



International Osoyoos Lake Board of Control
2022 Report to the International Joint Commission





Cover Photo:

Aerial view of Osoyoos, BC and Osoyoos Lake.

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EXECUTIVE SUMMARY

This report documents the activities of the International Osoyoos Lake Board of Control (IOLBC or Board), hydrologic and climatic conditions of the Okanagan/Okanogon and Similkameen basins, and compliance of the Applicant to the International Joint Commission (IJC or Commission) Orders of Approval for Osoyoos Lake during 2022. The Board, comprised of ten members with equal representation from Canada and the U.S., was established on September 12, 1946 by the IJC to carry out the provisions of the Commission's Order of Approval. In 2022, the Board operated under the authority of the Commission's Supplementary Order dated January 29, 2013.

To fulfill its mandate, the Board's efforts were focused on water-level management issues related to the operation of Zosel Dam, located on the Okanagan (Canadian spelling)/Okanogon (U.S. spelling) River about 1.6 mi (2.6 km) downstream from the outlet of Osoyoos Lake, a water body that straddles the international boundary between Canada and the United States. Zosel Dam is owned by Washington State, which is referred to as the Applicant in the IJC Orders and this annual report. The dam is operated by the Oroville-Tonasket Irrigation District under contract with the Washington State Department of Ecology (WADOE).

During 2022, the Board held quarterly teleconferences, hosted in-person annual Board and Public meetings, and briefed IJC Commissioners during the spring and fall semi-annual meeting to fulfill its mandate from the IJC to oversee the IJC Orders for Osoyoos Lake. The Board also oversaw several special projects in 2022, including: bathymetric survey of Osoyoos Lake and parts of the Okanogon and Similkameen Rivers, which will contribute to the climate change study described below. The integration of the Similkameen and Okanogon hydrologic models to assess and plan for the effects of projected climatic changes within the Okanogon River Basin on the IJC Orders of Osoyoos Lake. And, to assess the history and environmental conditions contributing to the formation of ice jams on Osoyoos Lake. Finally, the Board oversaw the planning of the Osoyoos Lake Water Science Forum, which was held in October 2022 in Osoyoos, B.C.

Temperatures varied above and below normal throughout 2022. Precipitation was below normal for the majority of the year apart from a period of high rainfall in June. Snowpack in the Similkameen basin shifted from above normal to below normal over the 2022 water year whereas snowpack in the Okanogon basin was consistently below normal. Cool spring and early summer temperatures resulted a delayed peak and snowmelt in both basins. This delayed snowmelt, combined with the June rainfall led to later and above average freshet peaks throughout the basins. Similkameen River April-July cumulative runoff exceeded the 1,000,000 acre-feet drought criterion. Okanogon Lake inflow peaked a month later than normal in June, though net losses were first seen in August, consistent with the historical period. Both Okanogon Lake April-July net inflow and Jun-July elevation exceeded their drought criterion of 195,000 acre-feet and 1,122.6 feet, respectively. Since no drought criteria for the IJC Orders for Osoyoos Lake were met in 2022, a drought was not declared for the purposes of the Order. Osoyoos Lake elevation exceeded the rule curve from June 8 to July 27, though the applicant remained in compliance as all Zosel Dam gates were open during this time. During the freshet, no measured backwater conditions from the Similkameen River occurred and Osoyoos Lake peaked at 912.99 feet on June 22. For the purposes of the Order, discharge capacity of the Okanogon River (2,500 cfs) when Osoyoos Lake level is 913 feet and no backwater occurs was demonstrated in 2022.



UNIT CONVERSION FACTORS

Customary (Imperial) to Système International (Metric)

Multiply	By	To obtain
<i>Length</i>		
inch (in)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<i>Area</i>		
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)
<i>Volume</i>		
acre-feet (ac-ft)	1,233	cubic meter (m ³)
Thousand acre-feet (Kac-ft)	1.233	thousand cubic decameters (kdam ³)
<i>Flow Rate</i>		
cubic foot per second (cfs)	0.02832	cubic meter per second (cms)

Système International (Metric) to Customary (Imperial)

Multiply	By	To obtain
<i>Length</i>		
millimeter (mm)	0.03937	inch (in)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
<i>Area</i>		
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)
<i>Volume</i>		
cubic meter (m ³)	0.0008107	acre-feet (ac-ft)
thousand cubic decameters (kdam ³)	0.8107	Thousand acre-feet (Kac-ft)
<i>Flow rate</i>		
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:

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

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

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



LIST OF ACRONYMS

IJC	International Joint Commission
IOLBC	International Osoyoos Lake Board of Control
ECCC	Environment and Climate Change Canada
WSC	Water Survey of Canada
USGS	United States Geological Services
USACE	United States Army Corps of Engineers
OLRS	Okanagan Lake Regulation System
OBWB	Okanagan Basin Water Board
OTID	Oroville Tonasket Irrigation District
cfs	cubic feet per second
cms	cubic meters per second
SWE	Snow water equivalent





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OSOYOOS LAKE

Osoyoos Lake is a 10-mile (16-km) long by 1-mile (1.6-km) wide lake that spans the international boundary between Canada and the United States in southcentral British Columbia and northcentral Washington State (

Figure 1). The Okanogan River flows into Osoyoos Lake north of Osoyoos, BC, and is largely regulated by Okanogan Lake Dam operations. During normal hydrologic conditions, outflow from Osoyoos Lake into the Okanogan River is controlled by the operation of Zosel Dam about 1.6 mi (2.6 km) downstream from the outlet of Osoyoos Lake. During periods of high runoff, the Similkameen River may cause backwater of the Okanogan River at which point the stage of the Similkameen River controls outflow from Osoyoos Lake. The Similkameen River's watershed is mostly within Canada, but two of its headwaters tributaries, the Pasayten and Ashnola Rivers, originate in the United States.

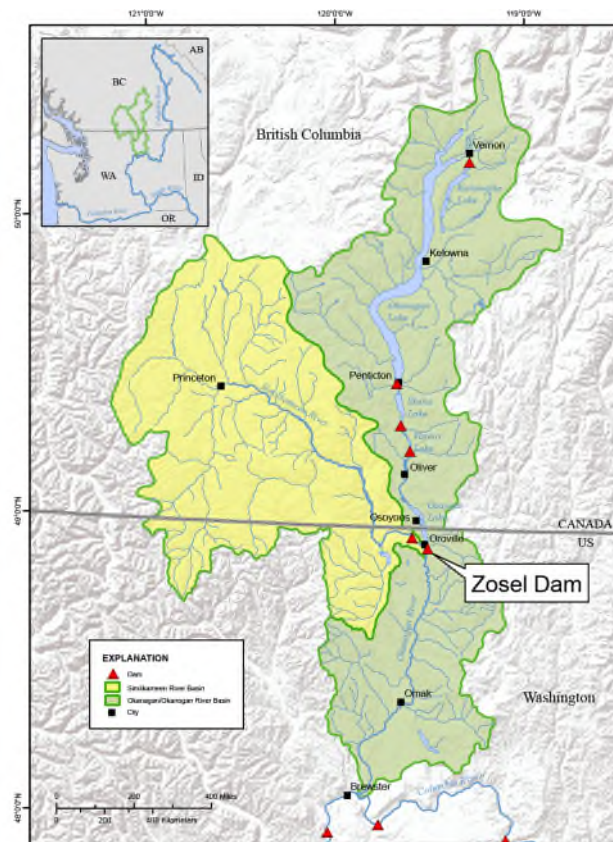











Figure 1. Location of Zosel dam, and the Okanagan/Okanogan and Similkameen watersheds.

BOARD MEMBERSHIP

In 2022, the size of the Board remained the same at twelve total members with equal representation from Canada and the U.S. There were no changes to the Board’s membership.

Canadian Section		U.S. Section	
	<u>Dave Hutchinson</u> (Co-Chair) Regional Chief, Pacific and North Hydrometric Operations Environment & Climate Change Canada		<u>Cindi Barton</u> (Co-Chair) Director (retired) U.S. Geological Survey – Washington Water Science Center
	<u>Ted White</u> (Member) Director and Comptroller of Water Rights B.C. Ministry of Forests		<u>Col. Alexander Bullock</u> (Member) District Engineer U.S. Army Corps of Engineers – Seattle District
	<u>Anna Warwick Sears</u> (Member) Executive Director Okanagan Basin Water Board		<u>John Arterburn</u> (Member) Principle Biologist Confederate Tribes of the Colville Reservation
	<u>Sue McKortoff</u> (Member) Mayor of Osoyoos Town of Osoyoos		<u>Kris Kauffman</u> (Member) Water Resource Engineer
	<u>Brian Symonds</u> (Member) Director (retired) B.C. Ministry of Forests, Lands, Natural Resource Operations & Rural Development		<u>Arnie Marchand</u> (Member) Private Citizen
	<u>Martin Suchy</u> (Secretary) Water Management Scientist National Hydrological Services Environment & Climate Change Canada		<u>Andrew Gendaszek</u> (Secretary) U.S. Geological Survey – Washington Water Science Center

ORDER OF APPROVAL

Rule Curve

Throughout any given year, Osoyoos Lake levels may fluctuate in accordance with criteria specified in the IJC’s Supplementary Order of Approval dated January 29, 2013. These criteria are summarized within the rule curve presented in Figure 2.

The gray area in Figure 2 shows the allowable range of normal operating elevations: an upper range of 911.5 ft (277.8 m) on January 1; 911.5 ft (277.8 m) on March 1; 912 ft (278.0 m) on May 1; 912 ft (278.0 m) on September 15; 911.5 ft (277.8 m) on November 1 and 911.5 ft (277.8 m) on December 31; and to the extent possible the elevation of Osoyoos Lake does not fall below the NGVD 1929 elevation of 909.0 ft (277.0 m) on January 1; 909.0 ft (277.0 m) on March 31; 910.0 ft (277.4 m) on April 1; 911 ft (277.7 m) on June 1; 911 ft (277.7 m) on September 15; 910.0 ft (277.4 m) on October 31; 909.0 ft (277.0 m) on November 1 and 909.0 ft (277.0 m) on December 31. Elevation limits are linearly interpolated between dates.

The area between the red dashed lines in Figure 2 shows the lake elevations authorized by the IJC from April 1 to October 31 if drought criterion 8(a) and either 8(b i) or 8(b ii) in Table 1 are declared in effect



by the Board, or such as in 2019, when a Condition 10 variance is approved. During such conditions, the elevation of Osoyoos Lake may be raised to 912.5 ft (278.1 m) from April 1 to September 15, after which the lake level shall be decreased to reach an elevation of 911.5 ft (277.8 m) by November 1. To the extent possible, during the April 1 to October 31 period, the elevation of Osoyoos Lake should not fall below 910.0 ft (277.4 m) on April 1; 910.5 ft (277.5 m) on June 1; 910.5 ft (277.5 m) on September 15; and 910.0 ft (277.4 m) on October 31. Between dates, elevation limits are linearly interpolated. Condition 9 of the 1982 Order recognizes that backwater from high flow in the Similkameen River and (or) excessive flow in the Okanagan River may cause Osoyoos Lake levels to rise above the authorized range.

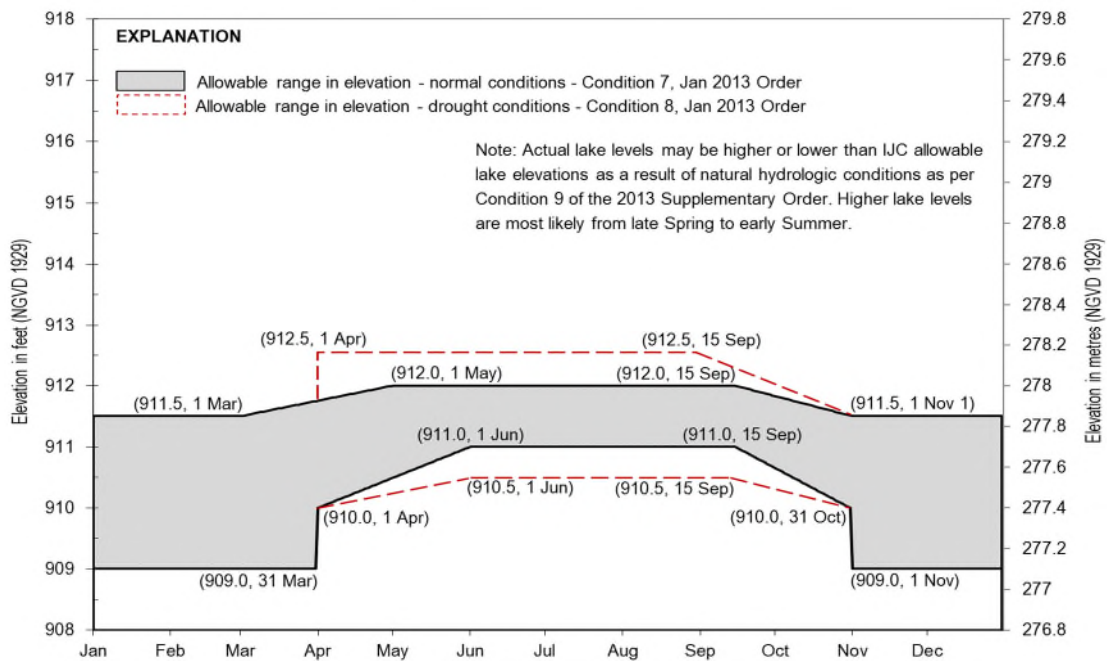


Figure 2. 2013 Osoyoos Lake Supplementary Order of Approval Rule curve.

Drought Criteria

Condition 8 of the Commission's Supplementary Orders of Approval dated January 29, 2013, provides three criteria for declaring a year of drought (Table 1). In a year when the Board has declared a drought, Osoyoos Lake level may be managed under the drought rule curve specified within Condition 8 that allows a wider range from April through October as compared to non-drought years (Figure 2).



Table 1. Summary of drought criteria. The Board declares a drought if condition 8(a) and either condition 8(b i) or 8(b ii) are met (af, ac-ft; acre-foot; ft, feet)

Condition	Criteria for declaring a drought	Numerical criteria
Condition 8(a)	Volume of flow in the Similkameen River at Nighthawk, WA, for the period April through July as calculated or forecasted by U.S. authorities is less than 1 million ac-ft	< 1,000,000 acre-feet
Condition 8(bi)	Net inflow to Okanagan Lake for the period April through July as calculated or forecasted by Canadian authorities is less than 195,000 ac-ft	< 195,000 acre-feet
Condition 8(bii)	Level of Okanagan Lake in June or July is less than or is forecasted by Canadian authorities to be less than 1,122.6 ft (Canadian Geodetic Survey Datum)	< 1,122.6 feet

HYDROLOGIC CONDITIONS

Climate and Snowpack

Climatological conditions within the Okanagan/Okanogan and Similkameen basins varied during 2022. In fall 2021, NOAA issued a seasonal outlook for La Nina conditions, which typically results in wetter conditions on the coast and colder conditions inland, with Osoyoos Lake at the boundary between the two. While near-normal temperatures prevailed at the start of the year, temperatures decreased below normal in the spring and early summer, exceeded normal through summer to early autumn, and decreased to below normal by late fall and early winter. In general, precipitation was below normal for the majority of 2022 apart from a period of above-normal rainfall in June (Figure 3).

Snowpack in the Similkameen basin, as measured at Blackwall Peak (elevation 1,940 m (6,365 ft)), was mostly above normal through fall 2021 and early winter 2022 but shifted to mostly below normal between February and May (Figure 4). Snow water equivalent (SWE) at Blackwall Peak reached its annual maximum in early May 2022 just after the historical mean, but delayed melt resulted in above average SWE during May and June with complete snowmelt by early July. In the Okanagan basin, as measured at Mission Creek (elevation 1,780 m/5,840 ft), the snowpack was below normal from the beginning of the water year to early May (Figure 4). It peaked by late May, well after the historical mean, and melted completely by late June. The delayed snowmelt in both basins was due in part to the cooler than normal spring and early summer temperatures. Prior to June, snow water indices for the Okanagan and Similkameen were below and near normal, respectively (Figure 5). In June, snow water indices for both basins were well above 100% percent of normal.

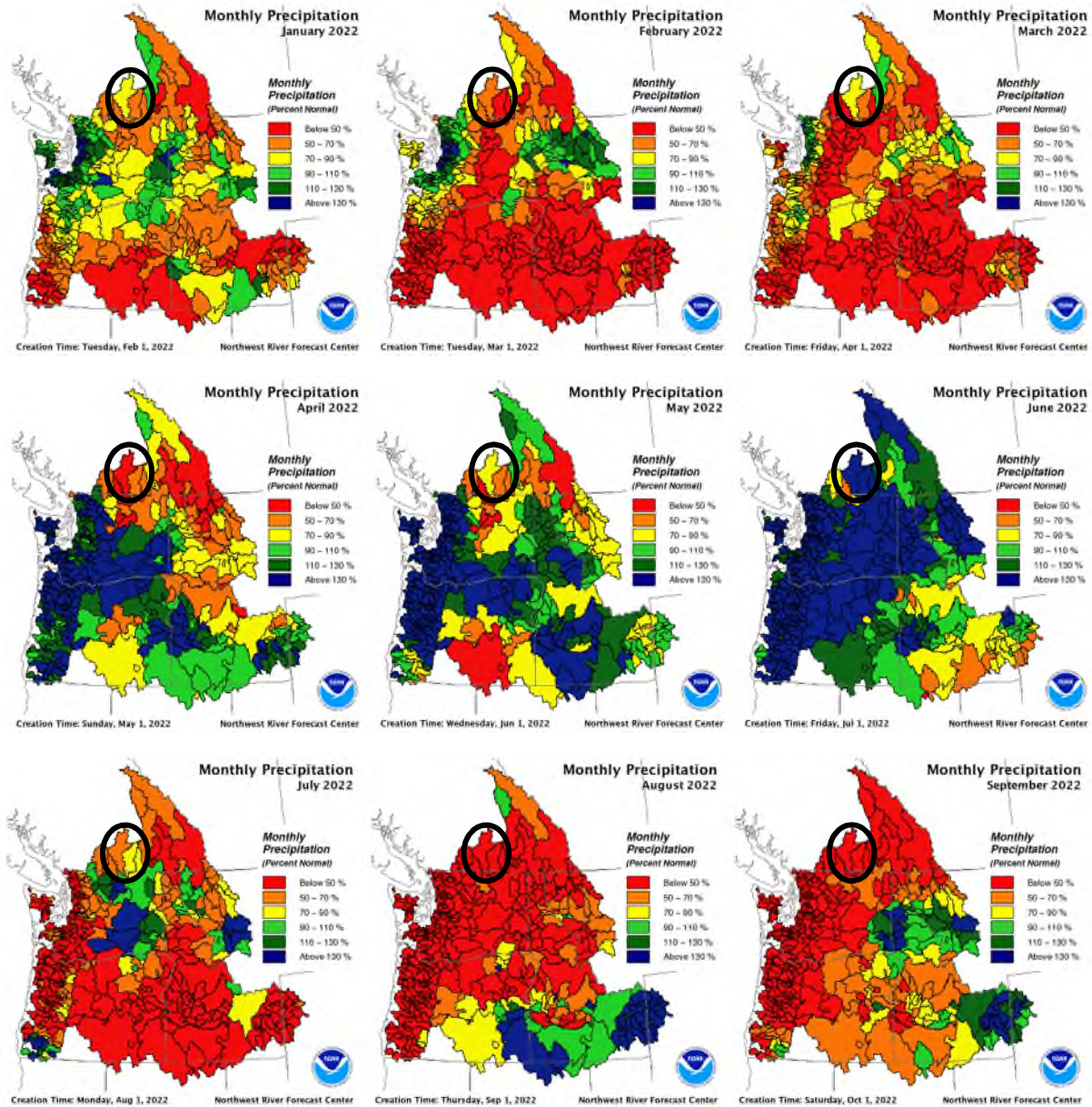


Figure 3. Monthly Precipitation in the Columbia River Basin. The black oval represents the Okanagan/Okanogan and Similkameen River Basins. January to September 2022.

NOAA, https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?date=10/01/2019&tab=1

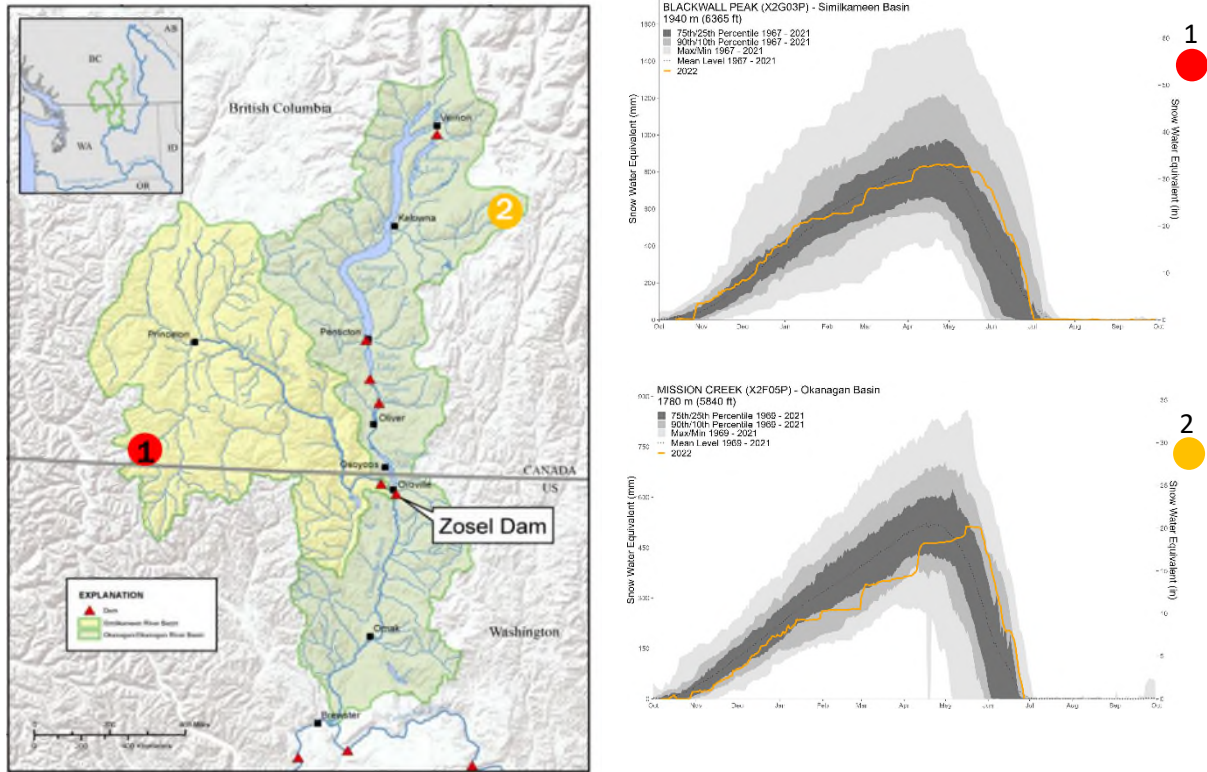


Figure 4. Mountain snowpack conditions for water year 2021-2022. Historical Maximum, 75th/25th Percentile, Daily Mean, Minimum, and 2021/2022 data. 1) Blackwell Peak (1967-2022) Similkameen River Basin, 2) Mission Creek (1969-2022) Okanagan/Okanagan River Basins. (BC River Forecast Center, 2022).

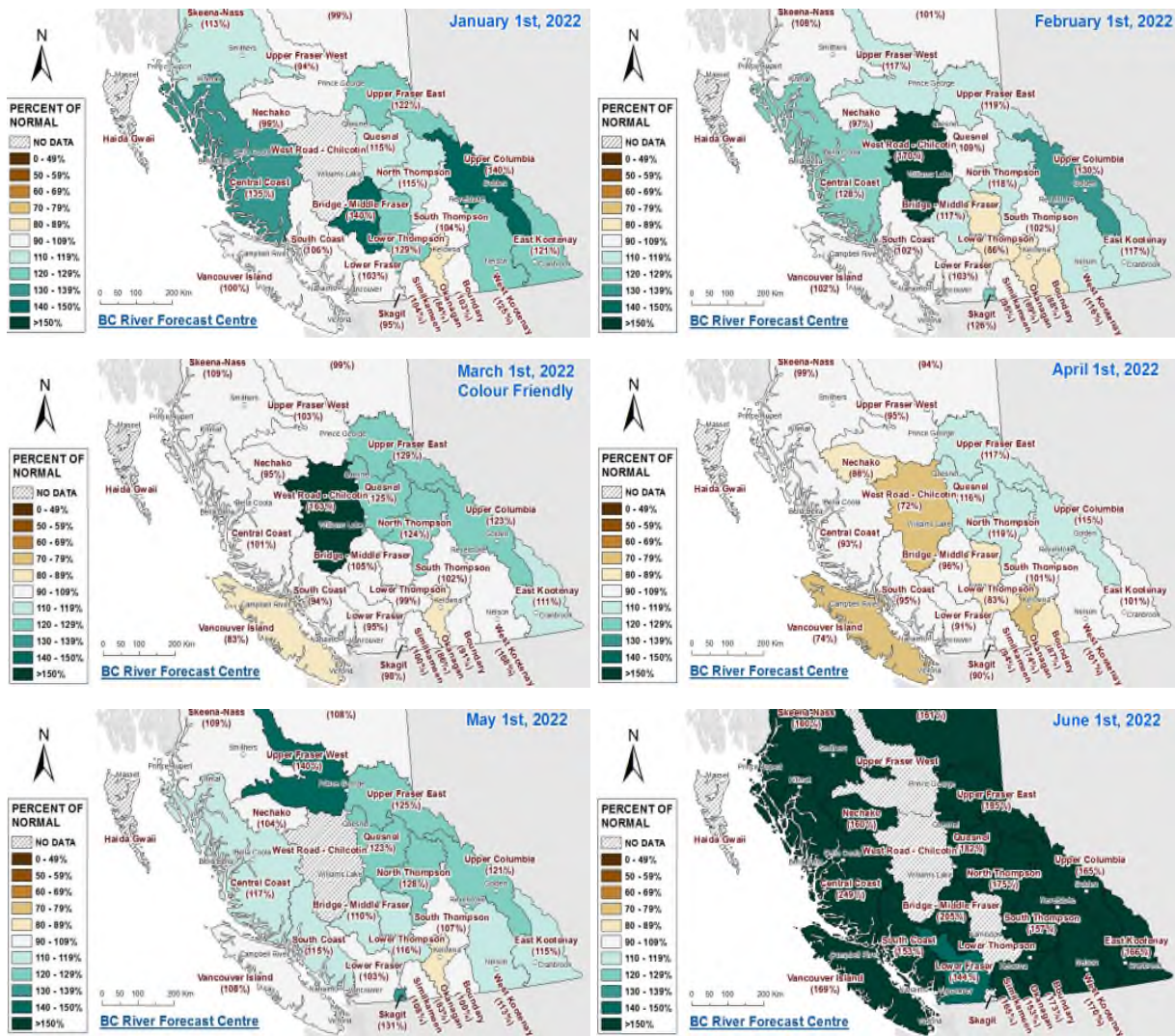


Figure 5. Monthly Basin Snow Water Index, indicating conditions as a percent of normal. For the period January to June 2022 (Province of British Columbia, River Forecast Centre, 2022).

Okanagan Lake and Okanagan River

The monthly net inflow was greatest in June at 229,000 acre-feet (283 million m³), which was a month later than normal due to cooler June temperatures and persistent snowpack (Figure 6). Net losses from the lake began in August, consistent with the period of record (1944-2021) average. The cumulative April 1 to July 31 net inflow reached 492,000 acre-foot (607 million m³), well above the 195,000 acre-feet drought threshold (Condition 8bi). In 2022, the peak Okanagan Lake level reached 1,124.10 feet (342.63 m) on June 27, exceeding the operational target of 1,123.6 feet (342.48 m) (Figure 7), while also being close to the period of record average peak on June 28. The peak lake level exceeded the early April and May forecasted levels of 1123.00 and 1123.03 feet, respectively. All levels surpassed the drought criteria threshold of 1122.6 feet for the June and July period.

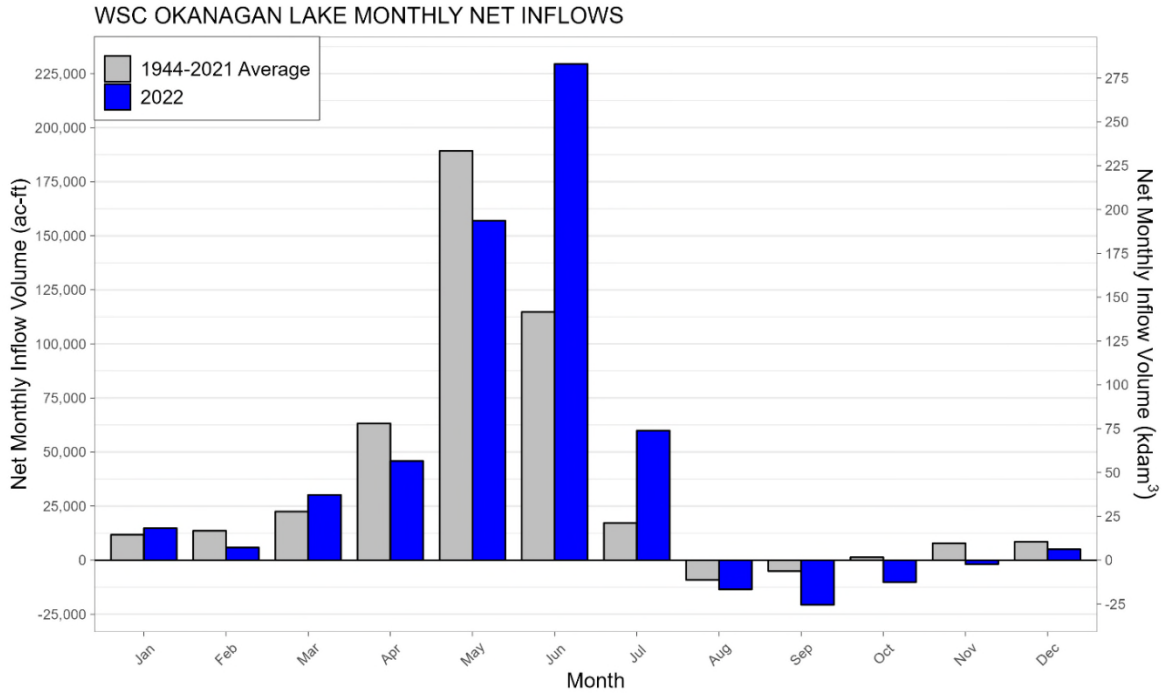


Figure 6. Historical monthly mean (1944-2021), and 2022 monthly net inflow to Okanagan Lake.

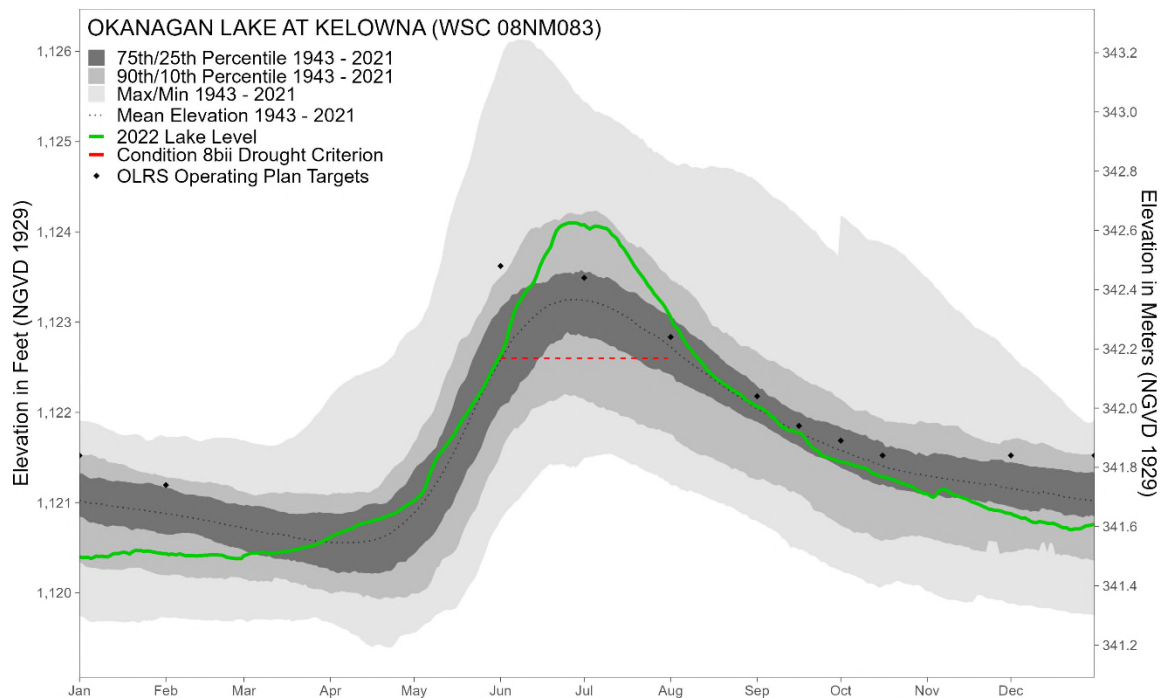


Figure 7. Okanagan Lake at Kelowna (WSC station 08NM083), BC. Historical (1943-2021): Maximum, 90th/10th and 75th/25th Percentiles, Daily Mean, Minimum, 2022 water-surface elevation (Environment and Climate Change Canada, 2022), Condition 8(bii) Drought Criteria – 1,122.6 ft (IJC Order of Approval), and Okanagan Lake Regulation System operating plan target lake levels (BC Ministry of Forest, 2022).

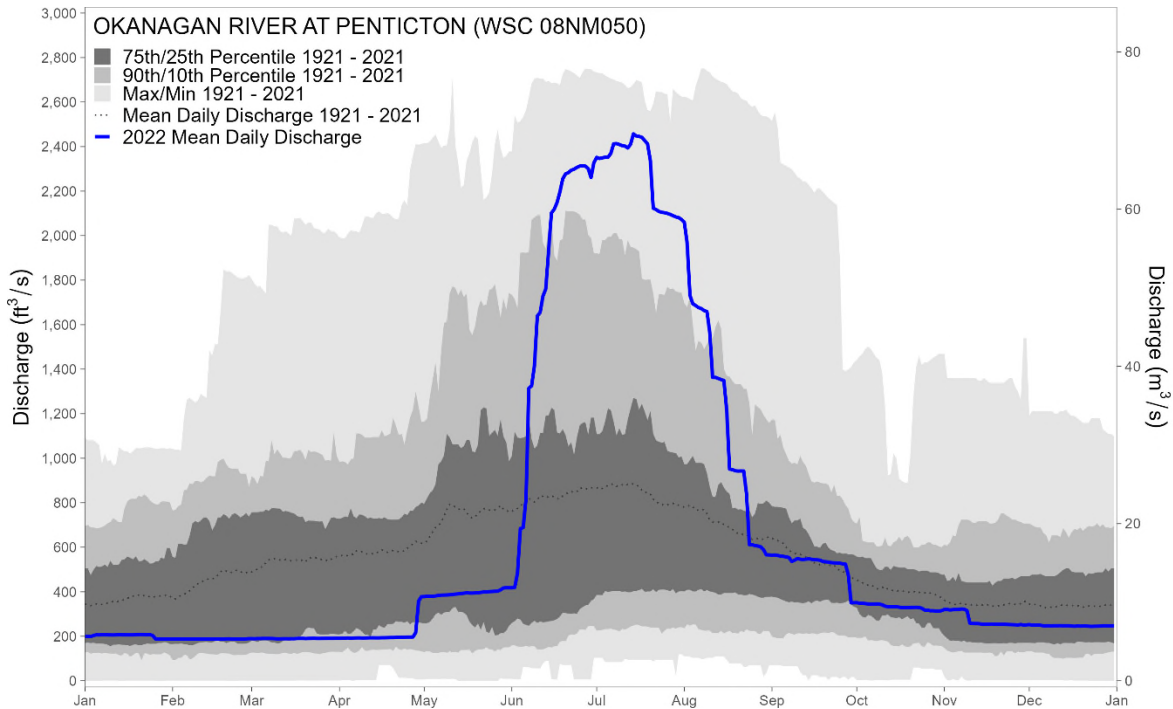


Figure 8. Okanagan River at Penticton (WSC station 08NM050), British Columbia. Historical (1921-2021): Maximum, 90th/10th and 75th/25th Percentiles, Daily Mean, Minimum, and 2022 streamflow discharge (Environment and Climate Change Canada, 2022).

Okanagan River at Penticton (Figure 8) reached a peak discharge of 2,457 cfs (69.6 cms) on July 14, which is congruent with the average historical peak, and was close to the 97th percentile for the 101-year period of record (1921-2021). Discharge in the Okanagan River at Penticton was below average and close to the 25th percentile for most of the 2022 winter, as the Okanagan Lake Regulation System (BC Ministry of Forest) limited lake outflows to replenish depleted storage within Okanagan Lake (Figure 7) following the dry conditions in summer/fall 2021. Lake levels reached historical average conditions by March 30, and remained above average until September 7, when they once again dropped below average. Fall 2022 average daily discharge remained below average after September 28 due to warm and dry conditions.

Discharge of the Okanagan River near Oliver (Figure 9) reached a peak discharge of 3,244 cfs (91.9 cms) on June 20, which was approximately four weeks delayed from the average peak flow period of late May. Because of the late persistent snowpack at higher elevations, the peak flow set a historical maximum (period of record 1944-2021) for June 20. The delayed discharge peak at Oliver was due to delayed snowmelt in June, which contributed to higher unregulated tributary inflows into the Okanagan River main stem between Penticton and Oliver. The fall flow regime at Okanagan River near Oliver mostly mirrored that of flow at Penticton, as the tributary inflow was minimal during the warm and dry fall period. Discharge measured at this hydrometric station represents inflows to Osoyoos Lake.

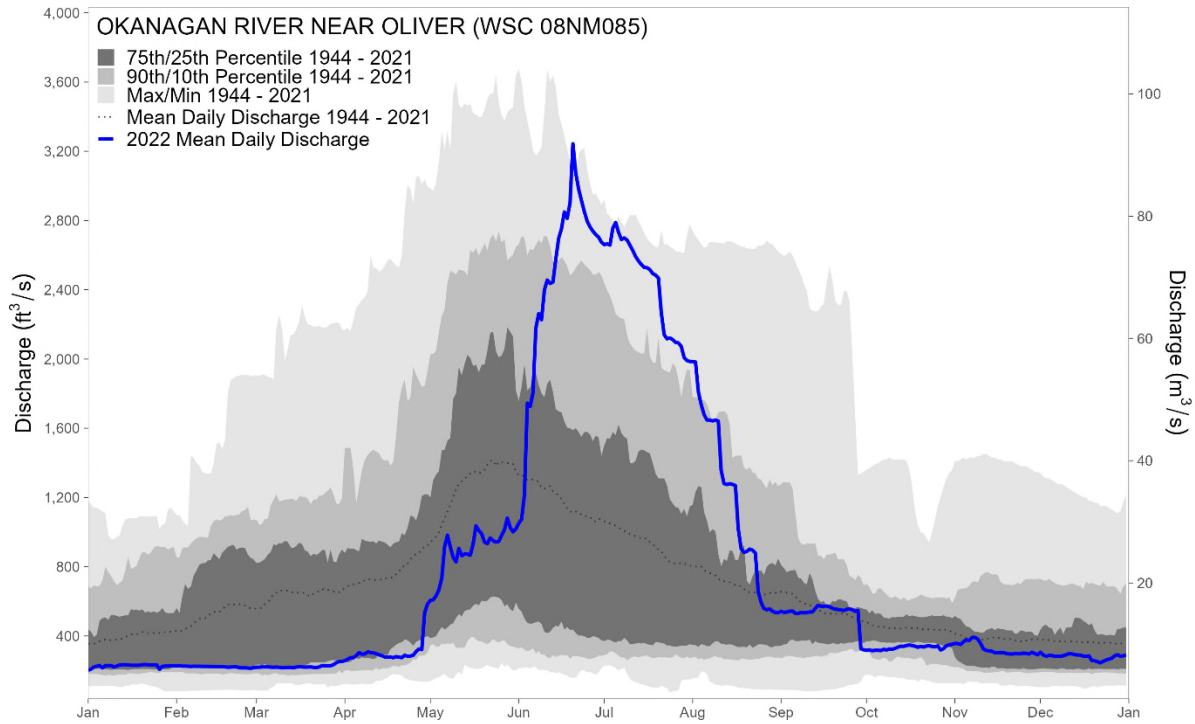


Figure 9. Okanagan River near Oliver (WSC station 08NM085), British Columbia. Historical (1944-2021): Maximum, 90th/10th and 75th/25th Percentiles, Daily Mean, Minimum, and 2022 streamflow discharge (Environment and Climate Change Canada, 2022).

Similkameen River and Okanagan River

The drought criteria 8a threshold for the Similkameen River was not met in 2022 (Table 1). Cumulative April - July flow volume for the Similkameen River was 1,476,000 acre-feet (1,820 million m³) as measured at the USGS streamflow gaging station at Nighthawk, which was lower than the early April and early May forecasts of 1,483,000 and 1,512,000 acre-feet, respectively, but still above the 1-million-acre-foot threshold.

The Similkameen River near Nighthawk (USGS station 12442500) discharge was generally above the 75th percentile for most of the 2022 winter/spring (January to April), with flows returning to near average conditions by mid-April. The river reached a peak discharge of 14,700 cfs (416 cms) on June 6 and 7 (Figure 10), which was delayed from the average historical peak (May 30). The 2022 daily mean peak was close to the 88th percentile for the 93-year period of record (1928-2021). Summer flows dropped to below average by mid-July, and remained low through the late summer and fall due to warm temperatures and extended dry conditions in the basin.

As of November 12, Similkameen River discharge data became unavailable due to ice cover and remained so through the remainder of the year. Discharge was estimated for this period.

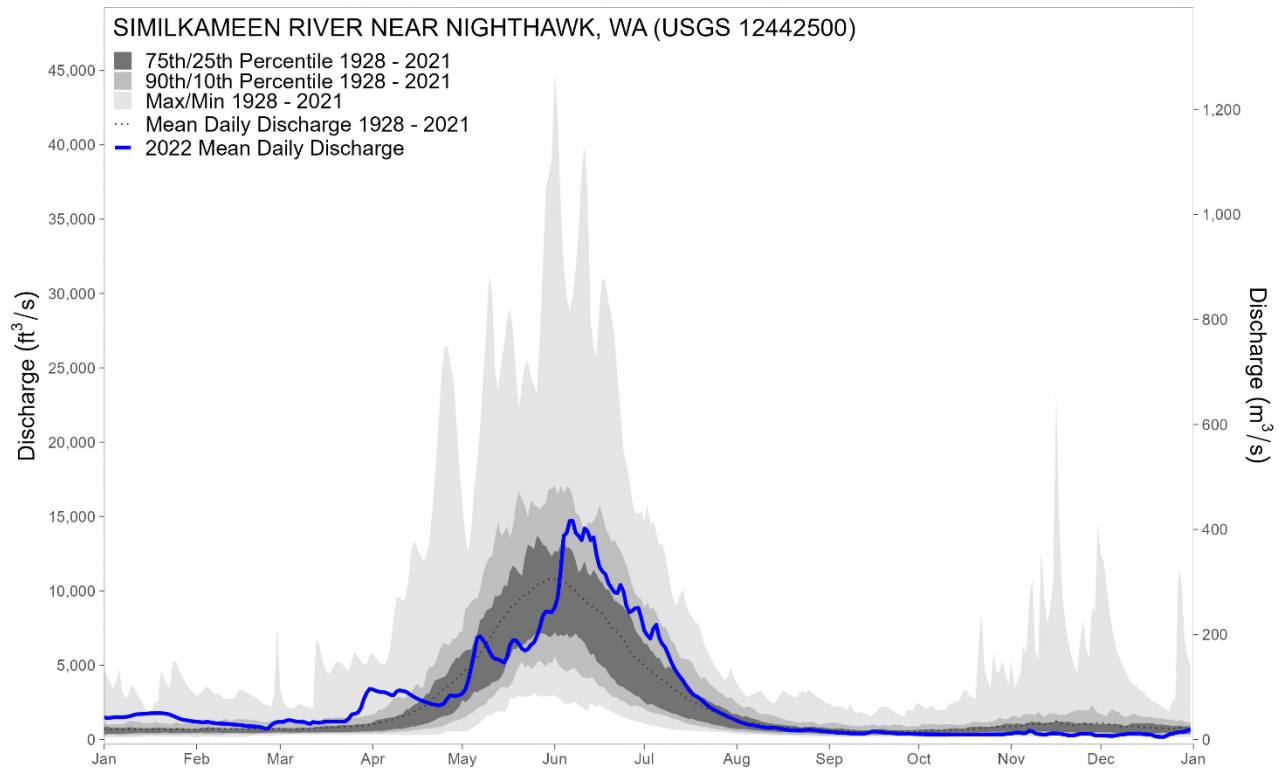


Figure 10. Similkameen River at Nighthawk (USGS 1244250), Washington. Historical (1928-2021): Maximum, 90th/10th and 75th/25th Percentiles, Daily Mean, Minimum, and 2022 mean daily discharge (US Geological Survey, 2022).

Mean daily discharge of the Okanogan River at Oroville (downstream from Zosel Dam) ranged from a minimum of 173 cfs (4.9 cms) over multiple days in March to a maximum of 3,120 cfs (88.3 cms) on Jun 21 and 22 (Figure 11). During the days of maximum discharge, the corresponding Osoyoos Lake elevation was 912.98 ft (278.28 m) and 912.99 ft (278.28 m) (Figure 12). There exists the potential for ice jams to occur in the southern section of Osoyoos Lake due to the accumulation of ice flows during periods of sub-freezing temperatures and strong northerly winds. These events can reduce the conveyance capacity of the Okanogan River and cause a concomitant increase in the level of Osoyoos. No ice jams were observed in 2022.

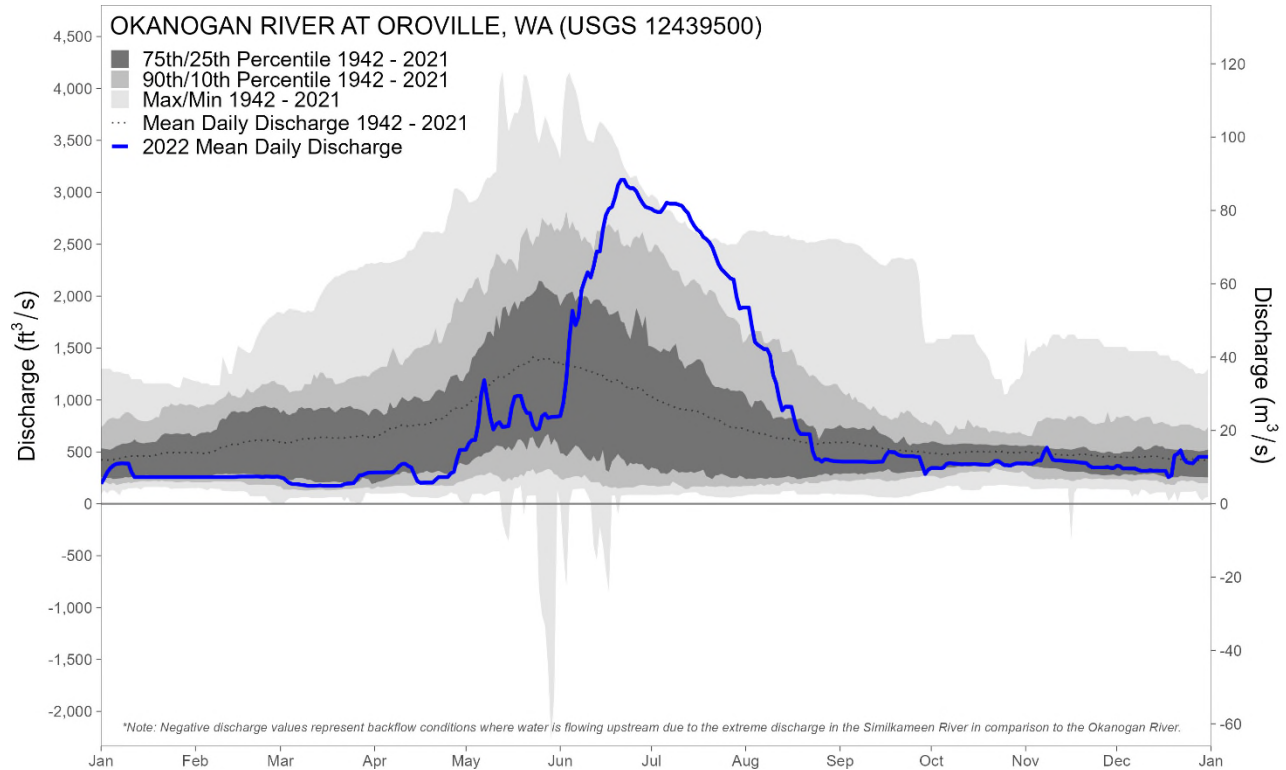


Figure 11. Okanogan River at Oroville (USGS station 12439500), Washington. Historical (1942-2021): Maximum, 90th/10th and 75th/25th Percentiles, Daily Mean, Minimum, and 2022 mean daily discharge (US Geological Survey, 2022).

Osoyoos Lake

Throughout any given year, Osoyoos Lake levels may fluctuate in accordance with criteria specified in the IJC’s Supplementary Order of Approval dated January 29, 2013. Lake levels are influenced naturally by discharge in the Okanogan/Okanogon and Similkameen Rivers and by the operation of Zosel Dam. Mean daily lake levels measured at the USGS Station no. 12439000 (Osoyoos Lake at Oroville) are plotted in green for 2022 (Figure 12). In 2022, January and February lake levels were close to historical minimum due to reduced outflows from Okanogan Lake as previously stated. Lake levels rose steadily from early March until late-May, and generally remained between the historical minimums and the 10th percentiles. In early-June, lake levels began to climb more rapidly, exceeding the Condition 7 Normal Rule Curve level of 912 feet on June 8, and reaching a mean daily peak of 912.99 feet (278.28 m) on June 22. Level remained above the Rule Curve until July 27, but the Applicant remained in compliance, as all Zosel Dam gates were open during this time. Lake levels remained near historical average in the months on August and September, then dropped to near historical daily minimums from early October until early November, after which they remained near the 10th historical percentile for the remainder of the year.

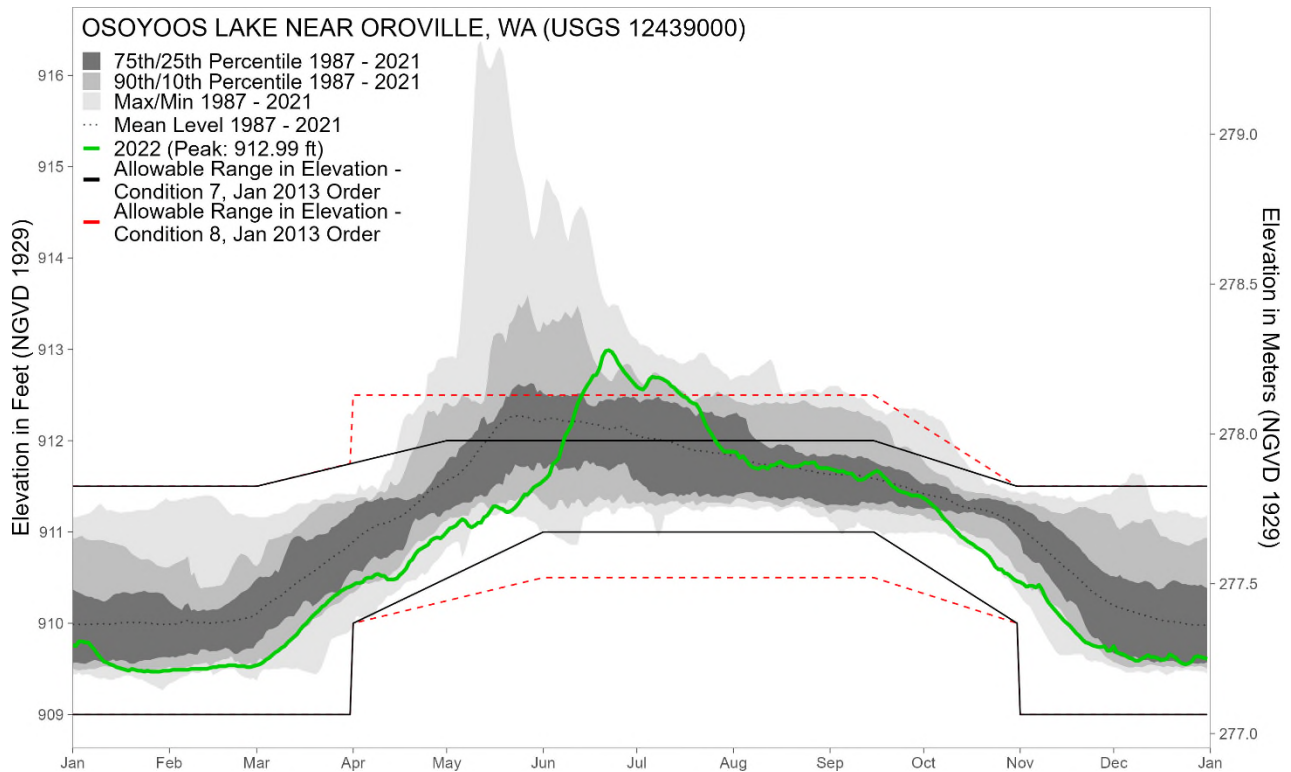


Figure 12. Allowable Osoyoos Lake elevations per IJC Supplemental Order of Approval dated January 29, 2013, Historical (1987-1921): Maximum, 75th/25th and 90th/10th Percentiles, Daily Mean, Minimum, and 2022 daily mean lake elevations recorded at USGS station 12439000.

Backwater Conditions

Low inflows into Osoyoos Lake from the Okanogan River, combined with high flows in the Similkameen River (at the confluence with Okanogan River) may result in a slowing or reversal of flow across Zosel Dam due to a backwatering that limits outflow from Osoyoos Lake under certain conditions.

In 2022, elevated discharge of the Similkameen River (above 10,000 cfs, Figure 13 – light blue line) began in early June, but did not correspond with reduced discharge of the Okanogan River at the outlet of Osoyoos Lake during the spring freshet (Figure 13 – dark blue line). The figure illustrates there were no spring backwater conditions in 2022.

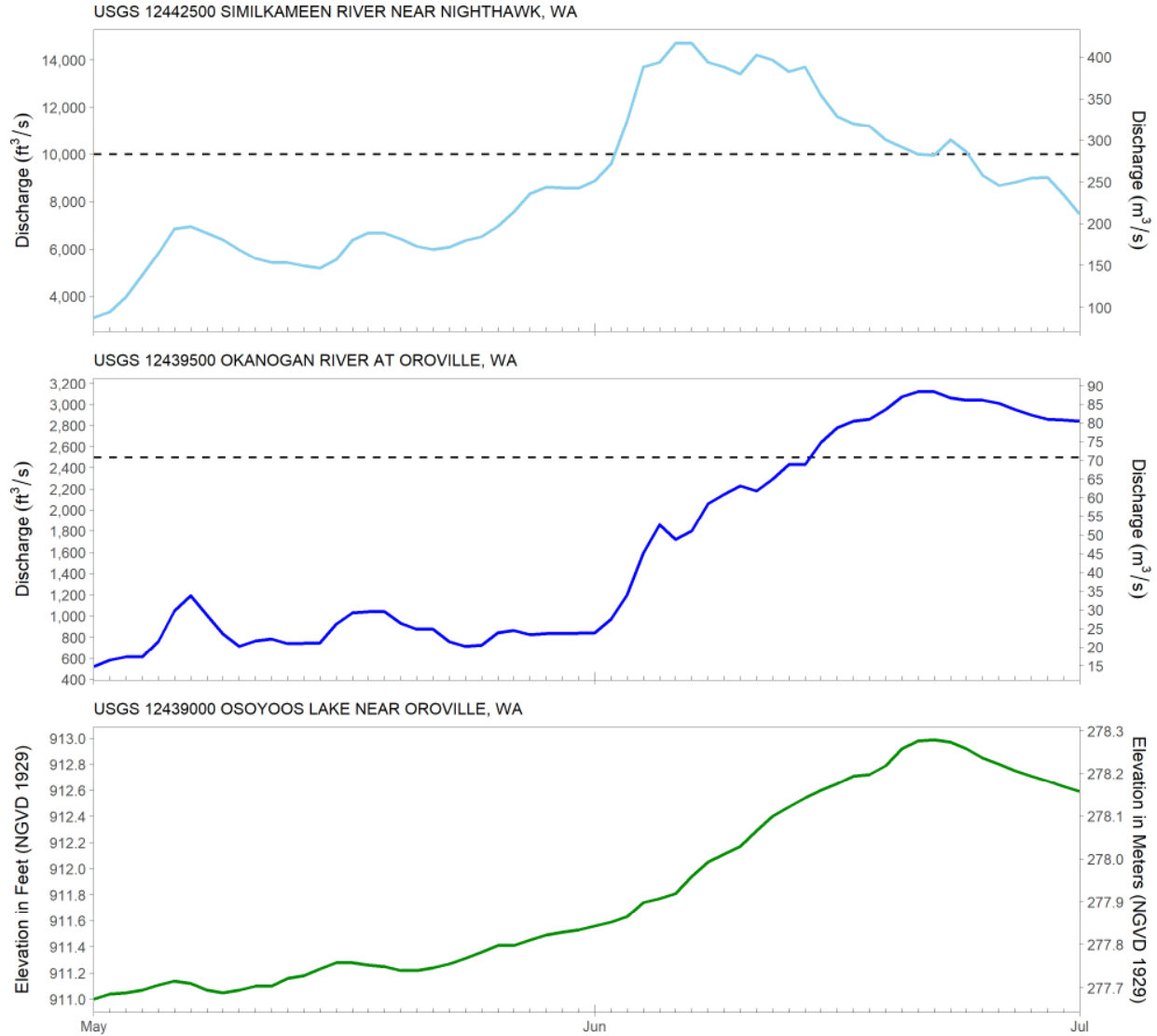


Figure 13. Similkameen River spring 2022 backwater conditions. As Similkameen discharge increases (particularly when above 10,000 cfs), Okanogan River at Oroville (between Zosel Dam and Similkameen/Okanogan River confluence) discharge would begin to decrease. If Osoyoos lake inflows continue, Osoyoos Lake levels rise quickly.

ORDER COMPLIANCE

Drought Criteria

In early spring 2022 (April 1 and May 1), the forecasted hydrologic conditions did not meet any of the three drought criteria within the IJC Order and drought conditions were not declared by the Board in 2022. Table 2 summarizes the drought criteria and final values for 2022. Drought concerns within the Okanogan and Similkameen basin did not increase throughout the late spring and early summer as a result of below normal temperatures resulting in a delayed snow melt.



The drought criteria 8a threshold for the Similkameen River was not met in 2022 (Table 2). Cumulative April - July flow volume for the Similkameen River was 1,476,000 acre-feet (1,820 million m³) as measured at the USGS streamflow gaging station at Nighthawk, which was lower than the early April and early May forecasts of 1,483,000 and 1,512,000, respectively, but still above the 1-million-acre-foot threshold.

Condition 8(bi) Okanagan Lake Net inflow also exceeded the drought criteria by over 100%. Okanagan Lake levels were forecasted in early April and May to marginally exceed the IJC Order drought threshold of 1,122.6 feet (Condition 8bii); however, the peak Okanagan Lake level reached on June 27 was actually 1,124.10 feet (342.63 m), well above the threshold. Plots demonstrating the hydrologic conditions with drought condition 8a and condition 8b for 2022 are shown in Figure 14 and Figure 15, respectively.

Table 2. Summary of drought criteria and forecast and actual values in 2022. The Board declares a drought if condition 8(a) and either condition 8(b i) or 8(b ii) are met (af, ac-ft; acre-foot; ft, feet)

Criteria for declaring a drought	Numerical criteria	2022 Value forecasted in (a) Early April (b) Early May	Actual 2022 value (c)	Drought criterion met?
Condition 8(a): Volume of flow in the Similkameen River at Nighthawk, WA, for the period April through July as calculated or forecasted by U.S. authorities is less than 1 million ac-ft	< 1,000,000 ac-ft	(a) 1,483,000 ac-ft (b) 1,512,000 ac-ft	(c) 1,487,000 ac-ft	(a) No (b) No (c) No
Condition 8(b i): Net inflow to Okanagan Lake for the period April through July as calculated or forecasted by Canadian authorities is less than 195,000 ac-ft	< 195,000 ac-ft	(a) 356,000 ac-ft (b) 432,000 ac-ft	(c) 495,000 ac-ft	(a) No (b) No (c) No
Condition 8(b ii): Level of Okanagan Lake in June or July is less than or is forecasted by Canadian authorities to be less than 1,122.6 ft (Canadian Geodetic Survey Datum)	< 1,122.6 ft	(a) 1,123.00 ft (b) 1,123.03 ft	(c) 1124.10 ft (peak June 27)	(a) No (b) No (c) No

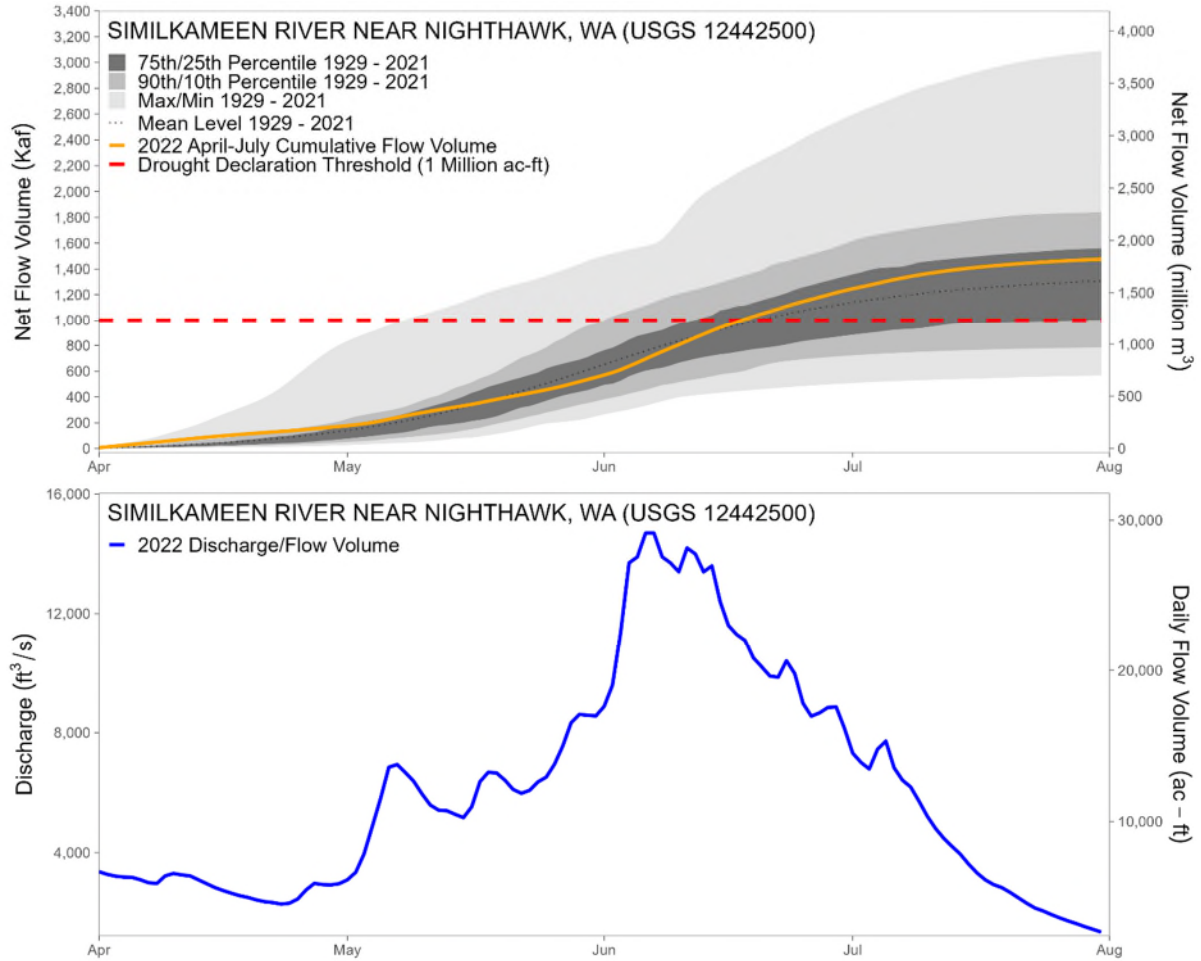


Figure 14. Top: Similkameen River Cumulative Flow Volume for the period of April to July 2022 and Condition 8a Drought Criteria – 1 Million ac-ft. Bottom: Similkameen River near Nighthawk (USGS station 12442500) discharge, and Daily Flow Volume for the period of April to July 2022.

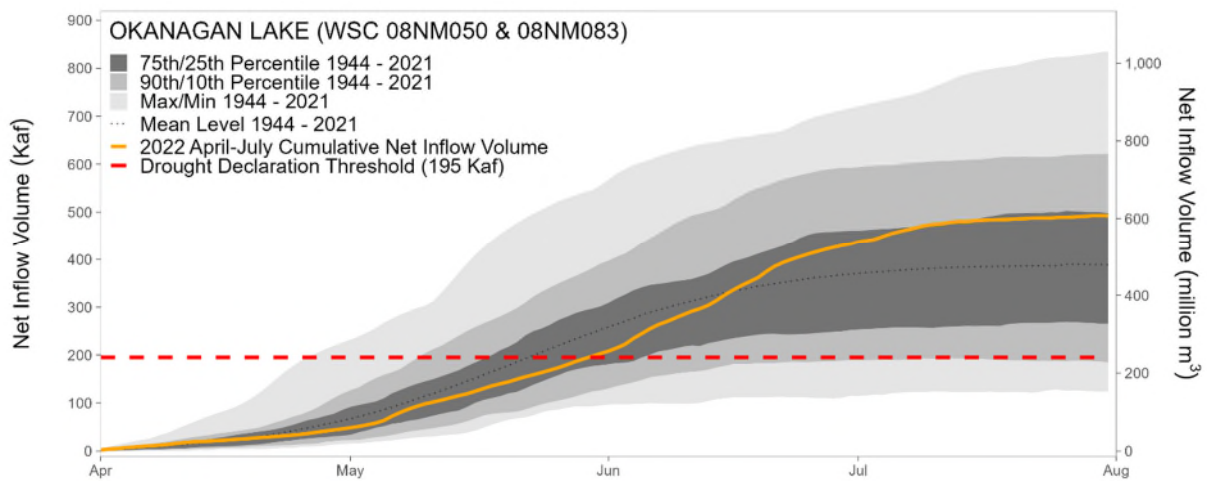


Figure 15. Okanagan Lake Cumulative Net Inflow Volume for the period of April to July 2022 and Condition 8bi Drought Criteria – 195 K-acre-feet.



Osoyoos Lake Rule Curve

Drought criteria were not met in 2022, meaning the Applicant operated the dam under the Normal Condition 7 rules, and no request from the Applicant for a Condition 10 variance was received. Lake levels were maintained within this rule curve except for a period between June 8 and July 27, where the lake level exceeded the maximum rule curve of 912.0 feet, but the Applicant remained in compliance as all Zosel Dam gates were open during this time and were not regulating lake levels. Key daily mean and instantaneous maximum and minimum Osoyoos Lake levels are reported in the Appendix A.

Flow Capacity of the Okanogan River and Zosel Dam

Conditions 3 and 4 of the IJC Order of 1982 specify that the flow capacity of the Okanogan River channel between the outlet of Osoyoos Lake down to and including Zosel Dam be at least 2,500 cfs (70.8 cms) when the elevation of Osoyoos Lake is 913.0 feet (278.3 m), and there is no appreciable backwater effect from the Similkameen River. Osoyoos Lake elevations technically did not surpass 913.0 feet (278.3 m) in 2022; however, an elevation of 912.99 feet (278.28 m) was reached on June 22 (Figure 16). Discharge of the Okanogan River as measured at the USGS gage at Oroville downstream of Zosel Dam (USGS station 12439500) on June 22 reached 3,120 cfs (88.3 cms), indicating the conveyance capacity was met in 2022.

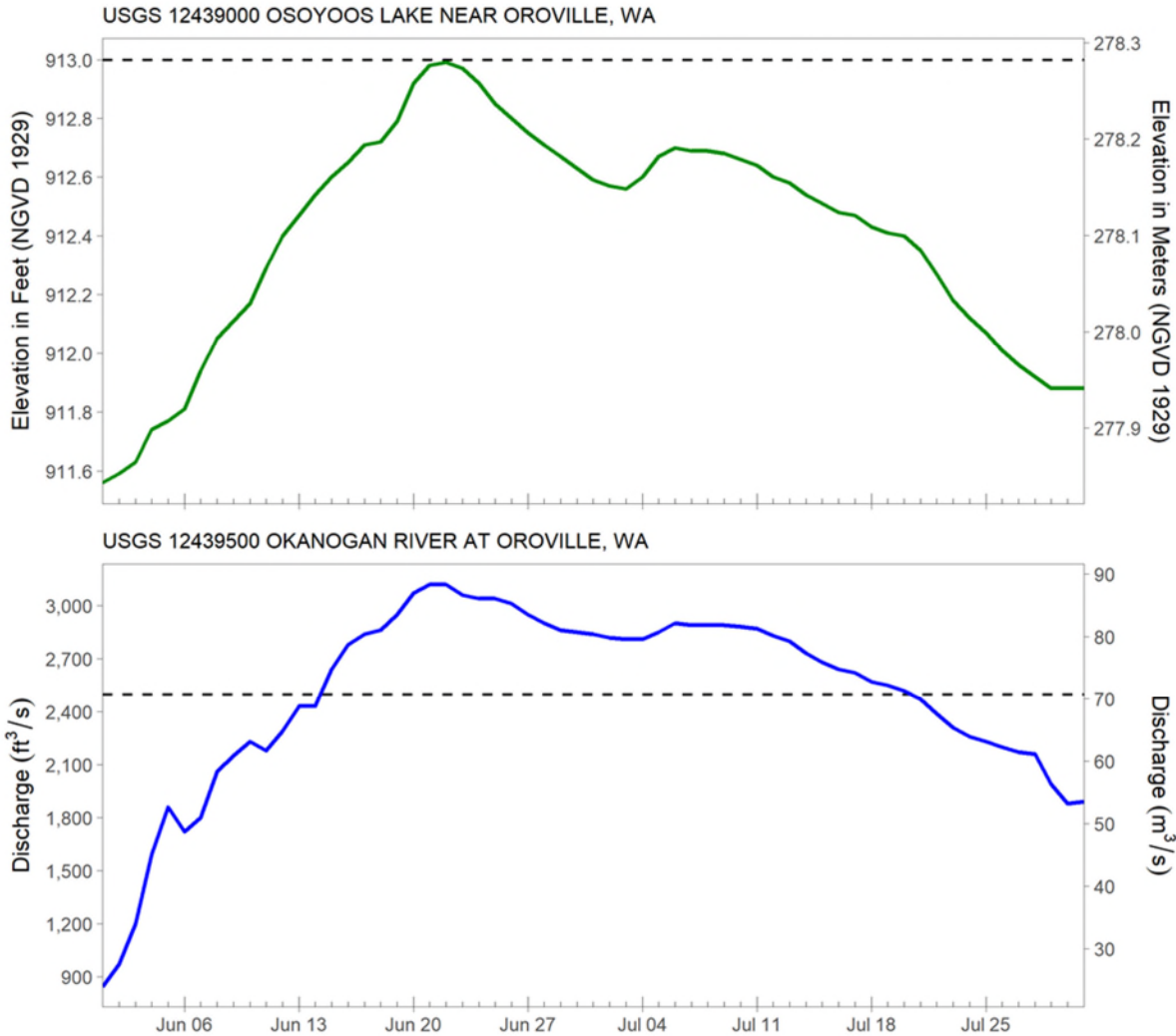


Figure 16. Okanogan River flow capacity demonstration for the period June 1 to July 31, 2022. Top, mean daily Osoyoos Lake elevations recorded at USGS station 12439000, along with 913 ft. threshold. Bottom, mean daily discharge recorded at Okanogan River at Oroville (USGS station 12439500) and 2,500 cfs threshold.

BOARD ACTIVITIES

Annual Board Meeting

The Annual Board Meeting was held Wednesday October 26, 2022 from 10:00 to 3:30 pm PDT. The hybrid meeting was held in-person for the first time since 2019 due to the COVID-19 pandemic at the Sonora Centre in Osoyoos, B.C. and hosted by the U.S. Section. Cindi Barton (Board Chair, U.S. Section) opened the meeting with welcoming remarks and introductions of the Board members, IJC Commissioners, and guests who were in attendance (either physically or virtually). The review of the IOLBC Work Plan was deferred to the December quarterly call.

The 2022 hydrologic conditions and compliance with the IJC Orders of Approval for Osoyoos Lake were reviewed by Martin Suchy (Secretary, Canadian Section). Brian Symonds (Board Member, Canadian



Section) provided an overview of the Okanagan Lake Regulation system (OLRS) operations in 2022 in place of Shaun Reimer (British Columbia – Ministry of Forest) who was unable to attend the meeting. No representative from the Washington State Department of Ecology was able to provide an update of Zosel Dam operations during 2022 at the Board meeting; instead, Derek Mendoza (OTID) provided an update at the public meeting.

Five presentations were given on the Board's special projects that occurred in 2022. Sven Cowan (NV5) presented Osoyoos Lake bathymetric data collected in September 2021. Martin Suchy (Board Secretary, Canadian Section) presented a summary of the second phase of the Okanagan/Similkameen model integration and a shift in scope to develop a hydraulic model within the U.S. part of the Okanogan River. Andy Gendaszek (Board Secretary, U.S. Section) presented an update about a proposal to the IJC-IWI program concerning the formation of ice jams at the southern end of Osoyoos Lake. Anna Warwick Sears (Board Member, Canadian Section) updated the Board about planning for the Osoyoos Lake Water Science Forum. Finally, Martin Suchy (Board Secretary, Canadian Section) updated the Board about automated scripts that he helped develop with others at ECCO to present hydrologic and climatic conditions of concern to the Board at regular intervals.

The Board discussed public outreach during 2022, which included seven news releases in response to an updated emphasis on regular communication within the Board's 2022 workplan. Several of the news releases were picked up by local media. The Board also discussed engagement with Tribes and First Nations; the most prominent of these efforts was the development of the Osoyoos Lake Water Science Forum, which was facilitated by indigenous facilitators.

Annual Public Meeting

The 2022 International Osoyoos Lake Board of Control annual public meeting was held on Wednesday October 26, between 6:30 – 8:00 PM (PDT). The meeting has held in-person at the Oroville High School, 1016 Ironwood Street, Oroville, Washington, while virtual attendance was available through the GoToWebinar platform. There were four members of the public in-person and two virtual participants at the meeting. Once again, it was the first time since 2019 that in-person participation was available due to the COVID-19 pandemic. Dr. Cindi Barton reviewed the protocols for the hybrid meeting, provided some opening remarks and presented an overview of the IJC, IOLBC, and the IJC Orders of Approval for Osoyoos Lake. Commissioner Yohe, and several IJC advisors attended the meeting.

Ted White (Board Member, Canadian Section) presented a review of hydrologic conditions of Osoyoos Lake, the Okanagan/Okanogan River, and the Similkameen River during 2022, including the historic November 2021 atmospheric river event, which impacted the basins.

Derek Mendoza (Oroville-Tonasket Irrigation District) then presented an update on the operation of Zosel Dam on behalf of the Washington Department of Ecology, which owns the dam, and is "Applicant" to the IJC Order of Approval.

Next, updates were provided on the Board's special projects. Martin Suchy (Board Secretary, Canadian Section) presented on the integration of the Similkameen and Okanagan hydrologic models to assess the impact of climate change on the IJC Orders for Osoyoos Lake with respect to the frequency and timing of deviations from the rule curve, and the frequency with which the drought criteria are met.



Anna Warwick Sears (Board Member, Canadian Section) presented on the Osoyoos Lake Water Science Forum (OLWSF) being held following the annual board and public meetings, at the Sonora Center in Osoyoos, BC (October 27-29). The event was co-organized with the Okanagan Basin Water Board (OBWB) and was hosted in partnership with the Osoyoos Indian Band and the Okanagan Nation Alliance. The event's theme was "Bridging Indigenous and Western Approaches to Knowledge, Science and Management". Topics included climate change, Osoyoos Lake management, watershed influences, fisheries restoration, water quality and modernization of the Okanagan Lake Regulation System (OLRS).

Andy Gendaszek (Board Secretary, U.S. Section) presented on the IJC-IWI Ice Jam Study. The project was conceptualized due to the potential for the formation of ice jams at the southern margin of Osoyoos Lake, which can lead to reduced lake outflow during the winter months potentially endangering incubating salmon eggs.

The Board subsequently solicited questions from the audience; however, there were no questions from the public and the meeting was adjourned at 7:35 pm.

Field Tour

Because the annual board meeting was immediately followed by the OLWSF, no board specific field trip was held in 2022. However, the Forum included a field trip to kłilix'w (Spotted Lake) and the Nk'Mip Desert Cultural Centre. Participants were provided an opportunity to learn about the water management and ecological health issues of importance to Osoyoos Lake and the greater transboundary watershed. Prior to the COVID-19 pandemic disrupting all in-person meeting plans, the board was planning to organize a field trip along the Similkameen River from the confluence of the Okanagan River near Oroville to the headwaters in Canada. This field trip will be considered for 2023.

IJC Semi-Annual Appearances

The fall Ottawa semi-annual meeting was held on October 18 with in-person attendance by the Canadian section Co-chair David Hutchinson and supported in person by the Canadian Board Secretary Martin Suchy. Virtual support was provided by the U.S. section co-chair Dr. Cindi Barton. The Board presented current activities and projects, along with providing an update on communications strategies and where additional IJC support could be provided. Participants in the October meeting also took part in an IJC workshop on communications.

The spring Washington D.C. semi-annual meeting was held on April 5 and attended in person by Board member Col. Alexander Bullock, and his board technical advisor Sonja Michelsen. The U.S. section co-chair Dr. Cindi Barton, U.S. Section Secretary Andrew Gendaszek, Canadian co-chair David Hutchinson, and Canadian secretary Martin Suchy, along with other Board members attended the presentation remotely (via MS Teams). In addition to reviewing the IJC Orders for Osoyoos Lake and the hydrologic conditions, the Board presented a summary of public engagement activities including: news releases, media exposure, annual Board public meetings, the Osoyoos Lake Water Science Forum, A River Film, high-water monuments, and Zosel Dam webcam.



Quarterly Conference Calls

The Board continued holding quarterly conference calls in March, June, September, and December (as initiated in 2015). Agenda items included discussion of current hydrologic conditions, tracking work plan and special projects progress, and preparing for upcoming meetings. Summaries of these calls are posted on the Board's public website (<https://ijc.org/en/olbc/library/minutes>).

Work Plan

During the December 2022 quarterly conference call, the Board updated the Work Plan for 2022/23. Ongoing Core Activities in the Work Plan were streamlined, specifically combining several items related to communications by referencing the Public Communications Plan. Priorities Through 2023 were updated to reflect completed items, prioritizing and editing existing items, and adding new items. Removed items included the installation of lakeshore monuments, the bathymetric mapping project and the Osoyoos Lake Water Science Forum. The Osoyoos Lake water demand model was deferred to 2024, while the Phase II model integration project and Ice Jam project were updated to reflect their current status. Work to update the Boards Communication Plan was added as a priority for 2023. A shortened Work Plan comprised of the Ongoing Core Activities and Priorities Through 2023 is included as Appendix B.

Public Communications

Correspondences

No correspondence was received by the Board in 2022.

News Releases

The Board posted four news releases on its website to inform the public and news media about Board activities and hydrologic conditions within the Okanagan/Okanogan and Similkameen Basins that affect Osoyoos Lake levels and the IJC Orders for Osoyoos Lake. The first news release on May 27 provided an update on the spring freshet, but that unseasonably cold temperatures have limited snowmelt and runoff. A second news release on June 24 indicated the level of Osoyoos Lake reached 913 feet (278.3 meters) on June 23 in response to runoff within the Okanagan/Okanogan and Similkameen basins. The next news release on July 29 informed the public that regulation of Osoyoos Lake by the Zosel Dam has resumed now that Osoyoos Lake levels have returned to within the rule curve. The final news release on October 12 informed the public of the upcoming annual public meeting, and the Osoyoos Lake Water Science Forum. The Board also worked with IJC IT staff to develop a push notification pilot where members of the public and media could subscribe to notifications when news releases and meeting minutes are posted to the board website. The accompanying news release was released in early 2023.

Updating Public Communications Plan

During the annual board meeting, the board decided to update and simplify its communications plan. The Board reviewed the communications plans of other organizations and discussed 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

The Board did not submit any IJC-IWI proposals in 2022; however, it continued working on several projects that were submitted for funding previously. These included:

1. Bathymetry survey of Osoyoos Lake and areas of the Okanogan and Similkameen Rivers in the U.S.;
2. The integration of hydrologic models of the Similkameen and Okanogan/Okanogan basins along with lake and channel hydraulic models and climate-change projections, and;
3. The history and frequency of the formation of ice jams at the outlet of Osoyoos Lake to the Okanogan River and the hydrological and meteorological factors that contribute to their formation.
4. Supporting the 2022 Osoyoos Lake Water Science Forum.

Topo-Bathymetric Survey

The IJC funded a proposal in August 2021 to survey the bathymetry and shoreline of the U.S. portion of Osoyoos Lake, and portions of the Okanogan and Similkameen Rivers. The Topo-bathymetric survey covered the Okanogan River main-stem from the Osoyoos Lake outlet to the confluence with the Similkameen River, the Similkameen River up to Enloe Dam, and the cross-channel between the Okanogan and the Similkameen Rivers. The contractor completed the survey in September 2021 and the resulting dataset was joined to a Public Safety Canada funded near-shore bathymetry project from Osoyoos Lake to Kalamalka Lake near Vernon. These bathymetric datasets were complete in March 2022 and the contractor presented the datasets to the Board during the 2022 Annual Board meeting. These data will be used during the integration of the Similkameen and Okanogan hydrologic models to be funded by a proposal to the IJC-IWI program to analyze future climate change scenarios on the hydrologic conditions of the Osoyoos Lake, the Similkameen River, and the Okanogan/Okanogan Rivers. The Okanogan Basin Water Board is maintaining the complete integrated bathymetric dataset that includes the Canadian and U.S. surveys.

Phase II Hydrologic Model Integration and Climate Change Vulnerability Study

The first phase of the project to develop a hydrologic model of the Similkameen River Basin to assess the impact of projected climate change on the IJC Orders of Approval for Osoyoos Lake was funded by the IJC-IWI in 2020 and was completed by the contractor, Northwest Hydraulic Consultants (NHC), in spring 2021. The second phase of this project, funded by the IJC will integrate the hydrologic model of the Similkameen Basin developed during the first phase of the project with previously developed hydrologic models of the Okanogan/Okanogan basin funded by the OBWB . This second phase will complete the assessment of the impact of projected climate change on the IJC Orders of Approval for Osoyoos Lake. The IJC-IWI selected the second phase of this project for funding by the U.S. Section of the IJC in spring 2021 following the completion of the Similkameen basin model. The Board Secretaries have been working with the IJC to contract the second phase; however, increases in the scope of the contract due to the need to develop a hydraulic model within the U.S. part of the Okanogan River required additional contract negotiations. Additional aspects of the project include new CMIP6 climate ensembles that require downscaling, and warming scenarios. The Board and the IJC are currently finalizing the additional scope and funding necessary to complete the second phase of this project and work will begin in 2023.



Ice jam Study

The proposal to investigate ice-jam history on Osoyoos Lake was conditionally approved for funding in fall 2021 with final approval in spring 2022 following Board responses to questions by the IWI panel. The purpose of this study is to document the historical occurrence and frequency of ice jams and the hydrological and meteorological conditions that contribute to their formation. The Board Secretaries developed a scope of work for this project and are working with IJC staff to contract the project. The project will commence in 2023.

Osoyoos Lake Water Science Forum

The October 2022 forum was hosted by the Osoyoos Indian Band and Town of Osoyoos in British Columbia. The event was supported by the IJC, ONA, OBWB, and other local, state, provincial, Indigenous and federal partners. This was the fourth edition of the conference, previously held in 2007, 2011 and 2015. The forum was titled “Osoyoos Lake (Nk’Mip) - The Heart of the Watershed,” with an overarching theme of bridging Indigenous and Western approaches to knowledge, science and management. The forum was facilitated by members of the Syilx Nation. The forum was well-attended by residents of Canada and the United States, both Indigenous and non-Indigenous, and connected residents, researchers, policymakers and water managers with a shared interest in the health of the lake.



APPENDIX A: KEY BASIN VALUES AND STATISTICS IN 2022

A. International gaging stations in operation throughout the year:

- (1) For Stage Records
 Osoyoos Lake Near Oroville, Washington
 Okanogan River at Oroville, Washington (auxiliary gage)
- (2) For Discharge Records
 Okanogan River near Oliver, British Columbia
 Okanogan River at Oroville, Washington (base gage)
 Similkameen River near Nighthawk, Washington

B. Compliance with the lake levels specified in the Orders of Approval is measured at the station “Osoyoos Lake near Oroville”, where elevations are expressed in terms of the U.S. National Geodetic Vertical Datum of 1929 (NGVD 1929).

C. Osoyoos Lake near Oroville (USGS station no. 12439000)

Maximum instantaneous elevation	913.02 ft (278.29 m)	Jun 23 06:30
Minimum instantaneous elevation	909.44 ft (277.20 m)	Feb 7 15:15, 16:00, 16:30
Maximum daily mean elevation	912.99 ft (278.28 m)	Jun 22
Minimum daily mean elevation	909.47 ft (277.21 m)	Jan 24, 26-29
Lake elevation at maximum daily mean discharge for Okanogan River at Oroville	912.99 ft (278.28 m)	Jun 22

D. Okanogan River at Oroville (USGS station no. 12439500)

Maximum instantaneous discharge	3,150 cfs (89.2 cms)	Jun 22 05:30, 06:30, 11:00, 12:00, 12:30
Minimum instantaneous discharge	9.16 cfs (0.3 cms)	Dec 19 01:30 – 02:30
Maximum daily mean discharge	3,120 cfs (88.3 cms)	Jun 21 – 22
Minimum daily mean discharge	173 cfs (4.9 cms)	Mar 10 – 12, 15 – 19
Annual mean discharge	789 cfs (22.3 cms)	

The annual mean discharge was 114 percent of the 79-year (1943-2021) average of 693 cfs (19.6 cms).

E. Similkameen River near Nighthawk (USGS station no. 12442500)

Maximum instantaneous discharge	15,000 cfs (425 cms)	Jun 6 16:15 – Jun 7 02:30
Minimum instantaneous discharge	155 cfs (4.4 cms)	Dec 21 20:45, Dec 22 08:45
Maximum daily mean discharge	14,700 cfs (416 cms)	Jun 6 – 7
Minimum daily mean discharge	165 cfs (4.7 cms)	Dec 22
Annual mean discharge	3,245 cfs (91.9 cms)	

The annual mean discharge was 140 percent of the 93-year (1929-2021) average of 2,323 cfs (65.8 cms).

F. Okanogan River at Oliver (ECCC station no. 08NM085)

Maximum instantaneous discharge	3,295 cfs (93.3 cms)	Jun 20 10:10, 10:40, 11:15, 11:25, 11:35, 11:45, 12:10
Minimum instantaneous discharge	191 cfs (5.4 cms)	Jan 6 17:30 – 18:40
Maximum daily mean discharge	3,244 cfs (91.9 cms)	Jun 20
Minimum daily mean discharge	202 cfs (5.7 cms)	Jan 1
Annual mean discharge	785 cfs (22.2 cms)	