International Kootenay Lake Board of Control

2022 Report to the International Joint Commission

Cover Photo:

Aerial view of Balfour, BC and Kootenay Lake.

(credit: https://www.nelsonkootenaylake.com/sites/default/files/images/regions/balfour_Tamarack.jpg)

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EXECUTIVE SUMMARY

Throughout 2022, FortisBC operated Corra Linn Dam in a manner consistent with that prescribed by the 1938 Kootenay Lake Order. During the 2022 spring freshet, Kootenay Lake inflows and lake levels were higher than average but avoided major flooding impacts.

During the spring draw-down period there was a brief increase in flows in early April, so Kootenay Lake did not reach the minimum lake elevation of 1739.32 ft (530.14 m) on or around April 1 as is required in the Order. It was at 1739.72 ft (530.27 m) on April 1 with Grohman Narrows limiting the total outflow. The lake reached the required minimum elevation on April 12, and the minimum lake elevation during the spring period was 1738.60 ft (529.93 m) on April 24.

The International Kootenay Lake Board of Control determined the date of the commencement of the spring rise as April 27. The cool spring combined with above-average snow pack led to higher flows in the Kootenay/Kootenai watershed in June. In 2022, daily mean inflow to Kootenay Lake was highest in mid-June, peaking at 100,800 cfs (2,854 cms) on June 11. The peak daily mean lake level was 1751.61 ft (533.89 m), reached on June 14. The Grohman Narrows determined releases so the lake was held below the IJC curve during the freshet. Kootenay Lake discharged 20.7 million acre-feet (25.5 cubic kilometers) of water in 2022, with an average flow of 28,597 cfs (809.8 cms). This represents 107 percent of normal for the period of record 1999-2021.

FortisBC made a payment of $27,217.98 USD in July 2022 to Idaho farmers to compensate for increased pumping costs during high lake levels in 2021. A payment has yet to be made for 2022 pumping costs.

UNIT CONVERSION FACTORS

Customary (Imperial) to Système International (Metric)

Multiply	By	To obtain
	Length	
inch (in)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,407	square meter (m^2)
acre	0.4047	hectare (ha)
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
acre-feet (ac-ft)	1,233	cubic meter (m^3)
thousand acre-feet (Kac-ft)	1.233	thousand cubic decameters ($kdam^3$)
	Flow Rate	
cubic foot per second (cfs)	0.02832	cubic meter per second (cms)

Système International (Metric) to Customary (Imperial)

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square meter (m^2)	0.0002471	acre
hectare (ha)	2.471	acre
hectare (ha)	0.003861	square mile (mi^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
	Volume	
cubic meter (m^3)	0.0008107	acre-feet (ac-ft)
thousand cubic decameters ($kdam^3$)	0.8107	thousand acre-feet (Kac-ft)
	Flow rate	
cubic meter per second (cms)	35.31	cubic foot per second (cfs)

Temperature in degrees Celsius (˚C) may be converted to degrees Fahrenheit (˚F) as follows:

$$^{\circ}\mathrm{F} = (1.8 \times {}^{\circ}\mathrm{C}) + 32$$

Temperature in degrees Fahrenheit (˚F) may be converted to degrees Celsius (˚C) as follows:

$$^{\circ}\mathrm{C} = \frac{(^{\circ}\mathrm{F} - 32)}{1.8}$$

LIST OF ACRONYMS

IJC	International Joint Commission
IKLBC	International Kootenay Lake Board of Control
ECCC	Environment and Climate Change Canada
USAC	Unites States Army Corps of Engineers
WSC	Water Survey of Canada
RDCK	Regional District of Central Kootenay
IWI	International Watershed Initiative
SWE	Snow Water Equivalent
cfs	Cubic feet per second
cms	Cubic meters per second

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KOOTENAY LAKE

Kootenay Lake is a large fjord-like lake that is located on the Kootenay (Kootenai, American spelling) River in British Columbia, Canada, 26 kilometers (16 miles) upstream of the confluence with the Columbia River. Kootenay Lake itself is entirely within Canada, but it has a backwater effect that can extend about 80 kilometers (50 miles) upstream, to the town of Bonners Ferry, Idaho. The area around the Lake is developed, and includes the City of Nelson as well as numerous smaller communities. The backwater area along the Kootenay/Kootenai River upstream of Kootenay Lake is predominantly agriculture land. The Kootenay Lake watershed is shown in Figure 1.

The level of Kootenay Lake is regulated by Corra Linn Dam (Figure 2) and is also influenced by a natural constriction upstream of the dam at Grohman Narrows. FortisBC controls discharge at Corra Linn Dam in accordance with requirements of the Order of the International Joint Commission dated November 11, 1938. FortisBC co-operates with BC Hydro which also manages a hydroelectric generating facility (the Kootenay Canal Project) that is hydraulically connected to the Corra Linn Dam forebay on the Kootenay River through a constructed canal.

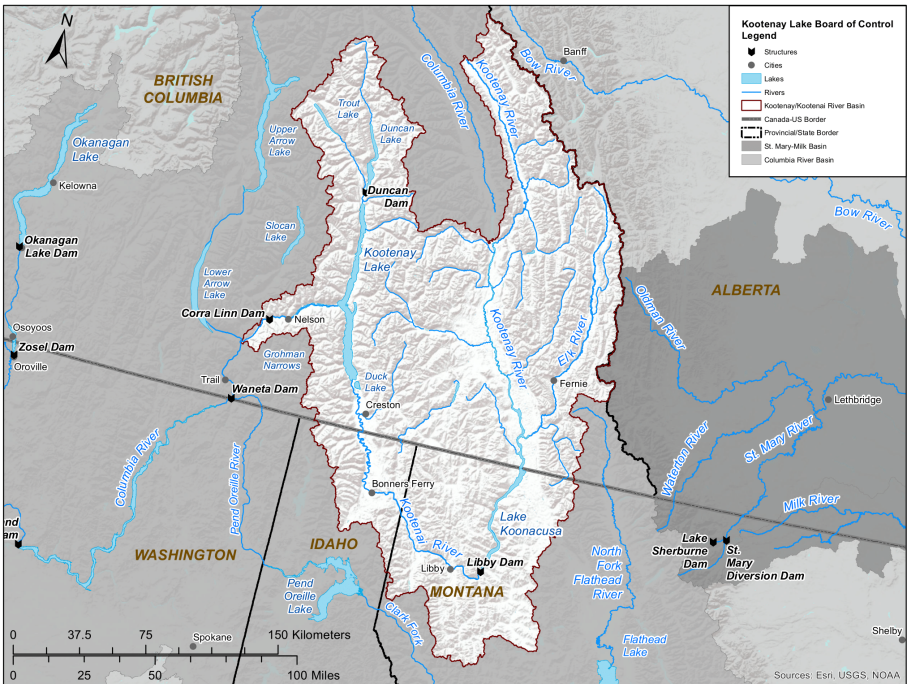

Figure 1. Kootenay Lake Watershed

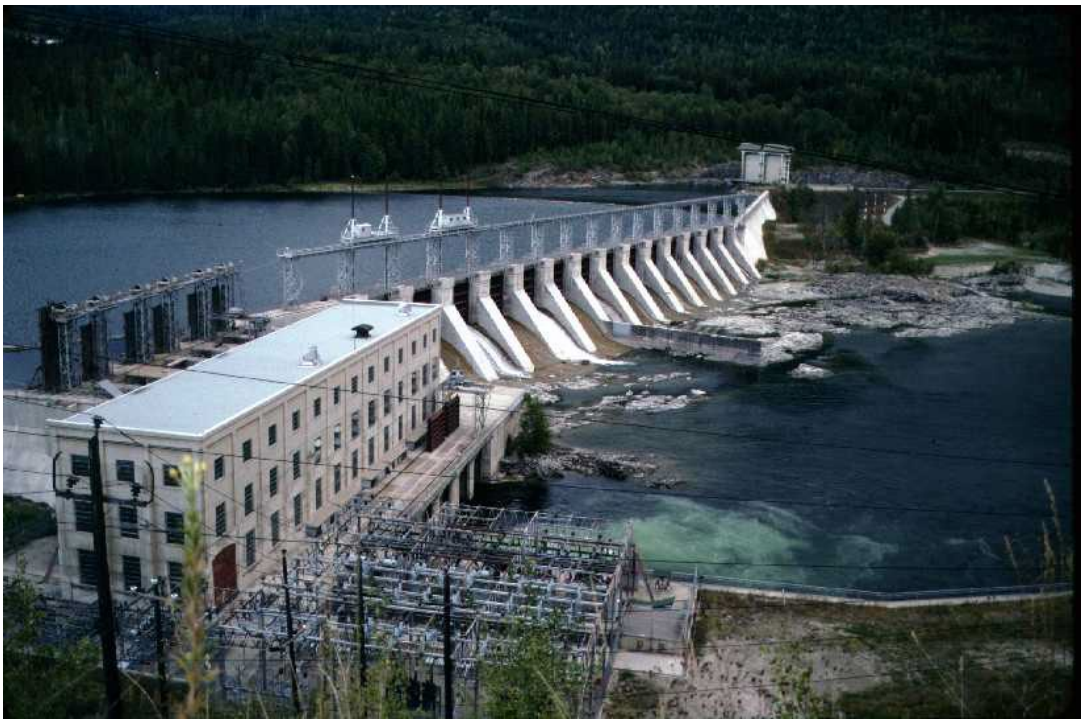

Figure 2. Corra Linn Dam

BOARD MEMBERSHIP

In 2022, the size of the Board remained the same at six total members with equal representation from Canada and the U.S. In January 2022, Ken Brettmann (US Secretary) stepped down and was replaced by Sonja Michelsen. In October 2022, Dave Hutchinson (Canadian Co-Chair) stepped down from the Board and was replaced by Evan Friesenhan.

	Canadian Section		**U.S. Section**
	Evan Friesenhan (Co-Chair) Manager, Engineering Services West and North National Hydrological Services Environment & Climate Change Canada		Col. Alexander Bullock (Co-Chair) District Engineer U.S. Army Corps of Engineers – Seattle District
	Ted White (Member) Director and Comptroller of Water Rights B.C. Ministry of Forests		Roy Bartholomay (Member) Director – Idaho Water Science U.S. Geological Survey
	Martin Suchy (Secretary) Water Resources Scientist National Hydrological Services Environment & Climate Change Canada		Sonja Michelsen (Secretary) Water Resource Engineer U.S. Army Corps of Engineers – Seattle District

ORDER OF APPROVAL

In November 1938, in response to an application submitted by the Government of Canada on behalf of the West Kootenay Power and Light Company (WKPL), which operated Corra Linn Dam, the IJC issued the 1938 Order of Approval. The 1938 Order has several provisions, including:

- Establishing the maximum elevation limits and operational criteria for the lake
- Appointing the IKLBC to monitor the regulation of the lake to assure the provisions of the order are followed
- Requiring excavation of the outlet of the lake at Grohman Narrows to expand the hydraulic capacity
- Providing for reimbursement of increased pumping costs resulting from flooding of agricultural lands caused by Corra Linn Dam operations

The maximum lake elevation limits are described in the Kootenay Lake rule curve (Figure 3). For the purposes of the Order, self-reported lake elevations from FortisBC are used to determine the applicant's compliance. The Water Survey of Canada operates a separate gage near the same location and uses the readings to validate those from FortisBC. Important statistics from both gages are presented in Appendix 1.

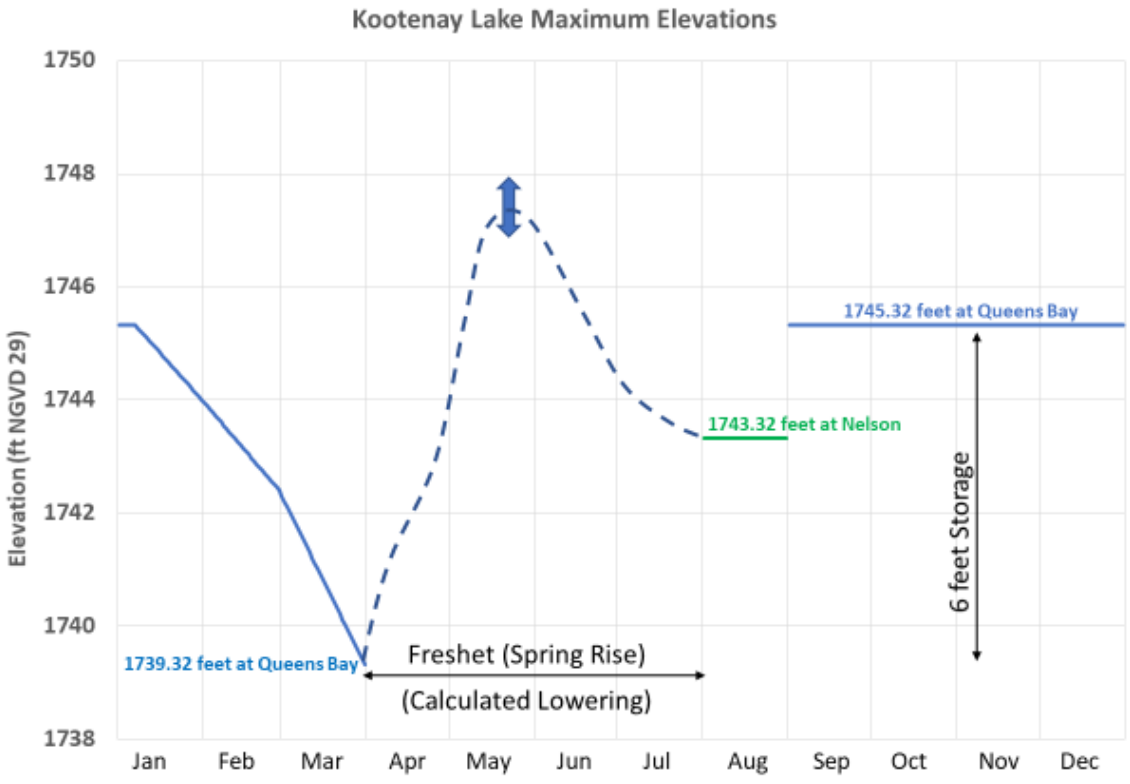

Figure 3. Kootenay Lake Order Rule Curve

1938 Kootenay Lake Order Sections 2(4) 2(5) and 2(6)

2(4) …the Applicant shall be permitted to store water in the main body of Kootenay Lake to a maximum elevation of 1745.32, Geodetic Survey of Canada datum, 1928 adjustment (i.e., six feet above zero of the Nelson gauge), in accordance with the rule curve detailed in Sub-section (5).

(5) That after the high water of the spring and early summer flood and when the lake level at Nelson on its falling stage recedes to elevation 1743.32, Geodetic Survey of Canada datum, 1928 adjustment, the gates of the dam may be so operated as to retain it at said level until August 31st, and after said date, the level of the main body of the lake may be raised to elevation 1745.32, which shall be the maximum storage level until January 7, and thereafter it shall be lowered so that it shall not exceed elevation 1744 on February 1, elevation 1742.4 on March 1, and elevation 1739.32 (i.e. zero of the Nelson gauge) on or about April 1, except under extraordinary natural high inflow conditions, when sufficient gates shall be opened and remain open throughout such period of excess so as to lower the level of the main body of Kootenay Lake to the storage level at that time obtaining as above defined.

6) ...throughout the period of flood flow in each and every year, (i.e., from the commencement of the spring rise in March or April until the level of the lake at Nelson returns to elevation 1743.32, Geodetic Survey of Canada, 1928 adjustment, on the falling stage), a sufficient number of gates and sluiceways of the dam shall be opened to provide, in conjunction with the flow through the turbines, for the lowering of the main body of Kootenay Lake ... by at least the amounts ... as follows:

Discharge from Kootenay Lake under original conditions (in second feet) [vs.] Amount of lowering to be affected on the main body of Kootenay Lake (in feet)

10,000	1.0
25,000	1.3
50,000	1.7
75,000	2.1
100,000	2.6
125,000	3.0
150,000	3.2
175,000	3.5
200,000	3.8
225,000	4.0

HYDROLOGIC CONDITIONS

Climate and Snowpack

Precipitation in 2022 was generally below average apart from a period of above normal rainfall in June. Temperatures began the year above normal in January but fell to below normal through to June. Above normal temperatures returned until November after which the basin finished the year cooler than normal. Snowpack in the West Kootenay basin, as measured at Redfish Creek (elevation 2,104 m (6,903 ft)), was consistently above normal throughout the 2022 water year. Snow water equivalent (SWE) at Redfish Creek peaked well after the historic average at 1,914 mm on June 5, a maximum for the day in the 2001-2021 historical period but below the historical maximum peak. This snowpack persisted longer than normal and did not melt completely until mid-July. Conversely, snowpack in the East Kootenay basin, as measured at Moyie Mountain (elevation 1,940 m (6,365 ft)), was consistently below normal historic conditions through the 2022 water year. SWE at this station saw somewhat of a plateau between mid-March and late April, peaking at 369 mm on April 24. This snowpack persisted slightly longer due to some periods of snowfall in May but melted completely by early June, in line with the historical period.

Snow basin indices for the East and West Kootenay basins, according to the BC River Forecast Center, were between 100-120% of normal from January to April and above 120% in May and June. Snowpack in the U.S. was generally closer to average but followed a similar trend. A snowpack of 100-120% of normal is typically enough to present a flood threat, but not enough to guarantee a flood. In such a year, floods could happen because of intense heatwaves, and/or rain on snowmelt events. The June rainfall occurred around the time when temperatures were beginning to warm and snowpacks were still present, however, major flooding was avoided in the basin for 2022.

Kootenay Lake

Figure 4 presents observed calendar-year 2022 water levels on Kootenay Lake and the elevations specified in the November 11, 1938, IJC Order. Water levels on Kootenay Lake were drawn down in accordance with the IJC Rule Curve, beginning in early January. The lake exceeded the Rule Curve between March 30 and April 11, and reached its annual minimum level as measured at Queens Bay on April 24 at 1,738.60 ft (529.93 m), approximately three weeks after that of the historical period. Shortly after, the Board declared the commencement of the Spring Rise, the point at which the IJC Rule Curve switches from maximum lake elevation criteria to the lowering formula as stipulated in the IJC Order, on April 27, 2022. Lake levels rose to a maximum of 1,751.61 ft (533.89 m) at Queens Bay on June 14, in line with the timing of the historical average but near the 96th percentile of the 1976-2021 historical period. The lake drafted below elevation 1,743.32 ft (531.364 m) at Nelson on August 6, triggering the end of the high-water period. Grohman Narrows was in control of lake outflows for the majority of the freshet, with Corra Linn in control in late April and late June for two days each. Lake levels stayed near or slightly below historical levels throughout the fall, but fell to around the 10th historical percentile in the early winter before rising to normal again by the end of December. The maximum and minimum Queens Bay water levels from FortisBC data are shown on Figure 4.

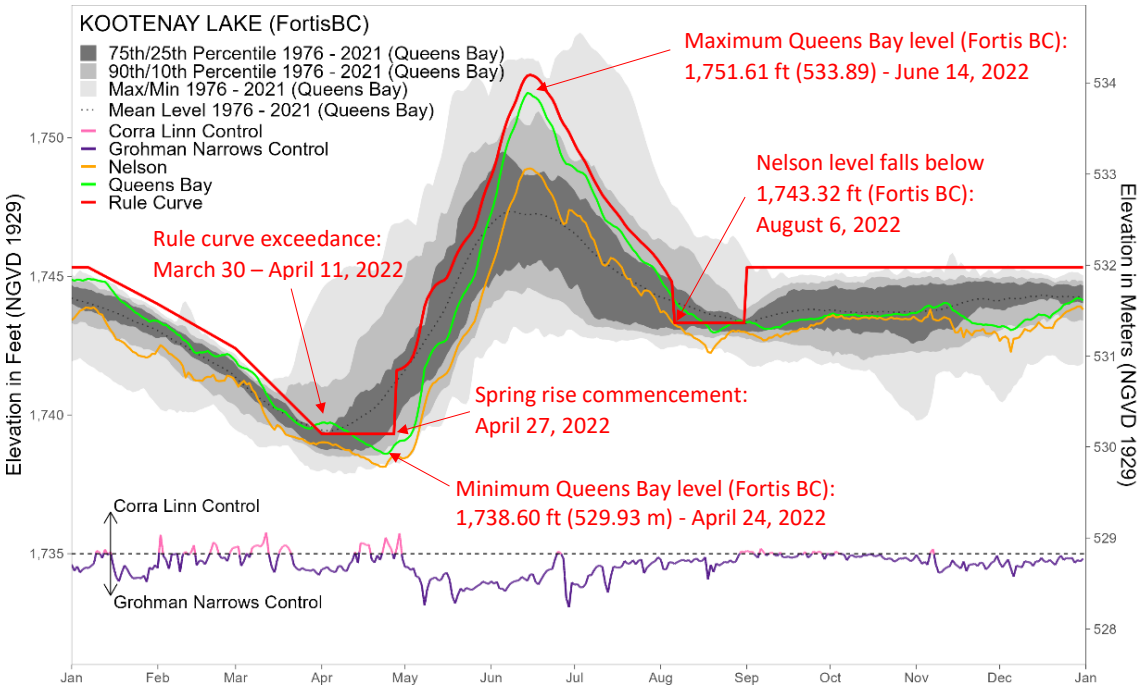

Figure 4. Kootenay Lake at Queens Bay and Nelson 2022 hydrographs (FortisBC), historical maximum/minimum, 90th/10th and 75th/25th percentiles, daily mean, rule curve, key transition dates along with the Corra Linn Dam / Grohman Narrows control balance. When the control line is above the black dotted line (pink), Corra Linn Dam controls the outflow from Kootenay Lake. When the control line is below the black dotted line (purple), this represents lake discharge controlled by Grohman Narrows.

Kootenay Lake daily inflows and outflows for 2022 can be seen in Figure 5. Daily mean inflows peaked at 100.8 kcfs (2,854 cms) on June 11 while daily mean outflows peaked at 83.6 kcfs (2,367 cms) on June 15. Both were historical maximums for their respective days and occurred later than their historical averages. In total, Kootenay Lake took in 20.6 million acre-feet (25.5 km^3) and discharged 20.7 million acre-feet (25.5 km^3) of water through Corra Linn Dam and the Kootenay Canal Plant. Total lake outflow has ranged from a high of 27.4 million acre-feet (33.8 km^3) in 1954 to a low of 11.2 million acre-feet km3 (13.8 km^3) in 1944.

FortisBC has continued to supply the Board with complete records of the regulation of Kootenay Lake as affected by the operations of Corra Linn Dam and the Kootenay Canal Plant.

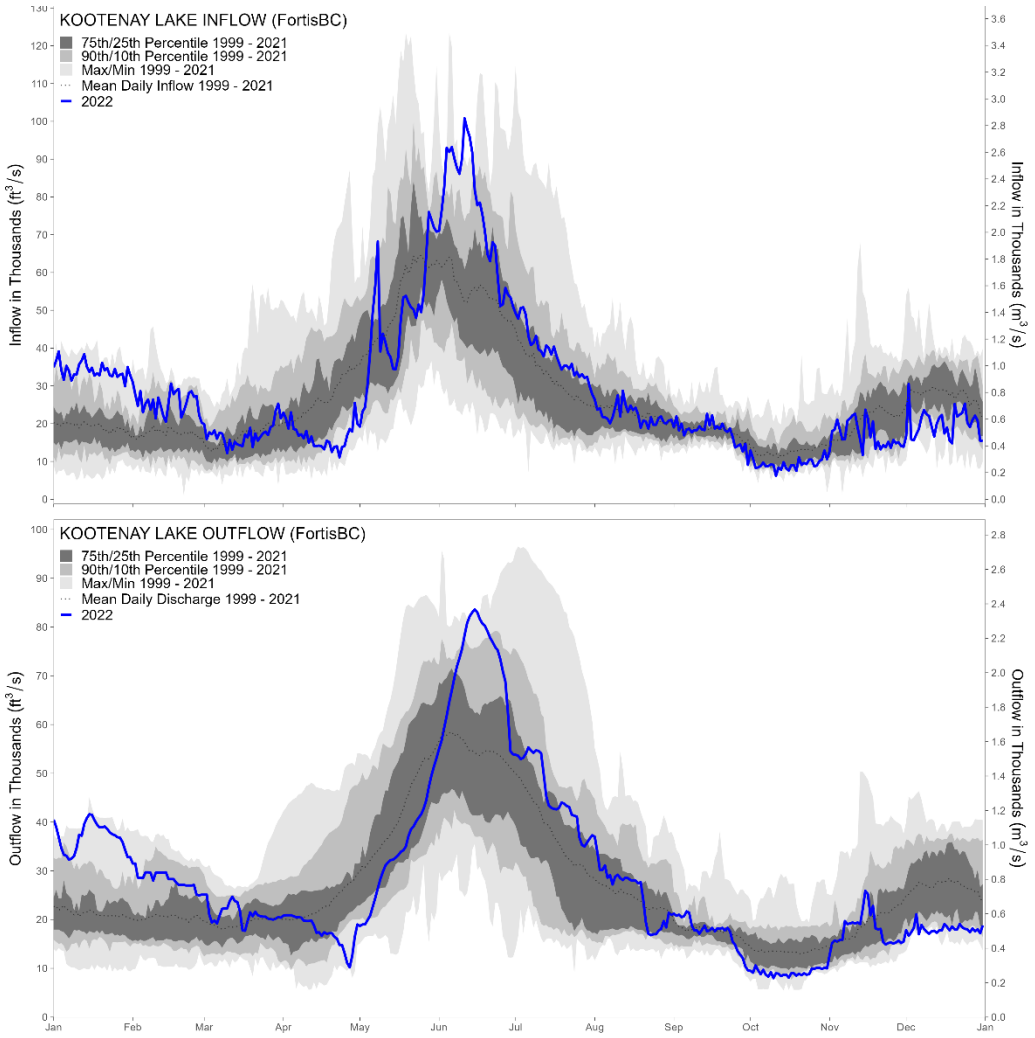

Figure 5. Kootenay Lake 2022 Inflow (top) and Outflow (bottom) hydrographs (FortisBC), historical maximum/minimum, 90th/10th and 75th/25th percentiles, daily mean.

ORDER COMPLIANCE

Kootenay Lake Rule Curve

The Kootenay Lake level at Queens Bay exceeded the rule curve during the drawdown period between March 30 and April 11 by a margin ranging from 0.02 ft (6 mm) to 0.41 ft (12 cm). Grohman Narrows was in control of lake outflow and Corra Linn Dam was in free fall during this time, indicating that the applicant was in compliance of the Order. At all other times in 2022, the Applicant maintained the lake below the IJC Rule Curve.

Minimum lake level was reached on April 24 (1,738.60 ft). Corra Linn was controlling outflow from the lake at this time. The Board made the Spring Rise Declaration on April 27, which triggered the rule curve to increase using the lowering formula. Except for two days in late April and late June, Grohman Narrows was in control of lake outflows during the freshet period. Maximum lake level was reached on June 14 (1,751.61 ft).

Applicant Payments

According to the 1938 Order, FortisBC must pay farmers on the Kootenai Flats in Idaho up to $3,000.00 (U.S) for additional pumping costs related to dyke seepage from higher water levels during storage periods. FortisBC has a separate agreement with the Kootenai Valley Reclamation Association for an additional pumping cost payment based on actual receipts. Payments have not yet been issued to Idaho for pumping costs in 2022 (typically invoiced in May of the following year), but will likely be within the range of the 2021 payment amount of $27,217.98 USD, which was made in July 2022.

Corra Linn Forebay Telemetry Incident

On January 13, 2022, FortisBC System Control Center noticed a reduction in power output at their Corra Linn Generating Station. This was assumed to be due to plugged intake trashracks and two clearings were made on January 14 and 19. On January 26, BC Hydro contacted FortisBC requesting they investigate their Corra Linn forebay telemetry readings citing an unusually large discrepancy between those at Corra Linn and those at the Kootenay Canal Generating Station intake. FortisBC field crews attended the Corra Linn Generating Station on January 27 and noticed that the stilling well had developed surface ice that was interfering with accurate elevation readings, likely due to a malfunctioning heating element. The field crews performed corrective action on the stilling well and restored the forebay telemetry to normal. On January 28, BC Hydro asked FortisBC to review their water records for the affected period (January 10-27) and provide corrected values for Corra Linn forebay elevation, plant discharge and plant spill. These values were provided on February 10 and a presentation was given to ECCC and USACE on February 23, at which time it was requested that the incident be written up into a formal report.

FortisBC confirmed that weekly manual verification of the forebay telemetry readings had occurred during the telemetry incident, though no concerns with accuracy had been brought forward. To improve reliability, FortisBC planned to install a second heating element at the Corra Linn forebay stilling well to provide redundancy in the event of another failure. Other operational changes were to be made, involving additions to the weekly inspection checklist to require visual inspection of the stilling well, a flashing indicator on the stilling well's exterior to indicate when a heating element has failed, and the addition of an alarm at FortisBC's Control Center to notify System Operators of large discrepancies between Corra Linn forebay and Kootenay Canal intake elevations. FortisBC committed to having these changes in place no later than September 30, 2022.

The forebay telemetry readings were corrected using the relationship between generator power output, pressure head, tailrace elevation and forebay elevation. The corrected forebay values were then used to correct plant discharge and spill. The corrected values aligned with the expected results. BC Hydro confirmed that the flow data from Corra Linn that was originally reported by FortisBC did not have an impact on the water level requirements of the IJC and had no impact on the elevations recorded at Queen's Bay.

BOARD ACTIVITIES

Annual Board Meeting

The Annual Board Meeting was held October 5, 2022 from 10:00 am to 3:30 pm (PST). The hybrid meeting was held in-person, for the first time since 2019 due to the COVID-19 pandemic, at the Kootenai River Inn and Casino and was hosted by the U.S. Section. Colonel Alexander Bullock (Board Chair, U.S. Section) opened the meeting with welcoming remarks and introductions of the Board Members, IJC Commissioners and guests who attended (physically or virtually). Guests included representatives from Fortis BC, BC Hydro, ECCC and Global Affairs Canada. Col. Bullock then reviewed the agenda and led a discussion on approval of the Board's summer conference call minutes.

Sonja Michelsen (Secretary, U.S. Section) reviewed the Applicant's IJC Rule Curve compliance and provided a 2021-2022 hydrology year-in-review. Shannon Price (representing the applicant, Fortis BC) presented on Corra Linn Dam operations, and Gillian Kong (BC Hydro) presented on BC Hydro Kootenay Lake and Duncan Dam operations. Ms. Michelsen then finished the hydrologic conditions section by presenting on the USACE Libby Dam Operations.

Sytec, contractor for the Kootenay Lake Visualization Tool, gave a guest presentation and updated the board on the project's progress.

After a round table and lunch break, the Board discussed a number of business items including public correspondences, the automated hydrologic conditions update reports, the order review and climate change vulnerability assessment, board expansion, a new communications plan and updating the workplan.

Annual Public Meeting

The Annual Public Meeting was also held in-person at the Kootenai River Inn and Casino on October 5, from 7:00 to 8:30 pm (PST). The meeting was attended by 12 public attendees (4 in-person and 8 virtual attendees). Colonel Bullock provided introductions and welcoming remarks, and then proceeded to give an overview of the International Joint Commission framework, responsibilities, and composition. He described the duties of the Kootenay Board, outlined the history of the Kootenay Lake Order of Approval, and referenced the geographic area of the Kootenay Basin. Col. Bullock detailed the main provisions of the Order, including the historical dredging of Grohman Narrows, and explained the significance of Grohman Narrows control on Kootenay Lake levels vs. Corra Linn Dam control, which reduced peak lake levels on Kootenay Lake. Col. Bullock also described the repayment of additional pumping costs to farmers in Idaho.

The U.S. Secretary reviewed the Applicants IJC rule curve compliance and provided a 2021-2022 hydrology year-in-review.

Col. Bullock then led the meeting in a discussion of the Board's activities throughout 2022.

The Board took questions from the audience, covering a wide range of public and Kootenay Lake stakeholder concerns and interests. All questions and the Board responses are summarized in the minutes of the public meeting, which have been posted to the Board's website following approval by the board.

Field Tour

The board took a field trip on October 6, 2022 involving visits to the Kootenai Tribe's Twin Rivers Sturgeon and Burbot Hatchery and Nimz Ranch. Attendees learned about fish spawning behaviors and hatchery techniques, as well as the habitat restoration program in place for flood plain zones along the Kootenai River.

IJC Semi-Annual Appearances

The board presented a progress report during the spring IJC semi-annual meeting on April 5, 2022. U.S. co-chair Col. Alexander Bullock and U.S. section secretary Sonja Michelsen attended in person, while others attended the appearance virtually. The presentation focused on hydrologic conditions, and core and complimentary responsibilities related to the Order. Complementary responsibilities were summarized including the Corra Linn Dam spillway gate replacement project, bathymetric mapping of the lower Kootenai River and Kootenay Lake, Order review, and the Kootenay Lake Visualization tool development. Additional focus was placed on the Board's public engagement activities, which included public meetings, news releases and information paper publication.

A similar presentation was made on October 18 for the fall IJC semi-annual meeting in Ottawa. The fall presentation was delivered in-person by the Canadian co-chair David Hutchinson, with support in-person from Canadian section secretary Martin Suchy and virtually by the other board members.

Semi-Annual Conference Calls

During the fall 2020 Annual Board meeting, Board members agreed on the benefits to hold semi-annual conference calls in the Spring and Summer to stay abreast and discuss board issues and projects throughout the year. For 2022, the Board decided to hold these conference calls on May 17 and June 21.

The May 17 conference call included hydrologic condition review, Kootenay Lake Visualization tool updates, Order Review deliberations, and board expansion discussion. The bulk of the meeting was used to discuss a potential Order Review through specific considerations including climate change, environment and ecology, agriculture, flood risk, and Grohman Narrows capacity. Board consensus settled on recommending a multi-phased climate change vulnerability assessment of Kootenay Lake and Corra Linn operations first, to inform and direct the recommended Order Review with more specificity. The Board also established support for expanding the board, with continued consideration on number of individuals.

The June 21 conference included hydrologic condition review, review of the correspondence with the IJC, discussion of the IWI proposal for climate change work, an update to the work plan, updates on the visualization tool, and continued deliberation on the board expansion. Following this meeting the Board sent two letters to the IJC for approval and support for the proposed board expansion and order review.

Work Plan

The Board updated the IKLBC Work Plan at the Annual Board meeting in October 2022, to reflect the priorities leading into 2023. Ongoing Core Activities in the Work Plan were edited to follow a new Public

Communications Plan that is being developed for the Kootenay Board. Priorities through 2023 were updated to reflect completed items, prioritizing and editing existing items, and adding new items.

The Kootenay Order review decision was removed from the Work Plan, but the Kootenay lake Order Review and the Climate Change Vulnerability Assessment were added. In addition, the Board Expansion initiative, which includes First Nations and Tribal engagement, was also added to the Work Plan. Lastly, the development of a Board specific Public Communications Plan and its integration with the Core On-gong Work Plan Priorities was added.

Public Communications

Correspondences

The Board received no correspondence in 2022.

Regional District of Central Kootenay Presentation

On February 17, IKLBC co-chairs gave a presentation to the Regional District of Central Kootenay (RDCK) board. The presentation gave an overview of the IJC, IKLBC board, its mandate and activities, along with a review of the Order of Approval, and the IJC International Watershed Initiative (IWI) Framework. Finally, the board presented on the process, outline and research areas of the recently approved Kootenay Lake Information Paper. The IJC requested that the Kootenay Board review the Order and make a recommendation as to whether it should be revised. The paper assembled all available information to support potential further research and study regarding Kootenay Lake water management. The RDCK Directors asked a number of questions pertaining to the Board and its mandate, initiatives, and future direction with respect to IWI watershed status and changes to the Order.

News Releases

The Board published four news releases throughout 2022 on its IJC website (News Releases | International Joint Commission (ijc.org) to inform the public and news media about Board activities and hydrologic conditions within the Kootenay Lake basin. The first release, published on May 2, notified the public of the announcement of the Spring Rise for Kootenay Lake and the resulting adoption of the lowering formula for the Kootenay Lake Rule Curve. The second, published on August 12, provided an update on Kootenay Lake levels and snowmelt over the course of the freshet period, as well as the official end of the high-water period. The third, published on September 2, invited the public to join the Board in-person or virtually at its Annual Public Meeting. The final news release for 2022, published on October 28, notified the public of the release of the Board's Kootenay Lake Information Paper and the implications it had for the review of the 1938 Order. The Board had decided to recommend a review to the IJC, but would begin by conducting a Climate Changes Vulnerability Assessment to determine how the existing Order is vulnerable to a changing climate.

Development of Public Communications Plan

During the 2022 annual board meeting, the board discussed the creation of a board specific communications plan. The Board discussed the potential format of a communications plan, referencing those of other IJC Boards and organizations, and considered which aspects to incorporate within the board's plan. The work was started in the fall of 2022, and will be completed in 2023.

Special Projects

FortisBC Corra Linn Dam spillway gate replacement

The Board has been tracking the progress of the FortisBC Corra Linn Dam spillway gate replacement project. The scope was to replace all 14 spillway gates, reinforce and paint the hoist superstructure and upgrade various components, with a projected cost of $66.8 million (CDN). The construction schedule was to be from June 2018 with completion in September 2021; however, the timeline has been extended again as a result of delays associated with replacing the concealed components supporting the spillway at certain gates. To date all gates have been completed, and the remaining work onsite includes electrical upgrades, installation of the hoist cart enclosures, and defect correction work. Electrical repowering of the spillway is progressing well and scheduled to be complete in Q2 2023. The final design of the hoist cart enclosures is complete; however, delivery of the enclosures is not expected until Q2 2023, which is typically when the spillway gates are used to pass spring run-off (freshet). The prime contractor is scheduled to complete this work after the facility stops spilling water through the spillway gates in June/July. The contractor was not able to repair all the defective painting work on the superstructure and spillway gates prior to winter. Due to the defective painting work being primarily on the spillway gates. The contractor is planning to complete this work during the summer months of 2023.

The project enabled the dam to pass the Probable Maximum Flood, even when gates were under restoration, and has not impacted FortisBC's ability to comply with the Order of Approval.

Kootenay Lake Visualization Tool

The Board submitted an International Watershed Initiative (IWI) proposal and the IJC approved it in spring 2020 for funding a user-friendly interactive web-based visualization tool to highlight the complexities limiting outflows from Kootenay Lake, specifically the channel constriction at Grohman Narrows, to the public and stakeholders (Figure 6). The tool will communicate the drivers, seasonality, and variability of Kootenay Lake water levels, the constraints of the IJC 1938 Order of Approval Rule Curve, along with other overlapping demands. In 2022, the scope of work was finalized and the contract initiated for Sytec Engineering to commence the project. Sytec delivered a tool mockup, gave a presentation at the annual board meeting and ultimately delivered a functioning tool, which was installed on IJC servers, along with a summary report and a technical design document. Prior to the end of 2022, a contract amendment was initiated to add additional functionality pertaining to differing hydraulic occurrences. The project is slated to be completed by March 31, 2023. Once completed the tool will be linked on the board website for anyone to access.

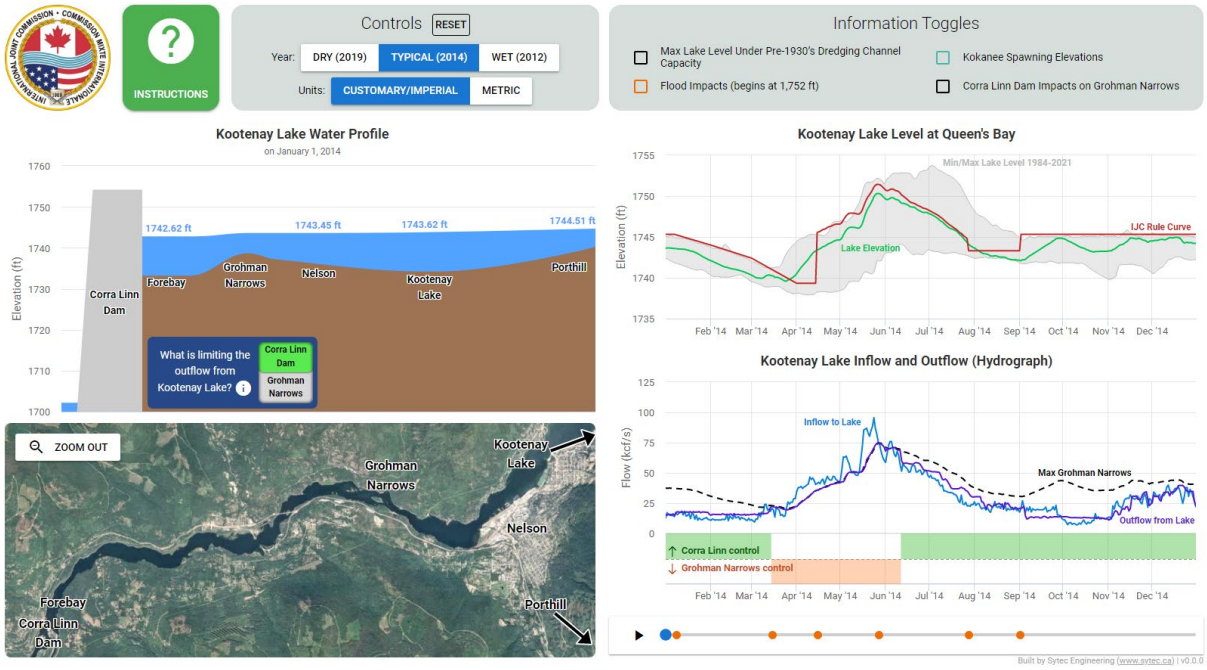

Figure 6. Kootenay Lake Visualization Tool screen capture.

Recommendations for Order Review and Climate Change Vulnerability Assessment

The 1938 Order has provided an effective means of managing Kootenay Lake for well over eight decades and provides direction for flood-risk reduction, hydropower production and agricultural interests. Some fishery needs have also been met outside of its scope. However, since 1938, significant changes, including the construction of two major upstream dams, flood-risk management actions, ecosystem improvements, etc., have occurred.

On July 29, 2022 the IKLBC sent a letter to the IJC to recommend a review of the 1938 Order, preceded by a climate change assessment. In response, the IJC replied in a letter on November 9, 2022 approving the public release of the Kootenay Information Paper, and approving the commencement of a climate vulnerability study followed by an eventual review of the Order. The IKLBC submitted an IWI proposal in November 2022 to begin scoping the climate change assessment.

Recommendation to Expand Board Membership

On the June 21, 2022 semi-annual conference call, the Board asked IJC liaisons for ways to best approach potential board expansion and a letter to the Commissioners was suggested. On August 2, 2022, the Board sent a letter to the IJC indicating that the Board wishes to expand the board by one or two members. The Board indicated that should the board expansion recommendation be approved, it would consider factors such as local basin connections, serving the public interest, having unbiased expertise, being well-informed and connected, and having binational viewpoints. The Board would consider Indigenous, municipal/regional governments, non-governmental organizations, and/or members of the public as potential individuals.

On November 9, 2022, the IJC responded with support and encouragement for the addition of local and Indigenous representation on board to better address transboundary water issues, improve communications, enhance diversity and increase engagement with local communities. The IJC approved the board's request with the proviso that the board consider that more than two members may be necessary. The Commission supports the above approach and encourages the Board to work with IJC liaisons as it considers and approaches prospective board members. The IJC recommended that the IKLBC get advice from the Tribes on preferred level of representation (advisory, voting member, non-voting member, etc), and the board concurred. The Board began reaching out the Tribes in winter 2023.

APPENDIX A: KEY BASIN VALUES AND STATISTICS IN 2022

A. Kootenay Lake at Queens Bay (FortisBC)

Maximum daily mean elevation	1,751.61 ft (533.89 m)	Jun 14
Minimum daily mean elevation	1,738.60 ft (529.93 m)	Apr 24
Annual mean elevation	1,743.68 ft (531.47 m)	

The annual mean elevation was 99.97 percent of the 93-year (1929-2021) average of 1,744.22 ft (531.64 m).

B. Kootenay Lake at Queens Bay (ECCC Station no. 08NH064)

Maximum instantaneous elevation	1,751.59 ft (533.89 m)	Jun 15 11:25
Minimum instantaneous elevation	1,738.56 ft (529.91 m)	Apr 25 17:45
Maximum daily mean elevation	1,751.57 ft (533.88 m)	Jun 15
Minimum daily mean elevation	1,738.58 ft (529.92 m)	Apr 25
Annual mean elevation	1,743.67 ft (531.47 m)	

The annual mean elevation was 99.96 percent of the 90-year (1932-2021) average of 1,744.30 ft (531.66 m).

C. Calculated Kootenay Lake Backwater

Maximum backwater	0.38 ft (0.12 m)	Mar 12
Minimum backwater	-0.97 ft (-0.30 m)	Jun 29
Annual mean backwater	-0.19 ft (-0.06 m)	

D. Kootenay Lake Inflow (FortisBC)

Maximum inflow	100,800 cfs (2,854 cms)	Jun 11
Minimum inflow	6,200 cfs (175.6 cms)	Oct 11
Annual mean inflow	28,512 cfs (807.4 cms)	

The annual mean inflow was 107 percent of the 23-year (1999-2021) average of 26,755 cfs (757.6 cms).

E. Kootenay Lake Outflow (FortisBC)

Maximum outflow	83,600 cfs (2,367 cms)	Jun 15
Minimum outflow	8,000 cfs (226.5 cms)	Oct 10
Annual mean outflow	28,597 cfs (809.8 cms)	

The annual mean outflow was 107 percent of the 23-year (1999-2021) average of 26,756 cfs (757.6 cms).