocation program- access, trapping, transport, and holding facilities at dams.
- Design new innovative traps and prototype larval/juvenile lamprey collection traps
- Continued funding for dam operation and maintenance of lamprey passage structures.
- Long-term monitoring.

Flood Risk Management

The Columbia River Treaty came into full force and effect on September 16, 1964. The Treaty's dual purposes are to optimize hydroelectric power production through the United States' system and to provide coordinated flood control. While the Treaty is evergreen, the coordinated flood control provisions change dramatically in 2024. After 2024 Canada will no longer be obligated to provide coordinated flood control management and protection to the United States. Instead, the U.S. will have to "call upon" Canada to provide flood control, which Canada interprets the Treaty to first require the United States to use all the storage facilities in the United States before calling upon any flood control relief from Canada. The U.S. will also have to pay Canada for operational and opportunity costs of providing flood control services.

The Canadian view, requiring that the U.S. first utilize all its available storage, would put at risk several dam and reservoir operations developed to integrate ecosystem function into U.S. hydropower operations and would substantially impact fish and wildlife resources beginning in 2025.

Recognizing the need to modernize the Treaty, and after several years of coordination and collaboration by the regional sovereigns, and

with input by stakeholders, the U.S. Entity Regional Recommendation for the Future of the Columbia River Treaty after 2024 was submitted to the U.S. Department of State in December 2013 for its review and consideration. The need for a flood risk management review was identified during the Sovereign Participation Process as a domestic matter to be undertaken as soon as possible, ideally starting as soon as 2014.

The Corps of Engineers should conduct a comprehensive study of flood risk in the Columbia Basin and the need to make regional decisions on balancing flood risk with multiple purposes of the system, including ecosystem function and effects on fish and wildlife. This review should include the following components:

- Seek input from the public and stakeholders.
- Address options to manage both medium- and high-flow events.

- Assess the full range of flood events.
- The review should address:
 - Infrastructure capacities and capabilities,
 - Floodplain management,
 - Columbia Basin reservoir operations and levees – both strategic improvements to existing levees and the potential need for additional levees.
 - Improvements in modeling and forecasting to improve real-time operations to insure a better balance between fish flows and flood control operations.

Total costs for the USACE comprehensive review of Columbia Basin flood risks are to be determined and are not included in the tables and summary numbers below.



Summary of Columbia River USACE Fish Budget Needs (8 years)

	Totals*	Annual Costs**
CRFM Estimated	\$ 389,150	\$ 48,644
O&M**	232,400	29,050
Lamprey	147,267	18,408
Grand Total	\$ 768,817	\$ 96,102

CRFM and O&M needs together are estimated to be roughly \$70M per year.

Lamprey needs are estimated to be roughly \$20M per year.

* These total costs are mostly one-time costs. Annual program costs are noted where information allowed and aggregated accordingly.

** These annual costs were estimated for an eight-year period by dividing the estimated total costs that are detailed on the accompanying spreadsheets by eight. The estimates are not adjusted for inflation. Implementation schedules are expected to vary with funding availability and other scheduling considerations.

Categorized Work Elements

Fish Ladder Repairs and Improvements	\$ 160,195
Spillway Repairs and Improvements	200,700
Lamprey Passage	147,267
River Mouth Sediment and Cold Water Refugia Actions	12,000
Fish Screen & JBS Maintenance	132,785
Survival & Monitoring Studies (Flex Spill Operations, Monitoring And Turbine Improvements)	55,450
Avian Predation Deterrents	31,200
Estuary Work	6,500
Total	\$ 746,097
 If Snake Dams Removed Cost Savings	 \$ (104,346)

All costs are in thousands of dollars.

Bonneville Dam

CRFM Items	Cost (8-YEAR TOTAL COST)
Bonneville Powerhouse 2 Fish Guidance Efficiency <i>(*In 2021 the cost was 1,860 for 1 unit and testing)</i>	\$ 8,500
Bonneville PIT Detection Sluiceway	2,600
Spillway Survival Improvements Deflectors	15,000
Spillway Rock Containment Options	8,000
Spillway Survival Improvements	70,000
Bonneville Pit Detection Barges	2,500
Orifice Bonneville Powerhouse 2 Improvements Air System	1,500
Increase Bonneville Powerhouse 2 Sluiceway Capacity	10,000
Total CRFM	\$ 118,100

O&M Items (mostly one-time costs)

Fish Ladder, Bradford Island A Branch Auxiliary Water Supply Conduit (AWS) Joint Repair	The conduit is not watertight and the significant leaks have resulted in a sinkhole and a small geyser that is undermining a sidewalk and potentially the ladder itself. Past repairs have not been able to adequately address the failure.	\$ 150
Cascade Island Fishladder Bridge Replacement	Scope is to replace or reinforce Cascade Island Fishladder Bridge to regain lead AASHTO Load Limits. The Cascade Island Fishladder Bridge has been derated to 29T and we can no longer move the 65T crane to the area to perform Fish Ladder Maintenance.	2,500
Fish Ladder, Bradford Island A Branch Fish Valves (FV1–2, 3–7, 3–9)	These valves provide all of the water for the A-branch, both for fish attraction and to the diffusers. These valves are original equipment from the 1930s, and are in need of refurbishment. FV 1–2 is currently only used under special circumstances due to its condition.	500
Fish Ladder, Cascades Island Diffusers	Some number of diffusers fail every year. Workarounds are implemented but can only partially address the problem. Structural degradation and aging equipment will soon preclude repair possibilities and will instead require complete replacement.	1,000
Fish Ladders, Cascades Island Fishway Report—Phase 2	Diffuser structural problems and air entrainment by fish valves that causes gas supersaturation of fishway above TDG limits (Fish Valve 1–1, 4–3, 4–4, 5–3, 5–4)	300

All costs are in thousands of dollars.

O&M Items (mostly one-time costs)

Fish Viewing Roof Replacement	Replace/repair leaking membrane and gutter system on Washington Shore Fish viewing building.	250
Bradford Island Fish Ladder Exit	Bradford Island Fishladder Exit requires expensive O&M dredging. A newly designed and built exit channel would remove the need for maintenance dredging in the future <i>\$500K per year (8-year total cost)</i>	2,000
Spillway Fish Elevators	Fish elevators are non-functional, have not been used in at least 50 years, and are an environmental and safety hazard. Fish elevators need to be decommissioned and removed from the project. The existing areas should be cleaned up and be made available for other uses.	8,000
Cascades Island Fish Ladder	Major overhaul	10,000
Major Screen Maintenance Overhaul	Major overhaul of existing screens	12,000
Total O&M		36,700
Grand Total		\$ 154,800

Categorized Work Elements

Fish Ladder Repairs and Improvements	\$ 26,200
Spillway Repairs and Improvements	103,000
Lamprey Passage	—
River Mouth Sediment and Cold Water Refugia Actions	—
Fish Screen & JBS Maintenance (<i>Total for 8 Years</i>)	20,500
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)	5,100
Avian Predation Deterrents	—
Estuary Work	—
Total	\$ 154,800

All costs are in thousands of dollars.

The Dalles Dam

CRFM Items		Cost (8-YEAR TOTAL COST)
The Dalles East Fish Ladder Emergency Auxiliary Water Supply		\$ 5,500
The Dalles Sluiceway PIT Detection Feasibility Evaluation		2,000
Increase Birdwire and Hazing		2,500
Total CRFM		\$ 10,000
O&M Items (mostly one-time costs)		
Fishway Arc Flash Mitigation	Several pieces of equipment have high arc flash incident energies (Cat 4). Arc Flash Hazard Analysis completed in March 2015 by HDR identified several pieces of equipment with high arc flash incident energies. The analysis provided recommended mitigation to lower the arc flash incident energy to a safe level for personnel. The majority of the recommended mitigation is being completed under a power funded contract; however, there is equipment remaining that requires mitigation which can not be power funded. The equipment with high arc flash incident energies are at substations FSQA, FSQ1, FSQ2, FSQ4 and FSQ6. These substations provide power to the fishway (lighting, gate controls, portable pumps, heating, and receptacles). To mitigate the arc flash energy at these locations a maintenance switch and indicating light would be installed providing an input to the protective relay associated with the feed to the substation. During maintenance or switching operations the maintenance mode would be used to lower the arc flash incident energy from category 4 to category 1.	\$ 250
Fishway Automation	Critical components are past useful life and unsupported by OEM. Originally installed fiber optic cable is failing. Replacement parts are no longer available for purchase. Procure and install new fishway automation for all entrance and exit weirs.	400
Fishway Diffuser	Removal of east fishway collection channel unused diffuser valves and permanent closure. Possible removal of east entrance, junction pool, east lower ladder and north ladder diffuser valves and maintain permanently opened.	5,000
Spillway Trudgen Pin replacement		1,200
Spillway Wire Ropes		1,000
Total O&M		7,850
Grand Total		\$ 17,850

All costs are in thousands of dollars.

Categorized Work Elements

Fish Ladder Repairs and Improvements	\$ 11,150
Spillway Repairs and Improvements	2,200
Lamprey Passage	—
River Mouth Sediment and Cold Water Refugia Actions	—
Fish Screen & JBS Maintenance	—
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)	2,000
Avian Predation Deterrents	2,500
Estuary Work	—
Total	\$ 17,850

All costs are in thousands of dollars.

John Day Dam

CRFM Items		Cost (8-YEAR TOTAL COST)
John Day Mitigation		\$ 2,000
Move Irrigation Intakes to Operate Below MIP		12,000
Adult Ladder Cooling Structure		10,000
Notched Gate for Overshoot Spill		9,500
Spillway Floating Guide Wall Tailrace Improvement		35,000
Total CRFM		\$ 68,500
O&M Items (mostly one-time costs)		
Bonneville Hatchery Well Field	Hatchery well field has iron bacteria problem and local well gravel pack silting.	\$ 2,000
Submerged Traveling Screen (STS) Rehab	Submerged Traveling Screen (STS) need major overhaul (corrosion, bearings, etc.). There are 48 working screens plus one extra screen (49 total).	50,000
AWS Rehab Remaining 2 Fish Unit Turbine Pumps	Age of turbines and possibility of failure leads to requirement for rehab. All 3 installed at same time, one has failed and pump 2 is near failure. One remaining functional pump will likely fail soon.	12,000
Bonneville Hatchery Wells	Well Field Production (Water) has decreased below MOU required level. Continued decrease in production projected.	6,000
JBS Expansion Joint	Needs to be re-designed for the larger/wider cover plates/recessed wall to stop water leaks	1,500
North Ladder Elevator	Repair Elevator to allow access and transport of Lamprey from North Shore Ladder	200
Total O&M		\$ 71,700
Grand Total		\$ 140,200

All costs are in thousands of dollars.

Categorized Work Elements

Fish Ladder Repairs and Improvements	\$ 23,700
Spillway Repairs and Improvements	44,500
Lamprey Passage	—
River Mouth Sediment and Cold Water Refugia Actions	—
Fish Screen & JBS Maintenance	50,000
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)	—
Avian Predation Deterrents	—
Estuary Work	—
JDA Mitigation	10,000
Return to MOP	12,000
Total	\$ 140,200

All costs are in thousands of dollars.

McNary Dam

CRFM Items		Cost (8-YEAR TOTAL COST)
McNary Avian Deterrent Deficiency Correction and Avian Wire Design Feasibility Report		\$ 5,500
Pit Barges/Pit Detection		6,500
Adult Ladder Cooling Structure		11,000
Notched Gate for Overshoot Spill		9,500
Total CRFM		\$ 32,500
O&M Items (mostly one-time costs)		
Oregon Fishway	Repair/replace three south shore AWS pumps	\$ 16,000
Oregon Fishway	Rejuvenate dewatering system; replace rotovalves, slide gates	5,000
Oregon Fishway	Rejuvenate dewatering system; Replace transverse stoplog guides	3,500
Oregon Fishway	Rejuvenate dewatering system; Rehabilitate all transverse stoplogs	2,000
Oregon Fishway	Rejuvenate dewatering system; Rehabilitate all floating weirs and guides	3,500
Oregon Fishway	Permanently close floating orifice gates not used	2,500
Oregon Fishway	Replace diffuser gratings and grate supports	5,000
Spillway	Add hoists to spillbays 2 and 19	8,500
Spillway	Rehab/replace spillway cranes 6 and 7	3,000
Juvenile Fish Facility	Replace outfall sprinklers	1,500
Juvenile Fish Facility	Add tailrace bird wires	1,500
Bypass System	Critical spare parts (<i>Total over 8 years</i>)	2,500
Fishways	Support for fishway temperature monitoring (<i>Assume \$50K per year</i>)	400
Total O&M		\$ 54,900
Grand Total		\$ 87,400
Categorized Work Elements		
Fish Ladder Repairs and Improvements		\$ 48,900
Spillway Repairs and Improvements		21,000
Lamprey Passage		—
River Mouth Sediment and Cold Water Refugia Actions		—
Fish Screen & JBS Maintenance		5,500
Survival & Monitoring Studies		6,500
(Flex Spill Operations, Monitoring and Turbine Improvements)		
Avian Predation Deterrents		5,500
Estuary Work		—
Total		\$ 87,400

All costs are in thousands of dollars.

Ice Harbor Dam

CRFM Items		Cost (8-YEAR TOTAL COST)
Spillway Pit Detector		6,000
Fish Ladder Cooling Structure		5,500
Improvement to Trap Facility for Emergency Trap and Haul		2,500
Notched Gate for Overshoot Spill		7,500
Total CRFM		\$ 21,500
O&M Items (mostly one-time costs)		
Powerhouse Deck	Repair/replace trash rake	\$ 4,500
South Fishway	AWS pump rehab	3,000
Fishways	Entrance hoists and controls replacement	450
Fishways	Replace missing/broken depth gauges	100
Fishway	Shad exclusion/deterrent devise	350
Forebay	Ladder exit debris booms	450
Juvenile Fish Channel	Expansion of air burst cleaning system under inclined screen	650
Fish Count Station	Air motors for window brushes	350
Juvenile Fish Channel	Spare actuator for water regulating weirs	150
Bypass System	Critical spare parts <i>(Total over 8 years)</i>	2,500
Fishways	Support for fishway temperature monitoring <i>(Assume \$50K per year)</i>	400
Total O&M		\$ 12,900
Grand Total		\$ 34,400
Categorized Work Elements		
Fish Ladder Repairs and Improvements		\$ 13,100
Spillway Repairs and Improvements		7,500
Lamprey Passage		—
River Mouth Sediment and Cold Water Refugia Actions		—
Fish Screen & JBS Maintenance		7,800
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)		6,000
Avian Predation Deterrents		—
Estuary Work		—
Total		\$ 34,400
If Snake Dams Removed Cost Savings		\$ (12,900)

All costs are in thousands of dollars.

Lower Monumental Dam

		Cost (8-YEAR TOTAL COST)
CRFM Items		
Adult Ladder Cooling Structure		\$ 6,500
Notched Gate for Overshoot Spill		7,500
Total CRFM		\$ 14,000
O&M Items (mostly one-time costs)		
Juvenile Fish Facility	Hoist system for tailrace tail screens	\$ 4,500
Juvenile Fish Facility	Primary Dewaterer repairs	2,500
Forebay	Install shear boom to move debris to spillway	4,500
Fishway	Fishway cooling system (<i>Covered in CRFM budget</i>)	—
Fishway	Repair/replace expansion joint seals	550
Bypass System	Critical spare parts (<i>Total over 8 years</i>)	2,500
Fishways	Support for fishway temperature monitoring (<i>Assume \$50K per year</i>)	400
Total O&M		14,950
Grand Total		\$ 28,950
Categorized Work Elements		
Fish Ladder Repairs and Improvements		\$ 6,900
Spillway Repairs and Improvements		8,050
Lamprey Passage		—
River Mouth Sediment and Cold Water Refugia Actions		—
Fish Screen & JBS Maintenance		14,000
Survival & Monitoring Studies		—
(Flex Spill Operations, Monitoring and Turbine Improvements)		—
Avian Predation Deterrents		—
Estuary Work		—
Total		\$ 28,950
If Snake Dams Removed Cost Savings		\$ (7,400)

All costs are in thousands of dollars.

Little Goose Dam

		Cost (8-YEAR TOTAL COST)
CRFM Items		
Adult Entrance Pit		\$ 650
Notched Gate for Overshoot Spill		7,500
Total CRFM		\$ 8,150

O&M Items (mostly one-time costs)

North Shore	Replace north shore jetty	\$ 12,000
Fishway	Re-design fish count station	2,800
Fishway	Repair/replace expansion joint seals	450
Fishway	Replace diffuser grating and support beams	1,800
Fishway	Replace fishway control system	450
Collection Channel	Repair/replace corroded outer steel orifice pipe with stainless steel	150
Collection Channel	Repair orifice valve cylinders	250
Bypass System	Critical spare parts (<i>Total over 8 years</i>)	2,500
Fishways	Support for fishway temperature monitoring (<i>Assume \$50K per year</i>)	400
Total O&M		\$ 20,800
Grand Total		\$ 28,950

Categorized Work Elements

Fish Ladder Repairs and Improvements	\$ 17,900
Spillway Repairs and Improvements	7,500
Lamprey Passage	—
River Mouth Sediment and Cold Water Refugia Actions	—
Fish Screen & JBS Maintenance	2,900
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)	650
Avian Predation Deterrents	—
Estuary Work	—
Total	\$ 28,950

If Snake Dams Removed Cost Savings	\$ (14,900)
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All costs are in thousands of dollars.

Lower Granite Dam

		Cost (8-YEAR TOTAL COST)
CRFM Items		
Lower Granite Juvenile Bypass Facility—Phase 1a (Gatewell to Separator), Phase 1b (Outfall) Close Out		\$ 4,500
Improve Adult Separator		1,500
Improve Kelt Holding Facility		3,500
Notched Gate for Overshoot Spill		7,500
Total CRFM		\$ 17,000
O&M Items (mostly one-time costs)		
Fishway	Modify adult trap turnpool gate	\$ 400
Fishway	Shad exclusion/deterrent devise	850
Fishway	Rehab/replace fishway AWS pumps	4,500
Fishway	Install/replace velocity meter in channel	85
Juvenile Fish Facility	Complete Phase 1a modifications and resolve programing issues	2,500
Fishway	Relocate south shore tailwater elevation sensor	45
Fishway	Correct Control System Programing malfunction	150
Fishway	Permanently close floating orifice gates not used	350
Fishway	NSE, SSE, and NPE local depth indication	85
Fishways	Rehab/replace fishway entrances. NSE1 and NSE2 are showing cracks in the concrete	650
Barges	Improve degassing system on 2000 barges	85
Bypass System	Critical spare parts (<i>Total over 8 years</i>)	2,500
Fishways	Support for fishway temperature monitoring (<i>Assume \$50K per year</i>)	400
Total O&M		\$ 12,600
Grand Total		\$ 29,600
Categorized Work Elements		
Fish Ladder Repairs and Improvements		\$ 12,515
Spillway Repairs and Improvements		7,500
Lamprey Passage		—
River Mouth Sediment and Cold Water Refugia Actions		—
Fish Screen & JBS Maintenance		9,585
Survival & Monitoring Studies (Flex Spill Operations, Monitoring and Turbine Improvements)		—
Avian Predation Deterrents		—
Estuary Work		—
Total		\$ 29,600
If Snake Dams Removed Cost Savings		\$ (2,900)

All costs are in thousands of dollars.

CRFM System Projects

CRFM Items	Cost (8-YEAR TOTAL COST)	<i>Assume 8 year time frame. Cost is a total. For studies if more than 1 year multiple cost by number of years.</i>
Overshoot Study	\$ 1,500	1 year cost
IHR Screen vs Bypass Study	5,500	1 year study
JDA Screen vs Bypass Study	8,500	1 year study
MCN Screen vs Bypass Study	8,500	1 year study
Estuary Habitat Studies	6,500	
Cold Water Refugee Monitoring at Mouths	4,000	\$50K per year
Cold Water Refuge Construction Projects	8,000	Estimate \$1,000K per year for 8 years
Avian Predation—Cormorant Management and Monitoring	8,000	\$1,000K per year
Avian Island PIT Detection	4,000	\$500K per year
Inland Avian Predation Blalocks Monitoring	1,600	\$200K per year
Caspian Tern Management Plan (Avian Predation Monitoring)	1,600	\$200K per year
Predation Management Lower Columbia	8,000	\$1,000K per year
Lower Columbia River Juvenile Survival Studies (Settlement Spill Evaluation)	14,000	2 year study
CRFM Reach Survival Estimates	12,800	PIT Trawl Reach Survival Support \$1,600K per year
FCRPS CRFM Program Management (NWP)	2,800	Assume 8 year total
FCRPS CRFM Program Management (NWW)	2,000	Assume 8 year total
Spillway and Turbine PIT Tag Detection Feasibility Study	2,000	
Total CRFM	\$ 98,900	

Categorized Work Elements

Fish Ladder Repairs and Improvements	—
Spillway Repairs and Improvements	—
Lamprey Passage	—
River Mouth Sediment and Cold Water Refugia Actions	12,000
Fish Screen & JBS Maintenance	22,500
Survival & Monitoring Studies (Settlement Spill Operations, Monitoring and Turbine Improvements)	34,700
Avian Predation Deterrents	23,200
Estuary Work	6,500
Total	\$ 98,900

If Snake Dams Removed Cost Savings	\$ (5,500)
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All costs are in thousands of dollars.

Lamprey—2018 Accords Extension MOA Action Items (\$17.8M Capability)

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Visitor Center	Procure and install automated blinds on visitor center windows to reduce light at night	Blinds will reduce nighttime light pollution in the ladder control section to improve lamprey passage. Purchase and install in FY20.	10,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Control Section	Convert wetted wall to lamprey trap-and-haul structure	Converting the wetted wall to a trap will allow us to monitor fish use of the structure and complete an evaluation of the wetted wall as a passage structure. Design and construct Winter 20-21. No "in-water" work.	25,500
NWP	Bonneville	Additional Adult Lamprey Improvements	Cascades Island Ladder	Picketed Leads	Modify two upper picket leads (upstream of new LPS trap) to exclude lamprey from AWS Channel	Replace existing picked leads with smaller mesh and eliminate gaps to prevent lamprey from straying into the "dead end" AWS channel. Install Winter 20–21	15,500
NWP	Bonneville	Additional Adult Lamprey Improvements	Cascades Island Ladder	LPS	Lower lamprey flume to eliminate lift pumps and reduce stranding risk	Lowering the section of the lamprey flume at the forebay deck will eliminate the need for lift pumps and simplify the system, reducing stranding risk in this section of the LPS. This will require moving existing electrical equipment in the area, as well as fabricating new brackets and new flume section. There is also water piping that may need to be re-routed if the flume is lowered. Purchase materials and fabricate in FY20, BON project staff install in FY21.	232,760

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	Bonneville	Additional Adult Lamprey Improvements	LPS	LPS	Upgrade all LPS pumps to standard 480V, lead-lag system for reliability	Bradford Island, Cascades Island, and Washington Shore LPS's will have current drop in well pumps replaced with standardized 480V surface mount pumps that will increase the reliability and flexibility of the Bonneville Dam LPS system. Purchase pumps and other materials in FY20, BON project staff install in FY21.	196,680
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	LFS	Redesign and replace LFS hatch	Washington Shore LFS was designed with a removable access hatch below the water. The hatch cover has been blown off by turbulent flow every time we've tried to operate the LFS since construction. The flawed hatch cover needs to be redesigned and reinstalled so it will stay in place. It does not need to be removable so we will weld or bolt the new hatch cover down. Fabricate in-house FY20, dive contract for installation FY21)	20,112
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Visitor Center	Procure and install automated blinds on visitor center windows to reduce light at night	Blinds will reduce nighttime light pollution in the ladder control section to improve lamprey passage. Cost estimate is from BON Fisheries, based on experience with current system at WA Shore Ladder (which is not performing well). Purchase and install in FY20.	10,000

** Note: All costs are listed in full dollar amounts.*

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	John Day	Additional Adult Lamprey Improvements	North Fish Ladder	Entrance LPS	Gravity feed water supply	Eliminate existing drop in well pumps and replace with gravity feed water supply from the adjacent elevated ladder section.	500,000
NWP	John Day	Additional Adult Lamprey Improvements	North Fish Ladder	Entrance LPS	Fabricate/install larger collection box	This is a fish safety/health issue and the upgrade needs to happen. Current water supply is insufficient so tank cannot be installed without upgraded (gravity feed) water supply.	10,000
NWP	John Day	Additional Adult Lamprey Improvements	North Fish Ladder	Variable Width Weir	Variable width weir (VWW) plating replacement	Weld plating on downstream side of weir to replace HDPE plating that continues to fail. Plating on downstream face provides smooth attachment surface. Welding plating here would improve reliability and provide unquantifiable benefits to lamprey.	20,000
NWP	John Day	Juvenile Lamprey RM&E	JBS	JBS	Investigate feasibility of off-season JBS operation	Scope assumed to be limited to a "table top" exercise using existing information	2,500
NWP	Bonneville	Tribal Access	Washington Shore Ladder	Lamprey Holding Facility	Convert FERL (Near AFF, Washington Shore Ladder) to lamprey holding facility	BON project staff for modifications. PDT to provide technical support for any necessary changes to plumbing. Scope to include O&M manual.	25,000
NWP	The Dalles	Tribal Access	East Fish Ladder	Lamprey Holding Facility	Lamprey holding tank	Per previous discussions during site visits, there is a request from the tribes for a holding tank to be located somewhere under the East Fish Ladder	25,000

** Note: All costs are listed in full dollar amounts.*

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	John Day	Tribal Access	South Fish Ladder	Lamprey Trap	Lamprey trap improvements	Increase capacity of system—Larger opening into box; larger box; modify guide; eliminate gate and counting-related structure. Likely could fabricate in-house. May require follow-on work if we have a capacity issue as a result of improvements.	30,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Control Section	Extensive minor modifications to serpentine weir section	Including refuge boxes, rounded corners on weirs, additional lamprey orifices, and (if practicable) new features such as artificial rocks.	200,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Transition Pool	Refuge boxes or similar structures on floors or walls	CRSO EIS measure. Intent is to provide “protected resting environment for lamprey migrating upstream.” Construct in conjunction with transition pool LPS	50,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Entrance	B-Branch entrance improvements (variable width weir, bollards)	Mirror image of CI. CI improved entrance efficiency but moves bottleneck upstream. This is implementation of BMPs for lamprey and has added benefit for long term O&M. Implement in conjunction with transition pool LPS at this fishway (similar to Cascades Island and JDA North). Install Winter 23–24 (FY24)	1,520,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	LPS	Design/install LPS at B-Branch transition pool	B-Branch transition pool is a relatively high priority area in terms of passage bottlenecks	510,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Ladder Section	Ramps to elevated orifices in B-Branch	Construct ramps to elevated orifices in the Bradford Island B-Branch ladder to improve lamprey passage through the orifices. Fabricate in FY21, install winter 21–22 (FY22)	30,000

** Note: All costs are listed in full dollar amounts.*

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	Bonneville	Improve Adult Counting	LPS	LPS	Evaluate alternative LPS counting systems (start with a workshop about goals and needs)	Scope to be determined by workshop late FY20 or early FY21 Test in situ or in BON AFF or FERL using mock-up LPS exit chute.	250,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Control Section	Wetted wall or similar structure at/near serpentine weir section	Hold off until serpentine weir section overhaul discussion is concluded and tribal lamprey collection path forward is resolved. Based on Bradford Island experience, should terminate in a collection tank, at least while it is evaluated. It could later be routed to the existing LPS (may be capacity issue) or used as collection structure permanently. This is an EIS measure so some version of this will likely move forward.	200,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Control Section	Full redesign of control section (DDR, P&S, Construction)	Assume 50/50 cost share with salmon passage funding. DDR in FY21, P&S in FY22–24, Award construction in late FY24, SA/EDC in FY25, Follow-on work and closeout in FY26?	3,580,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Entrance	Design/install refuge boxes or bollard-like structures to provide cover for lamprey in lower fishway section.	Design and award for Winter 22–23 installation	100,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	LPS	Design/install Transition Pool to Tailrace Deck LPS.	Design and award for Winter 22–23 installation	510,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Floating Orifice Gates	Evaluate closeable gates on Powerhouse 2 floating orifice gates (FOGs).	Align with adult lamprey post-construction study	20,000
NWP	The Dalles	Additional Adult Lamprey Improvements	East Fish Ladder	LPS	Design/install Transition Pool to Tailrace Deck LPS	Construction during winter 22–23	510,000

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	The Dalles	Additional Adult Lamprey Improvements	East Fish Ladder	Ladder Section	Modify elevated orifices in exit weirs 154–157	Construction during winter 22–23	30,000
NWP	John Day	Additional Adult Lamprey Improvements	South Fish Ladder	Entrance Weir	East entrance weir improvements (rounded crest, slot filler)	Caps cannot be added to South Ladder entrance weirs due to FPP submergence criteria. Weirs would have to be modified more extensively to provide rounded weir crests and weir guide slot covers. Old weir stored in boneyard could potentially be used to save cost? Construction during winter 21–22	150,000
NWP	John Day	Additional Adult Lamprey Improvements	South Fish Ladder	LPS	Design/install Transition Pool to Tailrace Deck LPS	Construction during winter 23–24	510,000
NWW	McNary	Additional Adult Lamprey Improvements	Oregon Shore Ladder	Entrance Weir	Rounded entrance weir caps on fishway entrance weirs		260,000
NWW	McNary	Additional Adult Lamprey Improvements	Washington Shore Ladder	Entrance Weir	Rounded entrance weir caps on fishway entrance weirs		60,000
NWW	Little Goose	Additional Adult Lamprey Improvements	Juvenile Fish Facility	Raceways	Portable wetted wall with trap for raceways		30,000
NWW	Little Goose	Integrate Lamprey Designs into Salmon Facilities	Juvenile Fish Facility	Raceways	Screens on Juvenile Facility Raceways		10,000
NWW	Lower Granite	Integrate Lamprey Designs into Salmon Facilities	Fish Ladder	Adult Fish Trap	Lamprey friendly modification of adult fish trap		0
NWW	Passage Study	Juvenile Lamprey RM&E	Juvenile Passage Study	Juvenile Passage and Survival	Juvenile Pacific Lamprey Passage Behavior and Survival RM&E plan development and implementation		5,000,000

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP	Passage Study	Adult Lamprey Migration RM&E	Adult Passage Study	Radio-telemetry	Adult lamprey radio-telemetry evaluation (post-construction, 2 yr study)	Primary focus of this study is on BON WA Shore control section remodel and an evaluation of FOG closure at BON WA Shore/Powerhouse 2. Compare 2 years of study results with historic to measure improvements in total dam passage efficiency and passage efficiency of the WA Shore Ladder. RT and HDX-PIT array coverage can be reduced as appropriate to reduce cost (in contrast with historic studies in which we monitored upstream dams). Award MIPR in FY24 to allow U of I to update RT and PIT arrays.	1,850,000
NWP	Passage Study	Adult Lamprey Migration RM&E	Adult Passage Study	Acoustic Telemetry	Adult lamprey fate in Lower Columbia River (BON to JDA)—acoustic telemetry evaluation and mechanisms	Align with juvenile studies so the arrays can be used for multiple studies	1,250,000
NWP/ NWW	All	Integrate Lamprey Designs into Salmon Facilities	Fish Ladder	Diffuser Grating	Conduct assessment of when diffuser grating is anticipated to be replaced at all eight dams, estimated cost, and feasibility of replacement with 3/4" grating (and trash rack/rake replacement, as needed) given considerations such as debris loading.		50,000
NWW	Ice Harbor	Integrate Lamprey Designs into Salmon Facilities	Powerhouse	Turbine Cooling Water	Install turbine cooling water strainer exclusion structure on one unit (prototype testing), summarize effectiveness monitoring following 2 years of use, write plan for future implementation elsewhere (NWW and NWP)		55,000

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Scope of Work	Total Estimated Capability*
NWP/ NWW	All	Additional Adult Lamprey Improvements	LPS	LPS	Improving LPS using pucks or augmented flow to enhance acoustics for attraction (i.e. sound underwater) or flow conditions conducive for passage	Install and evaluate a few simple modifications to increase attraction acoustics. Scope to be determined through further coordination with tribes and FFDRWG.	20,000
Total							\$17,878,052

** Note: All costs are listed in full dollar amounts.*

Lamprey—Additional Identified Needs

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Total Estimated Capability*
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Control Section	Extensive minor modifications (round corners, lamprey orifices, cover)	200,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Entrance	Design/install [EVALUATE] experimental "speed bumps" or alternative design to provide hydraulic refugia at/near telescoping entrance weir slots	50,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Control Section	Design and install experimental structure to guide lamprey from serpentine weirs toward AWS Channel LPS	200,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	LPS	Extend Bradford Island AWS LPS exit chute farther upstream	300,000
NWP	Bonneville	Tribal Access	Bradford Island Ladder	Entrance	A-Branch Entrance Tailrace to Shoreline at B1 Experimental Lamprey Collection Structure	100,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	LPS	Extend Washington Shore AWS LPS exit chute to forebay or fishway exit area	900,000
NWP	John Day	Additional Adult Lamprey Improvements	North Fish Ladder	Entrance LPS	Entrance LPS extension to forebay or part way up fish ladder	3,000,000
NWW	Ice Harbor	Additional Adult Lamprey Improvements	North Fish Ladder	Entrance Weir	Ice Harbor—North Ladder—Rounded caps on fishway entrance weirs	775,000
NWW	Ice Harbor	Additional Adult Lamprey Improvements	South Fish Ladder	Entrance Weir	Ice Harbor—South Ladder—Rounded caps on fishway entrance weirs	775,000
NWW	Lower Monumental	Additional Adult Lamprey Improvements	North Fish Ladder	Entrance Weir	Lower Monumental—North Ladder—Rounded entrance weir caps on fishway entrance weirs	1,530,500
NWW	Lower Monumental	Additional Adult Lamprey Improvements	South Fish Ladder	Entrance Weir	Lower Monumental—South Ladder—Rounded entrance weir caps on fishway entrance weirs	1,530,500

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Total Estimated Capability*
NWW	Little Goose	Additional Adult Lamprey Improvements	Fish Ladder	Entrance Weir	Little Goose—Rounded caps on fishway entrance weirs	947,000
NWW	Lower Granite	Additional Adult Lamprey Improvements	Fish Ladder	Entrance Weir	Lower Granite— Fish Ladder— Rounded entrance weir caps on fishway entrance weirs	947,000
NWP	Bonneville	Improve Adult Counting	Washington Shore Ladder	Control Section	Evaluate counting lamprey upstream of serpentine weir section (near ladder exits) at BON WA Shore and BON Bradford Island ladders	500,000
NWP	The Dalles	Improve Adult Counting	North Fish Ladder	Picketed Leads	Evaluate effects of exclusion of lamprey from behind picket leads at some locations to eliminate bypass around count slots	300,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Control Section	Full redesign of control section (DDR, P&S, and construction)	7,500,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Diffuser Plating	Diffuser plating (where feasible)	
NWP	Bonneville	Additional Adult Lamprey Improvements	Bradford Island Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	
NWP	Bonneville	Additional Adult Lamprey Improvements	Cascades Island Ladder	Diffuser Plating	Diffuser plating (where feasible)	
NWP	Bonneville	Additional Adult Lamprey Improvements	Cascades Island Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	
NWP	Bonneville	N/A	Powerhouse	Turbine Cooling Water	Turbine cooling water strainer intake exclusion at all 20 (10 PH1 and 8 PH2 main units + 2 fish units) units	3,303,000
NWP	Bonneville	Additional Adult Lamprey Improvements	Washington Shore Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	

** Note: All costs are listed in full dollar amounts.*

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Total Estimated Capability*
NWP	The Dalles	Additional Adult Lamprey Improvements	East Fish Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	
NWP	The Dalles	Additional Adult Lamprey Improvements	North Fish Ladder	Diffuser Plating	Diffuser plating (where feasible)	
NWP	The Dalles	Additional Adult Lamprey Improvements	North Fish Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	
NWP	The Dalles	N/A	Powerhouse	Turbine Cooling Water	The Dalles—Turbine cooling water strainer intake exclusion at all 22 (includes 2 fish units) units	3,628,000
NWP	John Day	N/A	Powerhouse	Turbine Cooling Water	John Day—Turbine cooling water strainer intake exclusion at all 16 units	2,653,000
NWP	John Day	Additional Adult Lamprey Improvements	South Fish Ladder	Diffusers	Diffuser Grating and trashrack replacement (replace 1" grating with 3/4")	
NWW	McNary	Additional Adult Lamprey Improvements	Oregon Shore Ladder	Diffuser Plating	Diffuser plating replacement (where feasible)	10,000
NWW	McNary	Additional Adult Lamprey Improvements	Washington Shore Ladder	Diffuser Plating	Diffuser plating replacement (where feasible)	40,000
NWW	McNary	Additional Adult Lamprey Improvements	Oregon Shore Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	6,000,000
NWW	McNary	N/A	Powerhouse	Turbine Intake Screens	McNary—Powerhouse—Replace existing (42) ESBSs with screens designed to reduce juvenile lamprey impingement/entanglement	52,170,000
NWW	McNary	N/A	Powerhouse	Turbine Cooling Water	McNary—Turbine cooling water strainer intake exclusion at all 14 units	2,328,000
NWW	McNary	Additional Adult Lamprey Improvements	Washington Shore Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	6,000,000

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Total Estimated Capability*
NWW	Ice Harbor	Additional Adult Lamprey Improvements	North Fish Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	750,000
NWW	Ice Harbor	N/A	Powerhouse	Turbine Cooling Water	Ice Harbor—Turbine cooling water strainer intake exclusion at all 6 units	1,028,000
NWW	Ice Harbor	Additional Adult Lamprey Improvements	South Fish Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	2,000,000
NWW	Lower Monumental	Additional Adult Lamprey Improvements	North Fish Ladder	Diffuser Plating	Diffuser plating (where feasible)	
NWW	Lower Monumental	Additional Adult Lamprey Improvements	North Fish Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	
NWW	Lower Monumental	N/A	Powerhouse	Turbine Cooling Water	Lower Monumental—Turbine cooling water strainer intake exclusion at all 6 units	1,028,000
NWW	Lower Monumental	Additional Adult Lamprey Improvements	South Fish Ladder	Diffuser Plating	Diffuser plating (where feasible)	
NWW	Lower Monumental	Additional Adult Lamprey Improvements	South Fish Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	
NWW	Little Goose	Additional Adult Lamprey Improvements	Powerhouse	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	
NWW	Little Goose	N/A	Powerhouse	Turbine Intake Screens	Little Goose—Powerhouse—Replace existing (18) ESBSs with screens designed to reduce juvenile lamprey impingement/entanglement	22,359,000
NWW	Little Goose	N/A	Powerhouse	Turbine Cooling Water	Little Goose—Turbine cooling water strainer intake exclusion at all 6 units	1,028,000
NWW	Lower Granite	Additional Adult Lamprey Improvements	Fish Ladder	Diffusers	Diffuser grating and trashrack replacement (replace 1" grating with 3/4")	

* Note: All costs are listed in full dollar amounts.

District	Project	2018 Accords Extension MOA Action	Project Feature	Component	Action	Total Estimated Capability*
NWW	Lower Granite	N/A	Powerhouse	Turbine Intake Screens	Lower Granite—Powerhouse — Replace existing (18) ESBSs with screens designed to reduce juvenile lamprey impingement/ entanglement	22,359,000
NWW	Lower Granite	N/A	Powerhouse	Turbine Cooling Water	Lower Granite—Powerhouse — Turbine cooling water strainer intake exclusion at all 6 units	1,028,000
Sum Future Items						\$ 147,267,000
Grand Total						\$ 165,145,000
If Snake Dams Removed Cost Savings						\$ (60,746,000)

* Note: All costs are listed in full dollar amounts.





Columbia River Inter-Tribal Fish Commission (CRITFC)
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