

Columbia River Operations Summary

Fall 2018



View of the City of Revelstoke and Arrow Lakes Reservoir from Revelstoke Mountain Resort. Photo by Thane Isert

The purpose of this publication is to provide an overview of BC Hydro's operations on the Columbia River. The Columbia River is the fourth largest river in North America. The headwaters of the 2,000 kilometre long Columbia River are in Canal Flats, B.C. From here, the river flows northwest through the Rocky Mountain trench and then south through B.C. and Washington, finally emptying into the Pacific Ocean at Astoria, Oregon. Other major tributaries of the Columbia River in Canada include the Kootenay and Pend d'Oreille rivers.

Although Canada has only about 15% of the Columbia River basin area, but the Canadian portion of the basin is mountainous and receives a lot of snow. On average, the Canadian portion produces 30 to 35% of the runoff for the entire basin. The river's heavy flow and relatively steep gradient gives it tremendous potential for the generation of electricity. The hydroelectric dams on the Columbia's main stem and tributaries produce more hydroelectric power than those of any other North American river.

BC Hydro's facilities in the Columbia basin include 11 hydroelectric dams, two water storage dams, and a system of reservoirs. Four of the larger reservoirs within Canada are operated according to the Columbia River Treaty and other agreements signed between Canada and the United States.



Columbia River Treaty

The Columbia River Treaty between Canada and the United States was ratified in 1964. The Treaty resulted in the construction of three dams in British Columbia (the Duncan, Hugh L. Keenleyside and Mica dams) for flood control and to increase hydroelectric generating potential in both countries. The Treaty also provided for the construction of Libby Dam in the United States and the resulting Kootenai Reservoir, which crosses the Canada–U.S. border.

Water stored, and then released, by Canadian reservoirs provides the U.S. with the potential to generate additional electricity. Under the terms of the Treaty, Canada receives a one-half share of the extra power generation potential in the U.S. This is called the Canadian Entitlement to Downstream Benefits and is owned by the Province of British Columbia.

The Canadian Entitlement varies from year to year, but is currently about 4,161 gigawatt hours (GWh) per year of energy and 1,304 megawatts (MW) of capacity. The Treaty can be terminated at any time provided that either country provides ten years' notice of its intent to terminate.

After extensive consultation with basin residents, the Province decided in March 2014 to continue with the Columbia River Treaty and to seek improvements within the existing Treaty framework. Canada and the U.S. started negotiations on modernizing the Columbia River Treaty in the spring of 2018. The negotiating sessions have been occurring approximately every two months, alternating locations between the U.S. and Canada. More information on the Treaty and its review process can be found at:

<http://blog.gov.bc.ca/columbiarivertreaty>.



Other agreements

The Treaty Entities (BC Hydro, Bonneville Power Administration (BPA), and the U.S. Army Corps of Engineers) periodically negotiate and sign supplemental operating agreements when there is mutual benefit to modify the water releases specified by the Columbia River Treaty.

In September 2013, the Treaty Entities signed a short-term agreement to address some of Canada's concerns about the timing of water releases from the Libby Dam (VarQ operating regime). This agreement was extended to be in effect until August 2019 and is supplemental to the Libby Coordination Agreement (signed in 2000). Under the new agreement, the U.S. has committed to continued coordination with Canada to consider alternative reservoir operations to reduce flood risk in both countries (similar to the extensive collaboration that occurred during the 2012 high water event). In addition, BC Hydro will be compensated for energy losses at its Kootenai Canal operations that result from the timing of water releases from the Libby Dam. The Entities have also agreed to continue working together to reach a long-term agreement.

In late 2017, the Treaty Operating Committee signed the 2018 Non-Power Uses Agreement. This annual operating agreement allowed Arrow Lakes Reservoir releases to be reshaped between January and July 2018 to protect Canadian whitefish and rainbow trout eggs and to provide flow-shaping benefits for endangered U.S. salmon.



Mountain caribou near Mica Dam

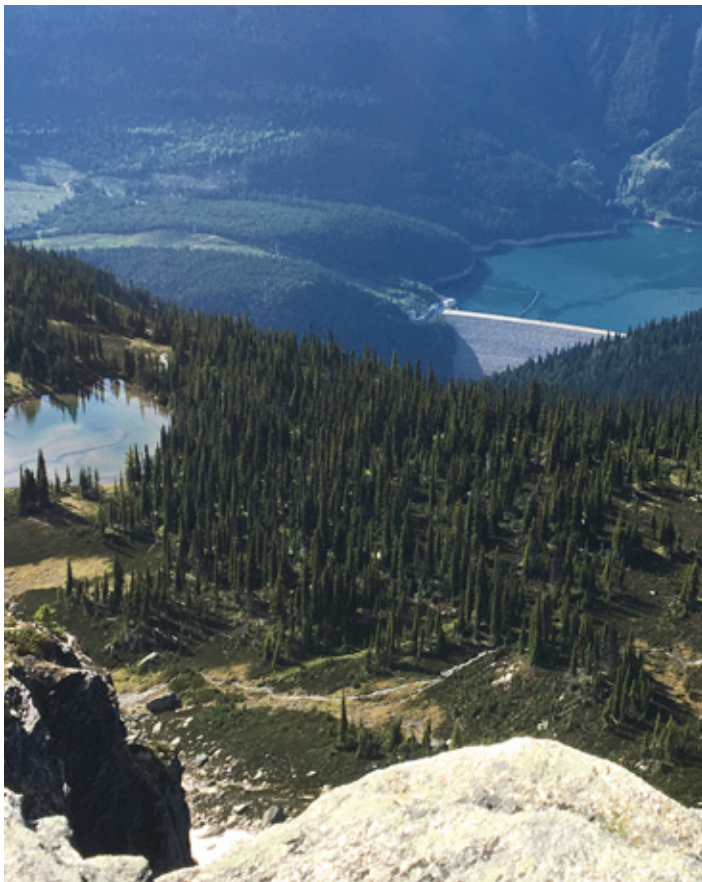
NON-TREATY STORAGE AGREEMENT (NTSA)

The Kinbasket Reservoir, created by the Mica Dam, is licensed for more storage than was required by the terms of the Columbia River Treaty. This additional water is called Non-Treaty Storage and the water can be released across the Canada-U.S. border only under agreement between BC Hydro and its U.S. partners. The current NTSA was signed by BC Hydro and BPA in 2012 and remains in effect until 2024.

The new NTSA gives BC Hydro more control over reservoir levels, provides more energy benefits to B.C., and gives BC Hydro more operating flexibility to better balance the competing non-power interests on the Columbia system, including recreational activities, wildlife habitat, and fisheries. Since the agreement was signed, BC Hydro and BPA have made good use of NTSA flexibility to reduce high and low-water impacts downstream of Arrow Lakes Reservoir and to improve power and non-power benefits for both countries.

Snowpack and runoff

Snowpack in the Columbia basin this year was above normal due to a wetter than normal spring primarily in the U.S. portion of the Columbia basin and the lower portion of the Canadian Columbia basin. This resulted in an above normal runoff forecast of 114% for the entire Columbia basin between April and September 2018. Although above average, this was lower than the high runoff of 123% of normal in 2017.



Mica Dam from Fred Laing peak. Photo by Riley Bartusek



KINBASKET RESERVOIR

Kinbasket Reservoir is created by the Mica Dam. Kinbasket Reservoir regulates discharges for both the Mica and Revelstoke Generating Stations as well as for power plants further downstream.

The winter of 2017/2018 was significantly colder than normal across the province. We experienced an early cold snap in November and unusually cold temperatures persisted throughout December and January. This caused a high demand for electricity and we generated at close to peak capacity from our Columbia basin facilities in late December and early January. As a result, the reservoir water level dropped quickly across December through February and by spring, was below its average level. The minimum water level reached was 719.24 metres (2,359.7 feet) on April 23, 2018. This water level was about 9.48 metres (31.1 feet) lower than the minimum level in 2017.

From February to August 2018, reservoir inflows were about average. However, summer electricity demand was much higher due to widespread hot weather across the Pacific northwest in July and August. As a result, the reservoir did not fully refill and the water level reached a maximum of 747.25 metres (2,451.6 feet) on August 17, 2018, about 7.13 metres (23.4 feet) below normal full pool.

The normal licensed range for Kinbasket Reservoir is between 754.4 metres (2,475 feet) and 706.96 metres (2,319.42 feet) respectively. The reservoir can be operated up to two feet above its normal maximum level, if approved by the Comptroller of Water Rights. Kinbasket Reservoir provides 7 million acre feet (MAF) of Treaty storage and 5 MAF of non-Treaty storage.

REVELSTOKE RESERVOIR

Revelstoke Reservoir is created by the Revelstoke Dam. Revelstoke Reservoir water levels may fluctuate in response to weather patterns, inflow levels, and electricity demand. During the spring freshet and winter peak load periods, it is common to have daily fluctuations of the reservoir within 1.5 metres (5 feet) of full pool. The reservoir may be periodically lowered to below its normal minimum level of 571.5 metres (1,875 feet) to meet increasing system needs for short-term generating capacity or may fill to near full pool during periods of high reservoir inflows.

The licensed range for Revelstoke Reservoir is between 573 metres (1,880 feet) and 554.7 metres (1,820 feet). Most of the time, Revelstoke Reservoir is maintained at or above 571.5 metres (1,875 feet).



Tubing on Revelstoke Reservoir



ARROW LAKES RESERVOIR



Arrow Lakes Reservoir near Revelstoke

Arrow Lakes Reservoir is created by the Hugh L. Keenleyside Dam. Arrow releases are regulated under the Columbia River Treaty and its supplemental operating agreements. During the winter, the reservoir was drafted as is usual under the coordination provisions of the Columbia River Treaty. The reservoir reached its minimum level of 429.16 metres (1,408 feet) on March 28, 2018. This water level was about 6.6 feet above the minimum level in 2017.

Since reaching its minimum level in March, Arrow Lakes Reservoir refilled for much of the year to a maximum level of 439.73 metres (1,442.7 feet) on July 13, 2018. This is about 0.40 metres (1.3 feet) below full pool and 0.15 metres (0.5 feet) above the 2017 maximum level. The Arrow Lakes Reservoir continued to draft across the summer months, with levels dropping to 435.25 metres (1,428 feet) by Labour Day.

The normal licensed range for Arrow Lakes Reservoir is between 440.1 metres (1,444 feet) and 49.9 metres (1,377.9 feet). The reservoir can be operated up to two feet above its normal maximum level (to 440.7 metres or 1,446 feet) if approved by the Comptroller of Water Rights. Arrow Lakes Reservoir provides 7.1 million acre feet (MAF) of Treaty storage.



DUNCAN RESERVOIR

Duncan Reservoir is created by Duncan Dam. Duncan Dam's operations help meet Treaty flood control requirements, help minimize flood risk on Kootenay Lake, and provide minimum fish flows year round as required by the Water Use Plan. On August 13, 2017, the Duncan Reservoir reached a maximum level of 576.50 metres (1,891.4 feet), about 0.18 metres (0.6 feet) below full pool.

Starting September 5, 2017, Duncan discharges were increased to lower the reservoir prior to the start of the kokanee and whitefish spawning downstream of Duncan Dam. From September 26 through December 21, 2017, discharges were reduced for kokanee spawning protection and then in winter were increased to meet Treaty flood control requirements.

For flood risk management downstream of Duncan Dam at Meadow Creek and on Kootenay Lake, Duncan Reservoir is typically drafted to its licensed minimum level of 546.9 metres (1,794.2 feet) each year by April or prior to the start of the freshet. Based on this fall/winter operation, Duncan Reservoir was drafted to a minimum level of 547.1 metres (1,794.9 feet) on April 19, 2018.



Hugh L. Keenleyside Dam navigation lock. Photo by Megan Chadwick

As is normal, the reservoir discharge was reduced to a minimum of 3 cubic metres per second (m^3/s) or 100 cubic feet per second (cfs) on May 26, 2018 to begin reservoir refill and manage the level of Kootenay Lake. Duncan Reservoir refilled to a maximum of 576.59 metres (1,891.7 feet) on August 1, 2018. This water level is about 0.09 metres (0.3 feet) below full pool.

The normal operating range for Duncan Reservoir is between 576.7 metres (1,892 feet) and 546.9 metres (1,794.2 feet). The reservoir can be operated up to 1.2 feet above its normal maximum level (577 metres or 1,893.2 feet) if approved by the Comptroller of Water Rights. Duncan Reservoir provides 1.4 million acre feet (MAF) of Treaty storage.

COLUMBIA RIVER FLOWS

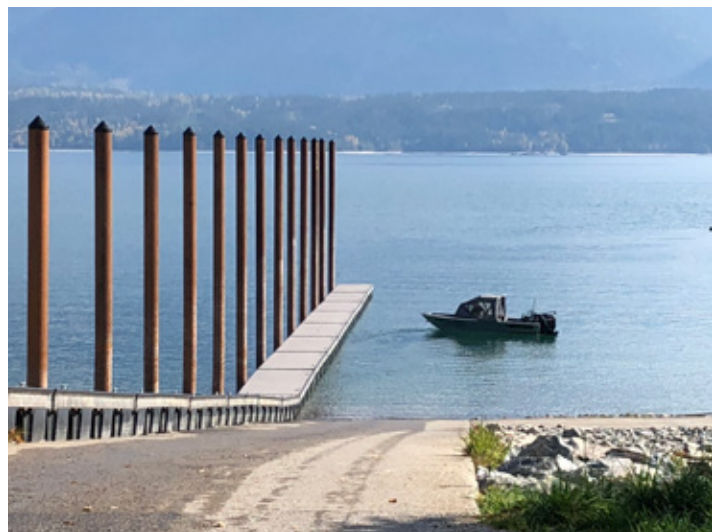
Columbia River flows downstream of the Kootenay River confluence at Castlegar are the result of flow regulation at Keenleyside and other dams on the mainstem Columbia, as well as dams on the Kootenay River system. Actual discharges depend on many factors, including upstream runoff and storage operations and Treaty discharge requirements.



Fishing on Kootenay Lake. Photo by Chad Gillespie

In 2018, there were no flood concerns on the Columbia River downstream of Hugh L. Keenleyside Dam. River flows at Birchbank (a measuring station between Castlegar and Trail) peaked at about 4,332 cubic metres per second (m^3/s) or 153,000 cubic feet per second (cfs) on May 27, 2018. Although the flow was above average for this date, it was well below both the peak regulated flow experienced in 2012 of 6,090 m^3/s (215,000 cfs), and the peak flow prior to dam construction of 10,590 m^3/s (374,000 cfs) in 1961.

BC Hydro's water licence has no minimum discharge requirements for the Columbia River downstream of Keenleyside Dam. Under the Columbia River Treaty, however, we are obliged to reduce flows to a minimum weekly average flow of 5,000 cfs under certain water conditions.



Boating at Shelter Bay Provincial Park

KOOCANUSA (LIBBY) RESERVOIR

The Koocanusa Reservoir on the Kootenay River is controlled by the Libby Dam in Libby, Montana and operated by the U.S. Army Corps of Engineers. The reservoir backs into Canada and provides approximately 5 million acre feet (MAF) of storage.

Koocanusa Reservoir reached a maximum level of 746.33 metres (2,448.6 feet) on August 2, 2017. This water level is about 3.17 metres (10.4 feet) below full pool. Libby Dam continues to be operated under VarQ procedures for U.S. fisheries interests and flood control. The latest Libby Operating Plan provides for:

- flows as needed during March–April to meet the April 30 flood control target;
- minimum flows in May and June necessary to meet the flow rates and sturgeon volume objectives in the U.S. Fish & Wildlife Service Biological Opinion (BiOp) for sturgeon spawning and recruitment;
- minimum bull trout flows as outlined in the BiOp; and,
- augmented downstream flows for salmon after the sturgeon flow operation is completed.



Nakusp marina

Koocanusa is drafted across the winter for Treaty flood risk management. The February to September 2018 runoff forecast for the Koocanusa Reservoir was about 103% of average. The reservoir refilled to 746.18 metres (2,448.1 feet) on July 23, 2018. This water level was about 3.32 metres (10.9 feet) below the normal full pool level. Since discharges were reduced to meet bull trout minimum flows in early September, the reservoir has been relatively stable with current levels at about 744.3 metres (2,442 feet).

The normal operating range for Koocanusa Reservoir is between 749.5 metres (2,459 feet) and 697.1 metres (2,287 feet). During periods of high downstream flood risk, the Treaty Entities may coordinate additional storage in Koocanusa Reservoir.

Information regarding the operation of Libby Dam and Koocanusa Reservoir water levels is available from the U.S. Army Corps of Engineers online at www.usace.army.mil or by calling 406 293 3421.

KOOTENAY LAKE

For information regarding Kootenay Lake, please contact FortisBC.

Website: [fortisBC.com](https://www.fortisbc.com)

Phone: 1 866 436 7847

Want to stay informed of BC Hydro operations?

REGIONAL OPERATIONS UPDATE MEETINGS

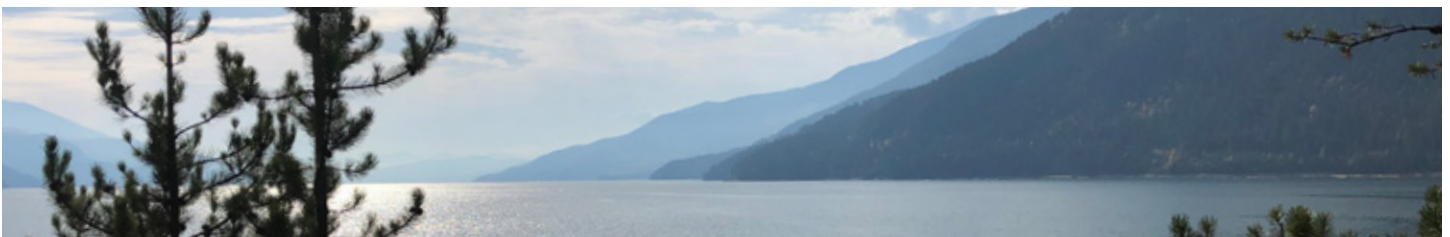
BC Hydro hosts its annual Operations Update meetings in the following Columbia basin communities: Castlegar, Cranbrook, Creston, Golden, Meadow Creek, Nakusp, Revelstoke, Valemount and Jaffray.

These meetings are held to:

- Listen to and learn from local residents, stakeholders, First Nations and community representatives who have an interest in the operation of the Columbia River Treaty facilities and BC Hydro facilities in the East Kootenay and Thompson/Okanagan/Columbia regions.
- Provide information on the operations of Columbia River Treaty facilities in Canada and other facilities that are operated in a coordinated manner on the Columbia system.
- Provide an update on BC Hydro activities.

OPERATIONS UPDATE CONFERENCE CALLS

BC Hydro periodically hosts conference calls to provide updates on our Columbia and Kootenay system operations. If you would like to receive email notifications regarding these meetings and conference calls, please contact Dayle Hopp at dayle.hopp@bchydro.com.





Hugh L. Keenleyside Dam. Photo by Thane Isert

BC HYDRO'S RESERVOIR LEVEL UPDATES

BC Hydro provides reservoir water level forecasts by email each week. To receive these updates, please contact daye.hopp@bchydro.com.

Near real time water level information for various locations around our reservoirs is available online at:

bchydro.com/energy-in-bc/operations/transmission-reservoir-data/previous-reservoir-elevations/columbia.html.

BC Hydro's toll-free reservoir information line

1 877 924 2444 also provides up-to-date reservoir elevation and river flow information. The recording is updated every Monday, Wednesday and Friday and includes:

- **Current Elevation Levels:** Arrow Lakes Reservoir, Duncan Dam Reservoir, Kinbasket Reservoir, Kootenay Lake, Revelstoke Reservoir, Sugar Lake Reservoir and Whatshan Lake Reservoir.
- **Current Flows:** Columbia River at Birchbank, Duncan River at the Lardeau Confluence, Shuswap River and the flow downstream from Wilsey Dam at Shuswap Fall.

Questions? Please contact:

Dag Sharman
Community Relations Manager
Thompson Okanagan Columbia
250 549 8531
dag.sharman@bchydro.com

Megan Chadwick
Stakeholder Engagement Advisor
Lower Columbia
250 365 4565
megan.chadwick@bchydro.com

Diane Tammen
Community Relations Manager
East Kootenay
250 489 6862
diane.tammen@bchydro.com

Jen Walker-Larsen
Stakeholder Engagement Advisor
Upper Columbia
250 814 6645
jennifer.walker-larsen@bchydro.com

