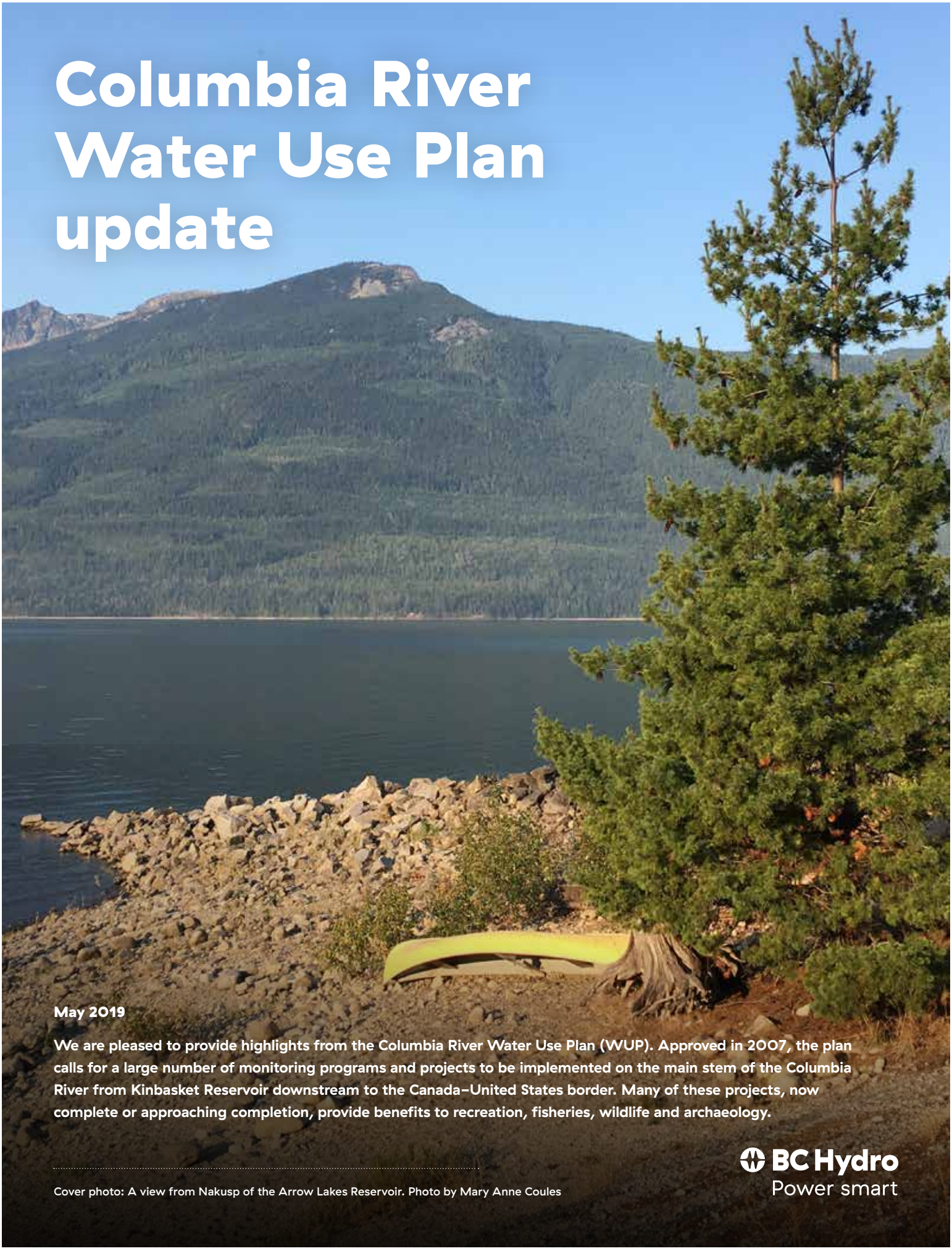
Columbia River Water Use Plan update



May 2019

We are pleased to provide highlights from the Columbia River Water Use Plan (WUP). Approved in 2007, the plan calls for a large number of monitoring programs and projects to be implemented on the main stem of the Columbia River from Kinbasket Reservoir downstream to the Canada–United States border. Many of these projects, now complete or approaching completion, provide benefits to recreation, fisheries, wildlife and archaeology.

Cover photo: A view from Nakusp of the Arrow Lakes Reservoir. Photo by Mary Anne Coules

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Boat ramp improvements

Between 2008 and 2016, we built new ramps and made improvements to existing ramps at two sites on Kinbasket Reservoir and eight sites on Arrow Lakes Reservoir. These new and refurbished ramps will provide area boaters with safe and improved access for many years to come.

Arrow Lakes and Kinbasket Reservoir boat ramp elevations				
Location	Elevation of ramp toe		Lowest operational water level*	
	Metres	Feet	Metres	Feet
Arrow Lakes Reservoir				
Syringa Creek	421.87	1,384.08	422.87	1,387.37
Anderson Point	425.00	1,394.30	426.00	1,399.02
Edgewood	425.76	1,396.7	426.76	1,400.13
Fauquier	424.66	1,393.24	425.66	1,396.52
Burton	425.40	1,395.67	426.40	1,398.95
McDonald Creek	426.00	1,397.64	427.00	1,400.92
Nakusp Boat	420.50	1,379.59	421.50	1,382.87
Shelter Bay	422.86	1,387.34	423.86	1,390.62
Kinbasket Reservoir				
Bush Harbour	724.60	2,377.30	725.60	2,380.58
Valemount Marina	727.59	2,387.11	728.59	2.390.39

*Operational according to the following boat dimensions: 9.3 metre length, 3.1 metre width, 1 metre maximum draft (amount below waterline), and maximum weight of 4 tonnes.

Boat ramp use study

This is the last year of the Boat Ramp Use Study which started in 2010. This study utilizes vehicle counters and face–to–face surveys to examine use and satisfaction with the upgraded WUP boat launches on both Arrow Lakes and Kinbasket Reservoirs. Interim results suggest that overall use of the upgraded boat launches has decreased over the study period; however, user satisfaction with the improved facilities has increased significantly. Of the eight upgraded boat ramps on Arrow Lakes, the Syringa and Nakusp ramps are responsible for approximately 60% of boats launched and Shelter Bay is responsible for approximately 10% of launches. A comprehensive report that examines the last 10 years of data collection will be produced after this year.

Wetland cleared of wood debris at Bush Arm. This is now habitat for amphibians (western toads). Photo by Mark Sherrington

Woody debris removal

We continue to remove floating woody debris from Kinbasket and Arrow Lakes Reservoirs and meet with Debris Management Committees in Castlegar, Nakusp, Golden and Valemount to plan and prioritize work. Since 2007, we have completed close to $7.5 million of debris removal work on Kinbasket and Arrow Lakes Reservoirs. We estimate that we have removed over 465,000 cubic metres of woody debris from Kinbasket Reservoir and over 90,500 cubic metres from Arrow Lakes Reservoir.

For Arrow Lakes Reservoir, we focused our efforts last year (2018) around the lower portion of the reservoir between Deer Park and Edgewood. That year, we piled and burned over 5,500 cubic metres of woody debris. This year's work on Arrow Lakes Reservoir will focus on the areas in the upper portion of the reservoir around Shelter Bay and Beaton Arm and we will also complete some work in Arrow Park and the Narrows. Crews started work in late March to limit fire risk and potential impacts to wildlife. We will consult with First Nations this spring to address heritage and archeology interests. Heritage and archeology post-impact assessment monitoring is planned again for this spring.

On Kinbasket Reservoir, we removed 15,000 cubic metres of debris in 2018. This year we will collect and burn debris on the west side of Columbia Reach (south end) and Bear Island just north of Bush Harbour. If burning conditions permit, we will continue shore based piling and burning in the Canoe Reach area south of Valemount.

Crews will also remove debris from high priority areas identified for the entire reservoir by the Golden and Valemount Debris Management Committees. If reservoir water levels reach close to full pool this year, we will conduct a water based collection program that focuses on the northern part of the reservoir where debris accumulations and densities are the highest.

In 2018, the Kinbasket Reservoir Debris Management Program collaborated for the third year with the Reservoir Archaeology Program (RAP). The RAP is an archaeological inventory program underway in Kinbasket Reservoir and a number of other Columbia reservoirs to identify and record archaeological sites within the active erosion zone. The goal is to ensure that ground disturbance as a result of debris management work is managed in a way that is consistent with our best management practices for heritage and archaeological resources, even though many of the locations have been used repeatedly in the past. The additional work focuses on assessing historical debris management locations for previously unrecorded archaeological material. The additional inventory data collected further supports the RAP to better understand settlement patterns and prehistoric land use in the region.

The collaboration is expected to continue in both Arrow Reservoir and Kinbasket Reservoir again in 2019.

Reservoir productivity

In 2019, we are continuing with programs that investigate links between reservoir biological productivity and the operation of Kinbasket and Revelstoke Reservoirs. These studies started in 2008 and focus on learning how the aquatic food webs work and whether we could make changes to reservoir operations to improve biological production. The food webs start with nutrients, such as phosphorus and nitrogen. Nutrients are made available to phytoplankton (algae) and then move up the food chain to zooplankton and kokanee.

Field sampling for water and plankton is conducted from April to October and kokanee populations are assessed in late summer and fall. Moored temperature monitoring stations were installed in the reservoirs in 2012 and provide more continuous data on how water, and thus nutrients, moves through the system. Both Kinbasket and Revelstoke Reservoirs are low in productivity and limited by phosphorus.

Total kokanee numbers are dominated by fry (up to 86%) so they vary widely year by year. Kokanee populations in Kinbasket and Revelstoke have been generally supressed since 2011, a period that also saw declines in other metrics, such as phytoplankton and zooplankton, that support fish. The cause of these declines is as yet unknown although we continue to investigate both operational and regional drivers, such as climate, by combining our data with other large reservoir information.

Rough waters while conducting field sampling on Kinbasket Reservoir. Photo by Karen Bray

Revelstoke dam minimum flow

We are continuing a suite of aquatic studies in the mid–Columbia River to determine whether minimum flows at Revelstoke Dam provide expected fisheries benefits. The studies, most of which started in 2007, monitor variables ranging from water temperature, water levels, nutrients, benthic productivity, and fish communities. We began providing a minimum flow from Revelstoke Dam of 142 cubic metres per second (5,000 cubic feet per second) in December 2010 when we started operating the newly installed fifth generating unit. Since that time we have always maintained discharge flows above the required minimum flow. Indeed, flows are typically well above that level to prevent damage to the turbines. So far, the data collected does not show that there has been any change to fish distribution, growth or diversity as a result of the minimum flow.

We are developing Habitat Suitability Indices (HSI) for juvenile fishes based on the minimum flow and will review these in conjunction with a Technical Committee (TC) in the spring. This same TC, composed on First Nations, BC Hydro and Agencies representatives, will also examine a recently developed bioenergetics model which looks at the effects of flows on Bull Trout and Mountain Whitefish energy expenditures.

White sturgeon

The Canadian portion of the Upper Columbia River white sturgeon population was listed as endangered under the Species at Risk Act in 2006. This was due to recruitment failure, where an insufficient number of young survive to become mature adults. We are working in cooperation with First Nations, stakeholders, and federal and provincial government partners to help restore the Upper Columbia River white sturgeon populations through long–term monitoring programs developed under the Water Use Plan.

We are conducting several studies to better understand white sturgeon spawning and how conditions at identified spawning locations influence when spawning occurs and the rate of egg development. Results have shown that sturgeon spawn from June through August at multiple locations throughout the Columbia River including downstream of Revelstoke Dam, near Kinnaird downstream of the Hugh L. Keenleyside Dam and the Arrow Lakes Generating Station, downstream of Waneta Dam, and in the United States.

A white sturgeon conservation aquaculture program that has released hatchery–raised sturgeon into the Columbia River each year since 2002 has been very successful. Monitoring shows that more of the young fish have survived than originally expected. As a result of high survival, numbers of

A juvenile White sturgeon

juvenile sturgeon being released into the Canadian portion of the Columbia River has been reduced over the years with only 200 fish being released in the spring of 2019 (compared to 4,000 a decade ago). The aquaculture program now focuses on collecting eggs and larvae from the wild for rearing in a hatchery. After being collected in the river, wild eggs and larvae are initially reared in a streamside trailer near the Waneta spawning location to make sure they incubate in natural river conditions. The larvae are then transferred to the hatchery and reared until nine months of age and 200 grams in weight, which has shown to improve survival after release into the Columbia River. This approach of collecting offspring produced in the wild is important to maintain as much genetic diversity as possible. In 2019, additional genetic work will begin with the goal of evaluating how many wild sturgeon have contributed to the juvenile sturgeon released from the hatchery program in recent years.

We are continuing stock assessments that estimate the number of wild white sturgeon remaining in the Columbia River between the Hugh L. Keenleyside and Grand Coulee Dams. The current estimate for the Canadian portion of the Columbia River is approximately 1,400 wild adults, with more than 5,000 hatchery–origin sturgeon at large. We are also finding that hatchery–origin sturgeon are becoming reproductive and preliminary results suggest that a small portion of hatchery–origin males are likely contributing to spawning events. A new study in 2019 will assess the movements and habitat use of hatchery–origin sturgeon to determine which spawning habitats they may be using. This information, along with population abundance estimates and juvenile survival numbers, is being used to help plan white sturgeon recovery efforts. Finally, we are evaluating the suitability of available spawning habitat and the feasibility of spawning habitat restoration to help stimulate recruitment.

Mid–Columbia River White sturgeon technical forum

A technical review of the mid–Columbia River white sturgeon management plan was held with regulators, First Nations, and key stakeholders involved in the recovery program. The purpose was to provide an overview of studies to date, identify learnings, data gaps and critical uncertainties in order to determine an approach until the Water Use Plan Ordered Review. A key outcome was continuing the experimental aquaculture program for the mid–Columbia River and Arrow Lakes Reservoir to determine if recovery is feasible in that area. This includes the extension of effectiveness monitoring programs to document spawning activity of wild adults, collect wild origin progeny for the aquaculture program, and determine growth, survival, and habitat use of hatchery–origin white sturgeon released into the mid–Columbia River.

Lower Columbia fish studies

We are continuing annual surveys on fish abundance, distribution and life history in the Columbia River below the Hugh L. Keenleyside Dam to better understand the effects of dam operations on fish populations. The Lower Columbia River Large River Fish Indexing Program completed its eleventh year of monitoring in 2017. Key species monitored include Rainbow Trout, Mountain Whitefish and Walleye.

We are also continuing field surveys during flow changes from the Hugh L. Keenleyside Dam. Juvenile fish are at risk of being stranded during flow reductions during the summer period when they are typically found in shallow, warm, productive inshore areas. In accordance with the Lower Columbia River Fish Stranding Protocol, we assess the risk of stranding fish before we plan to reduce discharge flows from the Hugh L. Keenleyside Dam using data collected during previous flow reduction events. For significant reductions in flows, we send out crews to look for stranded fish downstream on the Lower Columbia River. This represents considerable amount of staff effort to understand the impacts of our operations and protect fish. From April 1, 2017 to March 31, 2018, BC Hydro sent crews out 14 separate times.

Rainbow Trout are a key sportfish in the mainstem Columbia River and typically spawn in the Lower Columbia River from March until June. Key mainstem spawning areas below the Hugh L. Keenleyside Dam are Norn's Creek Fan and in the mainstem area near Genelle. Rainbow Trout eggs may be vulnerable to reductions in water flows until fry hatch about six to eight weeks after the eggs are deposited. This vulnerability is dependent on a number of factors including weather conditions, substrate, and duration of exposure to air (dewatering).

The Rainbow Trout spawning protection flows provide stable or increasing flows from April through June. Flows are also lowered at the end of March, prior to the peak spawning period, to encourage Rainbow Trout to spawn in lower elevations. This minimizes the chance that incubating eggs will be later dewatered.

Rainbow trout technical forum

An adult Rainbow Trout. Photo by Jeremy Baxter

While the results to date have shown that the Lower Columbia Rainbow Trout population has increased over the period of the Rainbow Trout spawning protection flow implementation, it is unclear if this is a direct result of the protection flows or another factor.

Starting this year, we will alternate between years of Rainbow Trout spawning protection flows and no Rainbow Trout spawning protection flows. During that time we will carefully monitor the survival of Rainbow Trout eggs at specific locations. This experimental approach will improve our understanding of the direct effects of these flows on the adult Rainbow Trout population in the Lower Columbia River.

At the end of the second year of the study, the Columbia River Rainbow Trout Flows Technical Forum will review the results and decide if enough data have been collected or if further study is required.

The study may continue for up to a five–year period.

Rainbow Trout redds in the lower Columbia River. Photo by Jeremy Baxter

Canoe Reach on Kinbasket Reservoir. Photo by Guy Martel

A bald eagle in the Lower Columbia. Photo by Guy Martel

The Columbia River through Castlegar. Photo by Guy Martel.

If the Rainbow Trout spawning protection flows are determined to provide significant benefits to the adult Rainbow Trout population, they will be considered for further implementation. This approach is endorsed by the Columbia River Rainbow Trout Flows Technical Forum, which is composed of regulatory agencies, First Nations and representatives from BC Hydro.

Grouse Creek on Kinbasket Reservoir. Photo by Guy Martel

Valemount peatland

This study's main objectives are to assess whether erosion is increasing or decreasing in the Valemount peatland and the primary causes of any observed erosion. A preliminary study conducted in 2008 concluded that erosion processes were directly related to Kinbasket Reservoir operations, although it would take 2,000 years to erode the entire site at the observed rates. We are evaluating if the current study (using the most recent available aerial surveys) can be used to better understand the erosion mechanisms and determine to what extent these are influenced by reservoir operations.

Wildlife habitat enhancement projects

ARROW LAKES RESERVOIR

BC Hydro is planning to construct a wildlife enhancement project in the drawdown zone of the mid to lower Arrow Lakes Reservoir. This project is expected to benefit nesting and migratory birds as well as other wildlife affected by reservoir operations. Two sites were considered for the wildlife enhancement project: Burton Flats and Lower Inonoaklin. Burton Creek is located south of Nakusp, on the east side of Arrow Lakes Reservoir, and the Lower Inonoaklin site is located south of the Fauquier ferry on the west side of Arrow Lakes Reservoir. We will not go ahead with the Lower Inonoaklin site, but may revist this at a later date. We decided to pursue the Burton Flats site because of a greater potential for benefits to wildlife. Feedback was gathered on preliminary site designs at a stakeholder meeting on August 31, 2017. We are planning for a phased construction. If conditions are suitable and we receive the necessary permits, we expect to be ready to start construction in the fall of 2019.

KINBASKET RESERVOIR

We are still waiting for full pool reservoir conditions, which did not occur in 2016 to 2018, to see whether the debris mounds we built in fall 2015 can withstand high water levels and wave action. The debris mounds are located at the east end of Bush Arm, 60 km north of Golden.

To protect wetland habitat in the Valemount Peatland, large amounts of accumulated woody debris was removed from several kilometres of the drawdown zone in January 2018. Removal of this woody debris in other Kinbasket Reservoir and Valemount Peatland locations has been followed by a positive response in vegetation growth and diversity of plants.

Revegetation on Bush Arm Debris Mounds—Balsam Poplar stakes planted and natural ingress of raspberry bushes. Photo by Mark Sherrington

Arrow Lakes Reservoir soft constraints performance 2018

Soft constraint	Target	2018 performance
Recreation	Reservoir water levels between 1,435 feet and 1,440 feet from May 24 to September 30. Flexibility to achieve lower reservoir levels of 1,424 feet during the recreation season would be acceptable with proposed construction/upgrade of boat ramps for recreation interests served by these formal access points.	The reservoir water level was between 1,435 and 1,440 feet 54.6% of the time during the recreation season (May 24 to September 30) and above 1,424 feet 100% of the time.
Wildlife	Ensure inundation of nesting bird habitat by rising reservoir levels and availability of fall migratory bird habitat is no worse than recent average (1984 – 1999). Target a reservoir level of 1,424 feet or lower from late April to mid-July for spring nesting birds and 1,438 feet or lower from early August 7 to late October for fall migratory birds.	Arrow Lakes Reservoir was below 1,424 feet for about 23.1% of the time between April 30 and July 16 for spring nesting birds. The reservoir water level was only below 1,424 feet prior to May 17. This resulted in below average conditions for spring nesting birds. The reservoir was below 1,438 feet for 100% of the time between August 6 and October 31 for fall migratory birds.
Fish	Reservoir levels above 1,424 feet to ensure tributary access during kokanee spawning period from late August to early November.	Reservoir was above 1,424 feet 100% of the time between August 25 and November 15.
Vegetation	Maintain current (2004) level of vegetation in the drawdown zone by maintaining lower reservoir water levels during the growing season.	Reservoir was below 1,424 feet for 9.2% of the time between May 1 and October 31.
Erosion	Minimize duration of full pool events and avoid sudden drawdown once full pool has been reached to avoid shoreline slumping. Reservoir water level of 1,440 feet is ideal.	The reservoir reached a peak level of about 1,442.7 feet on July 13, about 1.3 feet below full pool. Due to a return of drier summer conditions, the Columbia system was operated in proportional draft for the balance of summer. For this reason, the reservoir drafted to about 1,429 feet on August 31 and 1,427 feet on September 30.
Culture and Heritage	The original target was 'reservoir levels at or below 1,430 feet for as long as possible to limit impacts to archaeological sites'. During the five-year interim review of the Arrow soft constraints, this target was determined not to be effective due to the presence of 102 archaeological sites at elevations below 1,430 feet.	BC Hydro is implementing a multi-year Reservoir Archaeology Program (RAP) in the Upper and Lower Arrow Lakes to inventory heritage sites and identify impacts as a result of normal reservoir operations. Information gathered by the RAP is expected to assist future decision makers and development of an Archaeological Management Plan.

HOW TO GET MORE INFORMATION

Copies of the Columbia River Water Use Plan, study terms of reference, reports, performance measures, Columbia River WUP Consultative Committee report, and other water use planning information are available at: **bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river.html.**

Questions? Please get in touch.

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Completed projects

Shelter Bay Park boat ramp upgrades (Arrow Lakes Reservoir)
Nakusp boat ramp replacement (Arrow Lakes Reservoir)
MacDonald Creek Park boat ramp upgrades (Arrow Lakes Reservoir)
Burton boat ramp construction (Arrow Lakes Reservoir)
Fauquier boat ramp upgrades (Arrow Lakes Reservoir)
Edgewood boat ramp upgrades (Arrow Lakes Reservoir)
Syringa Park boat ramp upgrades (Arrow Lakes Reservoir)
Anderson Point boat ramp construction (Arrow Lakes Reservoir)
Bush Harbour boat ramp construction (Kinbasket Reservoir)
Valemount Marina boat ramp upgrades (Kinbasket Reservoir)
Cartier Bay wetland protection project (Revelstoke)
Airport Slough wetland protection project (Revelstoke)
Revegetation planting (Arrow Lakes Reservoir)
Sturgeon hatchery upgrade (mid–Columbia River)

Completed studies

Recreation demand study (Arrow Lakes Reservoir)
Woody debris removal environmental review (Kinbasket, Arrow Lakes Reservoir and Lower Columbia River)
Woody debris inventory, management strategy and removal (Kinbasket and Arrow Lakes Reservoir)
Feasibility of boat ramp improvements (Kinbasket, Arrow Lakes, mid–Columbia River and Lower Columbia River)
Indian Eddy dredging engineering and environmental review (Lower Columbia River)
Erosion protection and monitoring (mid–Columbia River)
Erosion long term monitoring (mid–Columbia River)
Inventory of vegetation resources (Kinbasket and Arrow Lakes Reservoir)
Juvenile fish stranding study (mid–Columbia River)
Bull trout monitoring program (Kinbasket Reservoir)
Rainbow trout monitoring program (Kinbasket Reservoir)
Burbot life history (Kinbasket and Arrow Lakes Reservoir)
Macrophyte study (Revelstoke Reservoir)
Nagle Creek wetland study (Revelstoke Reservoir)
Wetland vegetation study (Kinbasket Reservoir)
Sturgeon spawning habitat assessment (mid–Columbia River)
Sturgeon incubation and rearing study (mid–Columbia River)
Effects of Revelstoke 5 flow changes on incubation of sturgeon (mid–Columbia River)
Sturgeon inventory and habitat use (Kinbasket Reservoir)
Sturgeon recolonization risk assessment (Kinbasket Reservoir)
Spawning fish tributary access study (Arrow Lakes Reservoir)
Sculpin and dace study (Lower Columbia River)
Whitefish spawning study (Lower Columbia River)
Whitefish egg monitoring study (Lower Columbia River)
Great blue heron study (Lower Columbia River)
Nest mortality of migrating birds (Kinbasket and Arrow Lakes Reservoir)
Neotropical migrant bird use study (Arrow Lakes Reservoir)
Shorebird and waterbird monitoring study (Arrow Lakes Reservoir)
Amphibian and reptile monitoring study (Kinbasket and Arrow Lakes Reservoir)
Heritage monitoring wind and wave erosion study (Arrow Lakes Reservoir)
Archaeological overview assessment (Kinbasket, Revelstoke, and Arrow Lakes Reservoir)

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