

**Glen Canyon Dam Technical Work Group
Agenda Item Form
May 25, 2016**

Agenda Item

Basin Hydrology and WY 2017 Hydrograph

Purpose

This update on the current basin hydrology, and briefing on the development of the 2017 Hydrograph, is designed to prepare the Adaptive Management Work Group (AMWG) for considering a recommendation on the hydrograph from the Technical Work Group (TWG), and making a recommendation to the Secretary, at its August 24-25, 2016 meeting.

Action Requested

Feedback requested from AMWG members.

Presenters

Paul Davidson, Hydraulic Engineer, Water Resources Group, Resources Management Division, Upper Colorado Region, Bureau of Reclamation

Previous Action Taken

By AMWG: At the August 2015 AMWG meeting, AMWG recommended to the Secretary of the Interior her approval of the DOI-DOE Proposed Hydrograph for Water Year 2016.

By TWG: The TWG has been presented with an initial proposal for the WY 2017 Hydrograph and operational scenarios based on the range of current projected hydrology. TWG members will consider a recommendation to AMWG during their June 14-15, 2016 meeting.

Relevant Science

The anticipated range of conditions and objectives for 2017 remain similar to previous years; therefore, the targeted approach adopted as the 2012, 2013, 2014, 2015, and 2016 Hydrographs is recommended again for the WY 2017 Hydrograph.

Background Information

Basin Hydrology

The presentation is intended to provide pertinent information to AMWG members on the current water supply and forecasted hydrologic conditions within the Upper Colorado River Basin. The presentation will focus on projected reservoir conditions and operations at Lake Powell/Glen Canyon Dam for the remainder of water year 2016 and provide a general outlook for 2017. The presentation will cover the range of potential releases in the current and upcoming water years. Such information is provided to assist the AMWG in developing recommendations to the Secretary on the operation of Glen Canyon Dam for water year 2017.

WY 2017 Hydrograph

The second portion of the presentation will cover a brief review of the 2016 Hydrograph and an overview of the upcoming 2017 Hydrograph. In cooperation with the other federal agencies, Reclamation is developing a recommendation for the 2017 Hydrograph. The initial proposed 2017 Hydrograph for Glen Canyon Dam is the same as the 2016 Hydrograph that was unanimously approved by AMWG in August 2015. The proposal to be presented to the TWG in June is as follows:

- Annual Release Volumes will be determined by the 2007 Interim Guidelines and shall be reviewed and adopted through the normal annual operating plan process (in consultation with the Basin States as appropriate).
- Monthly Release Volumes are anticipated to shift depending upon: (1) the projected Annual Release Volume, (2) powerplant capacity, and (3) the magnitude of a potential High Flow Experiment.
- Monthly Release Volumes may vary within the targets identified below. Any remaining monthly operational flexibility will be used for existing power production operations under the Modified Low Fluctuating Flow (MLFF) alternative selected by the 1996 ROD and contained in the 1995 FEIS and in compliance with all applicable NEPA compliance documents (HFE EA, NNFC EA, 2007 IG). Monthly release volumes proposed in this hydrograph will not affect operating tier determinations for Lakes Powell and Mead under the 2007 Interim Guidelines.
- Release objective for June is:
 - 600 to 650 kaf for annual releases below 9.0 maf
 - 800 kaf for annual releases of 9.0 maf to less than 9.5 maf
 - 900 kaf for annual releases of 9.5 maf to less than 10 maf
 - Greater than 900 kaf for annual releases 10 maf and greater
- Release objective for August is:
 - 800 kaf for annual releases below 9.0 maf
 - 900 kaf for annual releases of 9.0 maf to less than 10 maf
 - Greater than 900 kaf for annual releases 10 maf and greater
- Release objective for September is:
 - 600 kaf for annual releases below 9.0 maf
 - 700 kaf for annual releases of 9.0 maf to less than 10.0 maf
 - 800 kaf or greater for annual releases of 10.0 maf or greater; up to powerplant capacity for high equalization releases
- Monthly Release Volumes will generally strive to maintain 600 kaf levels in the shoulder months (spring and fall) and 800 kaf in the December/January and July/August timeframe.

Additionally, the Bureau of Reclamation will continue to apply best professional judgment in conducting actual operations and in response to changing conditions throughout the water year. Such efforts will continue to be undertaken in coordination with the DOI/DOE agencies, and in consultation with the Basin States as appropriate, to consider changing conditions and adjust projected operations in a manner consistent with the objectives of these parameters as stated above and pursuant to the Law of the River.

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Managing Water in the West

Basin Hydrology, Operations and 2017 Hydrograph

Adaptive Management Work Group

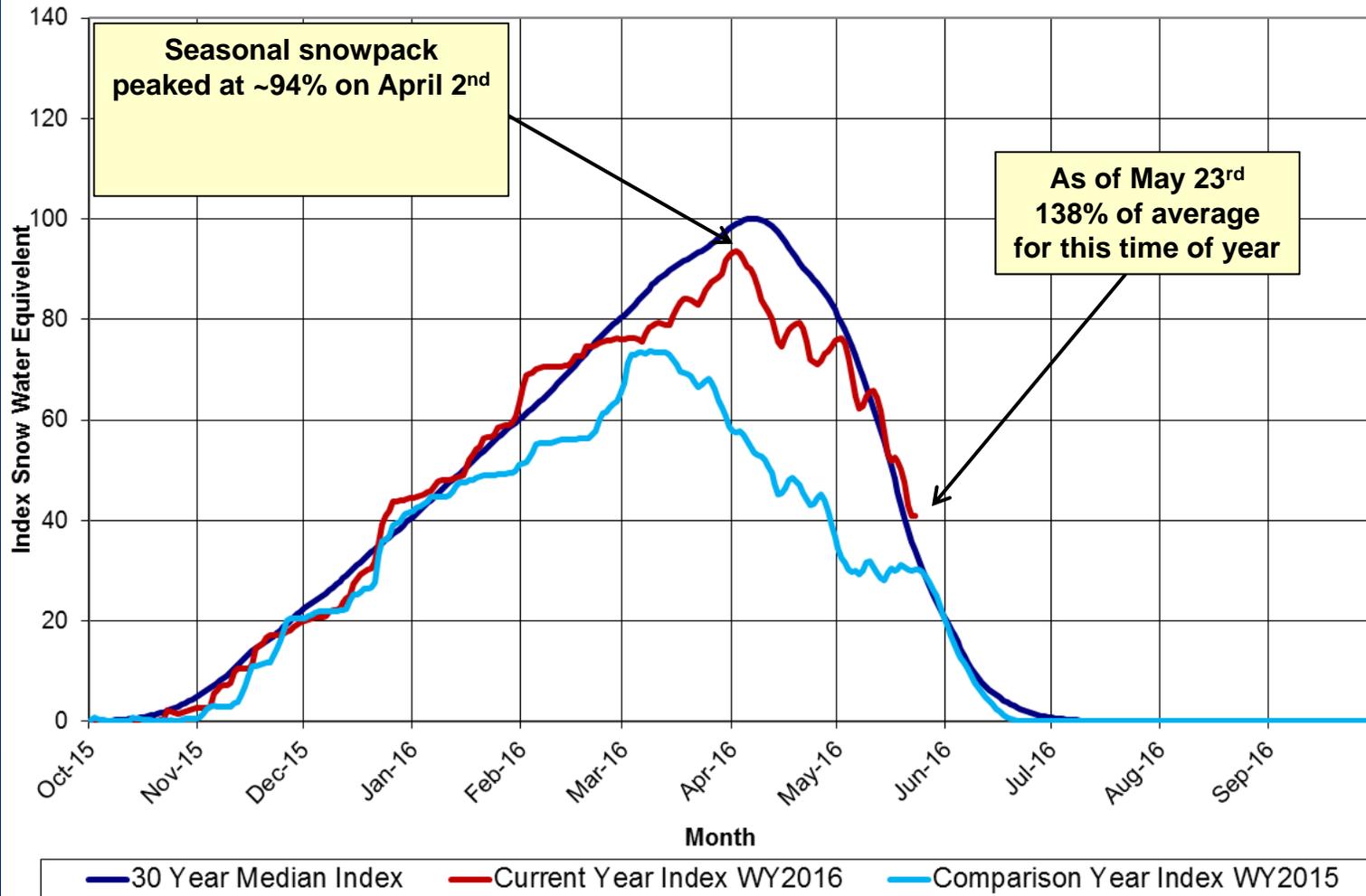
May 25, 2016



U.S. Department of the Interior
Bureau of Reclamation

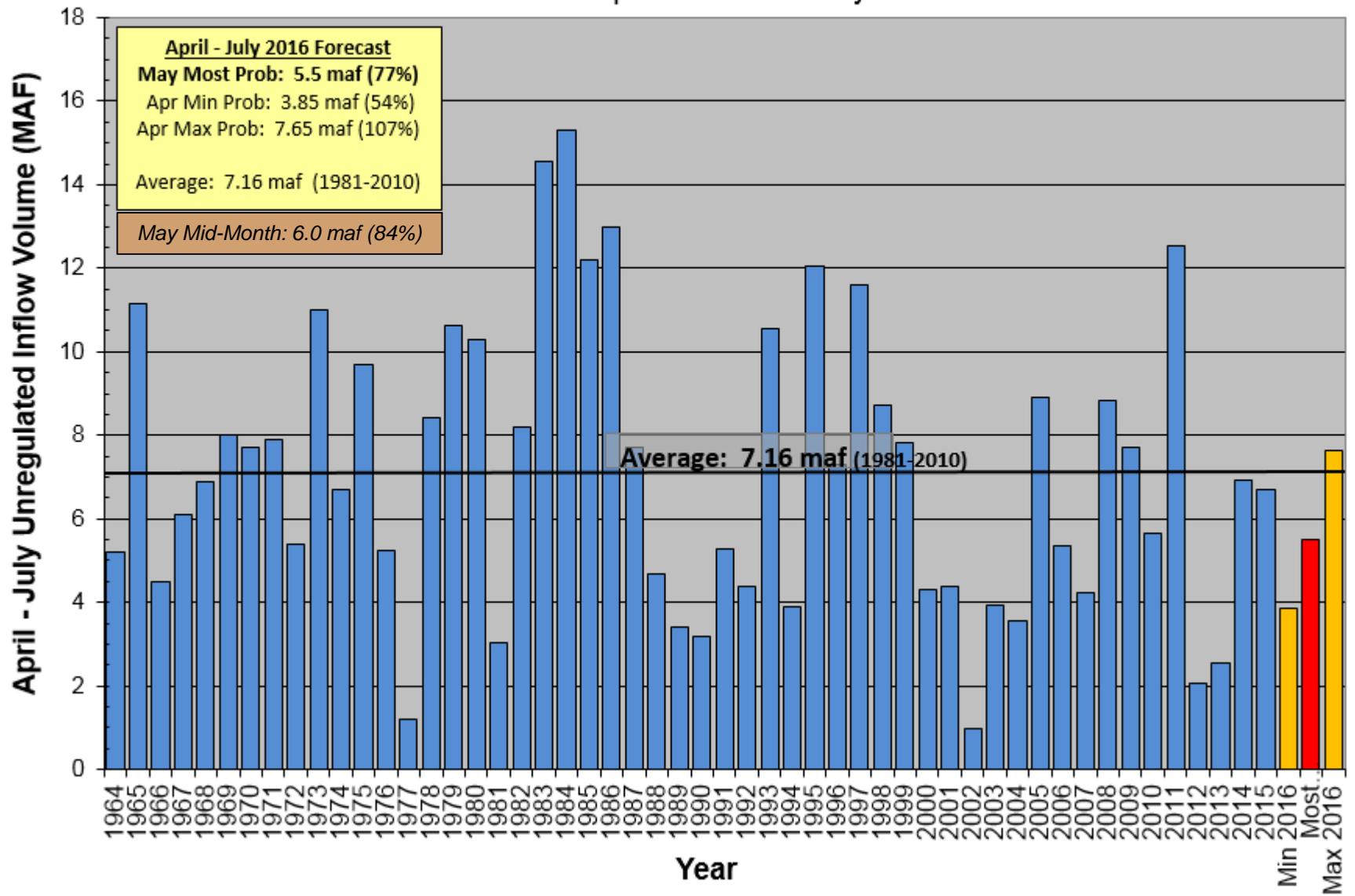
Snow Conditions

Upper Colorado River Basin Snotel Tracking
Aggregate of 116 Snotel Sites above Lake Powell



Data Provided by the Natural Resource Conservation Service

Lake Powell Unregulated Inflow April - July 2016 Forecast Comparison with History



Lake Powell 2016 Operating Tier

Upper Elevation Balancing

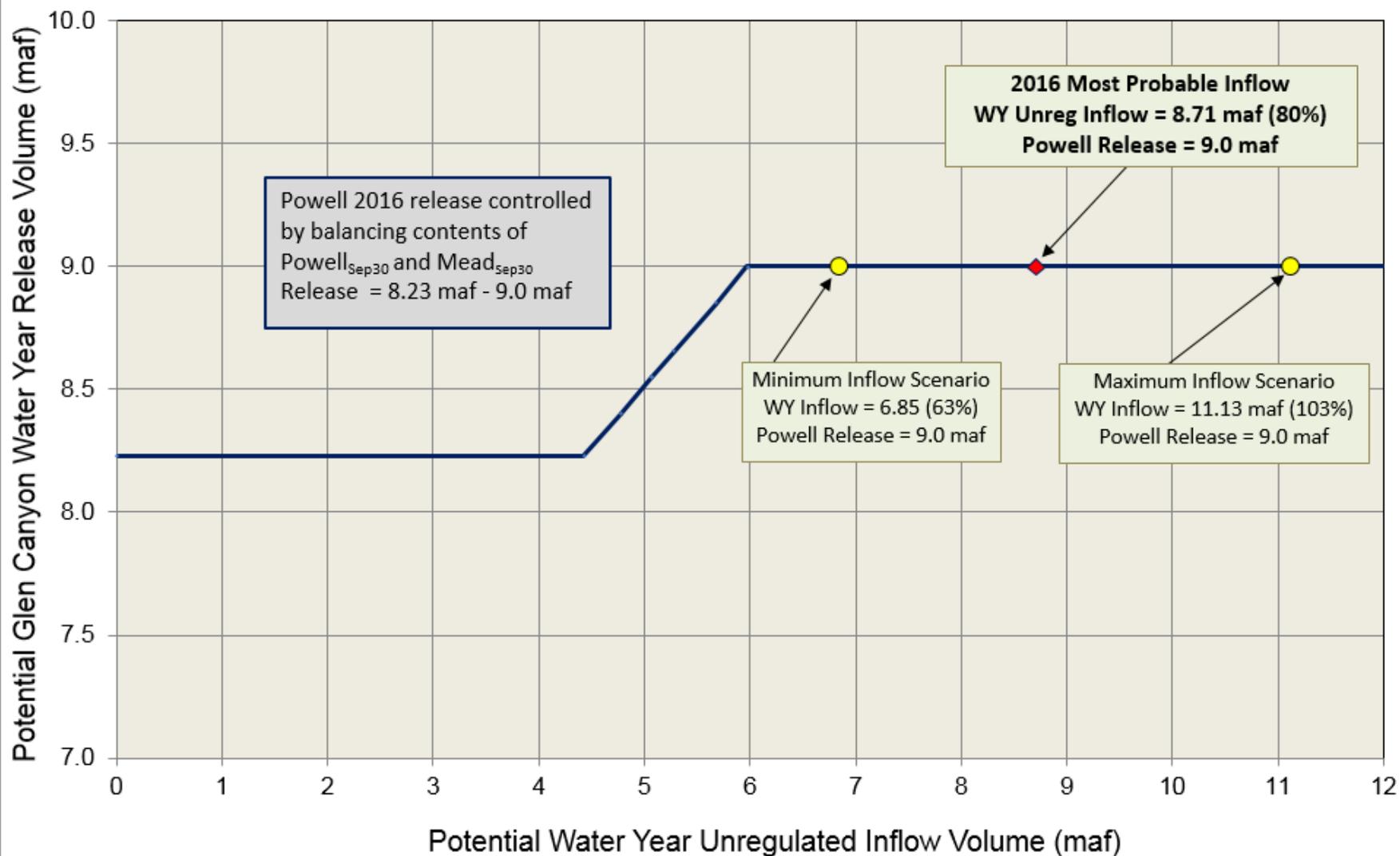
- Tier was set in August 2015
- April Adjustment to Balancing
- Goal: balance contents of Lake Powell and Lake Mead by end of water year
 - release 8.23 maf - 9.0 maf
 - Currently projecting 9.0 maf release

Lake Powell		
Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) ¹
3,700	Equalization Tier Equalize, avoid spills or release 8.23 maf	24.3
3,636 - 3,666 (2008-2026)	Upper Elevation Balancing Tier³ Release 8.23 maf; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf	15.5 - 19.3 (2008-2026)
3,575	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5
3,525	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	5.9
3,490		4.0
3,370		0

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Potential Lake Powell Release Scenarios

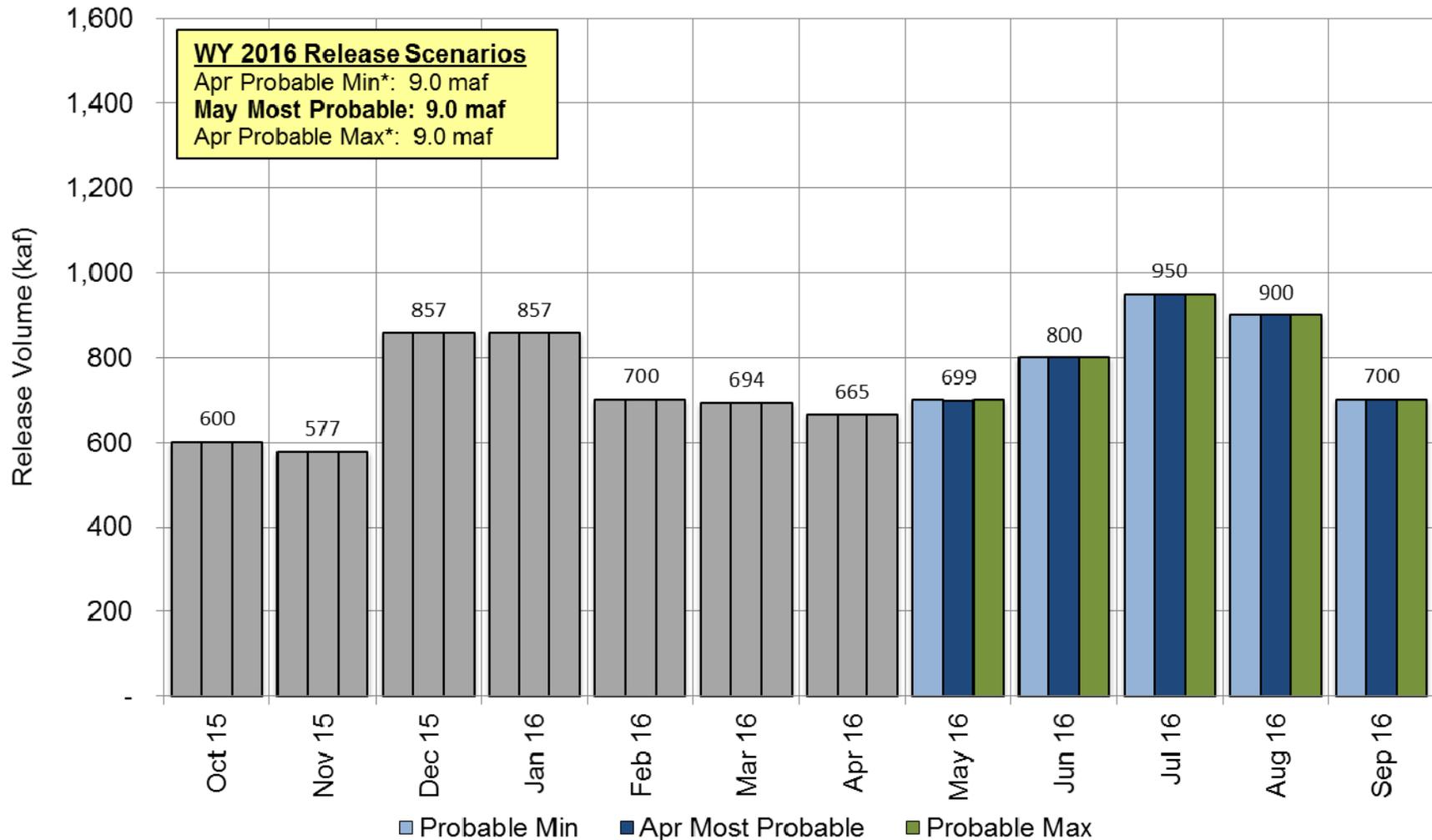
Water Year 2016 Release Volume as a Function of Unregulated Inflow Volume
based on May 2016 24-Month Study Conditions



Projected Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2016

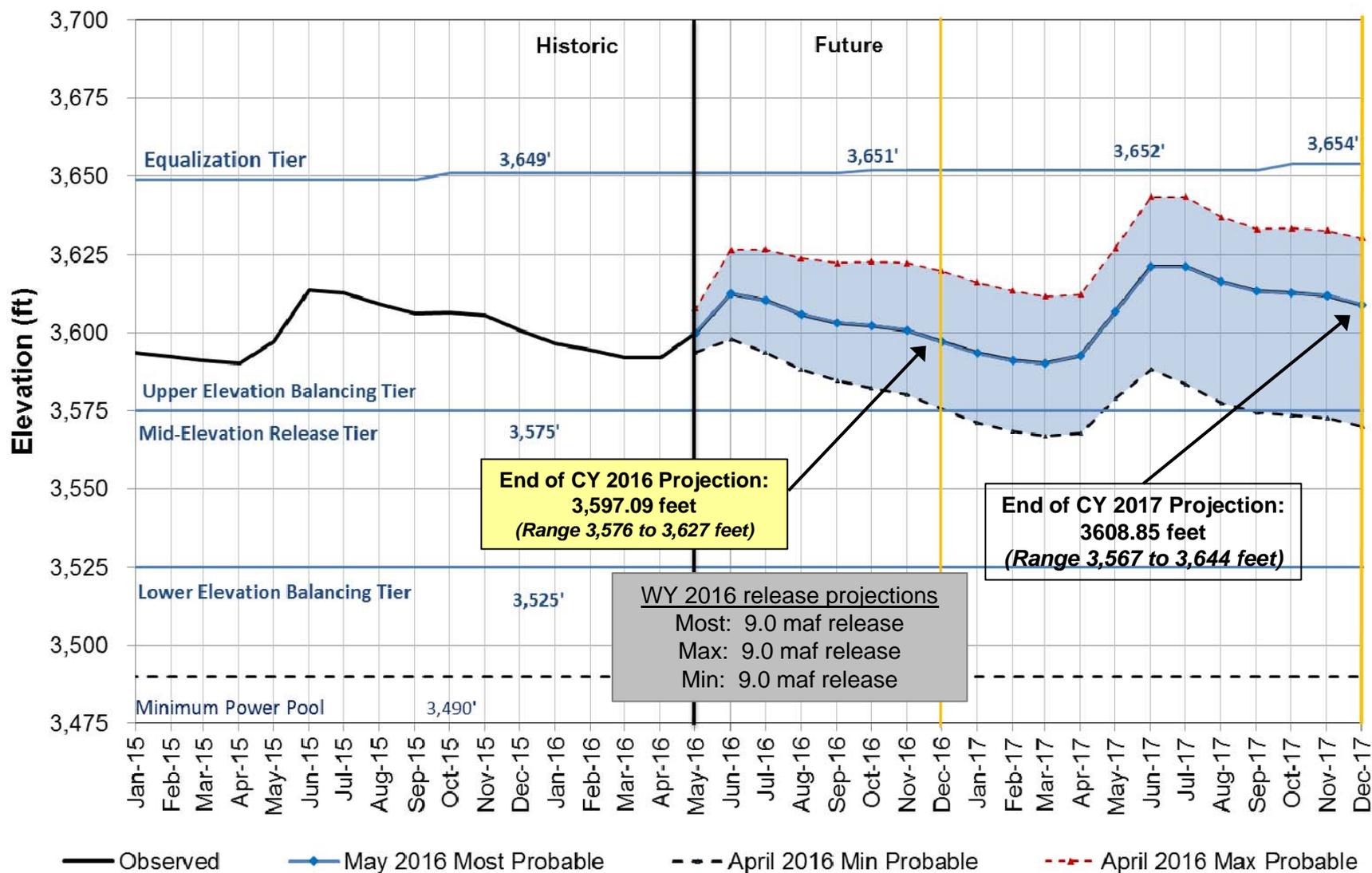
Updated May 2016



* Probable Min and Max annual release volume is based on January Min and Max inflow forecasts

Lake Powell End of Month Elevations

Historic and Projected based on May 2016 Modeling



Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2016

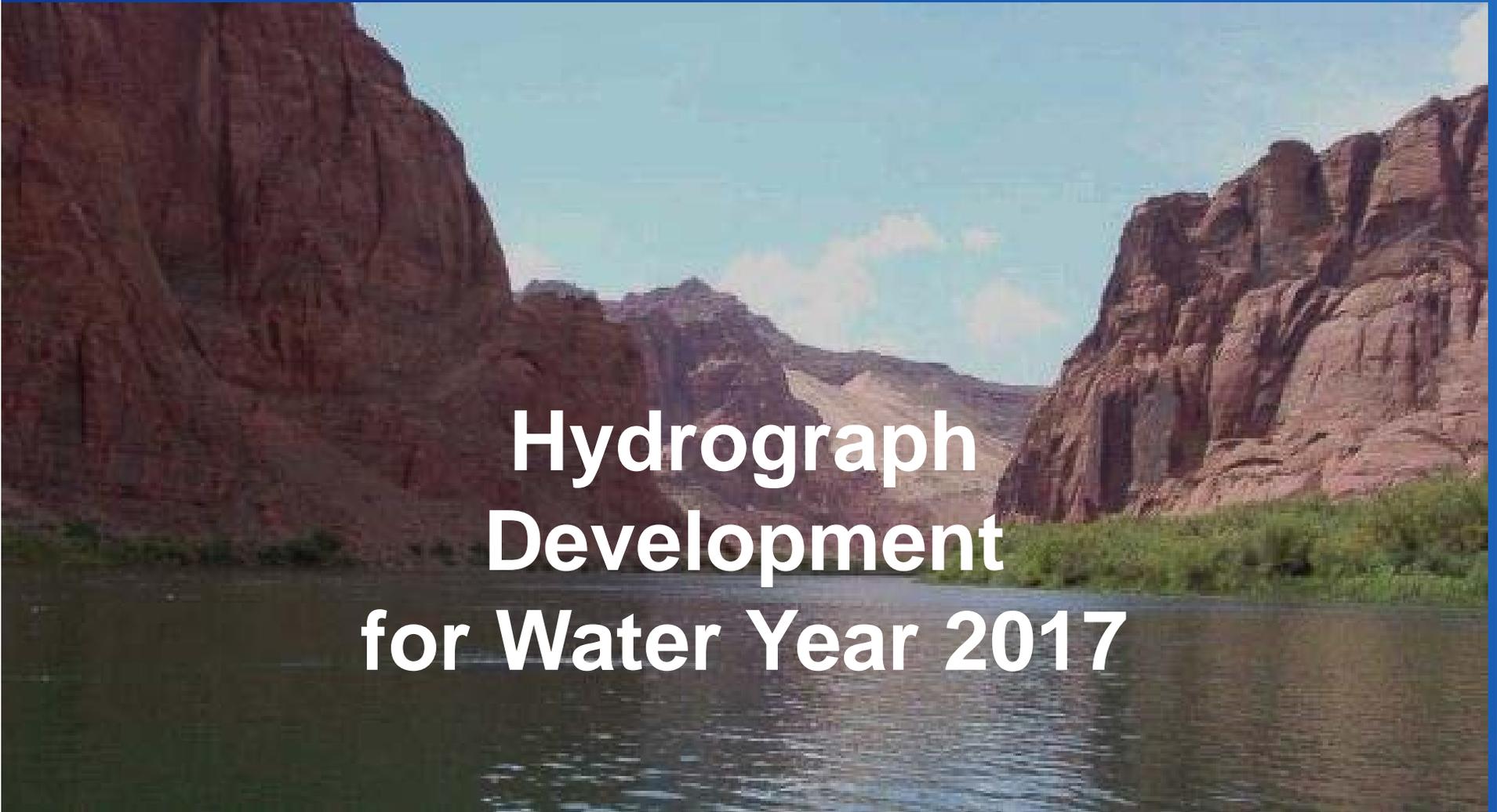
Unit Number	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	
1							■					■	
2	■		■									■	
3	■						■					■	
4						■		■					
5	■	■	■	■	■	■	■	■					
6						■	■	■	■	■	■		
7					■								
8					■								
Units Available	5	7	7	7	5	6	5	6	7	7	7	5	
Capacity (cfs)	18,400	22,100	22,100	22,100	15,500	15,300	15,300	18,800	22,100	22,100	22,100	14,900	
Capacity (kaf/month)	1,150	1,130	1,280	1,300	950	1090	970	1,150	1,310	1,310	1,320	930	
Max (kaf) ¹	--	--	--	--	700	694	665	699	800	950	900	700	9.0
Most (kaf) ²	600	577	857	857	700	694	665	699	800	950	900	700	9.0
Min (kaf) ¹	--	--	--	--	700	694	665	699	800	950	900	700	9.0

(updated 5-17-2016)

1 Projected release, based on April 2016 Min and Max Probable Inflow Projections and 24-Month Study model runs

2 Projected release, based on May 2016 Most Probable Inflow Projections and 24-Month Study model runs

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Hydrograph Development for Water Year 2017

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2017 Hydrograph Initial Thoughts

- Start with 2016 Hydrograph
 - Target lower August and September releases
 - Move water to other equal value months for hydropower (Dec/Jan)
 - Avoid shifting “extra” water to June (which cools temperatures at the mouth of the LCR)
- Consider proposed modifications

2017 Projected Annual Release

(Based on April and May 2016 modeling)

- **Min probable: 8.23 maf release**

(Upper Elevation Balancing Tier - with projected April adjustment to Balancing 8.23-9.0 maf release)

- **Most probable: 9.0 maf release**

(Upper Elevation Balancing Tier - with projected April adjustment to Balancing 8.23-9.0 maf release)

- **Max probable: 11.91 maf release**

(Upper Elevation Balancing Tier
with projected April adjustment to Equalization 8.23-11.9 maf release)

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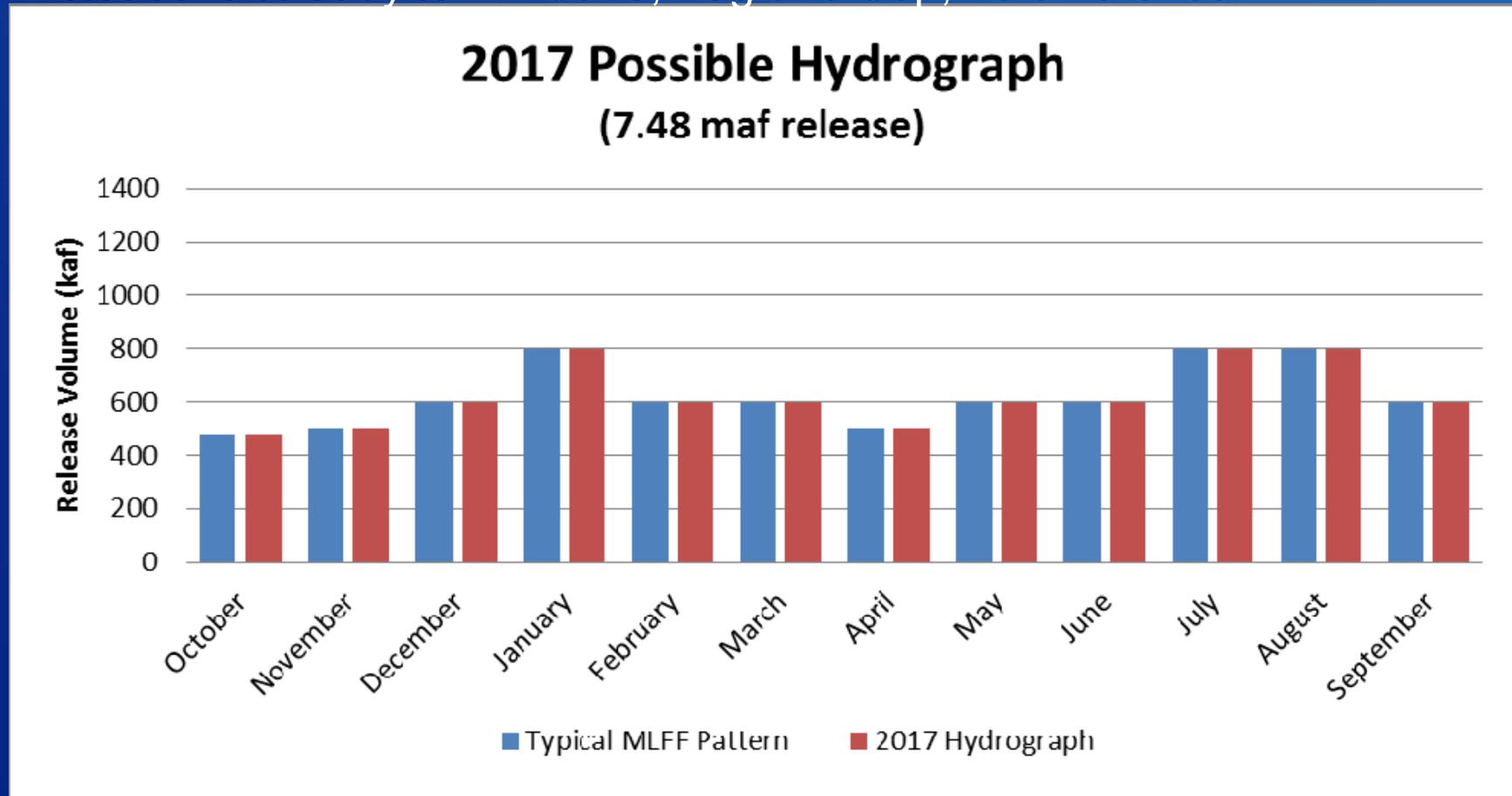
2017 Hydrograph Current Proposal

Annual Release Volume	June	August	September
less than 9.0 maf	600 kaf - 650 kaf	800 kaf	600 kaf
9.0 maf – less than 9.5 maf	800 kaf	900 kaf	700 kaf
9.5 maf – less than 10 maf	900 kaf	900 kaf	700 kaf
10 maf and greater	900 kaf or more	900 kaf or more	800 kaf or more

2017 Proposed Hydrograph

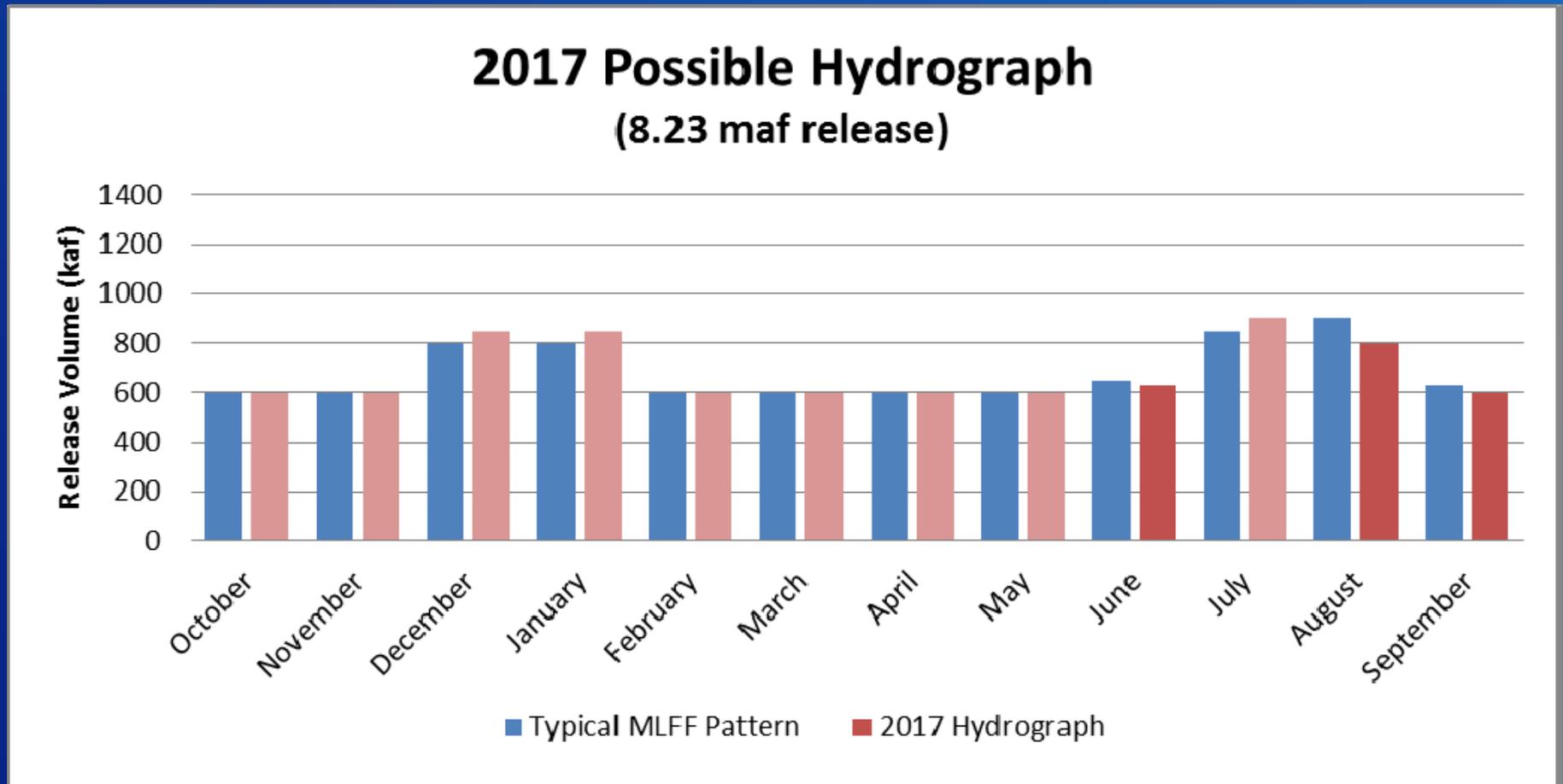
7.48 maf release

Release is already low in June, Aug and Sep, no difference



2017 Proposed Hydrograph

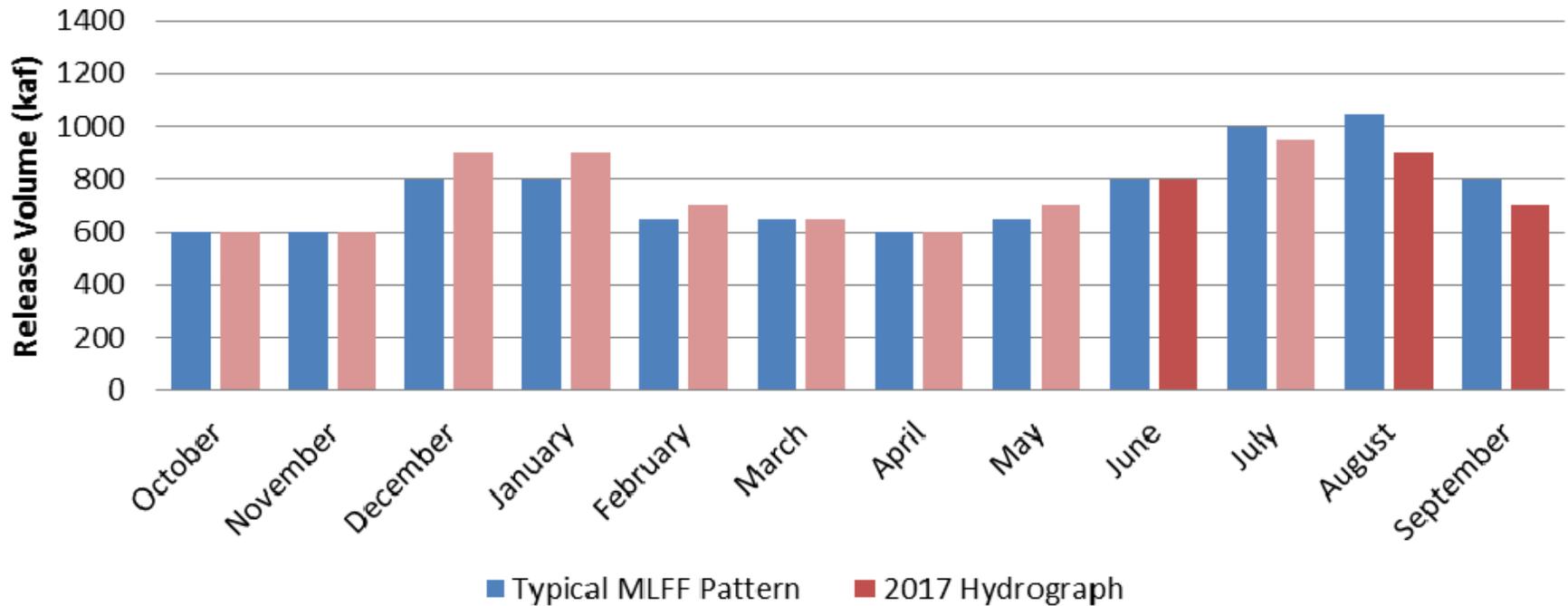
8.23 maf release



2017 Proposed Hydrograph

9.0 maf release

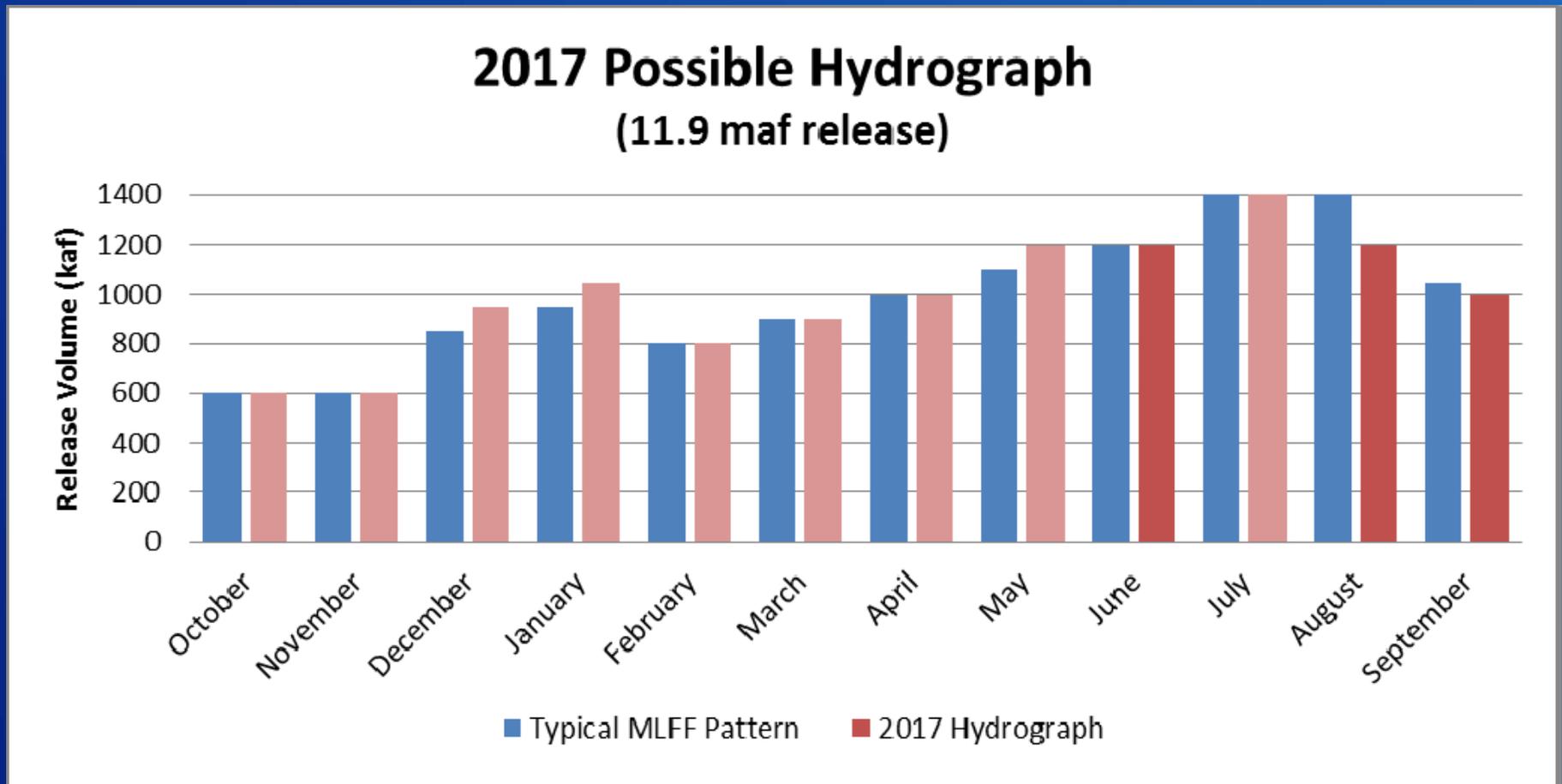
2017 Possible Hydrograph
(9.0 maf release)



2017 Proposed Hydrograph

11.9 maf release

- Lots of water to move: limited flexibility, minimal difference.



2017 Hydrograph Next Steps

- Continue to coordinate with AMWG member agencies
- Present to TWG in June for evaluation
- TWG present to AMWG August 26-7 with motion for approval to recommend to Secretary

Questions?

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801-524-3642

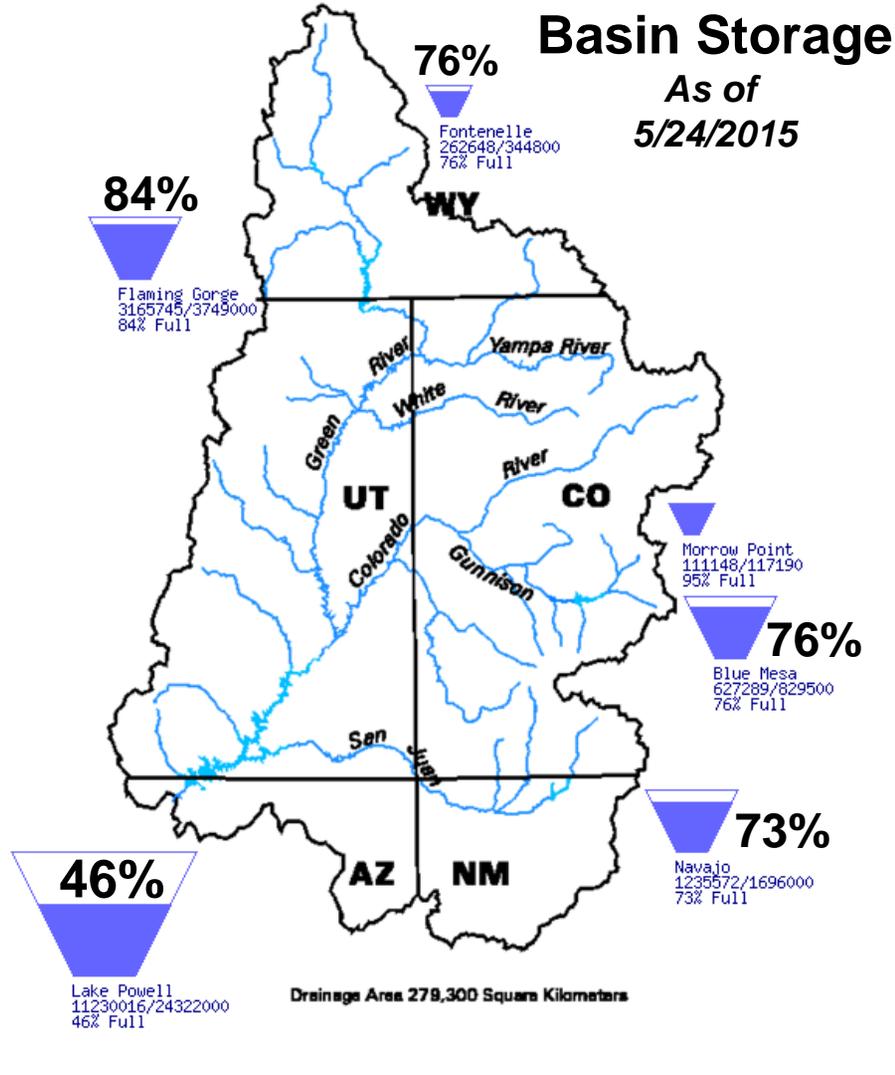
pdavidson@usbr.gov

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Data Current as of:
05/24/2015

Upper Colorado River Drainage Basin



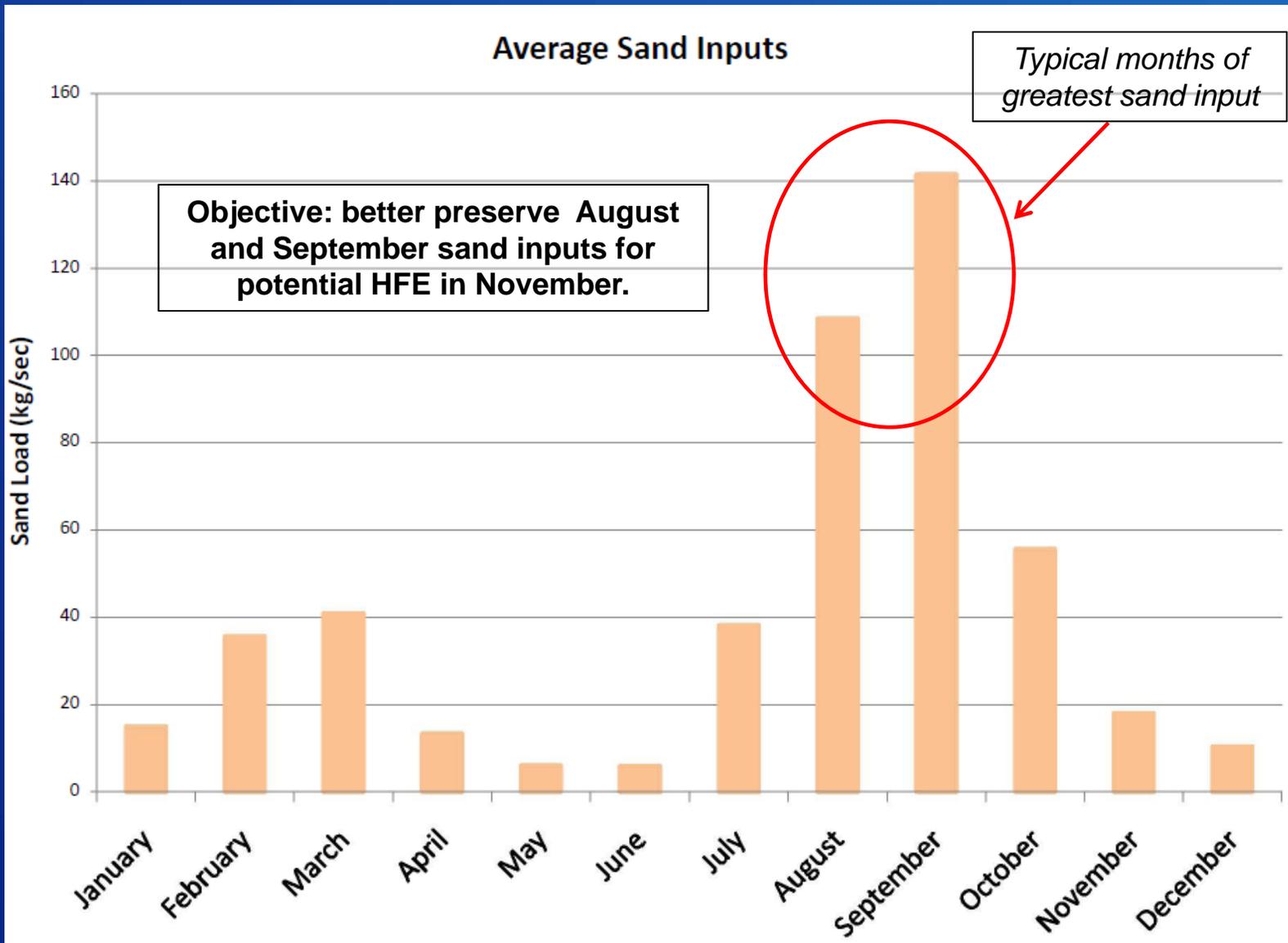
April to July 2015 Forecasted Inflow Issued May 4, 2015

Reservoir	A-J Forecast (KAF)	Percent of Average ¹
Fontenelle	495	68%
Flaming Gorge	570	58%
Blue Mesa	440	65%
Navajo	230	31%
Powell	3,000	42%

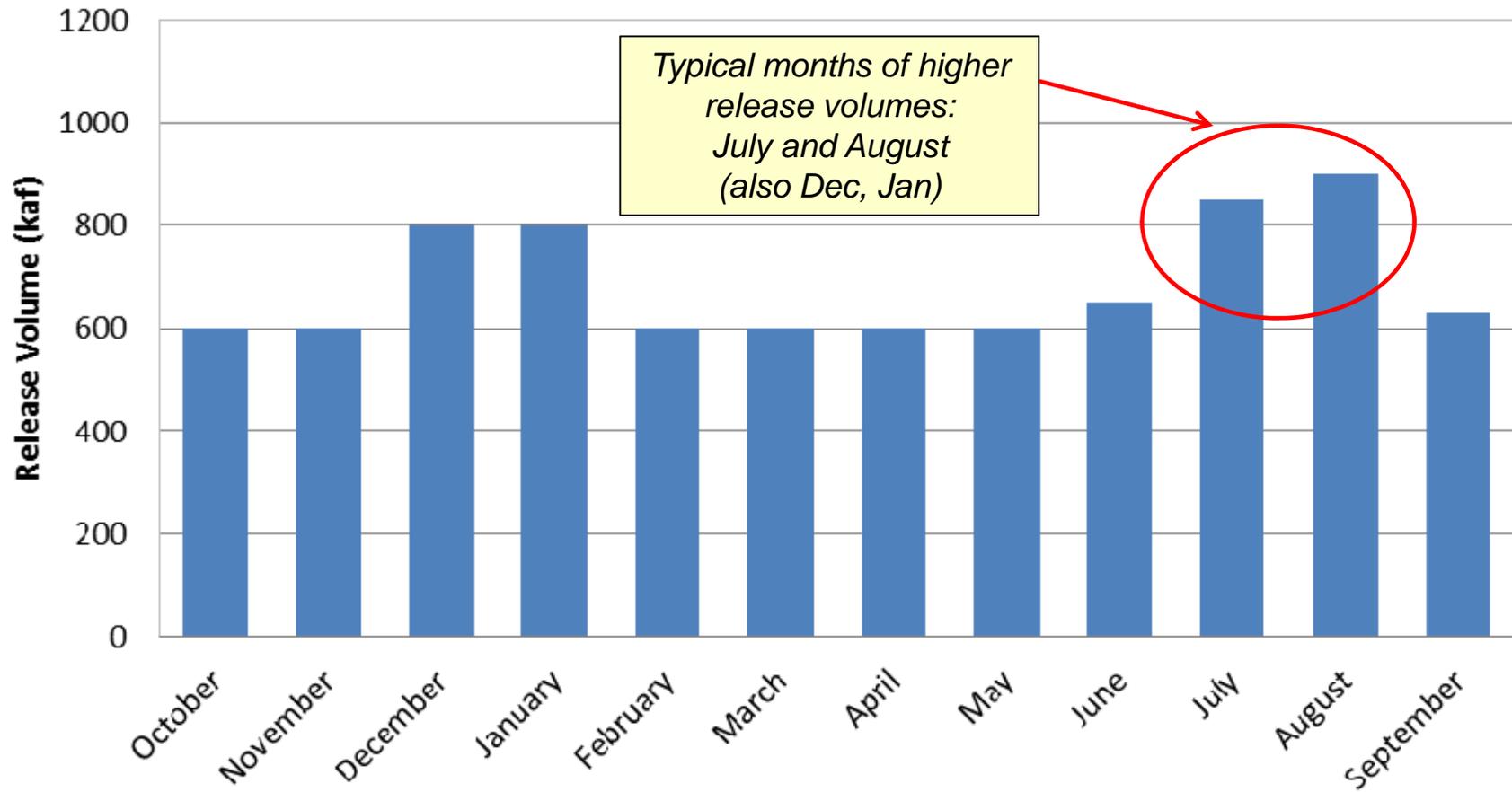
¹ percent of average based on period 1981-2010.

http://www.usbr.gov/uc/water/basin/tc_cr.html

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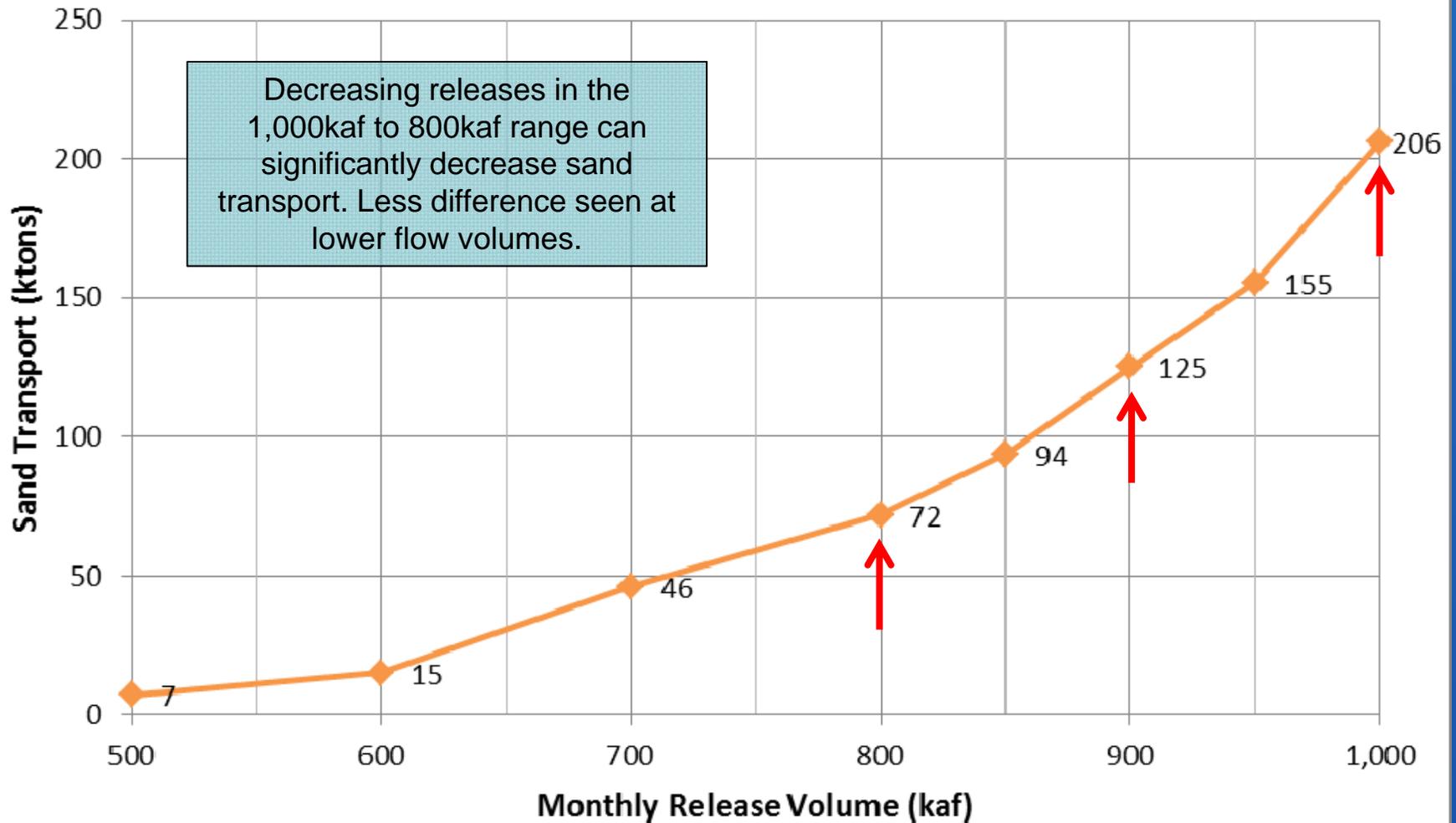


Typical Annual Release Pattern 8.23 maf year



Sand Budget Model - Marble Canyon Reach

(based on Dec-2013 initial conditions)



2015 Hydrograph

Monthly Release Objectives

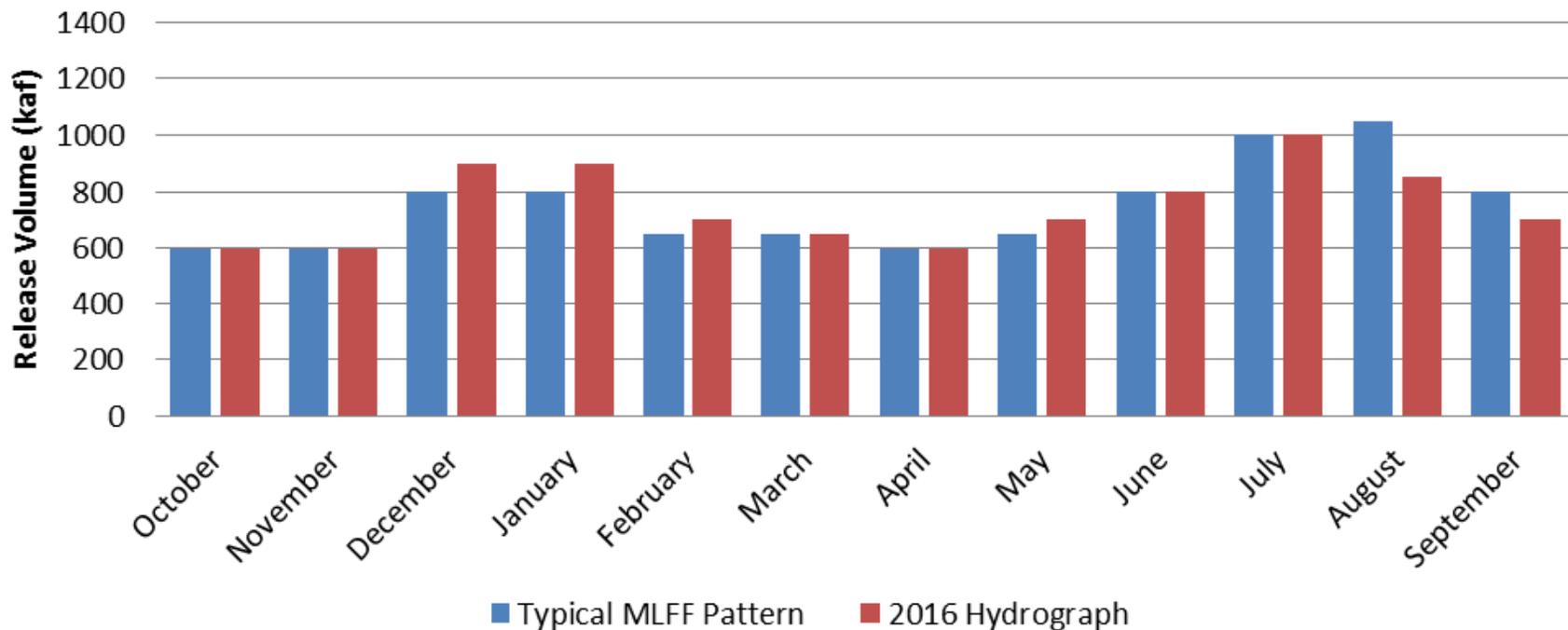
Annual Release Volume	June	August	September
less than 9.0 maf	600 kaf - 650 kaf	800 kaf	600 kaf
9.0 maf – less than 9.5 maf	800 kaf		700 kaf
9.5 maf – less than 10 maf	900 kaf		700 kaf
10 maf and greater	more than 900 kaf		800 kaf or more

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2016 Possible Hydrograph

9.0 maf release – initial consideration
presented at Feb AMWG meeting

2015 Possible Hydrograph (9.0 maf release)



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