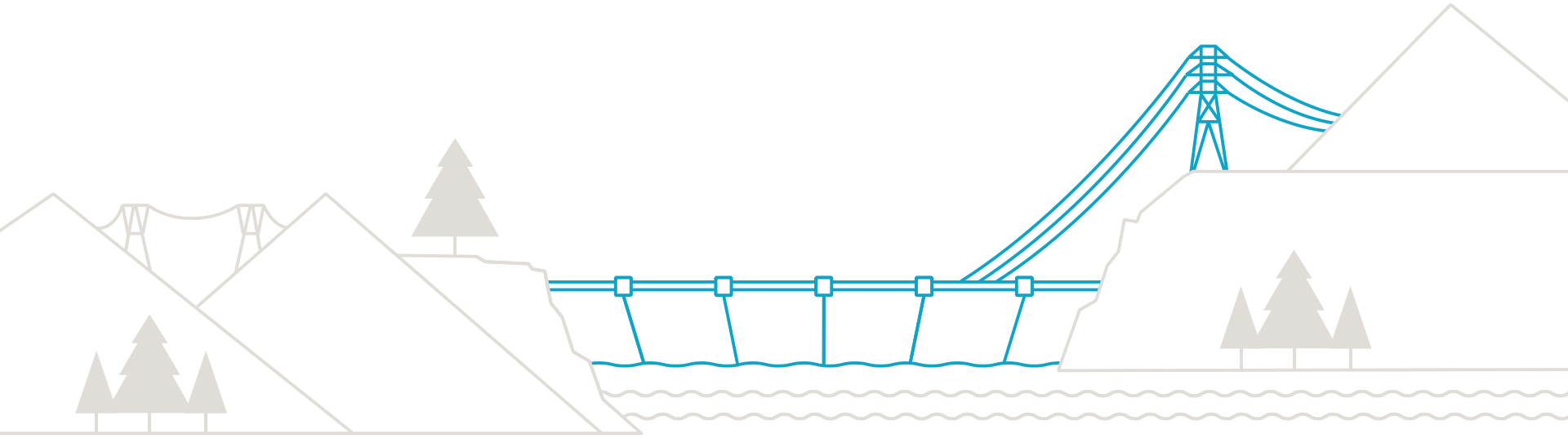
2019 Operations Update Meeting



Wed, 9 Oct, 2019

Gillian Kong

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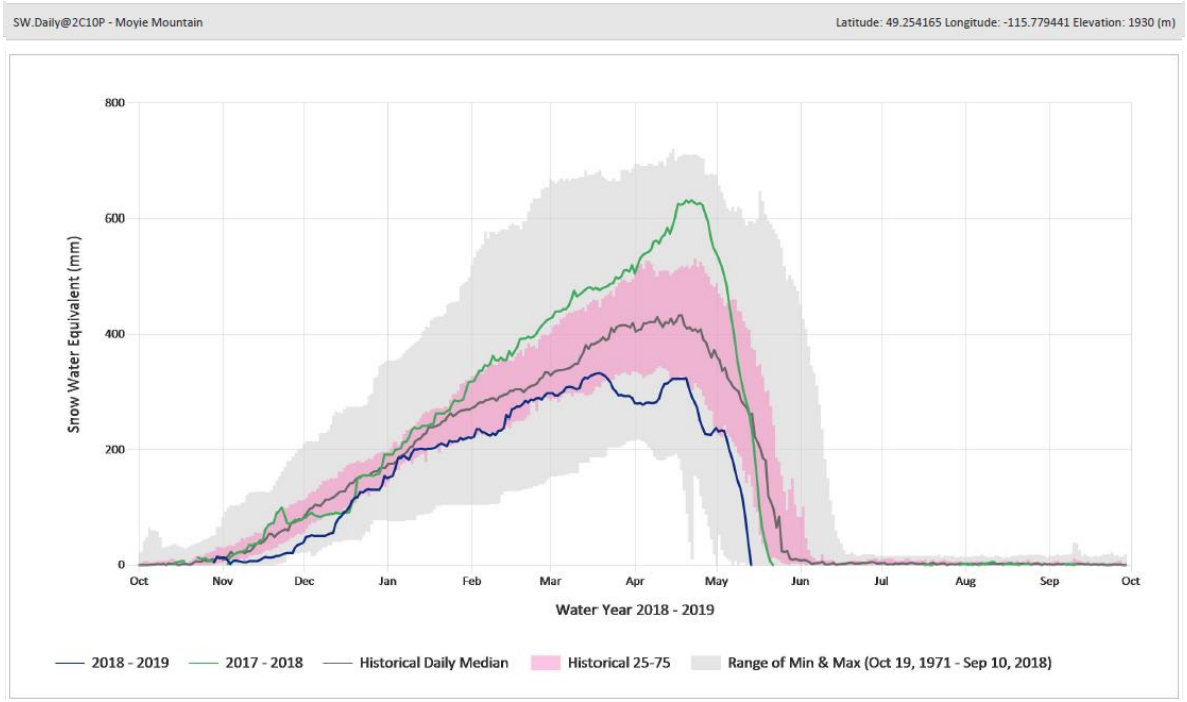
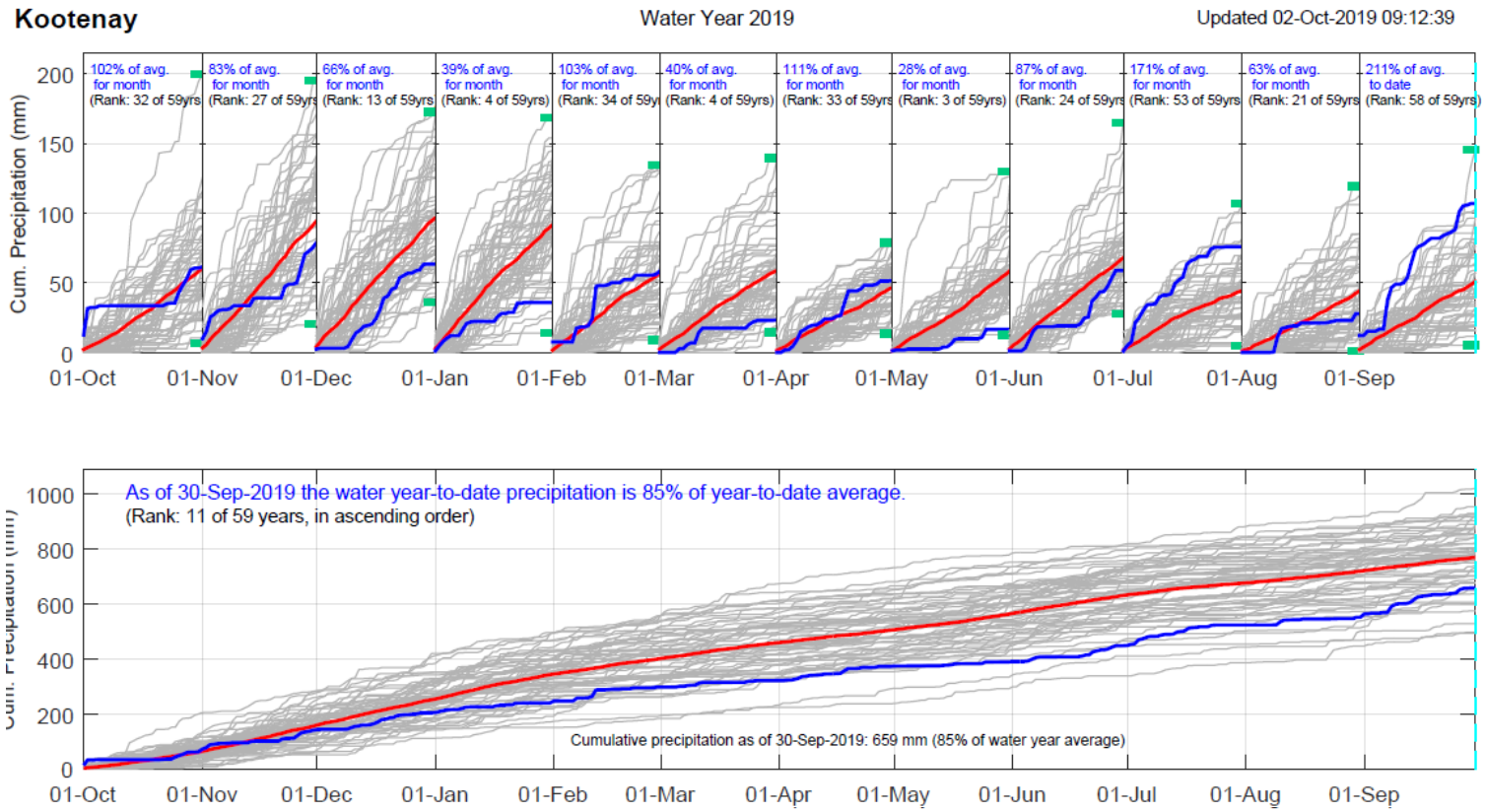
Canadian Columbia/Kootenay Snowpack

- Lack of precipitation contributed to low snowpack <25 percentile in most snowpillow stations.
- Freshet was a bit slow this year due to cold temperatures.
- Snowpack peaked in early May and rapidly declined with many running out of snow by the end of June, about 2 – 3 weeks earlier than normal.



2019 Precipitation Summary:



- Precipitation amounts in July and September were well above average between 140 – 220% in many parts of the Columbia and Kootenay basin.
- September precipitation was notably high:
  - MCA: 185% of average
  - REV: 195% of average
  - ARD: 174% of average
  - DCN: 216% of average (near record high)
  - KLK: 211% of average

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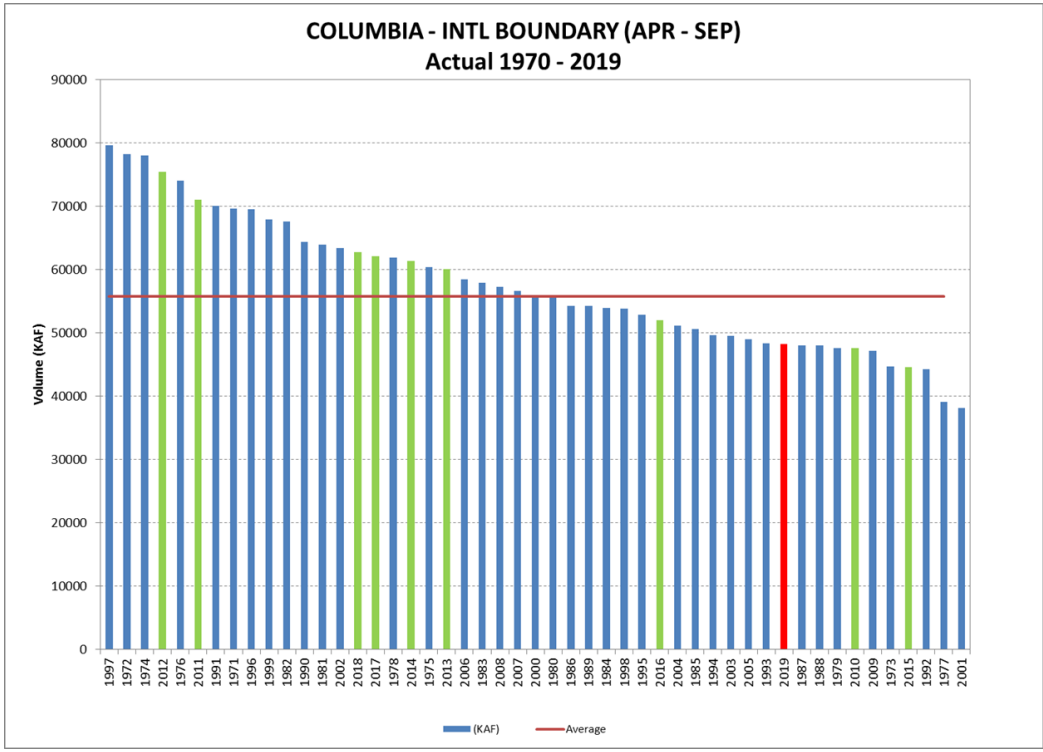
Columbia Runoff 2019 Year End Summary

- Low precipitation and snowpack contributed to low water supply in 2019.
- The actual runoff for the entire Columbia basin at The Dalles was 94% for Apr – Sep 2019, lower than 2018 at 114% of normal.
- The actual runoff for the Canadian portion of the basin is 87% of normal, lower than 2018 at 113% of normal.
- 2019 ranks 11th driest year on record for the Canadian Columbia basin.



Feb-Sep 2019 Actual Unregulated Inflows

- Mica: 98%
- Revelstoke: 96%
- Arrow: 84%
- Duncan: 92%
- Kootenay Lake: 71%

** Normal is based on 1981 - 2010*

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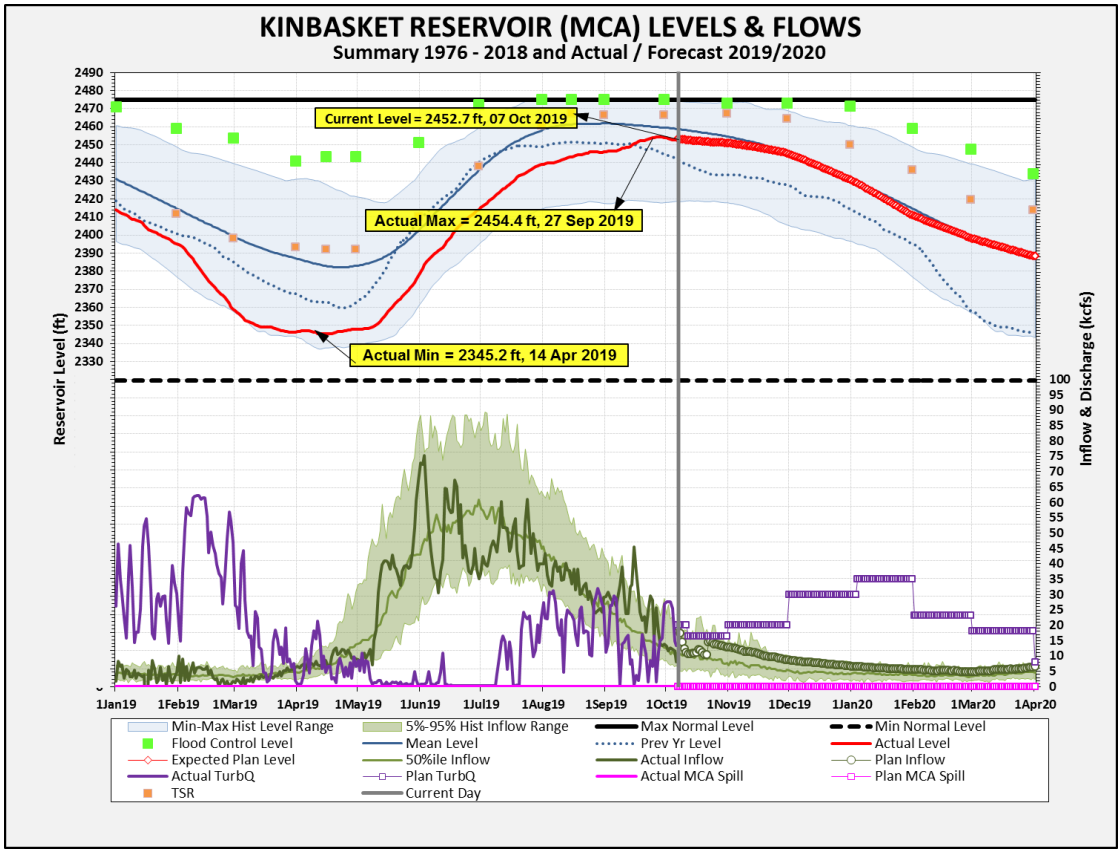
Kinbasket Reservoir

- Kinbasket Reservoir drafted lower than average in spring 2019 due to unprecedented cold and dry Feb/Mar.
- Kinbasket drafted nearly 40 ft in Feb reaching near record low by late Feb/early Mar.
- Mica was shutdown in May and June to support refill and economic purchases, then resumed operation in July.
- Mild summer temperatures resulted in less demand on generation and above normal summer precipitation and inflows helped support refill of Kinbasket reservoir.
- Kinbasket peaked at 2454.4 ft on 27 Sep and is forecast to trend towards average levels by the end of Fall 2019.



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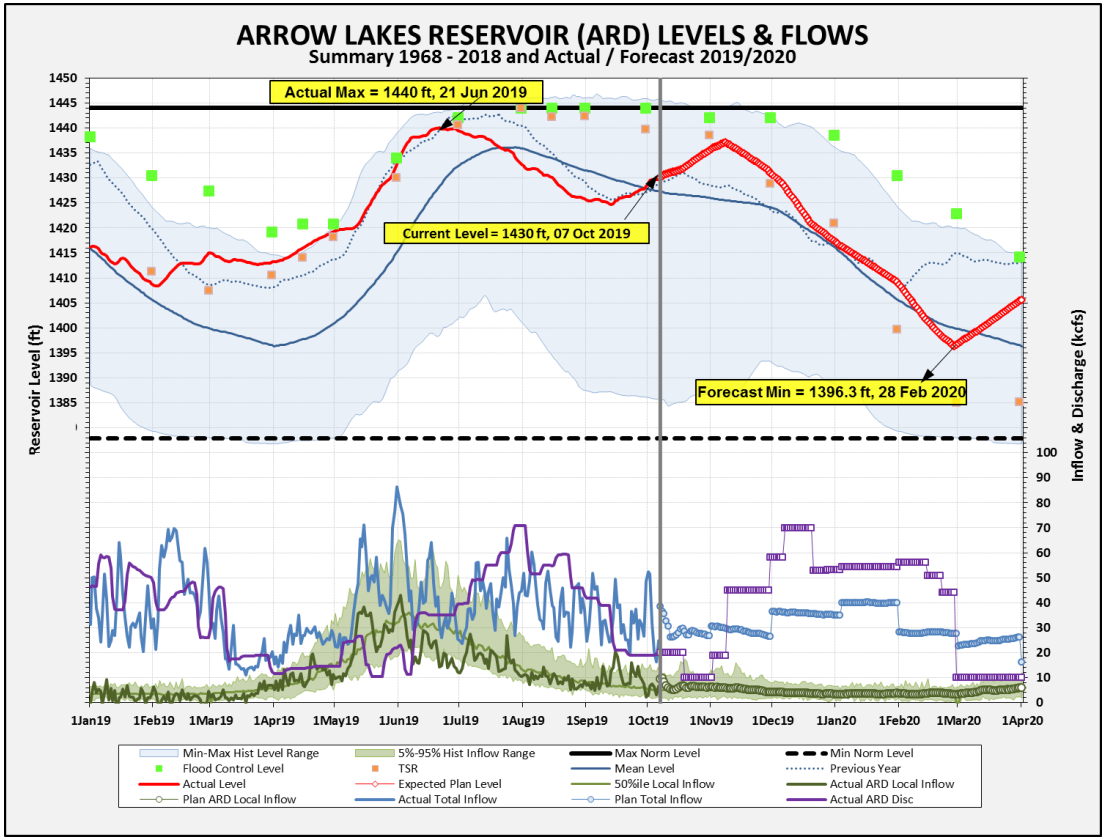
Arrow Lakes Reservoir

- Arrow level had been average to above average for much of the operating year.
- Arrow reservoir reached a max of 1440 ft, 4 feet below normal full pool on 21 Jun 2019.
- It drafted across the summer but remained above the soft constraint targets for recreation and kokanee access on Arrow reservoir. Current level is 1430 ft.
- Low flows are expected in the near term consistent with the principles of the Treaty when under wet conditions it is necessary to store excess water so that surplus energy is not generated by downstream U.S. Columbia River projects.
- Under current forecast wet conditions, Arrow is expected to refill over the next 2 months setting a second peak level at1435 ft by mid Nov.



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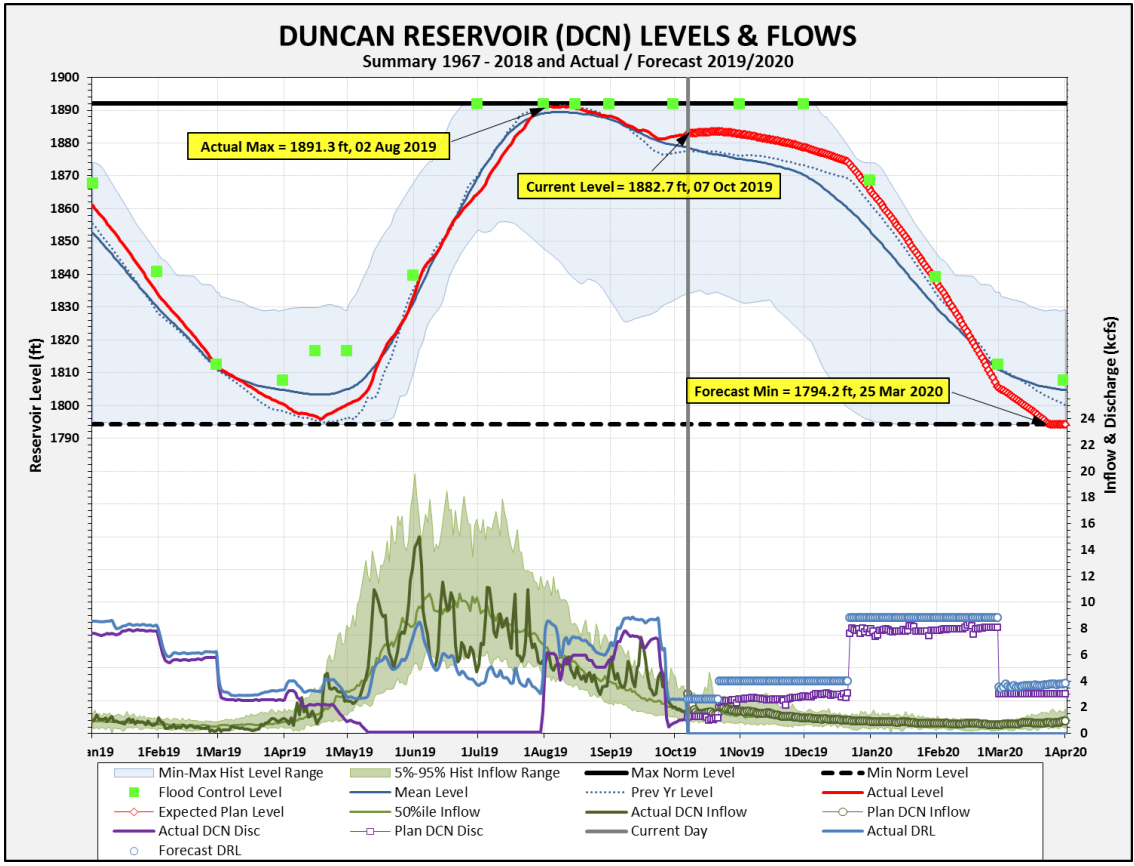
Duncan Reservoir

- Duncan normally operates for Treaty Flood Control and WUP provisions for flows and levels.
- DCN drafts to near empty by April each year for flood risk management at Meadow Creek and around Kootenay Lake later in the spring.
- Duncan flows were reduced to a min of 0.1 kcfs in May through July until the reservoir filled to within 1 ft from full pool by Aug 1 – a WUP target.
- DCN discharge was reduced to target 2.6 kcfs max at DRL in late Sep to until the end of kokanee spawning operation on 22 Oct.
- DCN discharges will be increased in the winter to ensure compliance to Treaty FRM.



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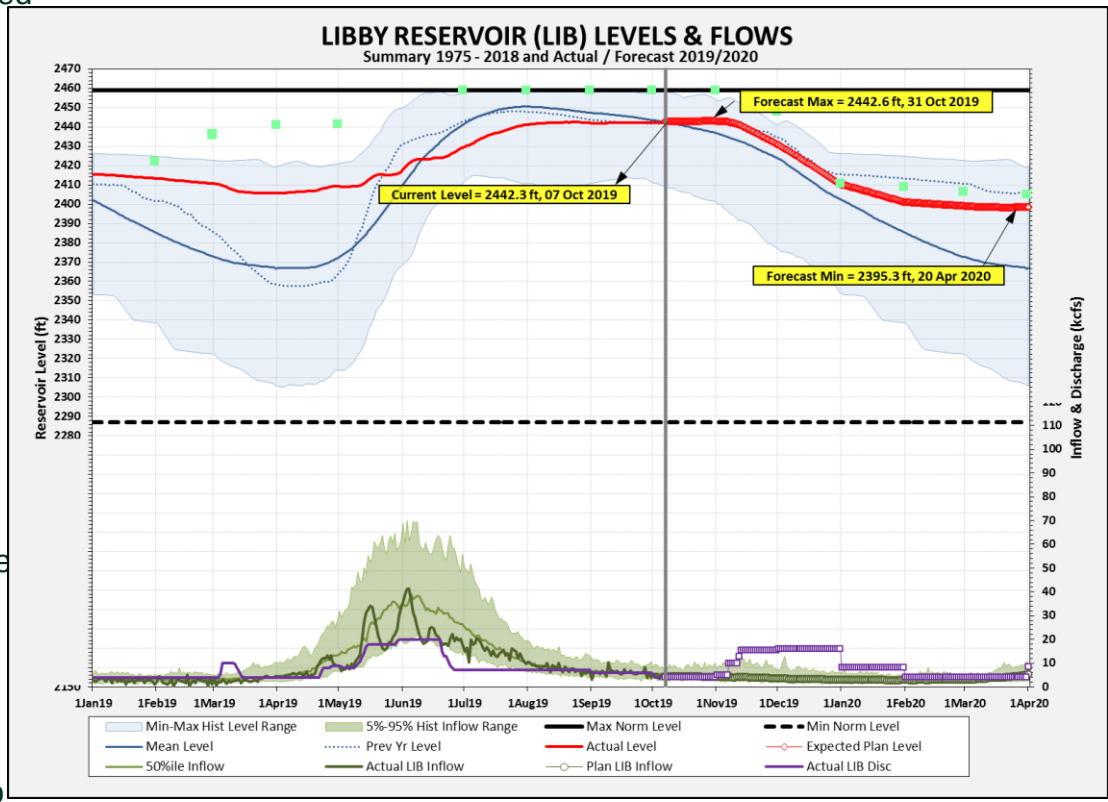
Libby Reservoir

- Libby - a U.S. Treaty project, owned and operated by the U.S. Army Corps of Engineers.
- Impounds Lake Koocanusa which backs into Canada and has ~ 5 Maf of storage.
- The water supply for Apr – Sep 2019 ranks 8th driest year on record.
- Due to low inflows, Libby operated on minimum flows in the winter to reduce draft on storage. It reached a min of 2405.7 ft on 24 Mar 2019.
- Libby operated for sturgeon flows in May/June and bull trout flows in July/Aug/Sep. Flows were reduced to min of 4 kcfs in Oct.
- Higher inflows this summer supported refill of Libby reservoir.
- Current level is about average and is forecast to peak at 2443 ft by the end of Oct, about 10 ft higher than forecasted in June.
- Forecasts for Libby Dam can be found here: http://www.nwrfc.noaa.gov/river/station/flowplot/flowplot.cgi?lid=LYDM8



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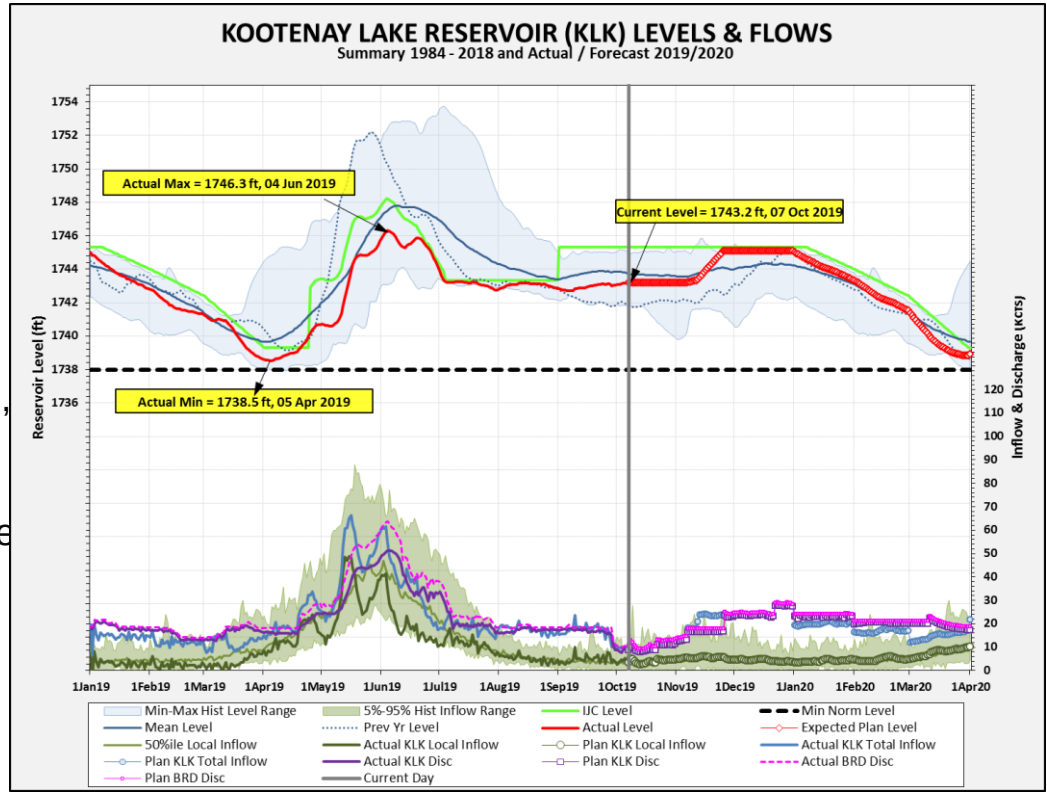
Kootenay Lake

- Kootenay Lake is regulated under the IJC. The IJC KLBC in consultation with FortisBC declared start of spring rise on 24th April.
- Lake was drafted below 1739 ft down to a min of 1738.5 ft on 5 April 2019 due to low inflows.
- It refilled to a max of 1746.3 ft on 4 Jun 2019, well below average for this date.
- The IJC compliance level was switched to the Nelson gauge on July 4th when the lake drafted below 1743.32 ft.
- The lake has been operating to pass inflows to provide for fish flows downstream of BRD under CPC's water licence.
- As inflows receded, Kootenay flows were reduced in Oct.
- Lake is forecast to refill by mid Nov when sufficient inflows are available to refill storage.



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Treaty Flood Control Benefits & Flood Studies

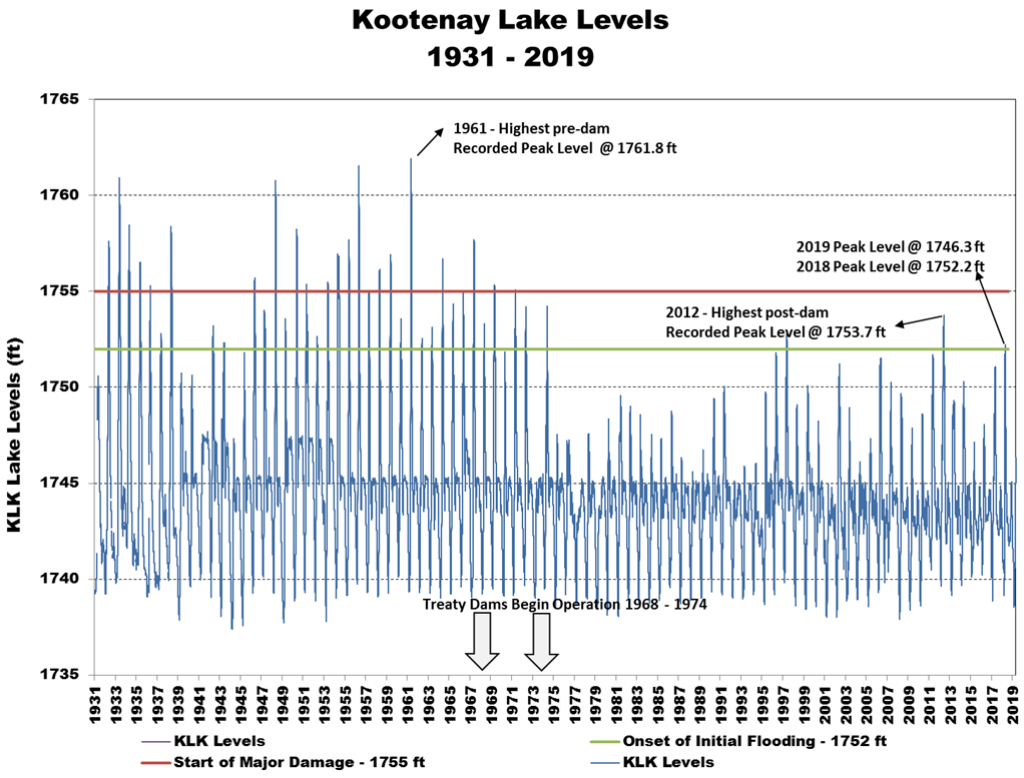
- Kootenay Lake has limited storage. High unregulated inflows and Grohman Narrows restriction add to the operational challenges of flood routing during high runoff years, i.e., 2012, 2017 and 2018.

- Recent flood routing operational challenges lec to RDCK undertaking region-wide flood damage assessment studies. Data when available will help inform operational decisions and flood related emergencies. Work is still ongoing. Status update can be found here: https://rdck.ca/EN/main/services/community-planning/flood-map-study.html

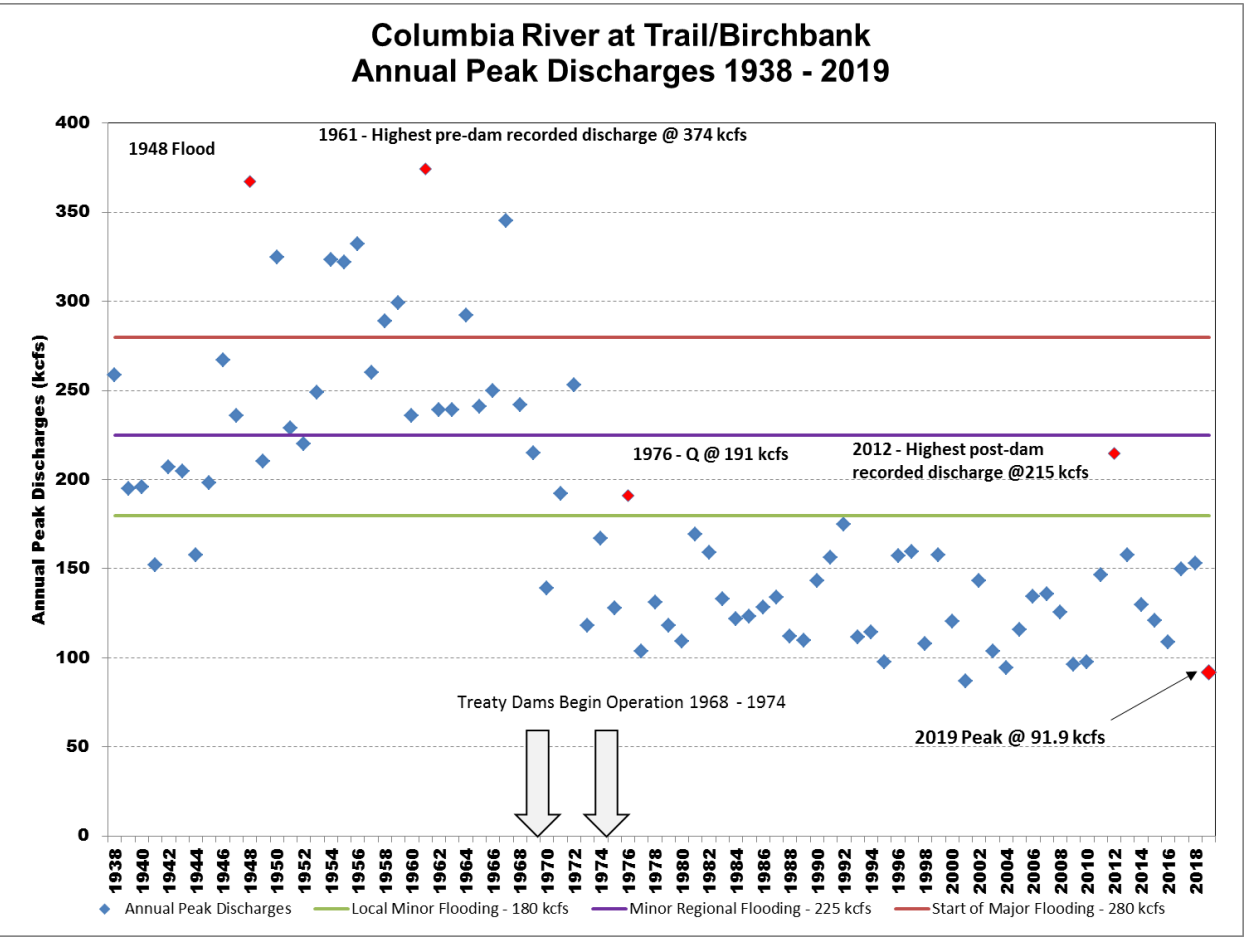
  - No flood concerns in 2019. The peak level was only 1746.3 ft on 4 June, below normal for this date.

  - Peak Kootenay Lake levels have been generally 5 – 8 ft lower since construction of the upstream Treaty dams (Libby and Duncan).

  - In 2012, CRT reservoir operation reduced peak level by about 6.6 ft (2 m).



Treaty Flood Control Benefits: Birchbank



- All CRT dams provide flood protection at Castlegar/Trail in BC and for Tri-Cities and Portland/Vancouver in the U.S.
- Flows at Trail were significantly lower with all the CRT dams in place since1974.
- 1961, highest pre-dam discharge at 374 kcfs. 2012, highest post-dam discharge at 215 kcfs.
- In 2012, CRT reservoir operation reduced peak river flow by 40%.
- By comparison, the peak flow for 2019 was relatively low at 91.9 kcfs on 28 July, comparable to 2001 – the driest year on record.

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