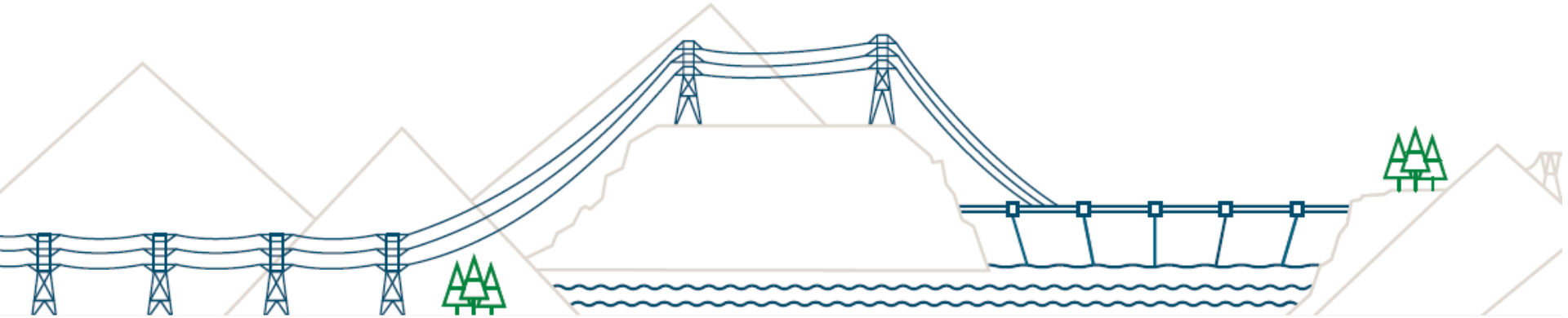
CRT Operations in Low Water Conditions



Friday, May 27, 2016

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Outline

- Utility Planning Background
- CRT Rule Curves
- 2015 Operations
- Future possibilities?

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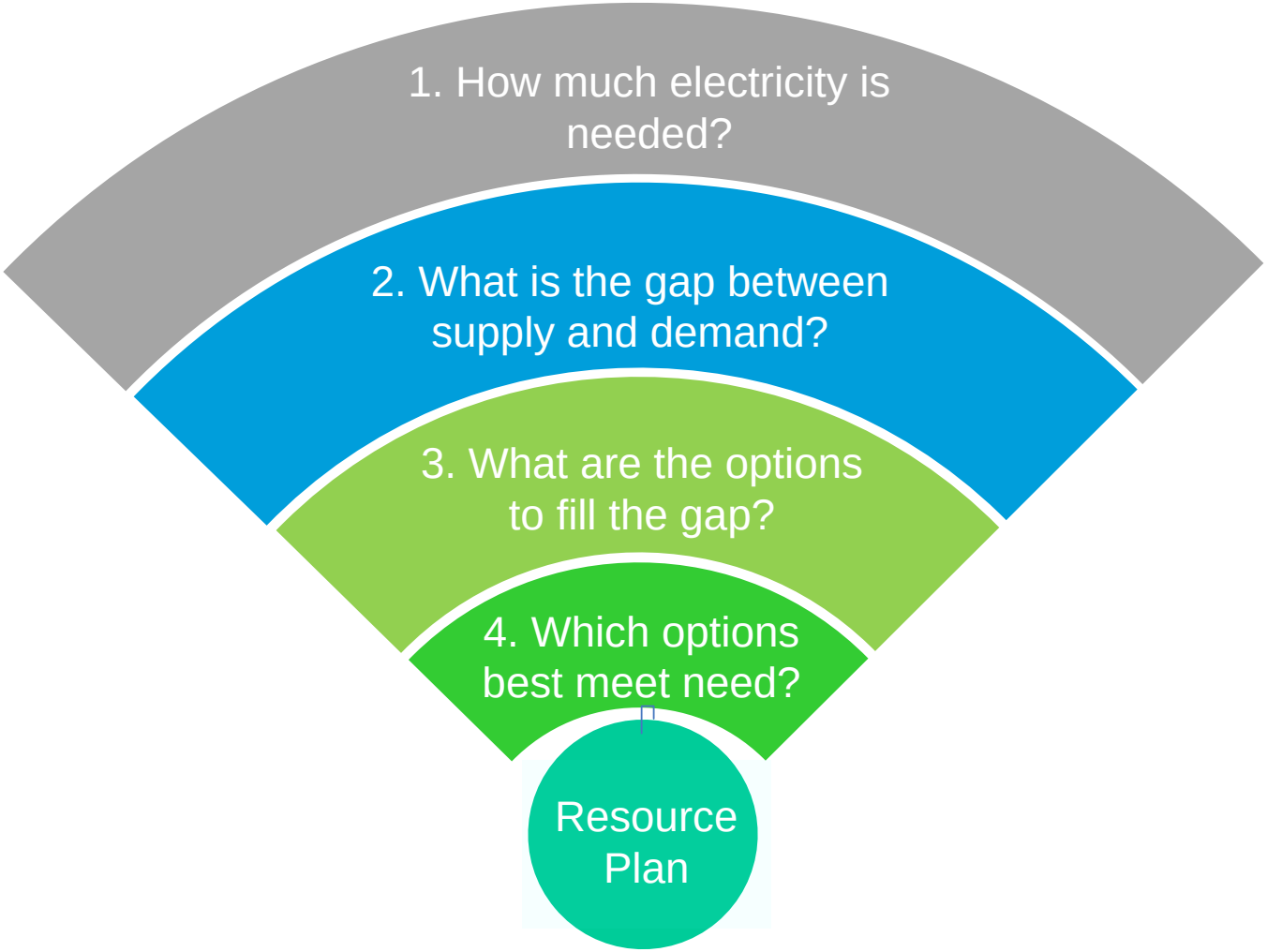
Integrated Resource Plan - Key Planning Questions



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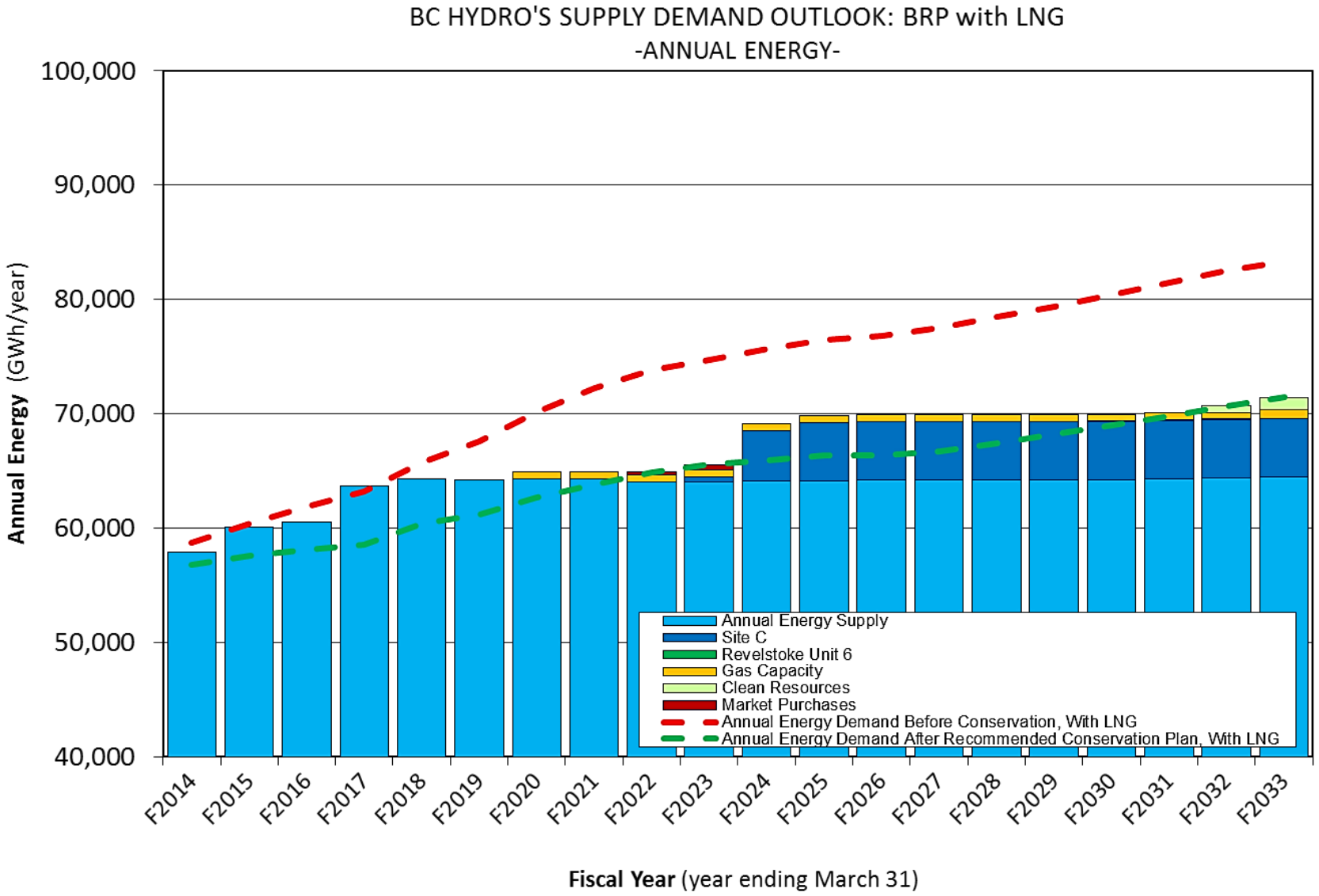

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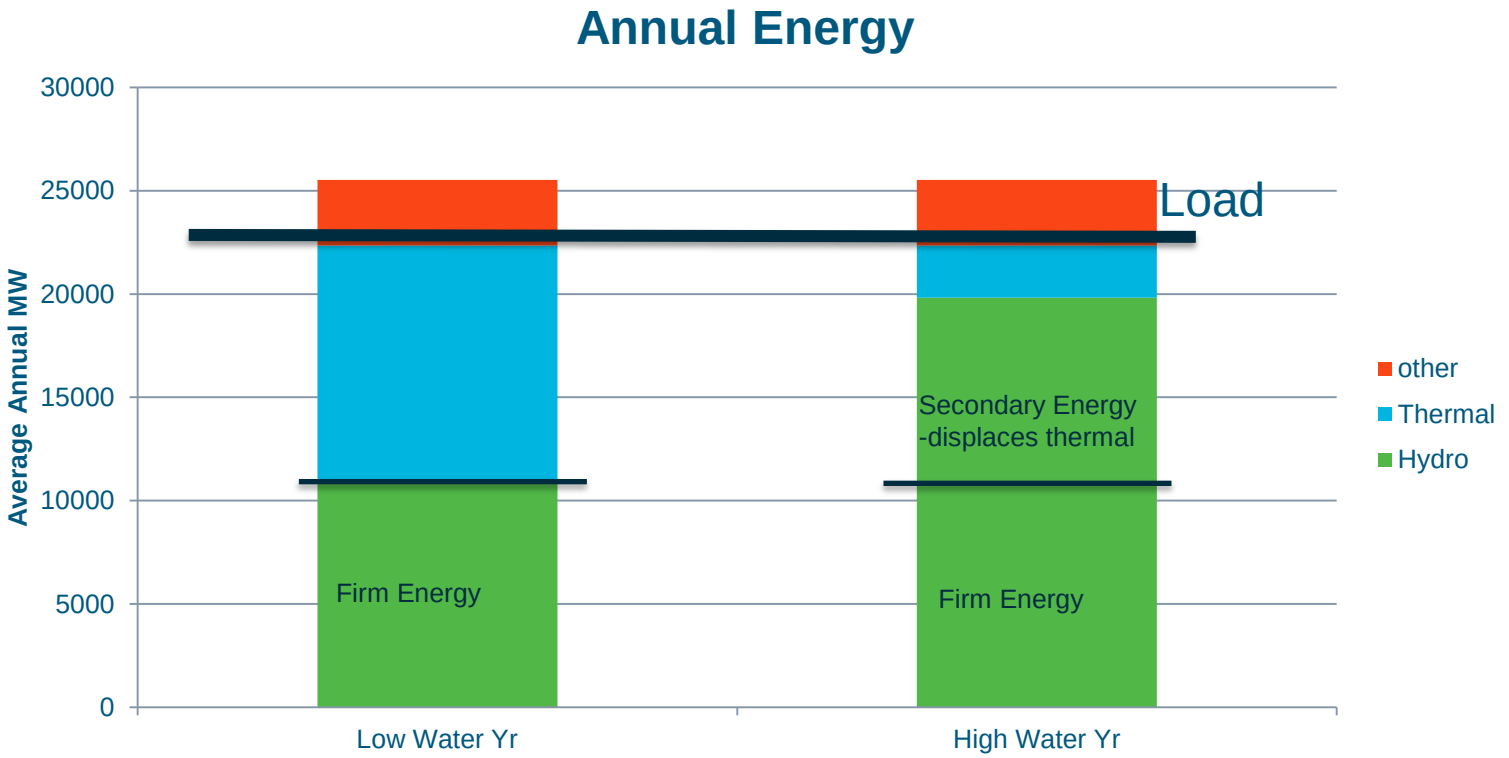
Load Resource Balance (1yr)
Pacific Northwest System



Definitions:

Firm Energy – energy generated during driest water conditions in historical record

Critical Period – time period during driest water conditions where reservoirs draft from full to empty

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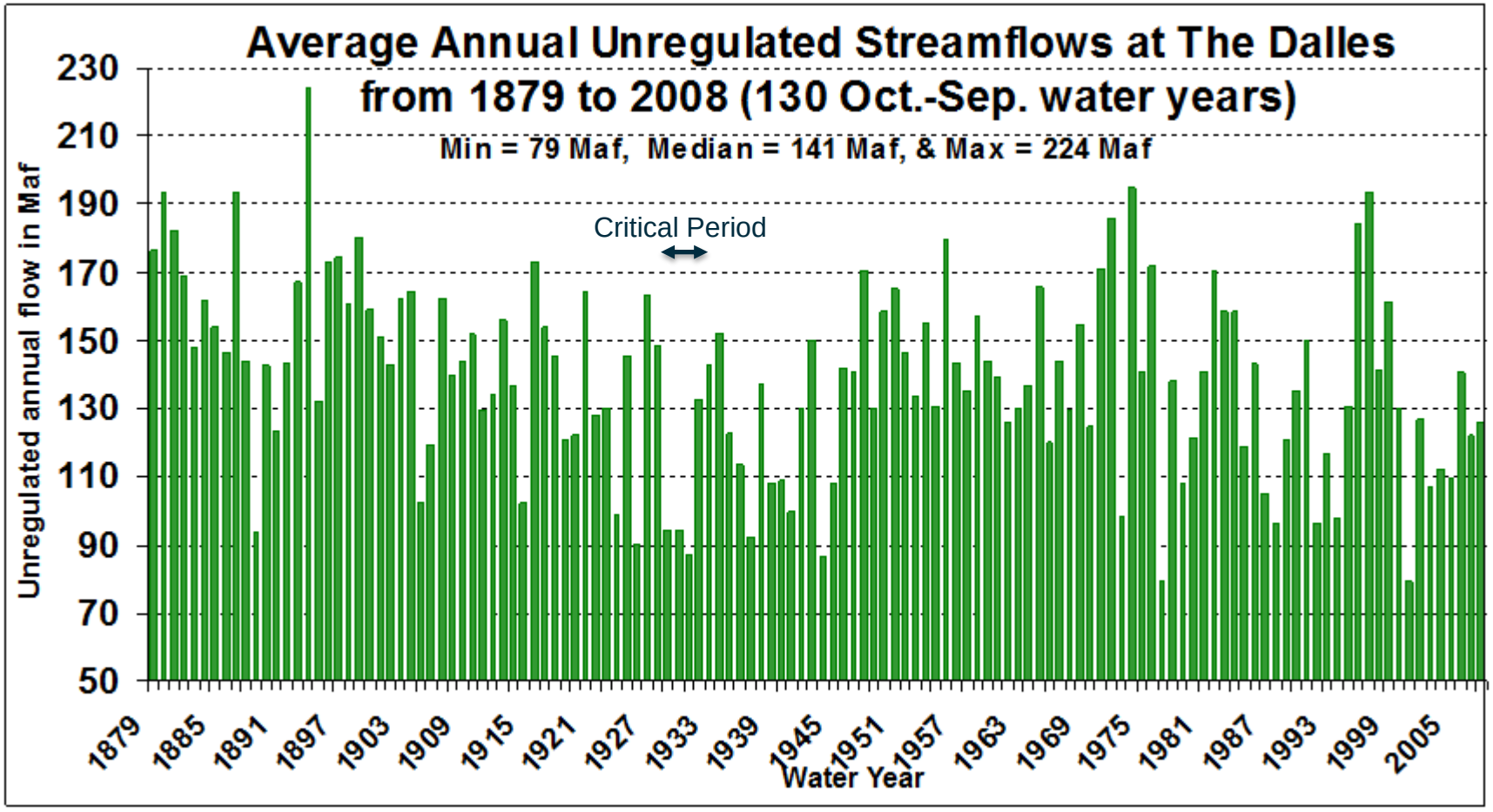
Critical Period: Aug 1928 to Dec 1932



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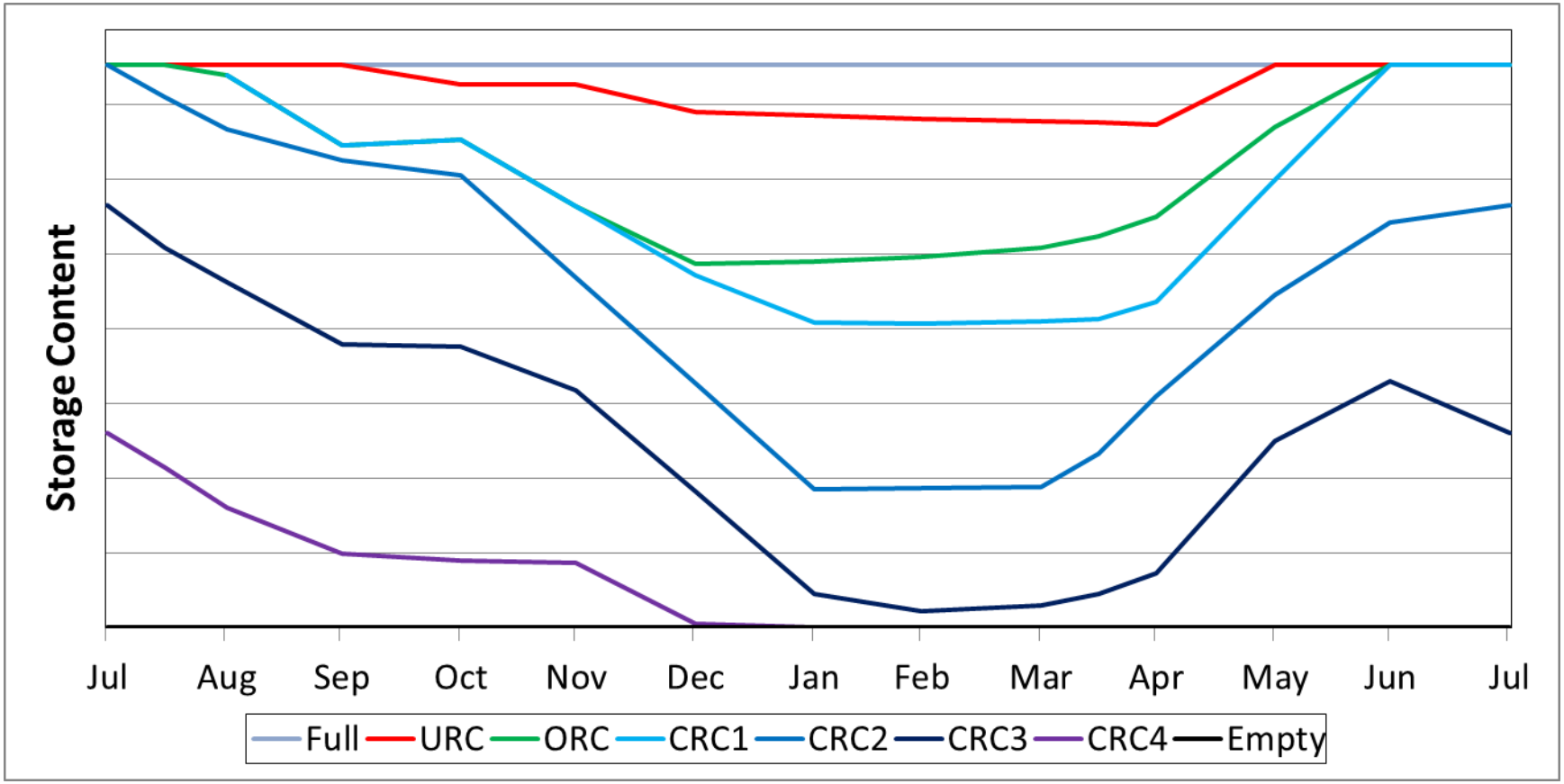
Critical Rule Curves



Proportional Draft: Under CRT, if generation for ORC does not equal the system firm energy target, then all coordinated reservoirs are modeled to be drafted proportionally between 1st and 2nd CRC; if still not meet then proportionally drafted between 2nd and 3rd CRCs, then 3rd and 4th.

URC = Upper Rule curve
ORC = Operating Rule curve

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Summary - CRT regulation under dry conditions

- Under dry conditions, more water is released from Canadian and U.S. Storage according to the terms of the Columbia River Treaty.
- Objective is to maximize the firm energy in the Critical period so reservoirs with lowest energy production drafted first:

  Arrow (180 MW) and Duncan (0 MW) drafted first, Mica and U.S. headwater projects (Libby, Dworshak, Hungry Horse) next, Grand Coulee drafts last (6800 MW)

- Canada obligated to draft reservoirs to the CRCs for energy reliability, while U.S. may re-regulate flows for other power or non-power purposes.
- Regardless of generation, U.S. obligated to deliver Canadian Entitlement to B.C.

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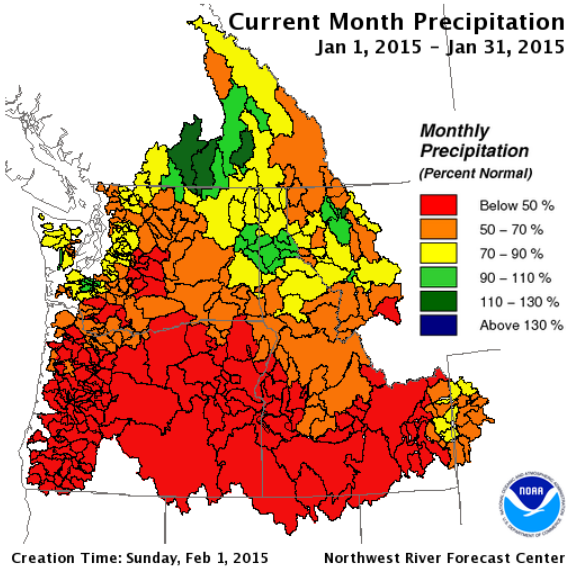
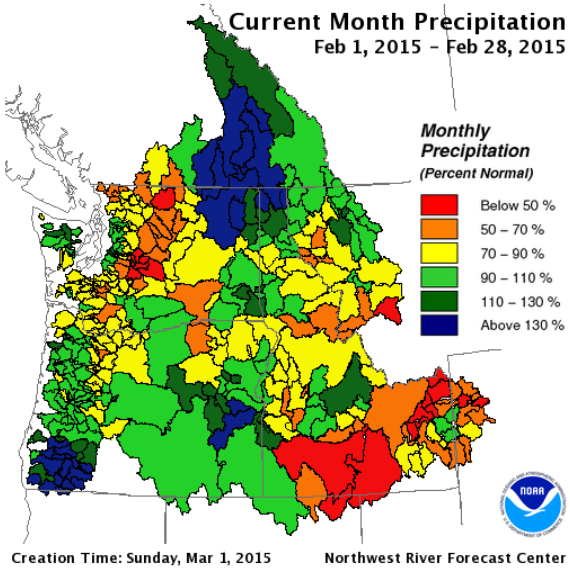
2015 Dry Conditions

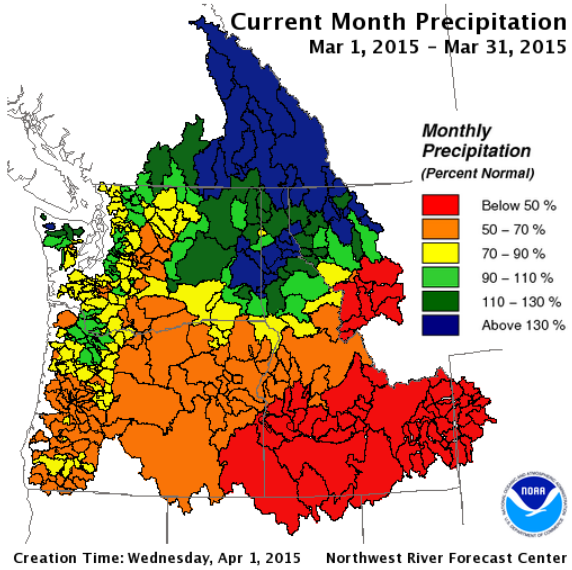
- This spring and summer's continued dry conditions in the US and Canadian portion of the Columbia Basin have resulted in lower levels for Canadian Storage and other Columbia Basin reservoirs in Canada and the U.S.

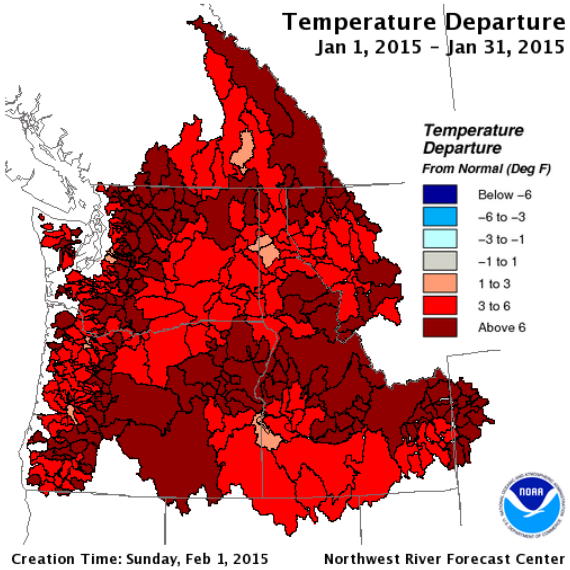
- 2015 was the third driest year on record for the overall Columbia River basin (US and Canada) since 1960. Total runoff for the Columbia basin between April and August was 67 per cent of normal. Similar conditions have not been observed since 2001

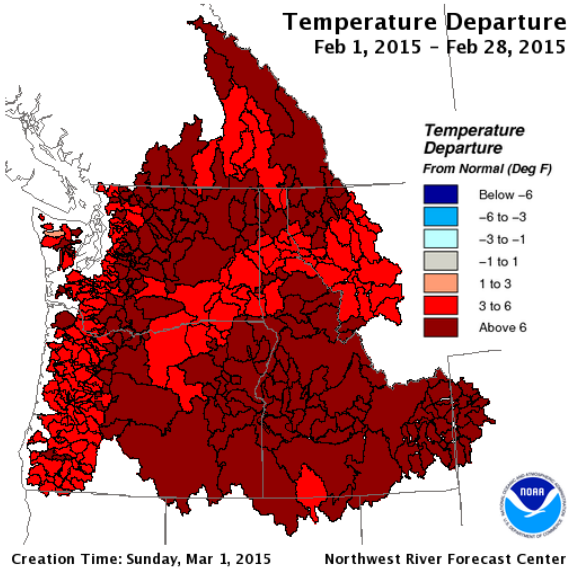
Precipitation and Temperature

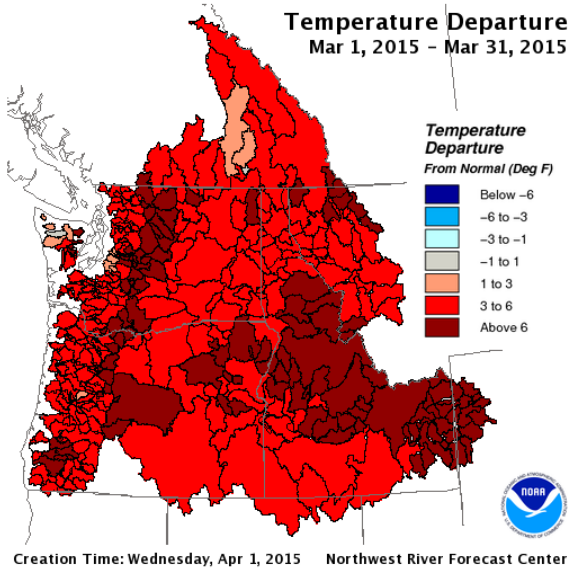












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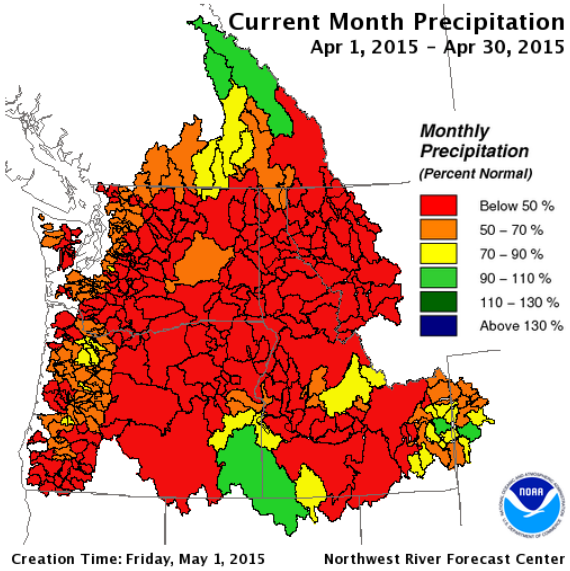
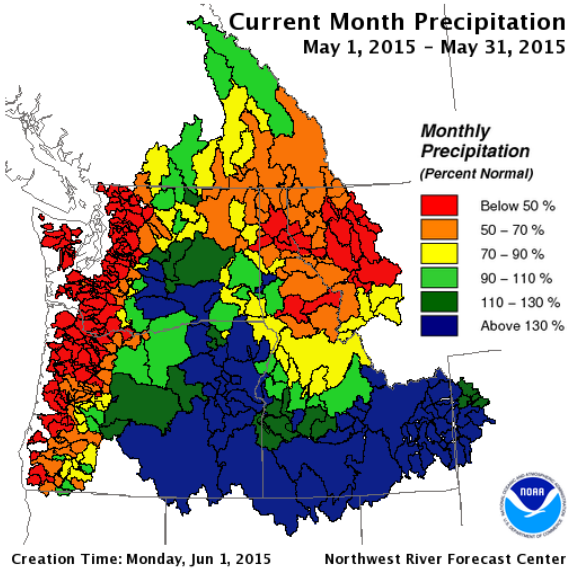
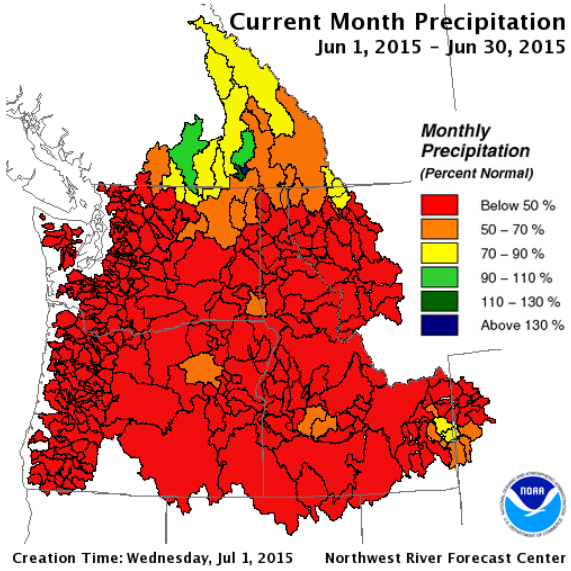
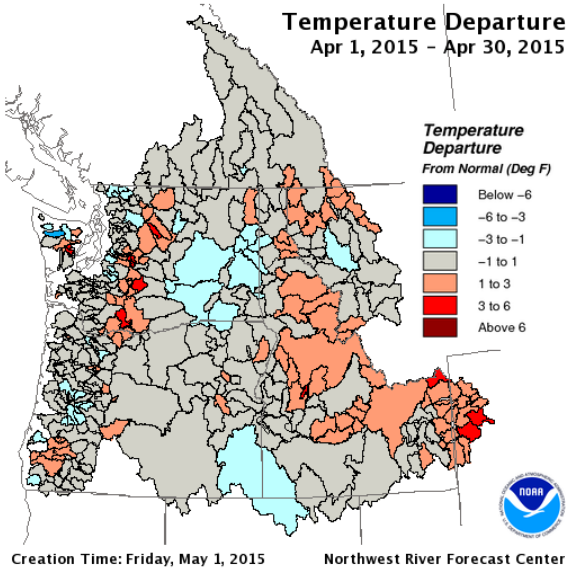
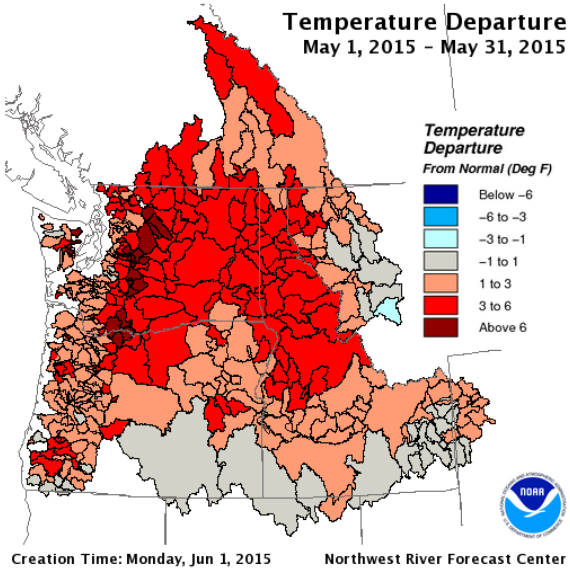
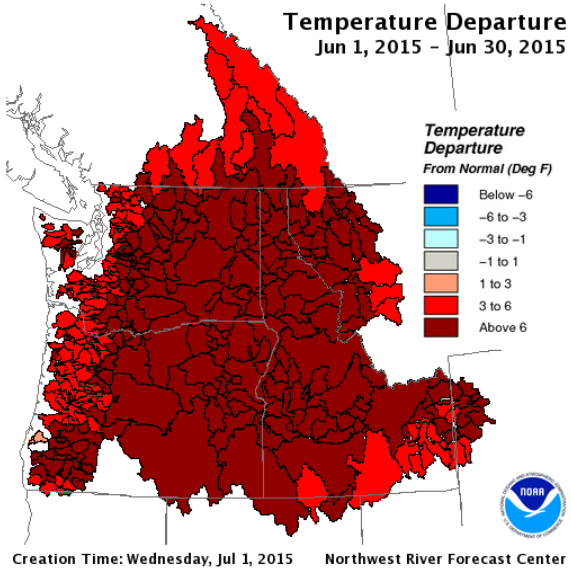




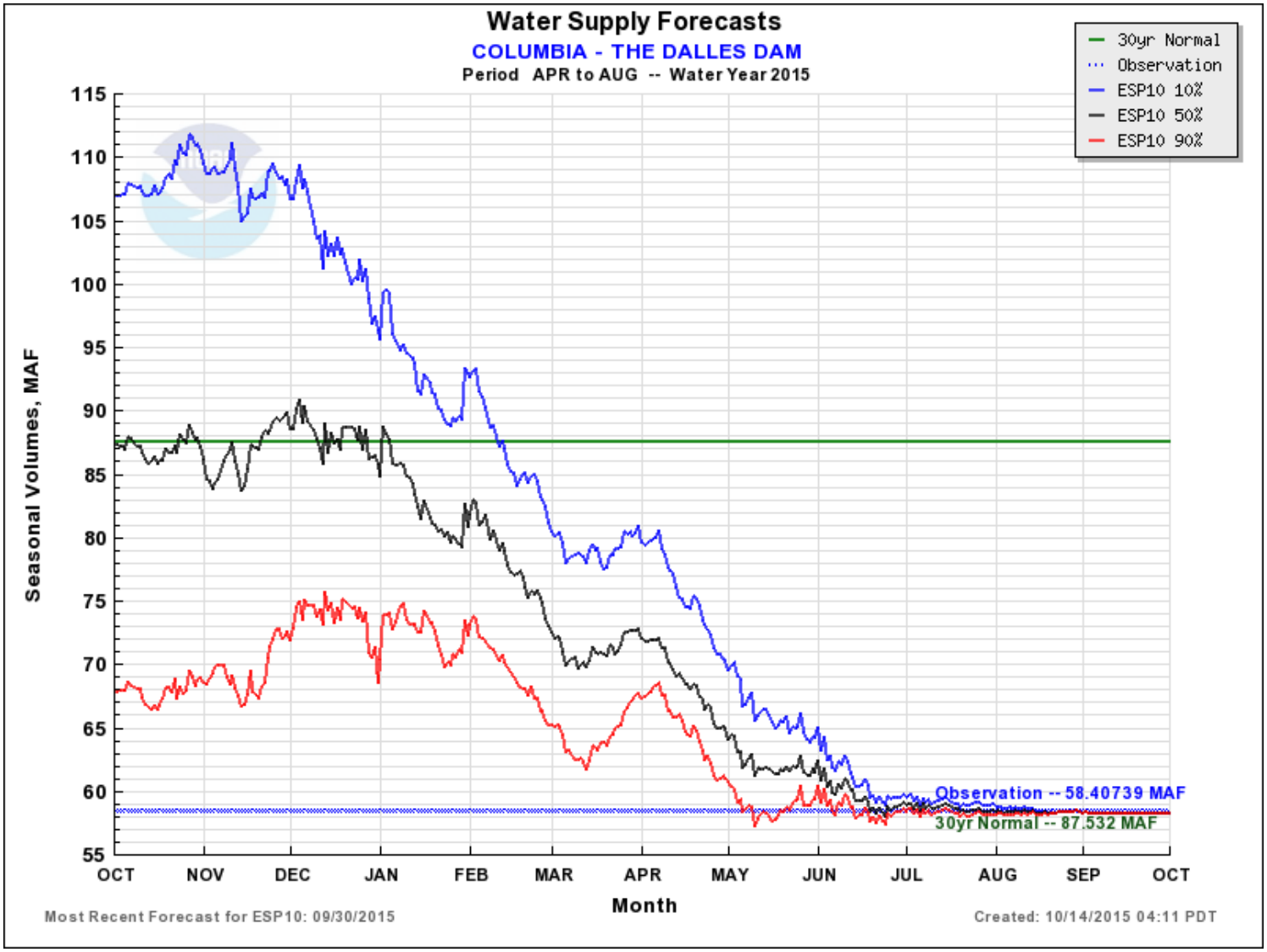








WATER SUPPLY FORECAST

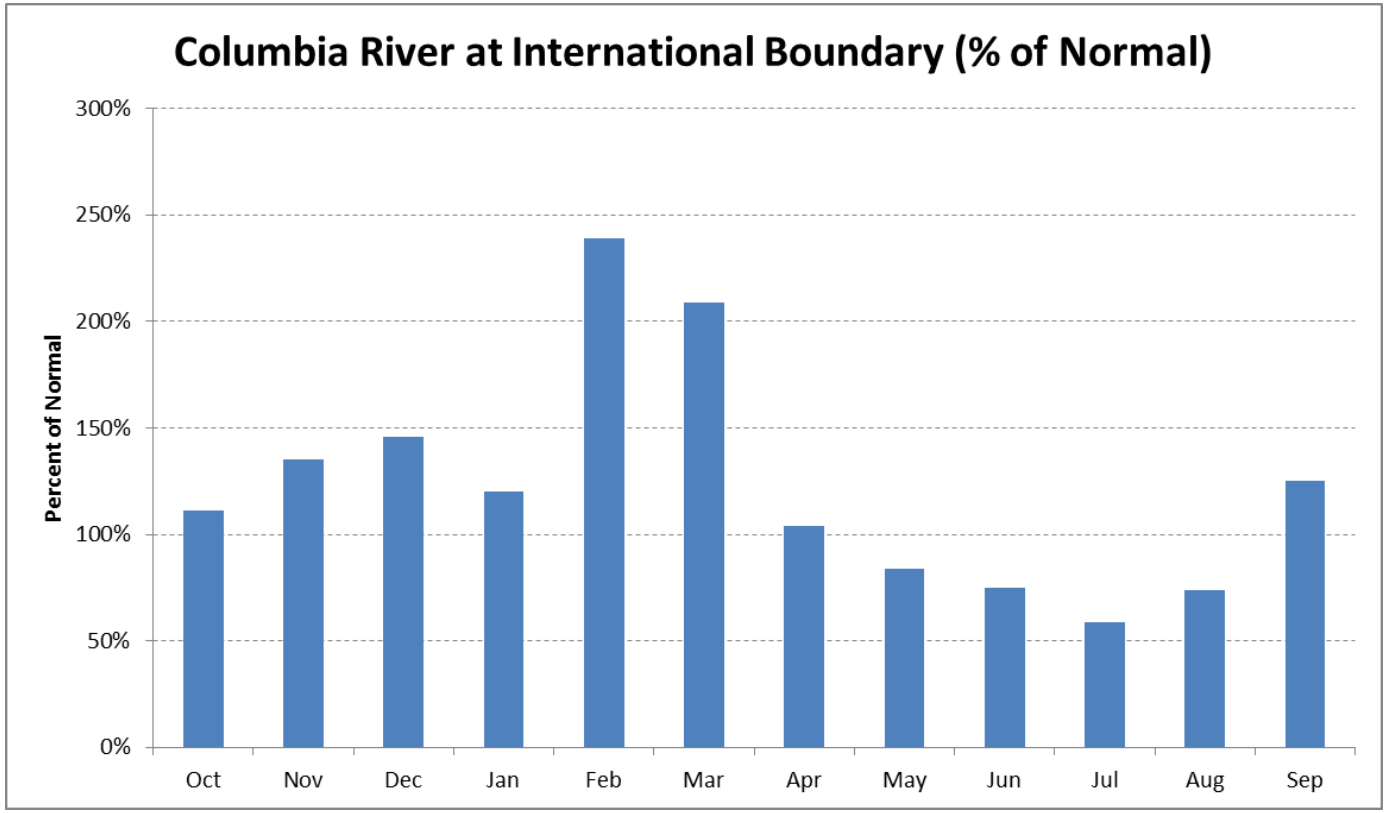


CANADIAN RUNOFF

Feb-Sep 2015 Unregulated Inflows

- Mica: 106% of normal
- Arrow: 93%
- Duncan: 96%
- Kootenay Lake: 81%

Normal is based on 1981 - 2010



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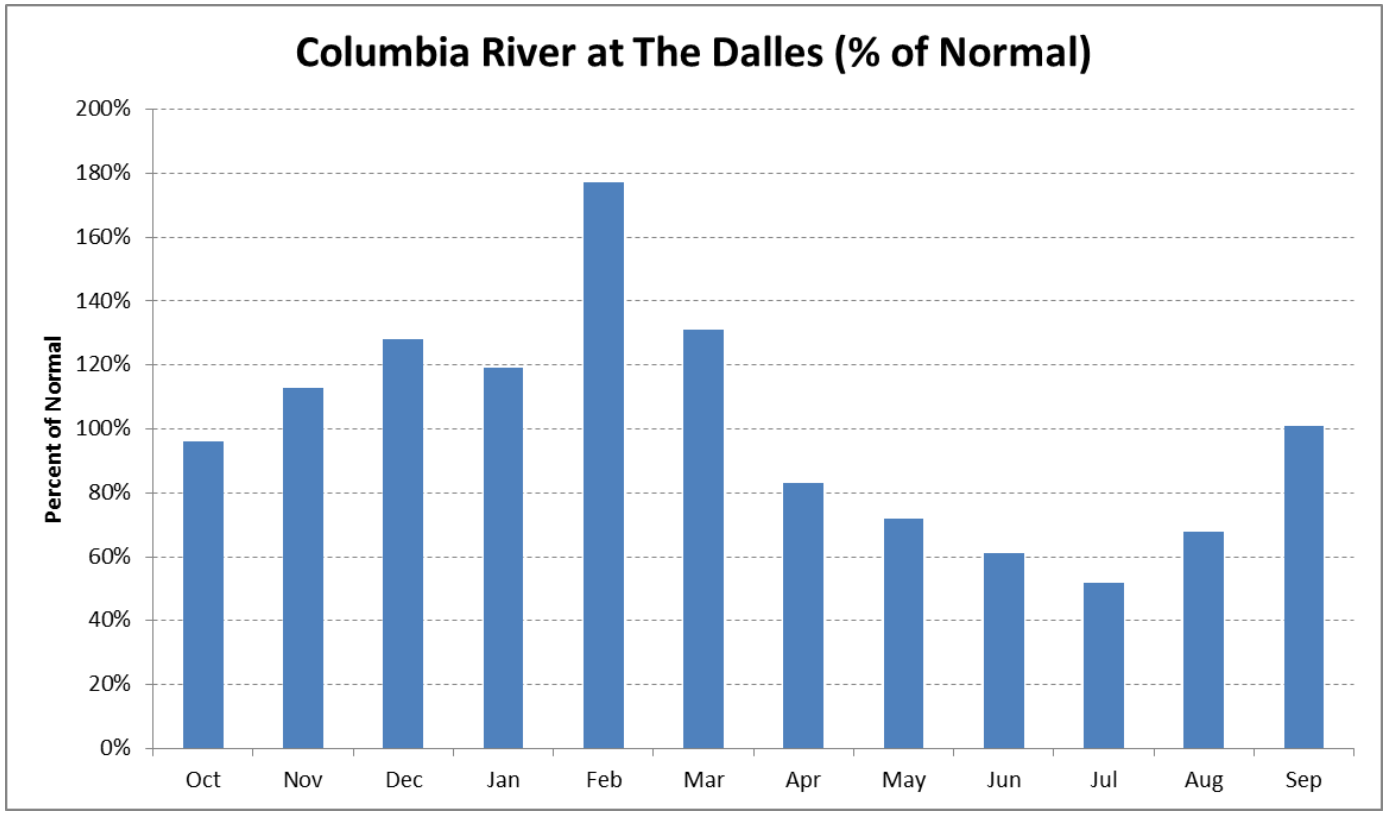
UNITED STATES RUNOFF

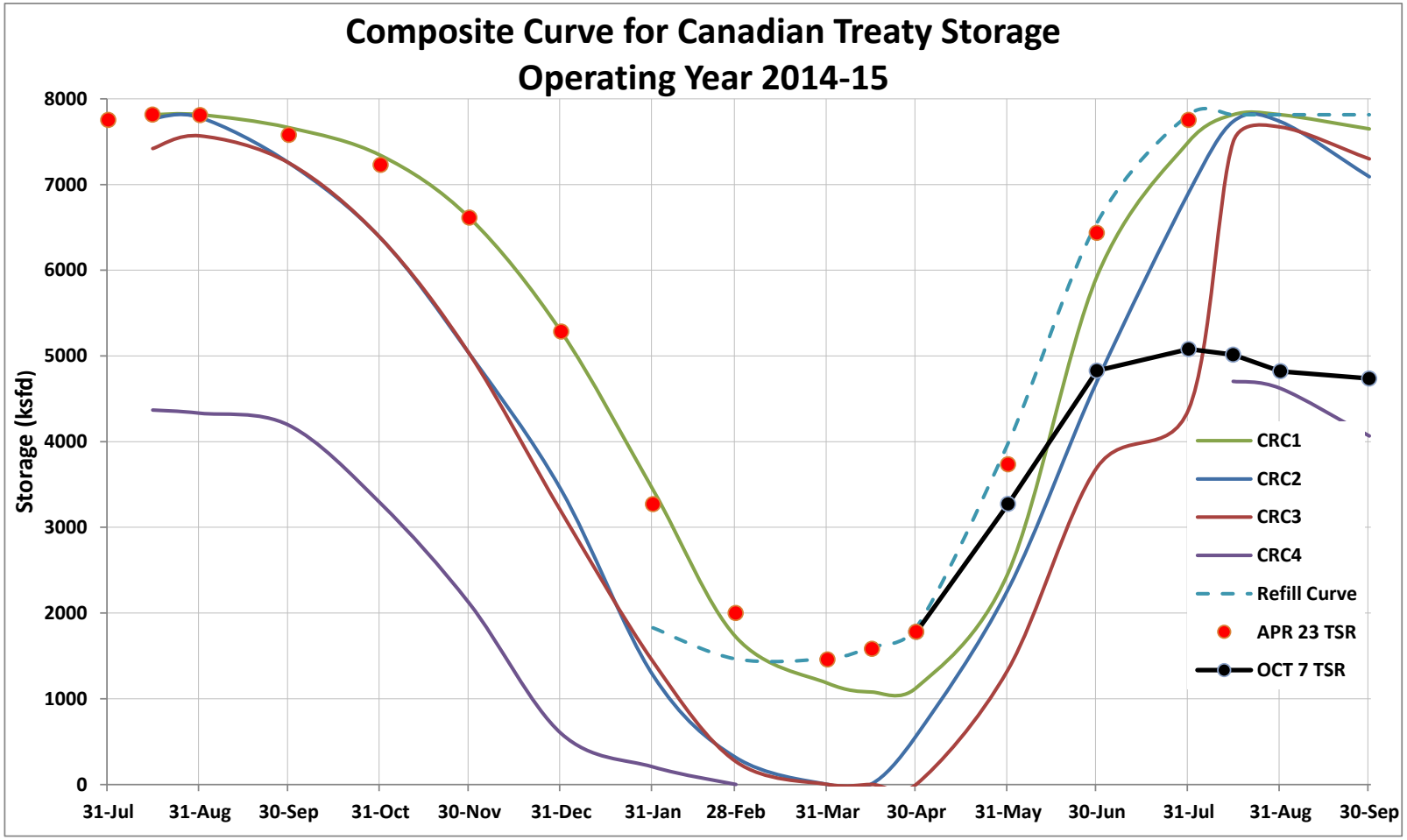
Apr-Aug 2015 Unregulated Inflows

- Grand Coulee: 74% of normal
- Lower Granite: 54%
- The Dalles: 67% (Jan-Jul at The Dalles was 83%)

Normal is based on 1981 - 2010



Critical Rule Curves



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Support for Arrow levels

- BC Hydro took many steps to keep Arrow Lakes Reservoir levels as high as possible throughout the summer and fall. Low elevations were improved by:
  - Increasing discharges from Duncan Dam to allow, under the Columbia River Treaty, reduced discharges from the Arrow Lakes Reservoir.
  - A Treaty summer storage agreement was developed between the Treaty Entities to delay Arrow Treaty releases from July into August.
  - Generating more from Mica than average to help support Arrow Reservoir levels. Between April and October, Mica discharges (to Arrow) have been approximately 180 per cent above average.
  - Retaining available Non-Treaty storage water in Canada.
  - Negotiating an agreement with the U.S. to provide storage access into each recallable account.

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Future changes in CRT for low water?

- Some things to think about:
  - There are tradeoffs between CND and U.S. interests
  - CRT is beneficial to U.S. in dry years and wet years, if we always had an ‘average year’ U.S. would probably terminate.
  - Canadian Entitlement ‘payment’ based on drafting for firm energy
  - U.S. ecosystem scenarios did the opposite – filled Arrow quickly and drafted it quickly. Scenario asking for 4 MAF of flow augmentation instead of current 1 MAF

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