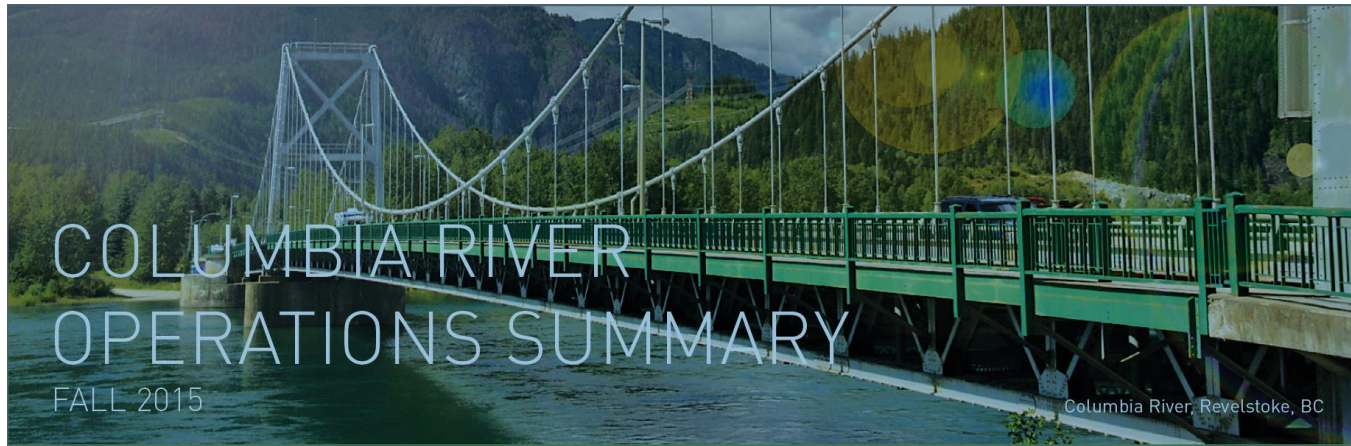
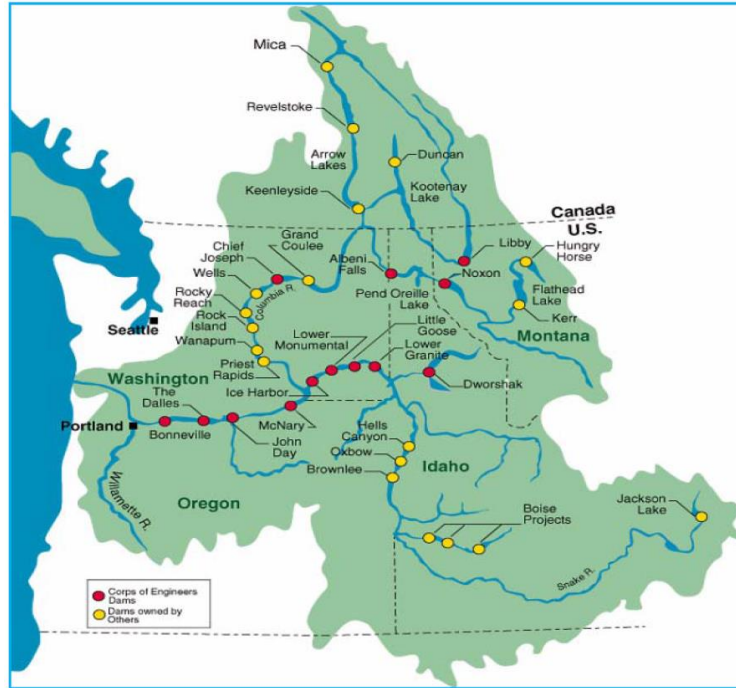


# Columbia Basin Operations Fall 2015



**23 Oct 2015**

# Columbia River Basin



- Columbia River is the fourth largest in North America and the “most powerful.”
- Canada has 15% of the basin area. The Canadian portion of the basin is mountainous, with much snow.
- On average, it produces 30-35% of the runoff for the entire basin. During flood years Canada has produced as much as 50% of the flows recorded at Portland.
- Most hydropower production, and need for flood control is in the USA. The best storage dam sites are in Canada

# Columbia Regulation Under Dry Conditions

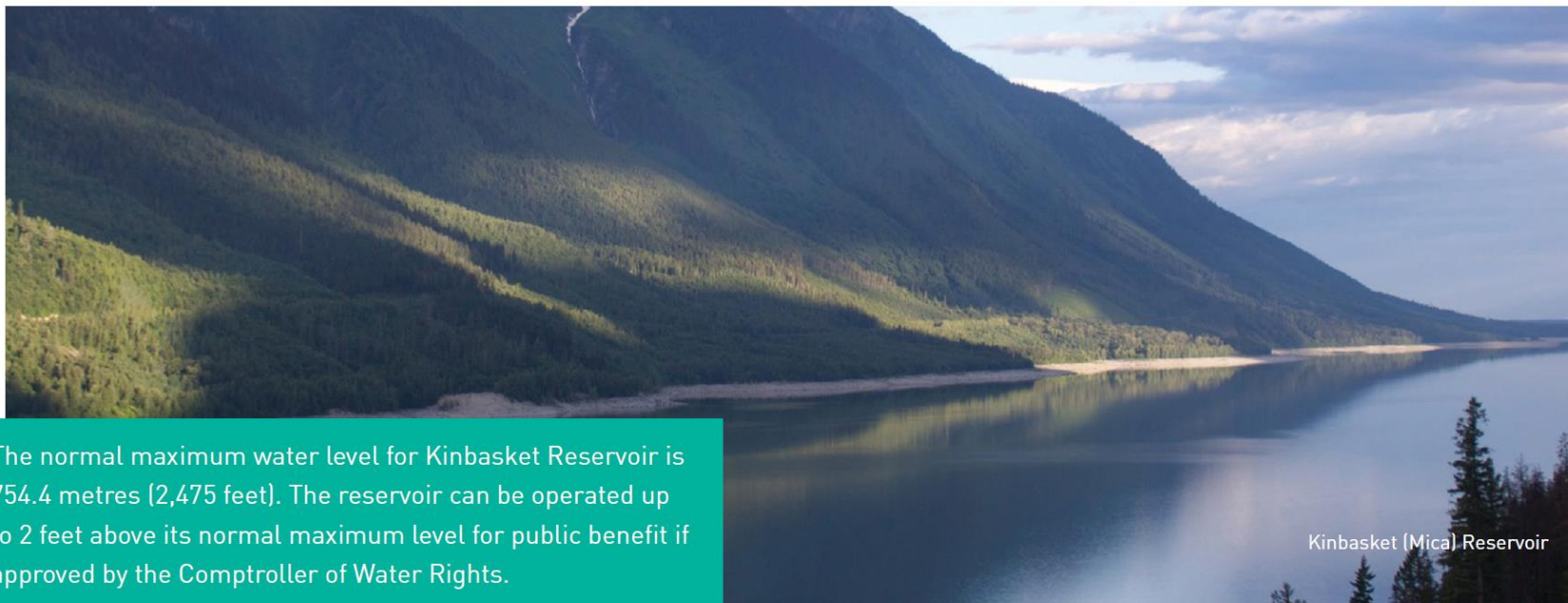
- This spring and summer's continued dry conditions in the US and Canadian portion of the Columbia Basin have resulted in lower levels for Canadian Treaty Storage in Canadian Columbia Basin reservoirs.
- Actual runoff to the combined Columbia Basin (Canada and U.S.) was 67% of normal April through August. This was the third driest year on record since 1960.
- Under dry conditions, more water is released from Canadian storage according to the terms of the Columbia River Treaty ("CRC: Critical Rule Curves").
- Note that while Canada must deliver its Canadian Treaty Storage according to the CRC curves, the U.S. is not obliged to operate to their CRC curves and may re-regulate flows to meet other power and non-power requirements. The U.S. does remain obliged, however, regardless of high or low water years to deliver Canadian Entitlement electricity to the Province of BC.

# Canada Reservoir Levels

For Canadian treaty projects, none of the reservoirs filled to full in 2015:

- Kinbasket reached a max of 2,463.8 ft on July 15<sup>th</sup>, 11.2 ft below full pool.
  - Current level ~2,451 ft (23 Oct 2015).
- Arrow reached a max of 1,428.7 ft on June 13<sup>th</sup>, 15.3 feet below full pool.
  - Current level ~1,402 ft (23 Oct 2015).
- Duncan reached a max of 1,886.6 ft on August 4<sup>th</sup>, 5.4 ft below full pool.
  - Current level ~1877 ft (23 Oct 2015).

# Kinbasket



Kinbasket (Mica) Reservoir

The normal maximum water level for Kinbasket Reservoir is 754.4 metres (2,475 feet). The reservoir can be operated up to 2 feet above its normal maximum level for public benefit if approved by the Comptroller of Water Rights.

Maximum water licence level for storage 2,475.0 ft.

Minimum water licence level for storage ~2,319.4 ft.

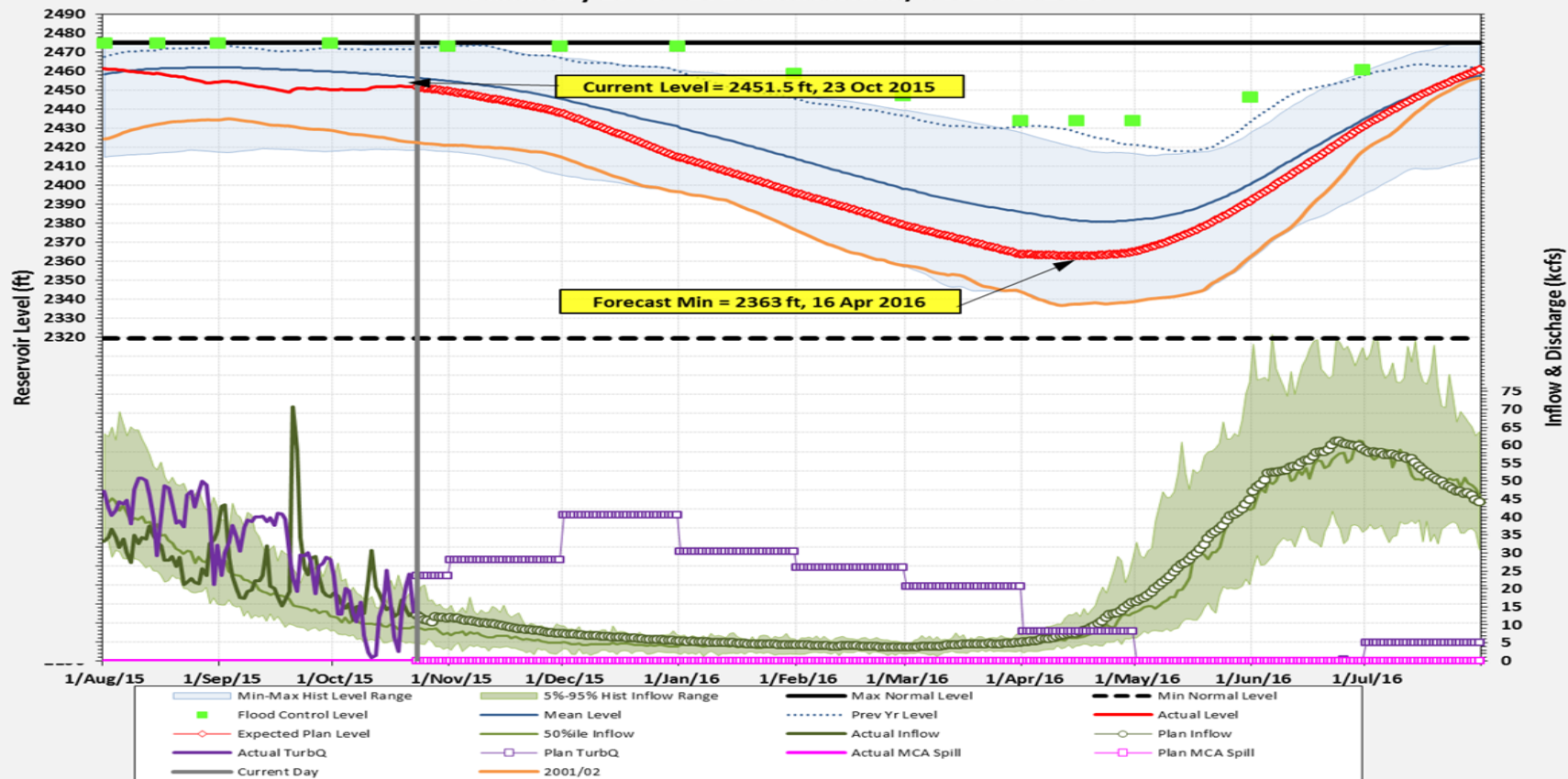
Active Storage ~155 ft: 12.0 MAF

# Kinbasket

Energy Study: Oct 08, 2015  
TSR Study: 21 Oct 2015

## KINBASKET RESERVOIR (MCA) LEVELS & FLOWS Summary 1976 - 2014 and Actual / Forecast 2015

ESP Update: Oct 19 2015  
Forecast Date: Oct 23, 2015





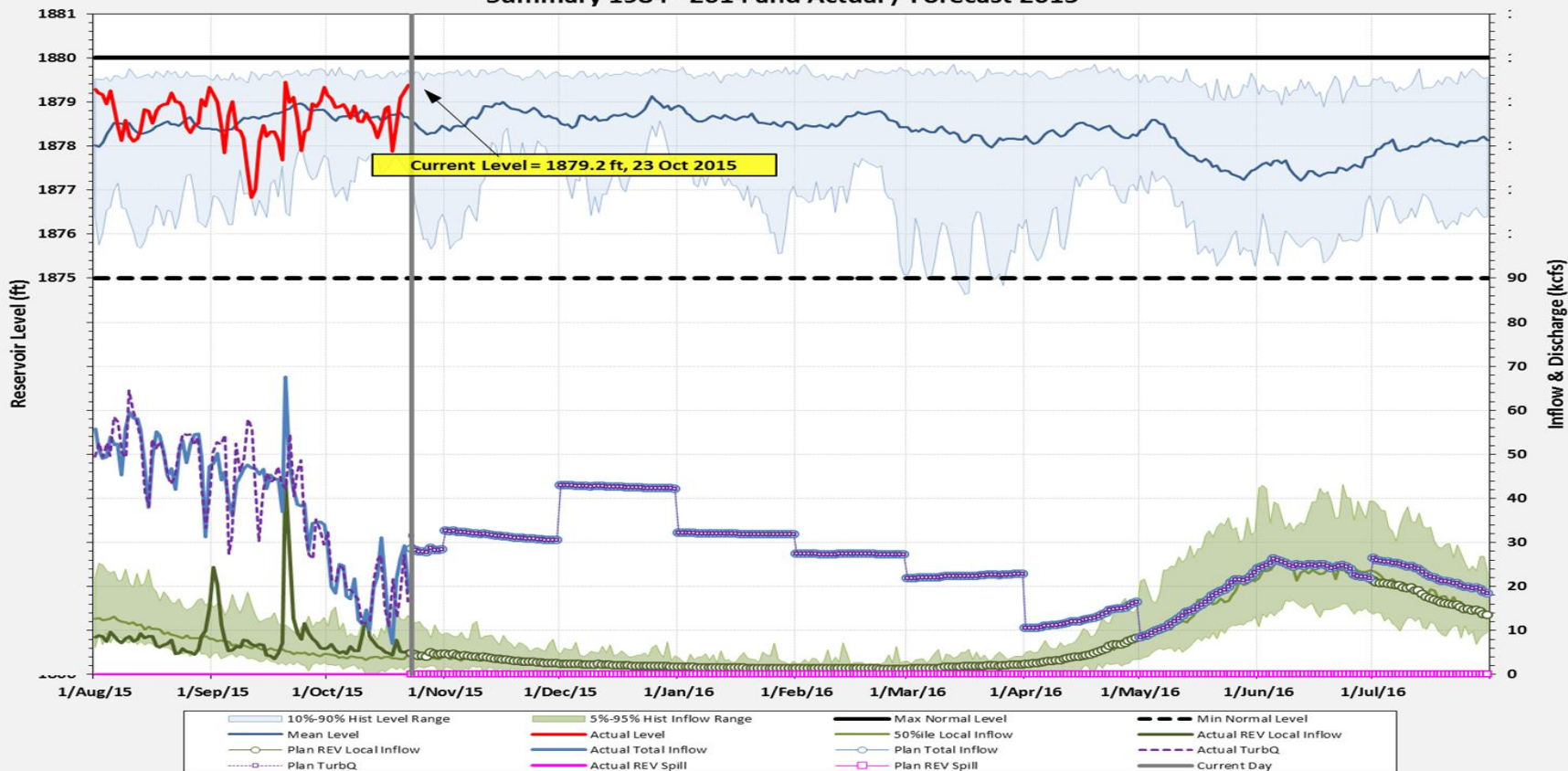
# Revelstoke

Energy Study: Oct 08, 2015  
TSR Study: 21 Oct 2015

## REVELSTOKE RESERVOIR (REV) LEVELS & FLOWS

Summary 1984 - 2014 and Actual / Forecast 2015

ESP Update: Oct 19 2015  
Forecast Date: Oct 23, 2015

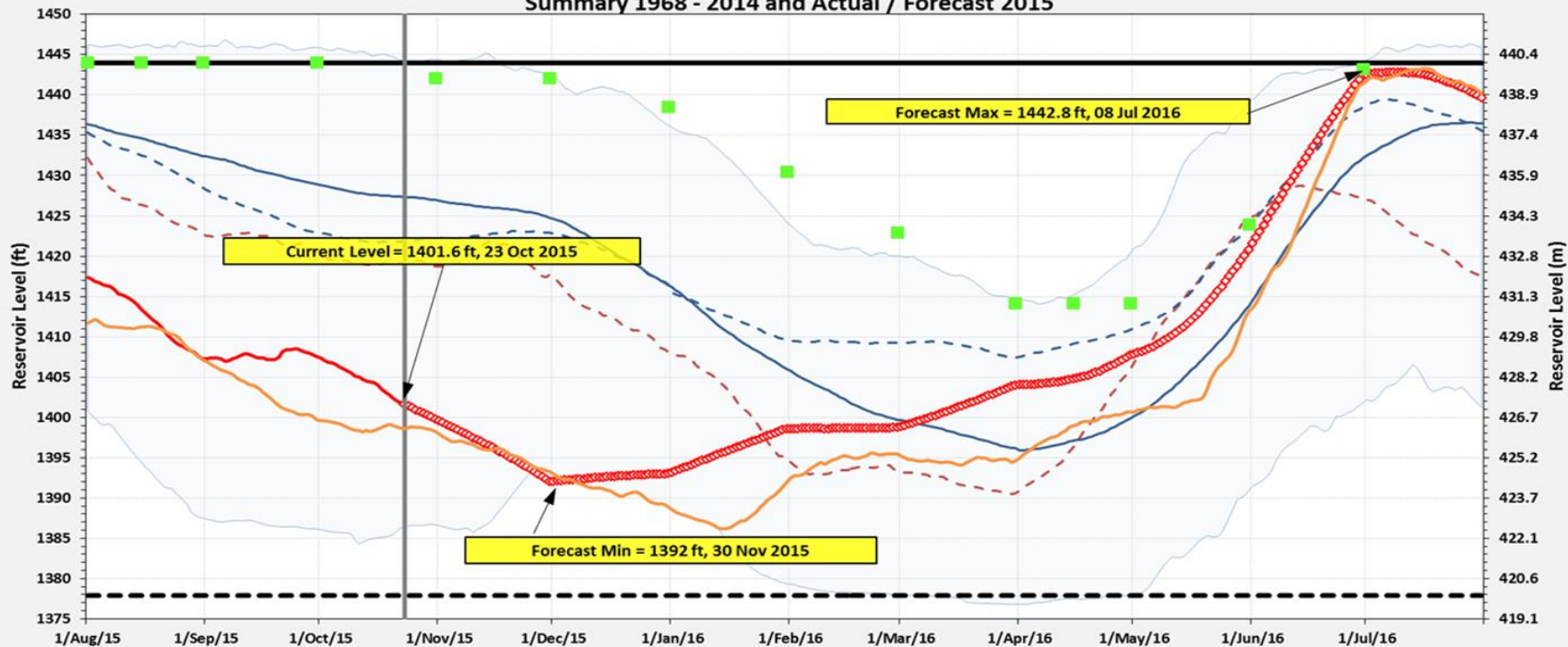


Energy Study: Oct 08, 2015  
TSR Study: 21 Oct 2015

## ARROW LAKES RESERVOIR (ARD) LEVELS

Summary 1968 - 2014 and Actual / Forecast 2015

ESP Update: Oct 19 2015  
Forecast Date: Oct 23, 2015



Min-Max Hist Level Range

Max Norm Level

Min Norm Level

Flood Control Level

Prev Yr Level

Mean Level

Mean Level, Last 10 Yrs

Actual Level

Expected Plan Level

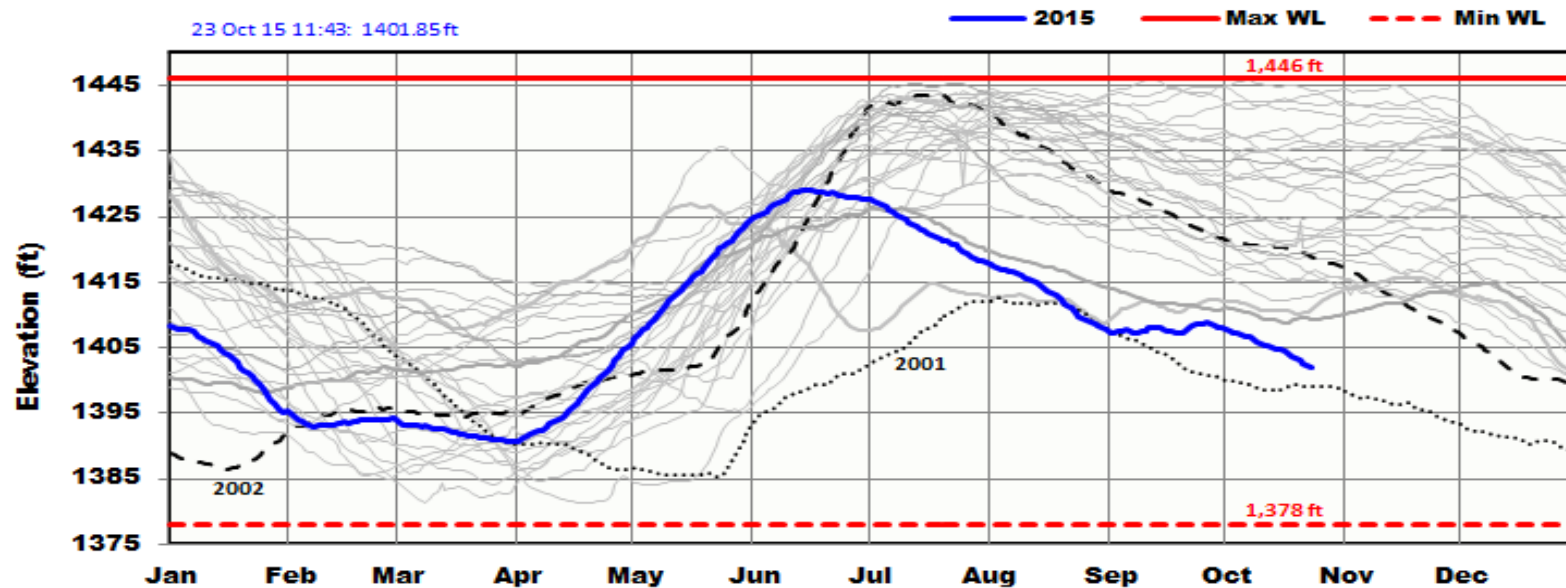
Current Day

2001/02



# Arrow

## Arrow Reservoir (1984 to Present)



Arrow operations in 2015 compared to historical levels (1984 to Present). Note that current (2015) operations are approaching those in 2001. Recovery of 2001 operations (in 2002) are also plotted for context.

Maximum WL 1446 ft, Minimum WL 1378 ft. Treaty Storage between 1444 ft and 1378 ft = 7.1 MAF: Active storage of ~66 ft.

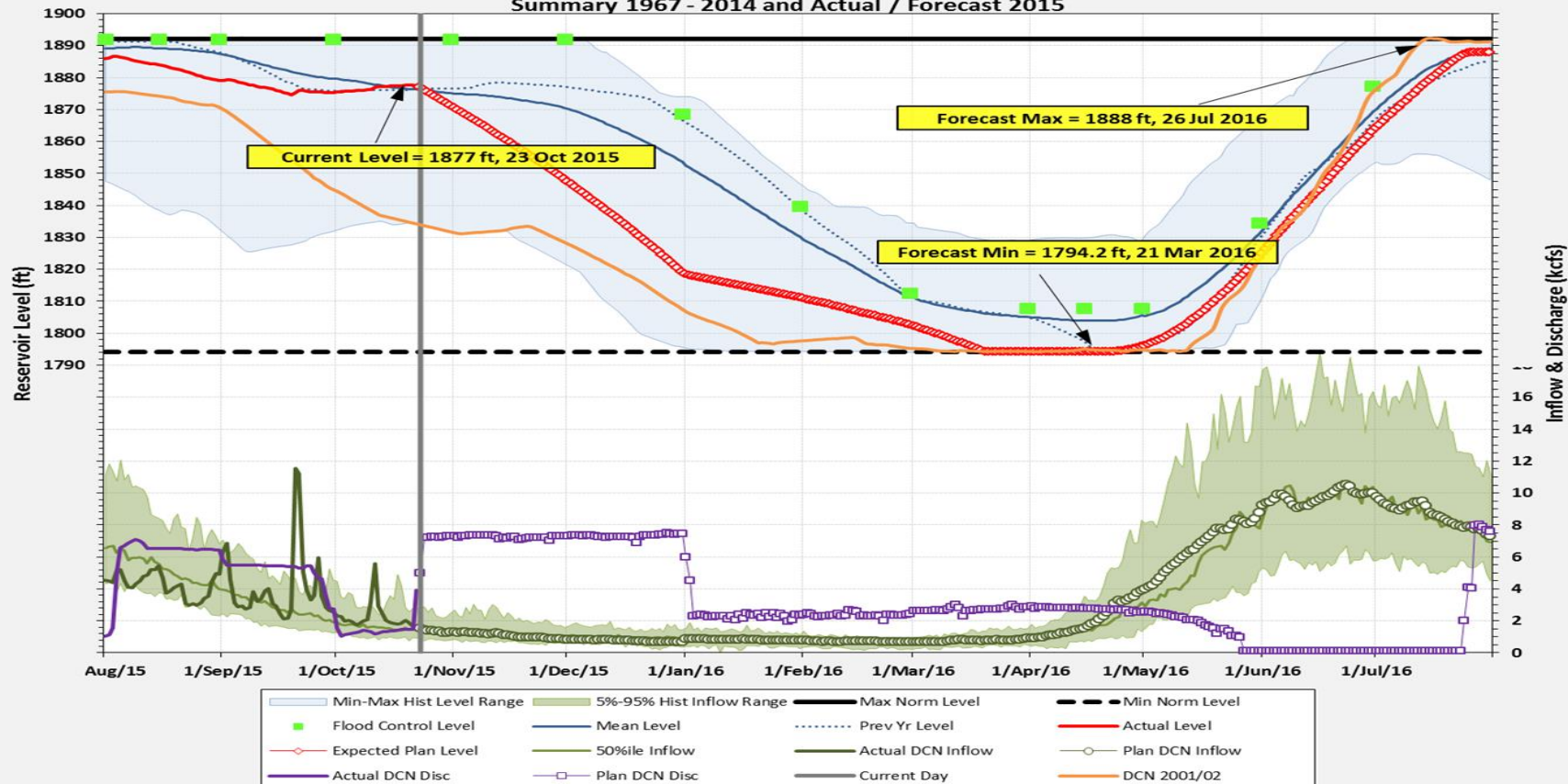
# Duncan

Energy Study: Oct 08, 2015  
TSR Study: 21 Oct 2015

## DUNCAN RESERVOIR (DCN) LEVELS & FLOWS

ESP Update: Oct 19 2015  
Forecast Date: Oct 23, 2015

Summary 1967 - 2014 and Actual / Forecast 2015



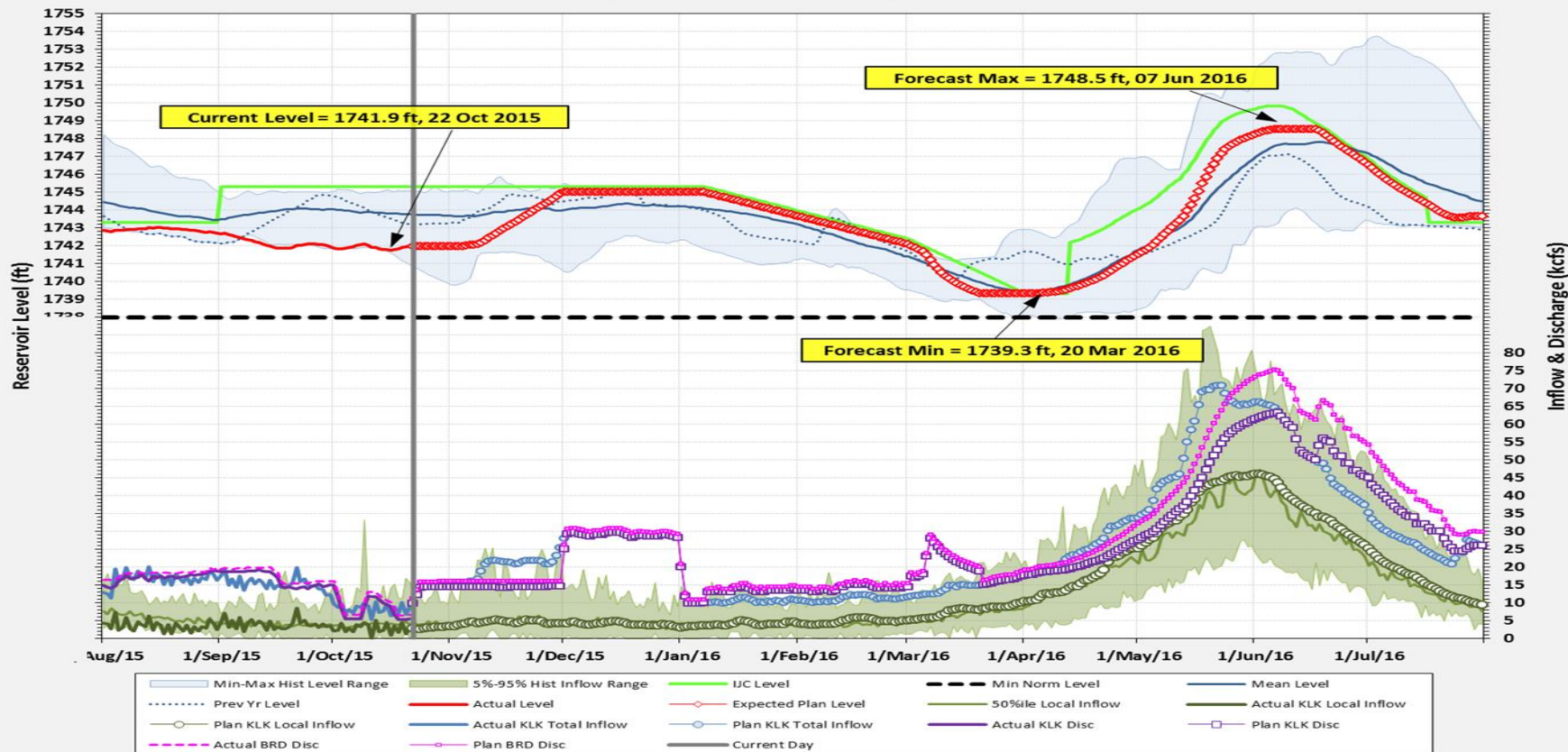
# Kootenay Lake

Energy Study: Sep 08, 2015  
TSR Study: 7 Oct 2015

## KOOTENAY LAKE RESERVOIR (KLK) LEVELS & FLOWS

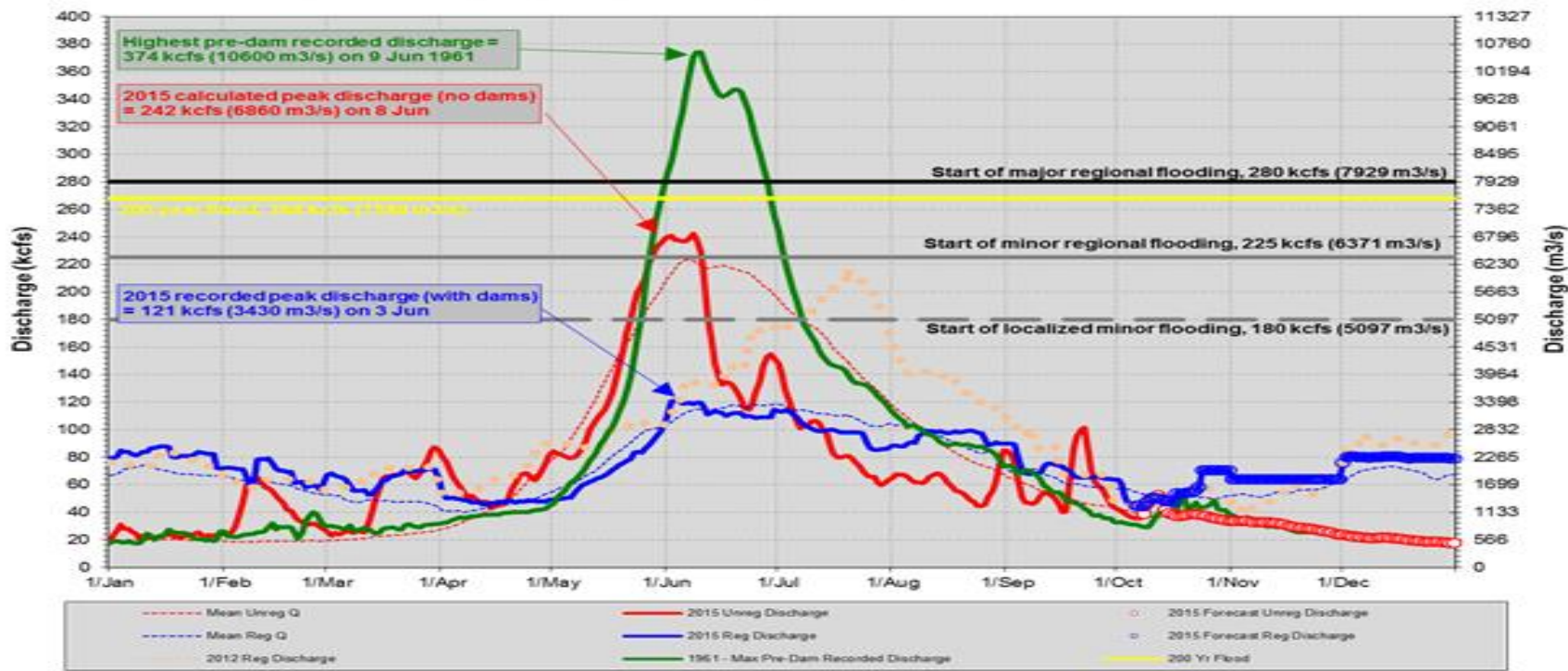
Summary 1984 - 2014 and Actual / Forecast 2015

ESP Update: Oct 8, 2015  
Forecast Date: Oct 22, 2015



# Columbia River at Birchbank

**COLUMBIA RIVER AT BIRCHBANK AVERAGE DAILY DISCHARGE**  
(Brilliant Project + Brilliant Expansion + Brilliant Spill + Arrow Lakes Hydro + Hugh Keenleyside)  
Summary 1937 - 2014 (unregulated) & Summary 1964 - 2014, Actual 2012 and Actual / Forecast 2015



In 2015 Birchbank flow peaked at 121 kcfs on 3 June. Without CRT dams, the peak 2015 Birchbank discharge would have been ~242 kcfs. CRT operations provided significant flood protection for communities on the Columbia River, e.g. Revelstoke, Castlegar, Genelle, Trail.



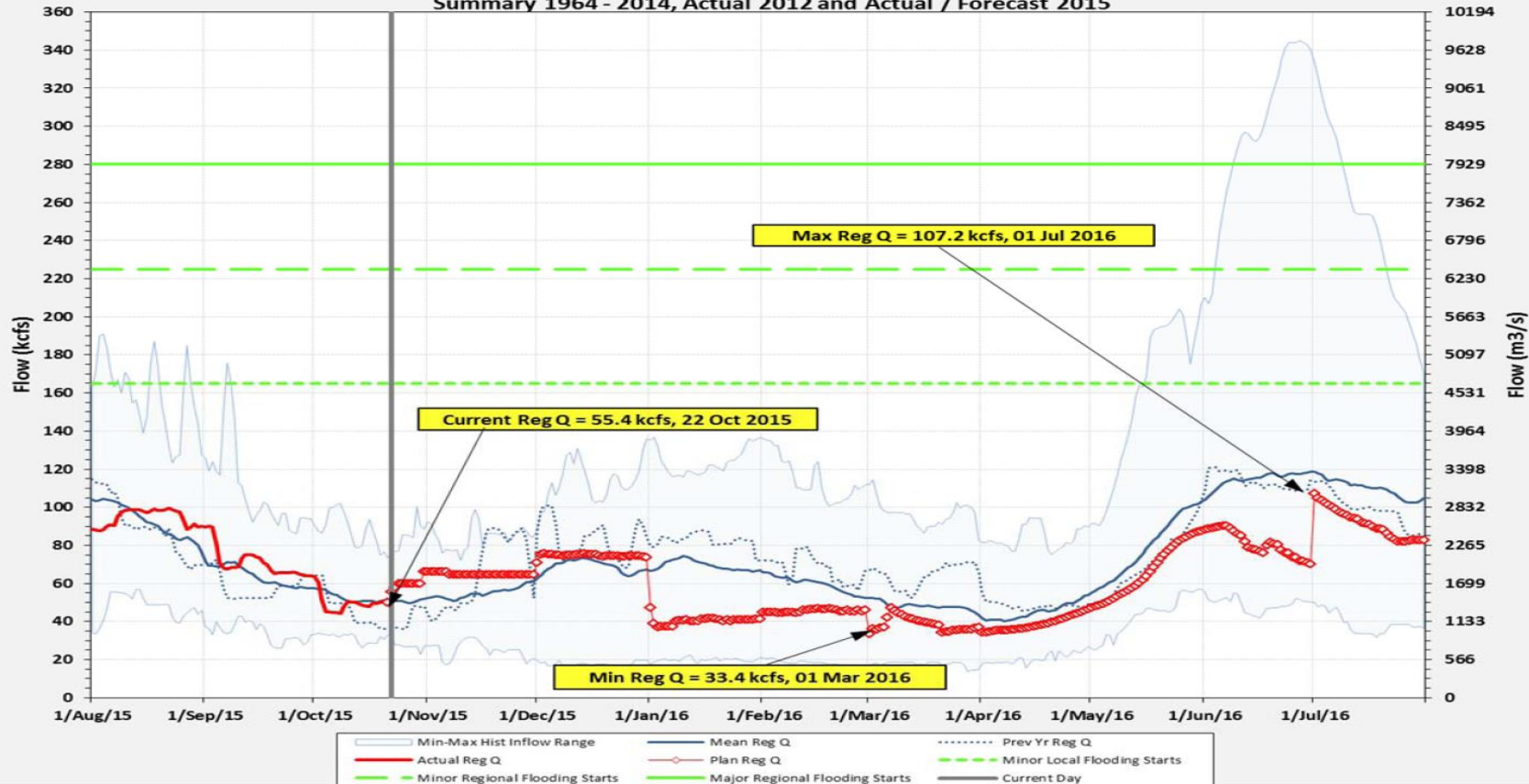
# Columbia River at Birchbank

Energy Study: Oct 08, 2015  
TSR Study: 21 Oct 2015

## COLUMBIA RIVER @ BIRCHBANK REGULATED FLOWS

ESP Update: Oct 19 2015  
Forecast Date: Oct 22, 2015

Summary 1964 - 2014, Actual 2012 and Actual / Forecast 2015





# 2015 Arrow Operations

To help offset even lower Arrow levels this year and to smooth the rate of draft, BC Hydro has taken several actions throughout the spring and summer including:

- BC Hydro has run Mica generating units harder than normal across the spring and summer.
- Duncan discharges were increased in August: Reduced contribution of Arrow releases.
- Retention of all available Non Treaty Storage in Canada (~ 4 MAF).
- Flow augmentation storage for U.S. and Canada fish benefits supported Arrow January through July 2015. Work is in progress for a new agreement which will cover the period Dec 2015 – July 2016 and, if implemented, will result in higher Arrow levels from Jan through July 2016.
- A cooperative arrangement with the US: Arrow Summer Storage Agreement (1 July – 30 September 2015).
- BPA and BC Hydro have both stored into the Non Treaty Storage Recallable accounts in Oct, refilling both accounts to full.

# Keeping You Informed

- Annual operations update meetings;
- Toll-free phone line with reservoir levels and river flows at 1-877-924-2444;
- Near real-time reservoir level information on bchydro.com by searching for “hydromet data”;
- Weekly reservoir updates by email for the upper and lower Columbia with short-term reservoir level forecasts;
- Bi-annual Columbia Operations summaries explaining CRT and other agreements, system and facility operations, and reservoir water level information; and
- Regional annual reports, distributed every fall to local government, the media and stakeholders. These reports are also available on bchydro.com.

# UPPER COLUMBIA RESERVOIR UPDATE

PROVIDING RESERVOIR USERS WITH CURRENT DATA AND WEEKLY FORECASTS



OCTOBER 30<sup>TH</sup>, 2015

No. 46-15

The following forecast information is provided to federal, provincial and municipal officials, media and others who have expressed interest in receiving this information. Forecast information is subject to change at any time if there are significant changes in the projected weather patterns in the Columbia basin, load requirements, Columbia River Treaty provisions and other variables during this period.

NORMAL RESERVOIR LIMITS	CURRENT WATER LEVEL October 31/15	FORECAST WATER LEVEL November 7/15	FORECAST 7-day TREND
<b>Mica (Kinbasket)</b> 707.1 – 754.4 m / 2320 – 2475 ft	746.8m 2450.2 ft	746.7 m 2449.8 ft	↓
<b>Arrow Lakes</b> 420 - 440.1 m / 1378 – 1444 ft	426.6 m 1399.5 ft	426.0 m 1397.5 ft	↓

↑ Increasing ↓ Decreasing N/C = No Change

Mica (Kinbasket) Weekly Average Discharge 16.0 kcls = 453 m <sup>3</sup> /s	Arrow Weekly Average Discharge 44 kcls = 1246 m <sup>3</sup> /s
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There is currently no water supply forecast information for 2016 until December 2015. For 2015, the actual runoff at The Dalles, Oregon was 67% of normal for April through September, the third driest year on record. The actual elevation of the reservoirs is influenced by snowpack, inflow levels, weather patterns and other factors such as load requirements.

**Kinbasket Reservoir** is currently (October 30<sup>th</sup>) 746.86 m (2450.3ft) measured at the forebay. The reservoir drafted slightly 0.43 m (1.4 ft) in the last week. The reservoir is expected to draft to between 742.2 – 745.2 m (2435 – 2445 ft) by the end of November. Note, however, that near and long-term forecasting is inherently uncertain due to the unpredictability of future events and conditions. The Kinbasket Reservoir reached its last maximum elevation of 750.95 m (2463.8 ft) on July 15, 2015 and its latest minimum elevation of 736.97 m (2417.9 ft) on May 15, 2015.

**Revelstoke Reservoir** is normally operated between 571.50 metres (1875 ft) and 573.02 metres (1880 ft). However, drafts to 571.10 m (1873.7 ft) or lower for limited durations may be required to meet short term generation requirements. During the spring freshet and winter peak load periods, it is common to have frequent daily fluctuations of the reservoir within about 1.5 m (5 ft) of full pool in response to weather patterns and inflow levels. Recreation users are advised to take necessary precautions to ensure public safety.

**Arrow Lakes Reservoir** is currently (October 30<sup>th</sup>) at about 426.64 m (1399.7 ft) measured at the Fauquier gauge. The reservoir drafted by 0.57 m (1.9 ft) in the last week. The reservoir is expected to draft to between 422.1 – 425.2 m (1385 – 1395 ft) by the end of November. The Arrow Lakes Reservoir reached its last maximum level of 435.48 m (1428.73 ft) on June 13, 2015 and its latest minimum elevation of 423.82 m (1390.5 ft) on March 30, 2015.

For current reservoir levels, please visit BC Hydro's website at [http://www.bchydro.com/energy-in-bc/our\\_system/transmission\\_reservoir\\_data/previous\\_reservoir\\_elevations.html](http://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/previous_reservoir_elevations.html). For additional information, or if you do not have access to the internet, please call 1-877-924-2444.

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# LOWER COLUMBIA RESERVOIR UPDATE

PROVIDING RESERVOIR USERS WITH CURRENT DATA AND WEEKLY FORECASTS



OCTOBER 30<sup>TH</sup>, 2015

No. 46-15

The following forecast information is provided to federal, provincial and municipal officials, media and others who have expressed interest in receiving this information. Forecast information is subject to change at any time if there are significant changes in the projected weather patterns in the Columbia basin, load requirements, Columbia River Treaty provisions and other variables during this period.

NORMAL RESERVOIR LIMITS	CURRENT WATER LEVEL October 31/15	FORECAST WATER LEVEL November 7/15	EXPECTED 7-day TREND
<b>Arrow Lakes</b> 420 - 440.1 m / 1378 – 1444 ft	426.6 m 1399.5 ft	426.0 m 1397.5 ft	↓
<b>Kootenay Lake</b>	531.1 m 1742.4 ft	531.1 m 1742.6 ft	↑
<b>Duncan</b> 546.9 - 576.7 m / 1794 – 1892 ft	570.7 m 1872.3 ft	569.3 m 1867.8 ft	↓

↑ Increasing ↓ Decreasing N/C = No Change

Arrow Weekly Average Discharge 44 kcls = 1246 m <sup>3</sup> /s	Brilliant Weekly Average Discharge 15.2 kcls = 431 m <sup>3</sup> /s	Duncan Dam Weekly Average Discharge 7.3 kcls = 206 m <sup>3</sup> /s
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There is currently no water supply forecast information for 2016 until December 2015. For 2015, the actual runoff at The Dalles, Oregon was 67% of normal for April through September, the third driest year on record. The actual elevation of the reservoirs is influenced by snowpack, inflow levels, weather patterns and other factors such as load requirements.

**Arrow Lakes Reservoir** is currently (October 30<sup>th</sup>) at about 426.64 m (1399.7 ft) measured at the Fauquier gauge. The reservoir drafted by 0.57 m (1.9 ft) in the last week. The reservoir is expected to draft to between 422.1 – 425.2 m (1385 – 1395 ft) by the end of November. The Arrow Lakes Reservoir reached its last maximum level of 435.48 m (1428.73 ft) on June 13, 2015 and its latest minimum elevation of 423.82 m (1390.5 ft) on March 30, 2015.

**Duncan Reservoir** is currently (October 30<sup>th</sup>) about 570.76 m (1872.6 ft) measured at the dam. The reservoir drafted 1.28 m (4.2 ft) over the past week. The reservoir is expected to draft to be between 561.7 – 574.8 m (1843 - 1853 ft) by the end of November. The Duncan Reservoir reached its last maximum level of 575.02 m (1886.56 ft) on August 04, 2015, and its latest minimum elevation of 546.93 m (1794.4 ft) on April 20, 2015.

For current reservoir levels, please visit BC Hydro's website at [http://www.bchydro.com/energy-in-bc/our\\_system/transmission\\_reservoir\\_data/previous\\_reservoir\\_elevations.html](http://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/previous_reservoir_elevations.html). For additional information, or if you do not have access to the internet, please call 1-877-924-2444.

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