

# COLUMBIA RIVER WATER USE PLAN UPDATE

AUGUST 2014



BC Hydro is 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 physical works projects to be implemented on the mainstem Columbia River from Kinbasket Reservoir in the north downstream to the Canada /United States border on the lower Columbia River over 12 years. These projects are expected to provide benefits to recreation, fisheries, wildlife, and archaeology.

## BOAT RAMP IMPROVEMENTS

BC Hydro is committed to improving summer recreational boat access in Kinbasket and Arrow Lakes reservoirs as recommended by the Columbia River Water Use Plan. Planned boat ramp improvements for Kinbasket Reservoir that included a new ramp at Bush Harbour and upgrades to the Valemount Marina are complete.



On Arrow Lakes Reservoir, there are numerous boat ramp projects underway at various stages of completion. Improvements to Syringa Creek Park are now complete. For the majority of other projects, BC Hydro has so far been unable to complete the lowest level portion of the ramps to their ordered elevations due to fluctuating spring water levels. Although from 2008 to 2013, all boat ramps were submerged throughout the summer recreation season. These projects include new boat ramps at Anderson Point, Burton South, and Nakusp plus upgrades to existing boat ramps at Edgewood, McDonald Creek, and Fauquier.

## BOAT RAMP USE STUDY

Started in 2010, BC Hydro is conducting a ten-year Boat Ramp Use Study for Kinbasket and Arrow Lakes Reservoirs. This study will monitor trends in public use to assess whether boat ramp improvements planned and completed under the Columbia River Water Use Plan benefit recreation. Both volume of use and user satisfaction is measured through traffic counters installed at established recreation sites and face-to-face user surveys. For upgraded boat ramps on Arrow Lakes Reservoir and Kinbasket Reservoir, preliminary results show that visitor satisfaction has significantly increased with boat ramp facilities and parking lot conditions. Preliminary results also suggest that recreationists as a whole are satisfied with the operation of Arrow Lakes Reservoir. The vast majority stated that they would return even if the water level was lower or higher than what they had experienced on the day of their visit.



## WOODY DEBRIS REMOVAL

BC Hydro continues to remove floating woody debris from Kinbasket and Arrow Lakes Reservoir and meets with Debris Management Committees in Nakusp, Golden, and Valemount to plan and prioritize work. Since 2007, BC Hydro has funded close to \$5.5 million of debris removal work on Kinbasket and Arrow Lakes Reservoirs.



Woody debris on reservoir shoreline

For Kinbasket Reservoir, spring work focused on disposal of woody debris collected and piled the previous year in anticipation of high water levels. BC Hydro limited generation from Mica dam for much of the summer of 2013 to allow workers to safely replace aging switchgear equipment in the underground powerhouse. As a result of the lower than usual discharge from Kinbasket Reservoir, water levels went above the normal maximum water level in late-summer. Similar to 2012 when reservoir levels were above normal levels, BC Hydro allocated additional funding to implement a water-based debris removal program using tugs and barges to collect and corral woody debris using floating boomsticks. In 2013, well over 50,000 cubic metres of debris was collected. This summer, the reservoir water level is expected to be close to normal full pool and a floating debris removal program is underway.

On Arrow Lakes Reservoir, BC Hydro allocated additional funding for debris removal work in 2013 to address increased debris levels that resulted from the high water in 2012. Work was conducted in the Syringa, Galena Bay, and Shelter Bay areas.

## COLUMBIA RIVER FISH STUDIES

BC Hydro continues to conduct annual surveys on fish abundance, distribution and life history in the Columbia River below Revelstoke Dam and 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 seventh year of monitoring in 2013. Key species monitored include rainbow trout, mountain whitefish and walleye. BC Hydro continues work to understand how changes in discharge flows from Kootenay and Columbia River hydroelectric facilities can be implemented to benefit fish and fish habitat. BC Hydro also continued field surveys during flow changes in 2012 to assess current fish protection flow protocols. Fish are at particular risk of being stranded during flow reductions during the summer period when they are typically found in shallow, warm productive inshore areas



BC Hydro also continued to conduct yearly whitefish and rainbow trout spawning assessments in the lower Columbia River to assess the effectiveness of whitefish and rainbow trout protection flows. Rainbow trout are a key sportfish in the mainstem Columbia River downstream of Hugh L. Keenleyside Dam, and typically spawn in March, April and May. Key spawning areas are Norn's Creek, Norn's Creek Fan, lower Kootenay River by the oxbow, the old D-Bar-D area and the Genelle Island complex. Until the fry hatch about six to eight weeks later, the eggs are vulnerable to reductions in water flows. BC Hydro has managed Columbia River flows to protect rainbow trout spawning locations (redds)

from dewatering since 1999. Discharge flows from the facility are lowered during the peak rainbow trout spawning period to encourage the trout to spawn in deeper areas, reducing the chance that incubating eggs will be exposed during flow changes. So far, rainbow trout spawning surveys have shown that rainbow trout protection flows have protected, on average, more than 99.5% of the total number of eggs laid each year and the numbers of rainbow trout spawners and redds found during the surveys continue to increase. The abundance of rainbow trout spawners below Hugh Keenleyside, as predicted by spawner surveys in 2013, was 18,219 fish, almost double the previous year's estimate.

## WHITE STURGEON

BC Hydro is working in cooperation with federal and provincial Government partners to help restore Columbia River white sturgeon populations through long-term monitoring programs and physical works developed under the Water Use Plan. BC Hydro is conducting several studies to better understand white sturgeon spawning, egg incubation, growth, and survival throughout the Columbia River. Results have shown sturgeon are spawning at multiple locations throughout the Columbia River including downstream of Revelstoke Dam, downstream of Hugh L. Keenleyside Dam and the Arrow Lakes Generating Station, near Kinnaird Rapids, downstream of Waneta Dam, and in the United States. Results from genetic work found that more than 100 adults are spawning annually at these sites in the Canadian section of the Columbia River. A stock assessment was started in 2013 to estimate the number of white sturgeon in the Columbia River between Hugh L. Keenleyside and Grand Coulee Dams. This study represents the first range wide estimate for this population and will be used as a baseline for recovery planning. The stock assessment is being implemented in two sessions annually, one in the spring and one in the fall, until 2017. The average size of wild adult sturgeon captured in 2013 surveys was 6.4 feet in length and 141 pounds in weight.



Juvenile White Sturgeon

BC Hydro continues to fund rearing of white sturgeon at the Wardner Fish Hatchery for release into the Columbia River. Last spring, hatchery juvenile white sturgeon were released into the Columbia River below Hugh Keenleyside Dam (~4,000 fish) and into the Arrow Lakes Reservoir at Shelter Bay (~6,000) with the help of elementary school children from the communities. Juvenile sturgeon released into Arrow Lakes Reservoir have been grown to larger size compared to previous years to determine if it helps them survive the first year after release into the wild as very few juvenile sturgeon have been recovered in the Arrow Lakes to date. All age classes (1-12) of hatchery reared juveniles released into the Columbia River below Hugh Keenleyside Dam are doing well, with juveniles averaging 3 feet in length and 16.5 pounds in weight. Starting in 2014, a program focused on rearing wild caught eggs and larvae in a streamside white sturgeon conservation aquaculture facility will be implemented on the Columbia River near the Waneta spawning site. This is being implemented to improve the genetic diversity of hatchery released juveniles and will have more natural rearing conditions during incubation.



Helping release young white sturgeon at Shelter Bay.



## RESERVOIR PRODUCTIVITY

BC Hydro is continuing with programs to investigate links between reservoir productivity and our operation of Kinbasket and Revelstoke Reservoirs. These programs are focusing on learning how the aquatic food webs work and whether we could make changes to our reservoir operations to improve biological production. The food webs start with how nutrients such as phosphorus and nitrogen are made available to phytoplankton (algae) and then on up the food chain to zooplankton and kokanee populations. Field sampling for water and plankton is conducted from May to October and kokanee populations are assessed in late summer and fall. Moored temperature monitoring stations were installed in the reservoirs in 2012 to provide more continuous data on how water, and thus nutrients, move through the system. While low in productivity, both Kinbasket and Revelstoke.

## REVELSTOKE DAM MINIMUM FLOW

BC Hydro is continuing a suite of aquatic studies in the mid-Columbia River to determine whether minimum flows at Revelstoke Dam will provide expected fisheries benefits. BC Hydro began operating Revelstoke Dam to provide a minimum flow of 142 cubic metres per second in December 2010. Discharge flows over the last three years have varied widely throughout the day and typically been maintained well above the minimum flow level. As a result, the data collected so far has not shown any changes in fish distribution or diversity.



Monitoring plant cover and species composition.

## REVEGETATION

The goal of the revegetation program is to increase native plant cover and diversity in the drawdown zone of Arrow Lakes and Kinbasket reservoirs to benefit wildlife, fish, archaeological site protection and shoreline stability. During the first number of years, the program focused on planting sedge, cottonwood and other native plant species in both reservoirs using a variety of planting techniques. Large scale planting in Arrow Lakes Reservoir and Kinbasket Reservoir is complete. In both reservoirs, the planted sites are being monitored to determine success. Preliminary monitoring results show mixed results for planted sites in Arrow Lakes Reservoir. In general planting nursery plugs of native sedge species worked better than planting sedge seeds. Similarly, nursery grown plugs of native shrub species (cottonwood and willow) were more successful than planted shrub stakes. Plant survival was highest in stable soils at mid to upper elevations (436 to 440 metres). Planting treatments generally failed in mobile and/or highly compactible substrates like silt, sand, and clay. For Kinbasket Reservoir, the planting was generally unsuccessful due to lack of shoreline stability. In contrast, sedge and shrub plantings in the Bush Arm area appear to be doing well.

Reservoirs support short, efficient food chains that have resulted in relatively good kokanee populations. Kokanee numbers can vary widely by year as they are dominated by fry (up to 75%-86%). Numbers of all other ages have remained relatively consistent over the years, averaging about 2 million in Kinbasket Reservoir and 200,000 in Revelstoke Reservoir.

## UNDERSTANDING EFFECTS OF RESERVOIR OPERATIONS

A key component of the Columbia River Water Use Plan is to better understand how BC Hydro's Arrow Lakes Reservoir operations affect fish, wildlife, vegetation, recreation and archaeology. A number of studies are underway to gather this information that will be used to better inform future decision making.

### BURBOT

A five-year study to understand if BC Hydro's Arrow Lakes Reservoir and Revelstoke Dam operations affect burbot spawning was completed in 2013. During the study over 200 adult burbot were captured in upper Arrow Lakes Reservoir downstream from Revelstoke Dam and tagged with acoustic and radio transmitters so researchers could track their movements. Boat tracking surveys were conducted during the burbot's winter spawning season between November and February. Tracking data showed that most of the burbot (between 70 and 80 per cent) that moved during the winter spawning period went to the Beaton and Shelter Bay area while a smaller number (between 13 and 16 per cent) moved to the Narrows near MacDonald Creek. Data thus suggests that Arrow Lakes Reservoir and Revelstoke Dam operations do not affect burbot spawning. All aggregations of adult burbot observed during the spawning period occurred in deep water well below the winter drawdown level of Arrow Lakes Reservoir.

### TRIBUTARY ACCESS FOR SPAWNING FISH

A five-year study to determine whether Arrow Lakes Reservoir levels restrict kokanee, bull trout and rainbow trout access to spawning areas in tributary streams was completed in 2013.



The mouth of Crawford Creek when the Arrow Lakes Reservoir water level is high.

ARROW LAKES RESERVOIR STREAMS MONITORED BY THE TRIBUTARY ACCESS STUDY	
UPPER ARROW LAKES RESERVOIR	LOWER ARROW LAKES RESERVOIR
Akolkoex River	Burton Creek
Bannock Creek	Caribou Creek
Blanket Creek	Deer Creek
Cranberry Creek	Dog Creek
Crawford Creek	Eagle Creek
Drimmie Creek	Johnston Creek
Mackenzie Creek	Little Cayuse Creek
Nacillewaet Creek	Octopus Creek
Payne Creek	Renata Creek
	Taite Creek

The study initially assessed a total of 23 streams with potential for spawning and known or potential impediments to fish passage. Of these, 19 streams with moderate to high spawning habitat were surveyed on a regular basis every year during summer and fall spawning periods to assess spawning fish use and access. Rainbow trout spawning typically occurs in late spring compared to bull trout and kokanee that spawn usually from late summer through fall. The survey results indicate that reservoir water levels did not impede spawning fish access to tributaries from 2008 to 2012. However the study did identify that tributary access for spawning fish could be reduced if the Arrow Lakes Reservoir water level was below 429 metres (1,407 feet) and stream flows were low. Stream surveys have also shown that high spring stream runoff can move substrate and woody debris that can reduce fish passage.



The mouth of Crawford Creek when the Arrow Lakes Reservoir water level is low.



## MIGRATORY SONGBIRDS

Rising reservoir levels during the migratory bird breeding season has the potential to flood and destroy nests. BC Hydro continues to locate and monitor nests in the upper reaches of Arrow Lakes Reservoir (Revelstoke Reach) and Kinbasket Reservoir (Canoe Reach and Columbia Reach) under a ten-year study to better understand how nesting birds are affected by reservoir operations.

So far in Arrow Lakes Reservoir, nests have generally been found at higher elevations within the drawdown zone in shrub or forest habitat. Of the total 1,110 nests sampled to date, about 38 per cent successfully raised young. For the failed nests where the cause of

failure was known, the most common cause was predation (about 33 per cent). On average, rising reservoir water levels were responsible for the failure of 11.7 per cent of nests monitored each year in Arrow Lakes Reservoir. Some bird species are more susceptible to rising water levels than other species however due to differences in nesting habitat.

For Kinbasket Reservoir, the reservoir water level typically rises later in the season and affects fewer migratory bird nests. There is a relatively low nesting density (and species diversity) in Kinbasket Reservoir, but the species utilizing the Kinbasket drawdown zone (e.g., Savannah Sparrow, Spotted Sandpiper) enjoy an unusually high nesting success. So far a total of 430 nests have been sampled to date and about 65.2 per cent successfully raised young. On average, water levels were responsible for the failure of 3.6 per cent of nests monitored each year. Similar to Arrow Lakes Reservoir, the most common cause of nest failure was predation (about 22.7 per cent).

## SHOREBIRDS AND WATERBIRDS

BC Hydro is continuing a ten-year study in the Revelstoke Reach stretch of Arrow Lakes Reservoir to document how reservoir operations affect waterbirds and shorebirds using area wetlands. Last year was the sixth year of regular spring and fall surveys under the study.

Survey data suggests that there is a relatively predictable and stable community of waterfowl that rely heavily on wetlands in the Arrow Lakes Reservoir drawdown zone. Well used areas include Cartier Bay and Airport Marsh. Reservoir operations do appear to influence choice of where waterfowl select to forage during their migration stopover. Analyses have shown that usage of wetlands by waterfowl is negatively influenced by reservoir water depth, but this is offset because the grasslands become attractive to waterfowl when flooded, especially during the fall migration. Reservoir operations appear to have negative influence on most ground-nesting waterfowl species (not Canada Goose though) due to nest flooding impacts. Brood surveys shown negative relationships between duck brood counts and the modelled potential for the reservoir to flood nests.

### WINNERS AND LOSERS

Reservoir drawdown zones present habitats that are different from those outside of the reservoir footprint area; not surprisingly, some of these drawdown zone habitats are regionally important breeding areas for some species. In the Arrow Lakes Reservoir, the airport marsh is one of considered to be a very important breeding habitat for several regionally rare species (e.g., Virginia Rail, Pied-billed Grebe, Yellow-headed Blackbird, and Marsh Wren). The impact of reservoir operations on nesting success varies among species. Species nesting near the high water elevation (e.g., American Redstart, Least Flycatcher) tend to have relatively low nest flooding impacts because the reservoir does not inundate their nesting habitats every year, and because their nests are often elevated in shrubs above the high water mark. Species that nest earlier in the year, and/or lower in the drawdown zone (e.g., Killdeer, Savannah Sparrow, Common Yellowthroat) can have a much greater risk of suffering nest loss. With the completion of 6 years of study, 37 per cent of monitored nests, on average, were successful. For those nests that failed, the most common cause was predation (31.5 per cent). An average of 11.7 per cent were flooded due to reservoir operations.



American Redstart



Common Yellowthroat



Monitoring shorebird and waterbird use of the drawdown zone south of Revelstoke.

### REVELSTOKE WILDLIFE ENHANCEMENT PROJECTS

BC Hydro is planning a suite of wildlife habitat enhancement projects south of Revelstoke to benefit waterfowl, birds, turtles, and other wetland wildlife species affected by BC Hydro's Arrow Lakes Reservoir operations. Work to rip-rap a bank of the Airport Slough outflow channel to test if the rip-rap can halt further erosion and protect the wetland into the Columbia River was completed in fall 2013. Nest boxes were also installed at various locations in Revelstoke Reach in the summer of 2013 to provide additional habitat for cavity-nesting ducks. Another project to fill in two gaps in an abandoned railbed west of the Cartier Bay wetland with engineered dykes to protect the wetland and double its size has been put on hold to allow a more detailed analysis of potential project benefits and impacts.



Placing rock rip rap to protect the airport slough wetland near Revelstoke.

### AMPHIBIANS AND REPTILES

BC Hydro is conducting an amphibian and reptile monitoring program in the drawdown zones of Kinbasket

and Arrow Lakes reservoirs with surveys alternating between the two reservoirs every year. In Kinbasket surveys are conducted in Canoe Reach (Valemount Peatland and Ptarmigan Creek area) and Bush Arm. In Arrow Lakes surveys are conducted in Revelstoke Reach (Airport Marsh, Montana Slough, Cartier Bay), Beaton Arm, East Arrow Park and Burton Creek, and near Edgewood (north and south of Eagle Creek).

In Arrow Lakes Reservoir, four species of amphibians (Long-toed Salamander, Western Toad, Columbia Spotted Frogs and Pacific Chorus Frog) and six species of reptiles (Northern Alligator Lizard, Western Painted Turtle, Common Garter Snake, Western Terrestrial Garter Snake, Western Skink, and Rubber Boa) have been found. In Kinbasket Reservoir work is focused on the Canoe

Reach peatlands near Valemount. So far fewer species have been found, these species include Western Toad, Columbia Spotted Frog, Long-toed Salamander, and Common Garter Snakes.

A key question for both reservoirs is to understand how the amphibians and reptiles use the drawdown zone habitat that is only seasonally available when reservoir water levels are below full pool. Researchers have outfitted a number of amphibians and reptiles in Kinbasket and Arrow Lakes Reservoir with radio-tracking devices to record their movements over a range of reservoir water levels over the summer and late into the fall.



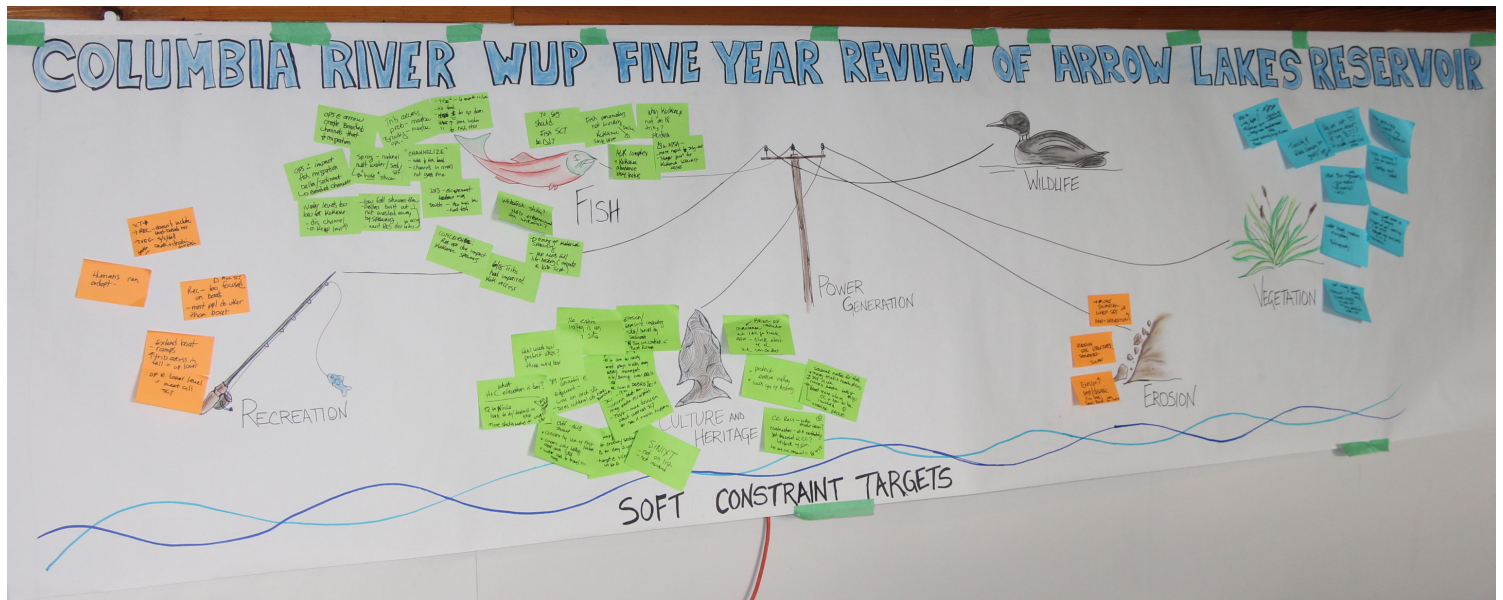
Garter Snake

Common garter snakes are found throughout southern B.C. These snakes spend the winter underground in dens (hibernacula) often shared with other snakes. After mating in the spring, most common garter snakes migrate to summer hunting grounds that may be several kilometres away. These hunting areas often are near water, where the snakes can forage, bask on cattail mats and logs, or dive under water to avoid predators.

Researchers working on the amphibian and reptile monitoring program have caught numerous garter snakes in the Arrow Lakes Reservoir and Kinbasket Reservoir drawdown zones. One garter snake captured in the Valemount peatlands was the largest on record for the Kinbasket area – over one metre long!

Work continues on a study to understand the life history of painted turtles living in the Upper Arrow Lakes Reservoir near Revelstoke. Visual surveys and radio telemetry of tagged turtles along with environmental monitoring will continue to understand turtle distribution, habitat use, abundance, productivity, and population demographics.





## FIVE YEAR REVIEW

In April 2014, BC Hydro held a two-day meeting session in Nakusp to review the last five years of Arrow Lakes Reservoir operations and performance. More than 50 people attended the session representing First Nations, governments, and interested stakeholder groups. This review looked at BC Hydro's operations as they relate to a suite of soft constraint targets identified by the consultative committee for the Columbia River Water Use Plan (WUP) to help guide Arrow Lakes Reservoir operations. Soft constraint targets were developed for vegetation, wildlife, fish, culture and heritage, recreation, and erosion. Some of the targets conflict as each target identifies the ideal/preferred reservoir operations (water level over the year) for the specific interest in isolation. Depending on water conditions and system flexibility each year, BC Hydro makes trade-offs between these



competing targets when making operating decisions and seeks to achieve a balance over the long term. Feedback from the review will be used to better understand local interests and inform the decisions BC Hydro need to make when operating the system.

## 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 information from the Arrow Lakes Reservoir Five-Year Review are available at [bchydro.com/planning\\_regulatory/water\\_use\\_planning.html](http://bchydro.com/planning_regulatory/water_use_planning.html).

**BC hydro**   
FOR GENERATIONS

### CONTACT A BC HYDRO COMMUNITY RELATIONS REPRESENTATIVE

Jennifer Walker-Larsen,  
Stakeholder Engagement Advisor  
Upper Columbia  
Email: [jennifer.walker-larsen@bchydro.com](mailto:jennifer.walker-larsen@bchydro.com)  
Phone: 250 814 6645

Sabrina Locicero  
Stakeholder Engagement Advisor  
Lower Columbia  
Email: [Sabrina.Locicero@bchydro.com](mailto:Sabrina.Locicero@bchydro.com)  
Phone: 250 365 4565