



Hugh L. Keenleyside Dam. Photo by Mary-Anne Coules.

Columbia River Operations Summary

Fall 2022

This publication provides an overview of BC Hydro's operations on the Columbia River. At 2,000 kilometres long, the Columbia River is the fourth largest river in North America. The headwaters of the Columbia River are in Canal Flats, British Columbia (B.C.). The river then flows northwest through the Rocky Mountain trench before heading south through B.C. and Washington, 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.

Only 15% of the Columbia River basin lies in Canada. The Canadian portion of the basin is mountainous and receives a lot of snow, and produces, on average, 30 to 35% of the runoff for Canada and the United States (U.S.) combined. The river's large annual discharge and relatively steep gradient gives it tremendous potential for the generation of electricity. The hydroelectric dams on the Columbia's mainstem and many more on its tributaries produce more hydroelectric power than on any other North American river.

BC Hydro's facilities in the Columbia basin include 13 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 U.S.



BC Hydro's operating agreements

COLUMBIA RIVER TREATY

The Columbia River Treaty between Canada and the U.S. was ratified in 1964. The Treaty resulted in the construction of three dams in British Columbia (Duncan, Hugh L. Keenleyside and Mica) for flood control and to increase hydroelectric generating potential in both countries. The Treaty also provided for the construction of Libby Dam in the U.S. and the resulting Koochanusa 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 3,990 gigawatt hours (GWh) per year of energy and 1,141 megawatts (MW) of capacity for the period between August 1, 2021 and July 31, 2022.

Since September 16, 2014, both Canada and the U.S. have had the option to terminate the Treaty. After extensive consultation with basin residents, the Province of British Columbia decided in March 2014 to continue with the Columbia River Treaty and to seek improvements within the existing Treaty framework. More information on the Treaty and its review process can be found online engage.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.

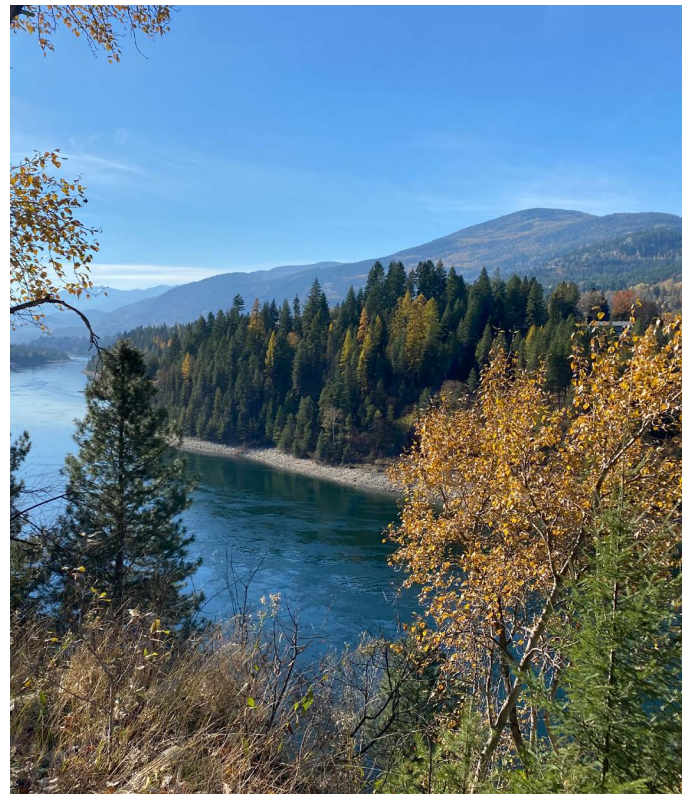
In September 2013, the Treaty Entities signed a short-term agreement to address some of Canada's concerns about the timing of water releases from Libby Dam (known as the VarQ operating regime). This agreement was extended to be in effect until August 2023 and is supplemental to the Libby Coordination Agreement (signed in 2000). Under this agreement, the U.S. 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 was compensated for energy losses at its Kootenay Canal operations that resulted from the timing of water releases from Libby Dam. The Entities also agreed to continue working together to reach a long-term agreement.

In late 2021, the Columbia River Treaty Operating Committee signed the 2022 Non-Power Uses Agreement. This annual operating agreement allowed Arrow Lakes Reservoir releases to be reshaped between January and July 2022 to protect Canadian whitefish in exchange for flow benefits for endangered U.S. salmon.

NON-TREATY STORAGE AGREEMENT (NTSA)

Kinbasket Reservoir, created by Mica Dam, is licensed by the Province of British Columbia 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 NTSA gives BC Hydro more control over reservoir levels, provides more energy benefits to B.C., and gives BC Hydro more operating flexibility to balance competing non-power interests on the Columbia system. These interests include 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.



The Columbia River downstream of Castlegar. Photo by Mary Anne Coules.

BC Hydro's Columbia operations

Snowpack and runoff

Snowpack in the Columbia basin this year was well above average, particularly in the Canadian portion of the basin, due to high precipitation in the fall and winter. This resulted in high runoff between April and September 2022: 111% of normal for the Canadian portion of the basin, and 107% of normal for the entire Columbia basin. By comparison, the runoff in the Canadian basin in 2021 was 88% of normal and the overall runoff in the Columbia basin was 82% of normal.

The seasonal runoff volumes in the Canadian Columbia basin were all above normal, ranging from 105 to 107% depending on the watersheds. Glacier-fed watersheds such as Kinbasket, Revelstoke, and Duncan saw higher runoff volumes, whereas watersheds that are not glacial fed, such as Arrow and Kootenay, saw lower runoff volumes overall.

2021–2022 weather events

We experienced several unusual weather events in 2021 and 2022. Summer heatwaves in June and July 2021 brought unprecedented temperatures of over 40 degrees to parts of the province. BC Hydro recorded our highest ever summer peak hourly demand on June 28, 2021 when demand reached 8,568 MW. This was more than 600 MW over the previous record set on August 18, 2020.

Several atmospheric river events occurred in November and December and brought heavy precipitation, predominantly snow, in the Upper Columbia and heavy rainfall in the Lower Columbia. Snowpack was above average by the end of November and either at or near record high by the end of December. A prolonged and intense arctic outbreak in December 2021 and January 2022 saw temperatures plummeting to record lows and an all-time peak hourly load record set at 10,787 MW on December 27, 2021. Cool conditions in early spring led to a delayed freshet and low basin inflows. Combined with late spring precipitation, this resulted in snowpack peaking towards the end of May, much later than normal.

KINBASKET RESERVOIR

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

Kinbasket Reservoir refilled to a maximum level of 752.47 metres (2,469.2 feet) on August 22, 2021 due to above average runoff conditions. This is about 6 feet below the normal maximum operating level of 754.4 metres (2,475 feet).

The winter of 2021–2022 was extremely cold and heavy snowfall throughout the province resulted in the highest and longest sustained loads experienced in the system. A series of active weather systems interspersed with another arctic outbreak in February brought unseasonably cold temperatures and consistent periods of light to moderate snow in the basin. This led to high electricity demand and increased generation requirements at Mica during the winter. Basin inflows were well below average in April and May, contributing to more draft of the reservoir in April and a slower refill across May. In 2022, the minimum water level reached was 718.84 metres (2,358.5 feet) on May 2, 2022, about 7 metres (23 feet) below average. A deeper draft was necessary to manage the higher snowpack and runoff, and to minimize spill risk.

From February to August 2022, reservoir inflows were about 116% of average. High inflows were due to above normal precipitation and snowpack along with some glacial melt in the summer. The reservoir refilled to a maximum level of 752.89 metres (2,470.5 feet) on September 18, 2022, about 1.3 metres (4.5 feet) below the normal maximum operating level of 754.38 metres (2,475 feet), equivalent to 98% of full storage.



The Columbia River in Castlegar. Photo by Mary Anne Coules.

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 seven million-acre-feet (MAF) of Treaty storage and five MAF of non-Treaty storage.

REVELSTOKE RESERVOIR

Revelstoke Reservoir is created by 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 (five feet) of full pool. The reservoir is also 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.

During low demand and high inflow periods, water is occasionally released over the Revelstoke Dam spillway to maintain minimum flows or to maintain the reservoir water level.

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).



Mica Dam and Generating Station.

ARROW LAKES RESERVOIR

Arrow Lakes Reservoir is impounded by the Hugh L. Keenleyside Dam. Arrow releases are regulated under the Columbia River Treaty and its supplemental operating agreements. For operations to be consistent with the principles of the Treaty, under wet conditions it is necessary to store excess water so that surplus energy is not generated by downstream U.S. Columbia River dams. Conversely, under dry conditions, storage must be drafted as far as necessary to meet Treaty firm loads consistent with the principles of proportional draft.

As early as July 2021, the coordinated system began operating in proportional draft due to exceptionally dry conditions. The April to August 2021 runoff period was estimated to be in the lowest 15th percentile for the Columbia basin at The Dalles. This resulted in more water releases from Arrow Lakes Reservoir in the summer months.

To support higher Arrow Lakes Reservoir levels in July of 2021, BC Hydro entered into an Arrow Summer Shaping Agreement with the U.S. to delay Arrow releases from July into August. This agreement resulted in about six feet higher Arrow Lakes Reservoir levels at the end of July; otherwise, there was no material impact to water levels at the end of August.

As the overall runoff conditions in the Columbia Basin improved in the fall, the coordinated system came off proportional draft by November 2021. Arrow Lakes Reservoir followed a typical draft across the winter to reach a minimum level of 426.4 metres (1,399 feet) on March 12, 2022.

Wet fall and winter conditions contributed to above normal snowpack and runoff in the Arrow basin. From February to August 2022, reservoir inflows were about 108% of average, with notably low inflows in April and May due to the delayed freshet. Arrow refill operations in the spring were coordinated with the USACE to meet local and system flood control objectives. Arrow refilled to a maximum level of 438.7 metres (1,439.3 feet) on July 8,

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 (MAF) of Treaty storage.

2022, about 1.4 metres (4.7 feet) below full pool or 92% of full storage. Arrow Lakes Reservoir drafted across the summer months, but water levels were within the recreational range until September 5, 2022.



Arrow Lakes Reservoir. Photo by Jen Walker-Larsen.

DUNCAN RESERVOIR

Duncan Reservoir is impounded 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 Duncan Dam Water Use Plan.

Duncan Reservoir reached a maximum level on August 2, 2021 of 576.62 metres (1,891.8 feet). This water level was 0.06 metres (0.2 feet) below full pool. The reservoir then drafted to about 575.5 metres (1,888 feet) by Labour Day.

From September through late December 2021, Duncan Reservoir was operated to provide the flows necessary for kokanee and whitefish spawning downstream of the dam. Discharges were later increased to facilitate drafting the reservoir for Treaty flood control requirements during the winter period.

For flood risk management downstream of Duncan Dam at Meadow Creek and on Kootenay Lake, Duncan Reservoir is normally drafted to its licenced minimum level of 546.9 metres (1,794.2 feet) each year by April or before the start of the freshet. In 2022, Duncan Reservoir reached a minimum level of 547 metres (1,794.7 feet) on May 3, 2022. The reservoir discharge was reduced to a minimum of three cubic metres per second (m^3/s) or 100 cubic feet per second (cfs) on June 11, 2022 to begin reservoir refill and manage water levels on Kootenay Lake.

From February to August 2022, reservoir inflows were about 114% of average. Duncan Reservoir refilled to a maximum of 576.4 metres (1,891 feet) on August 9, 2022. This water level is about 0.3 metres (1 foot) 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 foot 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 MAF of Treaty storage.



Sullivan Falls on Revelstoke Reservoir. Photo by Jen Walker-Larsen.

COLUMBIA RIVER FLOWS

Columbia River flows downstream of the Kootenay River confluence at Castlegar are the result of flow regulation at Hugh L. 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.

In 2022, despite above normal runoff, there were no flood concerns on the Columbia River downstream of the Hugh L. Keenleyside Dam. Columbia River flows are measured at the Birchbank flow measuring station downstream of the Kootenay River confluence between Castlegar and Trail. Columbia River flows peaked at about 4,332 m^3/s or 153,000 cfs on June 26, 2022. This flow was well below the peak regulated flow experienced in 2012 of 6,090 m^3/s (215,000 cfs), and the peak pre-dam flow 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 Hugh L. Keenleyside Dam. Under the Columbia River Treaty, however, BC Hydro is obliged to reduce flows to a minimum weekly average flow of 141.5 m^3/s or 5,000 cfs under certain water conditions.

KOOCANUSA RESERVOIR

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

Koocanusa Reservoir is typically drafted during the winter for Treaty flood risk management. The reservoir reached a minimum level of 720.4 metres (2,363.5 feet) on February 28, 2022, 3.6 metres (11.8 feet) below average for this date.

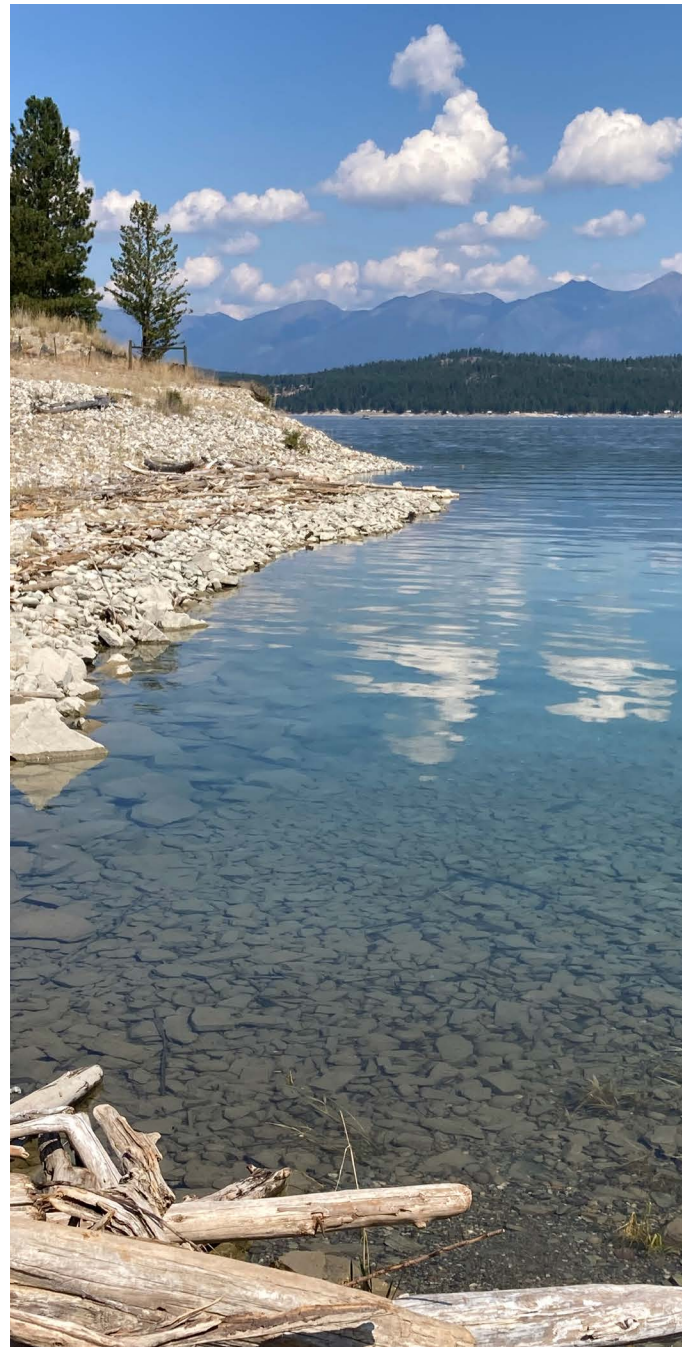
From February to August 2022, reservoir inflows were about 114% of average. Koocanusa Reservoir refilled to reach a maximum level of 748.1 metres (2,454.3 feet) on August 5, 2022. This water level is about 1.43 metres (4.7 feet) below full pool. Libby Dam continues to be operated under VarQ procedures for U.S. fisheries interests and flood control.

The latest Libby Operating Plan provides for:

- Flows as needed to meet flood control draft and refill requirements;
- 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.

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

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.



Koocanusa Reservoir. Photo by Sally MacDonald.

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 annual Operations Update meetings every spring for Columbia basin communities. 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 Southern Interior;
- 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; and
- Provide an update on BC Hydro local 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 us at southern-interior.info@bchydro.com.



12 Mile on Arrow Flats. Photo by Jen Walker-Larsen.

BC HYDRO'S RESERVOIR LEVEL UPDATES

BC Hydro provides reservoir water level forecasts by email each week. To receive these updates, please email southern-interior.info@bchydro.com.

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

bchydro.com/energy-in-bc/operations/transmissionreservoir-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, Koochanusa 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 Falls.

Questions? Please contact:

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