Glen Canyon Dam Technical Work Group
Agenda Item Information
June 24-25, 2014

Agenda Item

Basin Hydrology, Operations and 2015 Hydrograph

Action Requested

- ✓ Propose a motion for AMWG

Presenter

Katrina Grantz, Hydraulic Engineer, Bureau of Reclamation, Upper Colorado Region

Previous Action Taken

- ✓ By AMWG: At the August 2013 meeting, the AMWG passed a motion to recommend to the Secretary of the Interior her approval of the DOI-DOE Proposed Hydrograph for Water Year 2014. Previous year hydrographs (water years 2012 and 2013) were also reviewed by the TWG, and the AMWG and approved by the Secretary of the Interior.

Relevant Science

The TWG and AMWG have been presented with sediment and financial results from the DOI-DOE analysis of operational scenarios for the 2012, 2013, and 2014 Hydrographs. These analyses were based upon the USGS sand retention model and Western's GTMax power/financial model. In May 2014, the AMWG was presented with a range of possible operational scenarios for a potential water year 2015 hydrograph. The anticipated range of conditions and objectives for 2015 remain similar to the previous years; therefore, the targeted approach adopted as the 2012, 2013 and 2014 Hydrographs is recommended again for the 2015 Hydrograph.

Background Information

The first portion of the presentation is intended to provide pertinent information to TWG members on 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 2014 and provide an outlook for 2015.

The second portion of the presentation will cover the potential range of annual release volumes from Lake Powell in water year 2015 and the proposed 2015 Hydrograph.

RECLAMATION

Managing Water in the West

Basin Hydrology, Operations and 2015 Hydrograph

Glen Canyon Dam Technical Work Group

June 25, 2014

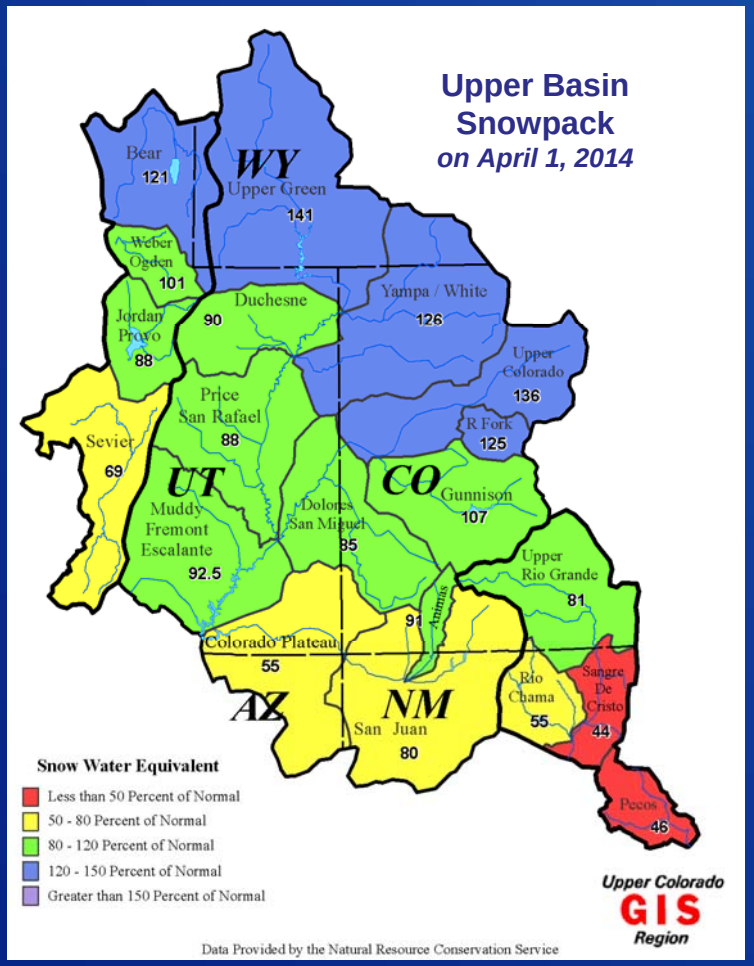
U.S. Department of the Interior
Bureau of Reclamation

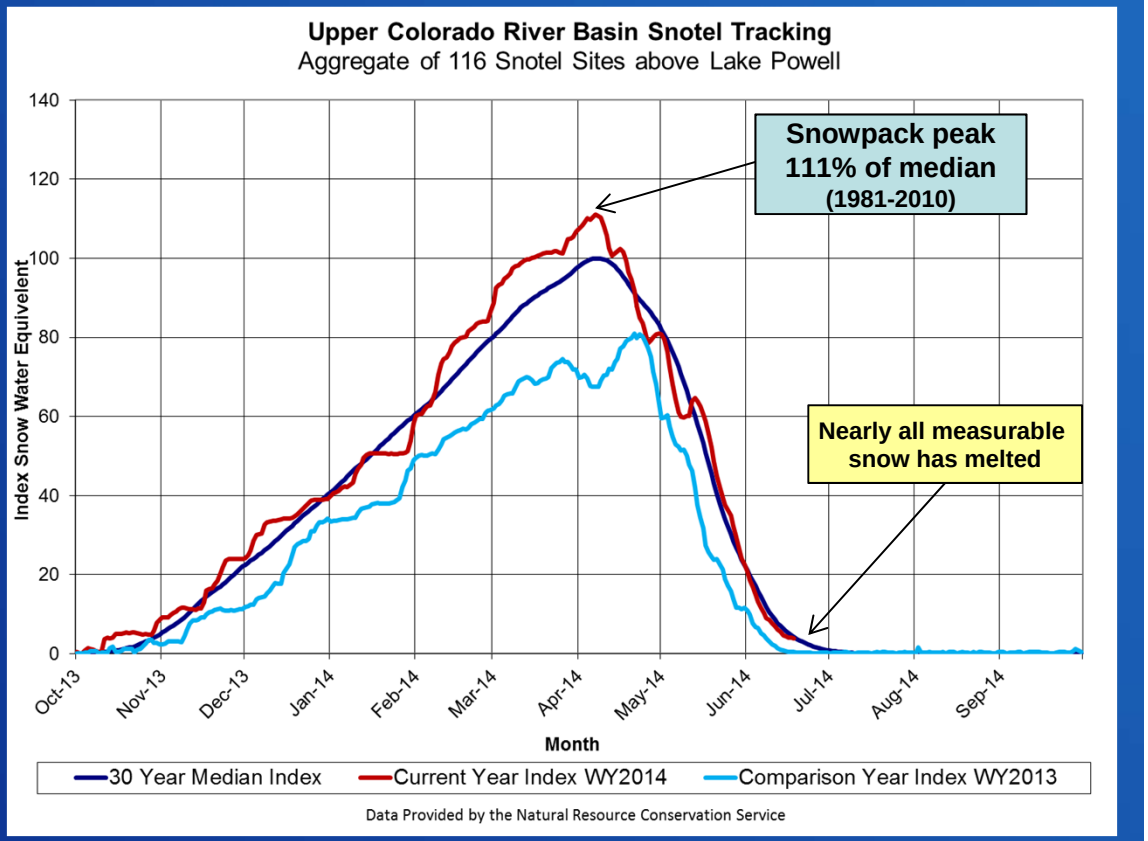
Katrina A. Grantz, PhD
Hydraulic Engineer, Glen Canyon Dam
Bureau of Reclamation

- **Upper Colorado River Basin Hydrology**
- **Glen Canyon Dam Operations**
  (WY 2014 and 2015)

RECLAMATION

Upper Colorado Basin Hydrology

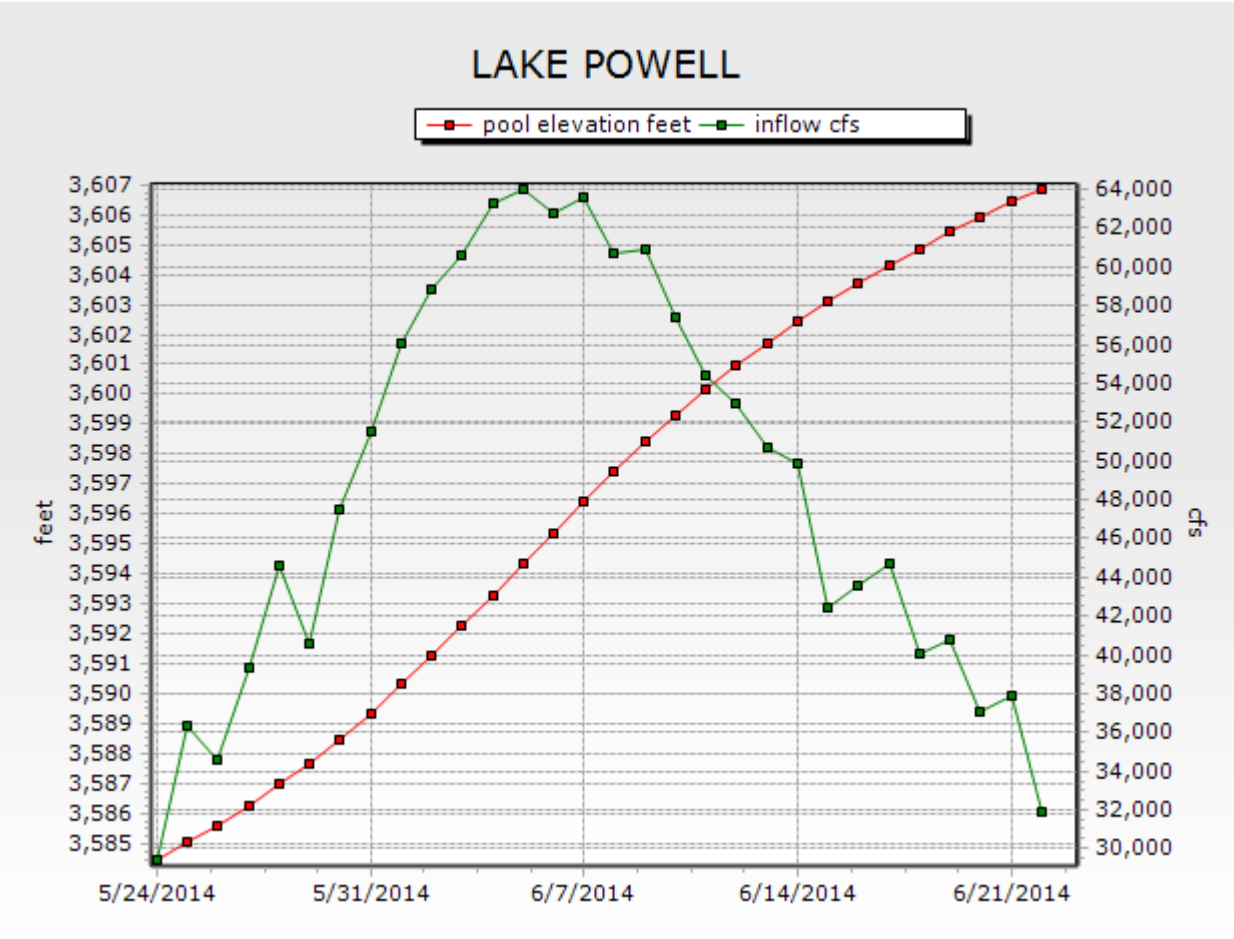




http://www.usbr.gov/uc/water/notice/Graphs/Upper_Colorado.html

RECLAMATION

Past 30 days of inflow and pool elevation

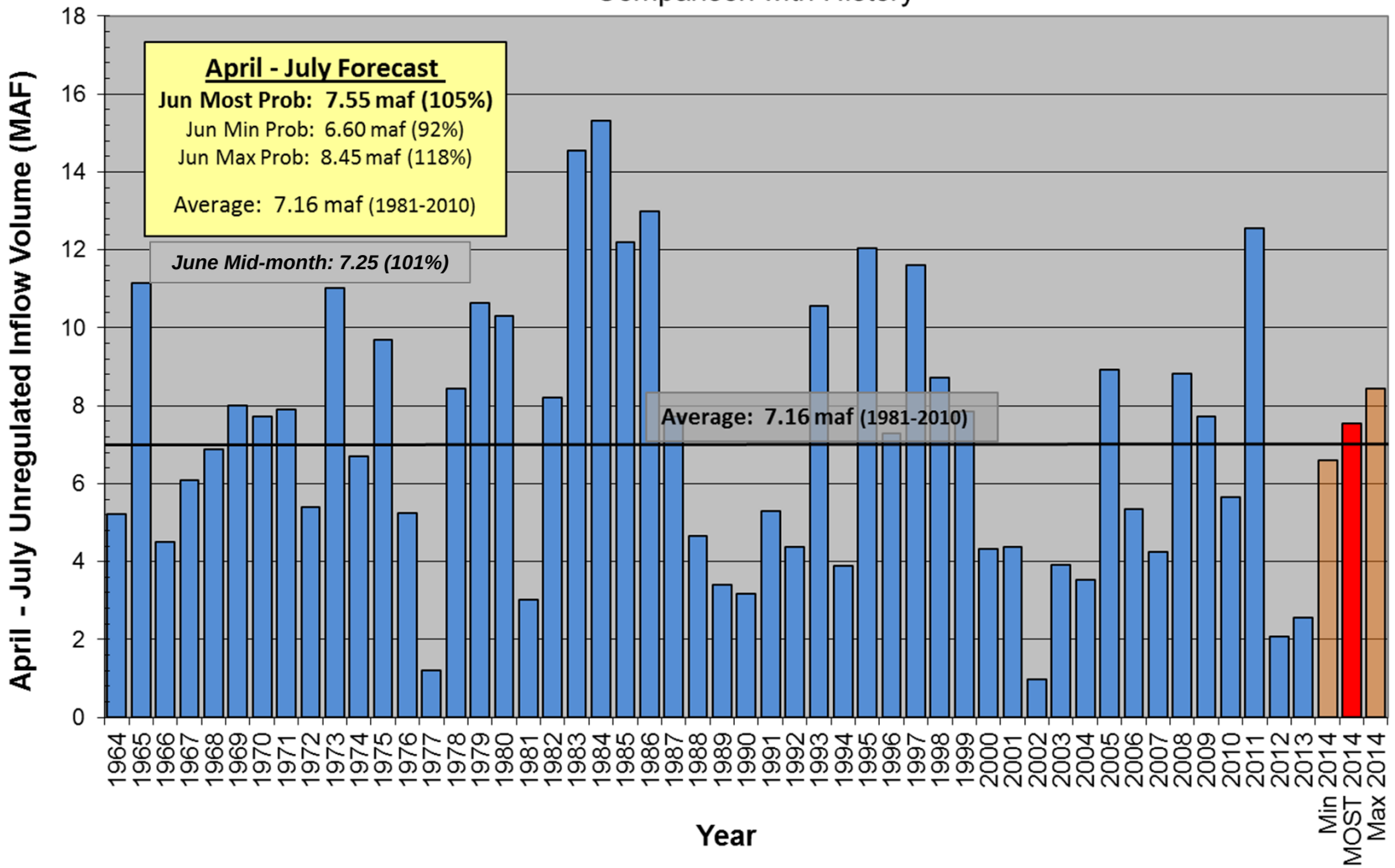


RECLAMATION

Lake Powell Unregulated Inflow

Apr - Jul 2014 Forecast *(issued June 2)*

Comparison with History



RECLAMATION

WY2014 Operations under Interim Guidelines

determined in August 2013 24-Month Study

Scenario	Operational Tier	Annual Release Volume
Minimum Probable	Mid-Elevation Release	7.48 maf
Most Probable	Mid-Elevation Release	7.48 maf
Maximum Probable	Mid-Elevation Release	7.48 maf

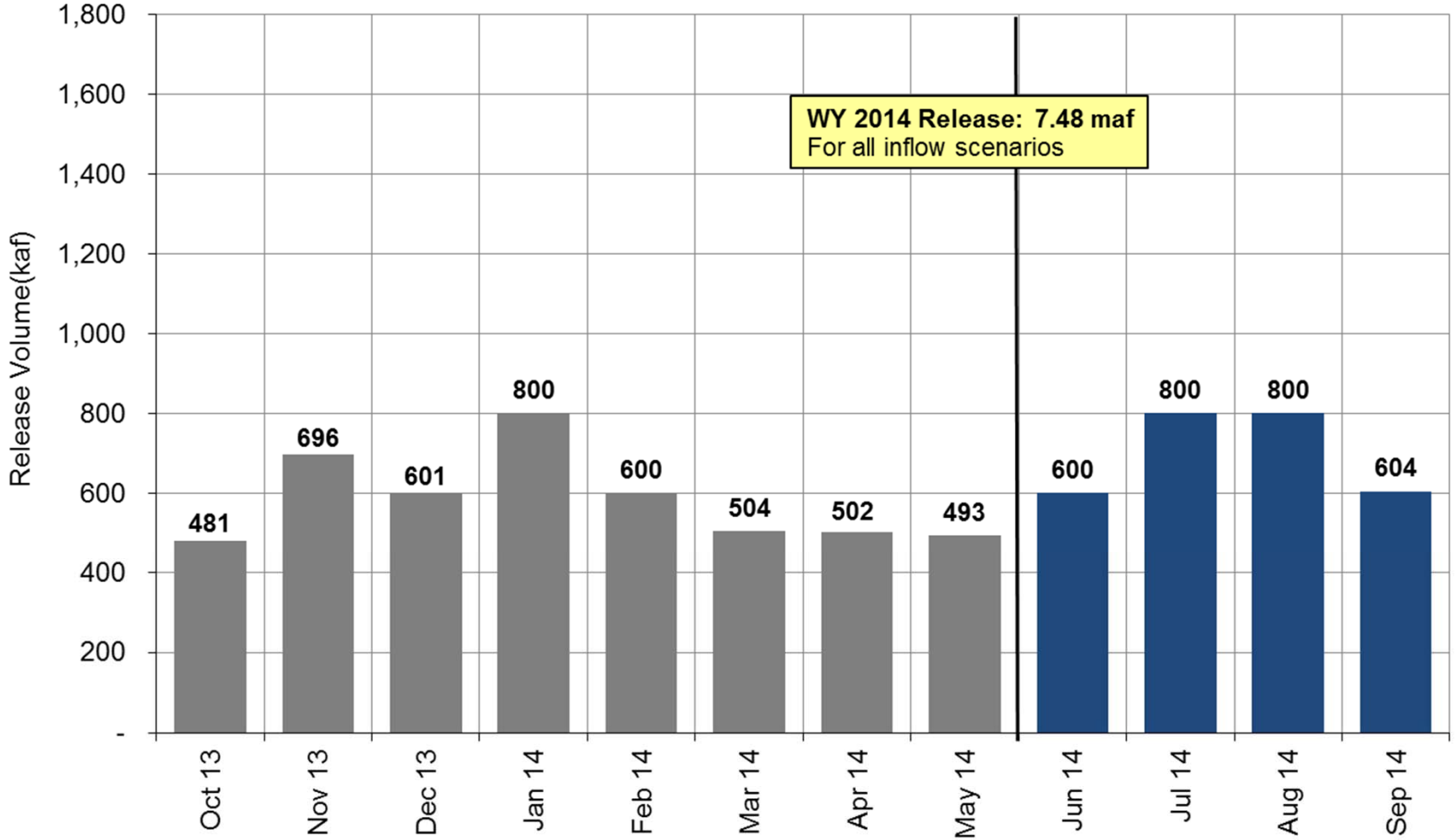
* Note that in the Mid-Elevation Release Tier, there is no provision for an April adjustment to the operating tier.

RECLAMATION

Projected Lake Powell Monthly Release Volume Distribution

June 2014 Release Projections

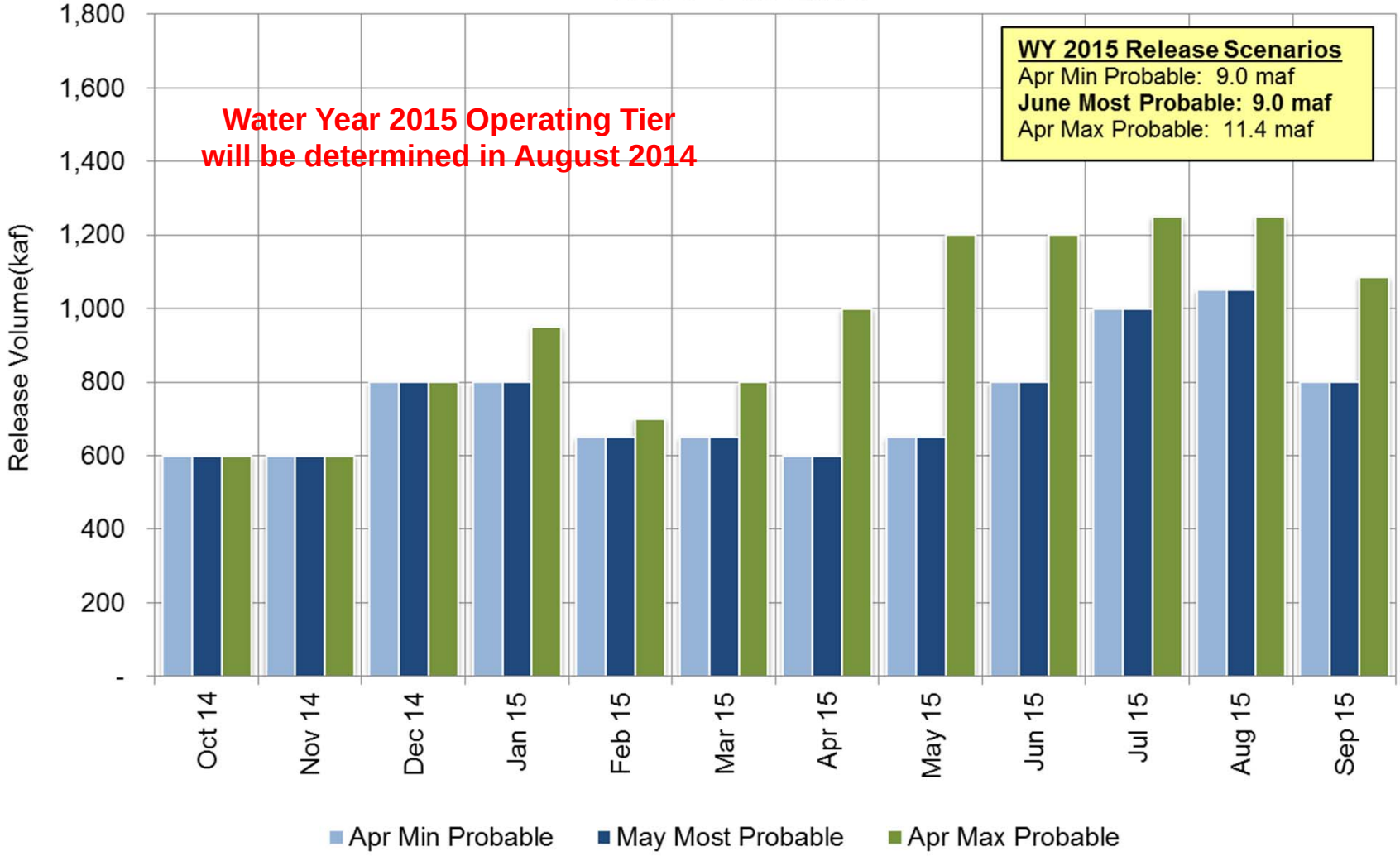
Water Year 2014



RECLAMATION

Projected Lake Powell Monthly Release Volume Distribution

April and June 2014 Projected Release Scenarios
Water Year 2015



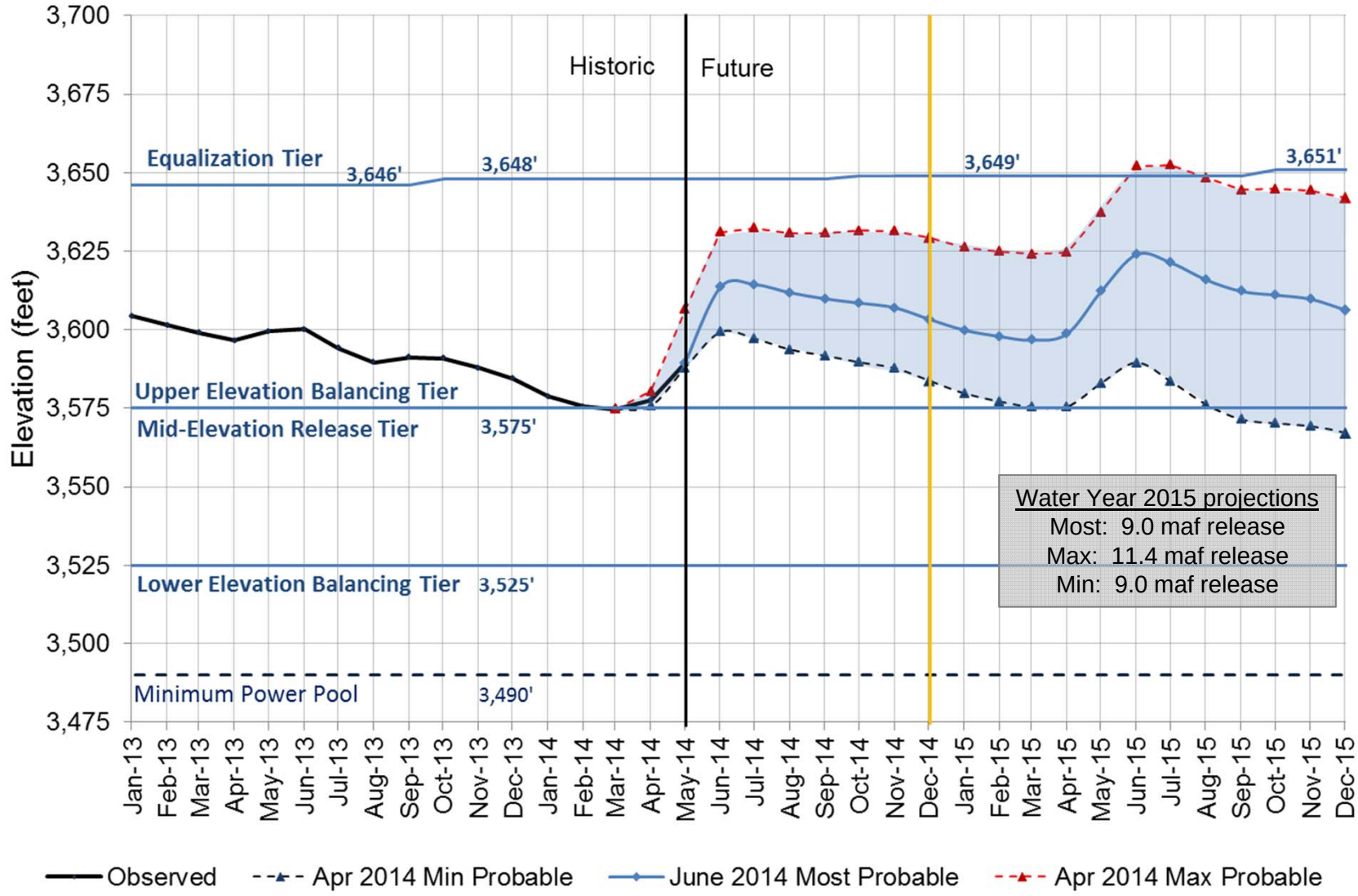
Water Year 2015 Operating Tier will be determined in August 2014

WY 2015 Release Scenarios
Apr Min Probable: 9.0 maf
June Most Probable: 9.0 maf
Apr Max Probable: 11.4 maf

RECLAMATION

Lake Powell End of Month Elevations

Historic and projected based on April and June modeling



RECLAMATION

Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2014

Unit Number	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	5	6 / 5	6	6	5 / 4	4 / 6	6	5 / 6	6	6	6	4 / 5
Capacity (cfs)	14,200	20,000 / 14,300	18,000	17,900	13,600 / 10,300	10,300 / 16,600	16,600	13,800 / 17,000	17,000	17,000	17,000	10,400 / 13,800
Capacity (kaf/month)	900	1040	1120	1100	750	850	950	950	1010	1050	1050	710
Max (kaf) [1]	--	--	--	--	--	--	--	--	600	800	800	604
Most (kaf) [2]	481	696	601	800	600	504	502	493	600	800	800	604
Min (kaf) [1]	--	--	--	--	--	--	--	--	600	800	800	604

7.48

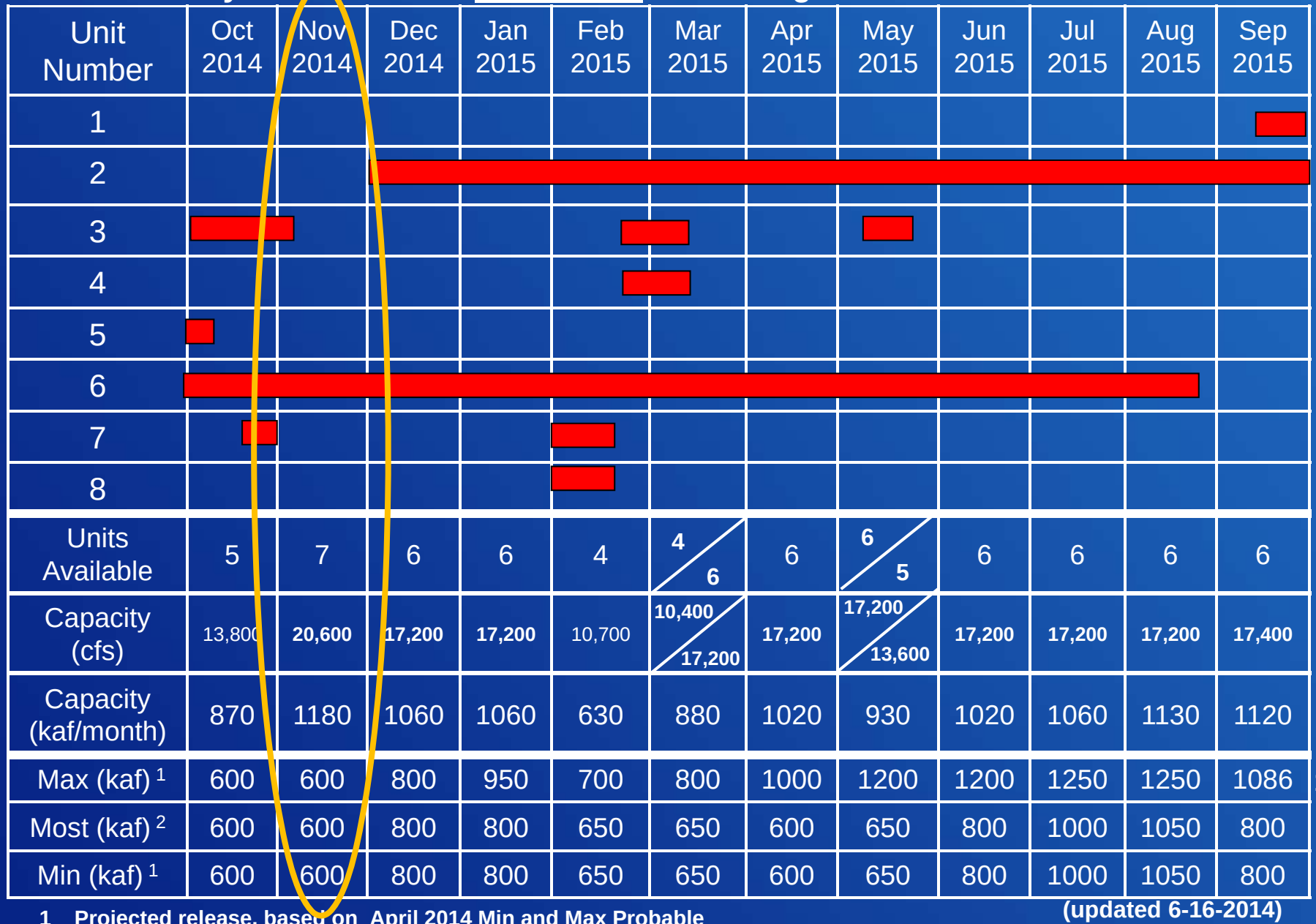
(updated 6-16-2014)

1 Projected release, based on April 2014 Min and Max Probable Inflow Projections and 24-Month Study model runs

2 Projected release, based on June 2014 Most Probable Inflow Projections and 24-Month Study model runs

RECLAMATION

Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2015



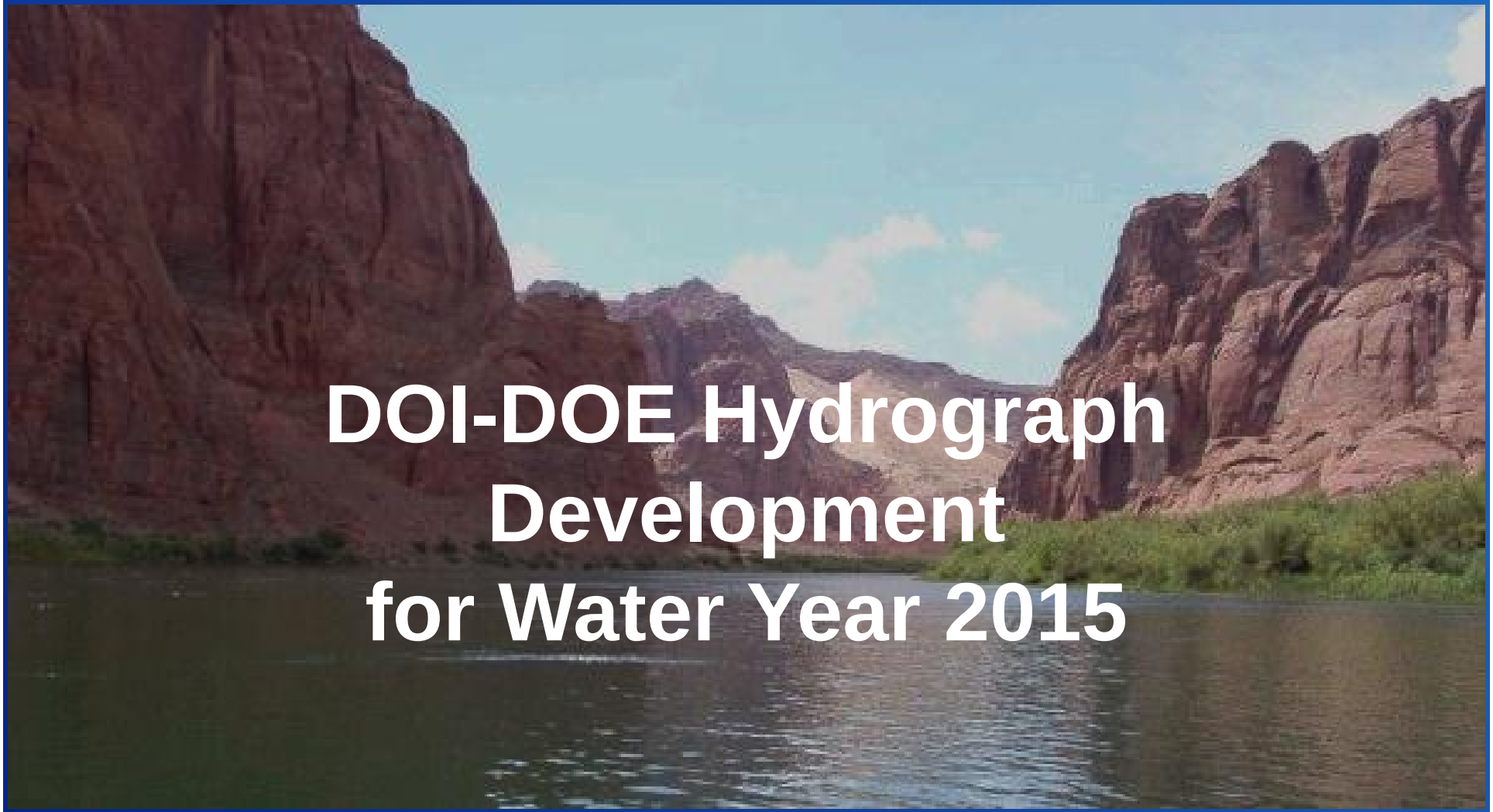
Unit Number	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	
Units Available	5	7	6	6	4	4 / 6	6	6 / 5	6	6	6	6	
Capacity (cfs)	13,800	**20,600**	**17,200**	**17,200**	10,700	**10,400** / **17,200**	**17,200**	**17,200** / **13,600**	**17,200**	**17,200**	**17,200**	**17,400**	
Capacity (kaf/month)	870	1180	1060	1060	630	880	1020	930	1020	1060	1130	1120	
Max (kaf) [1]	600	600	800	950	700	800	1000	1200	1200	1250	1250	1086	**11.4**
Most (kaf) [2]	600	600	800	800	650	650	600	650	800	1000	1050	800	**9.0**
Min (kaf) [1]	600	600	800	800	650	650	600	650	800	1000	1050	800	**9.0**

(updated 6-16-2014)

1 **Projected release, based on April 2014 Min and Max Probable Inflow Projections and 24-Month Study model runs**

2 **Projected release, based on June 2014 Most Probable Inflow Projections and 24-Month Study model runs**

RECLAMATION



DOI-DOE Hydrograph Development for Water Year 2015

RECLAMATION

2015 Hydrograph Development

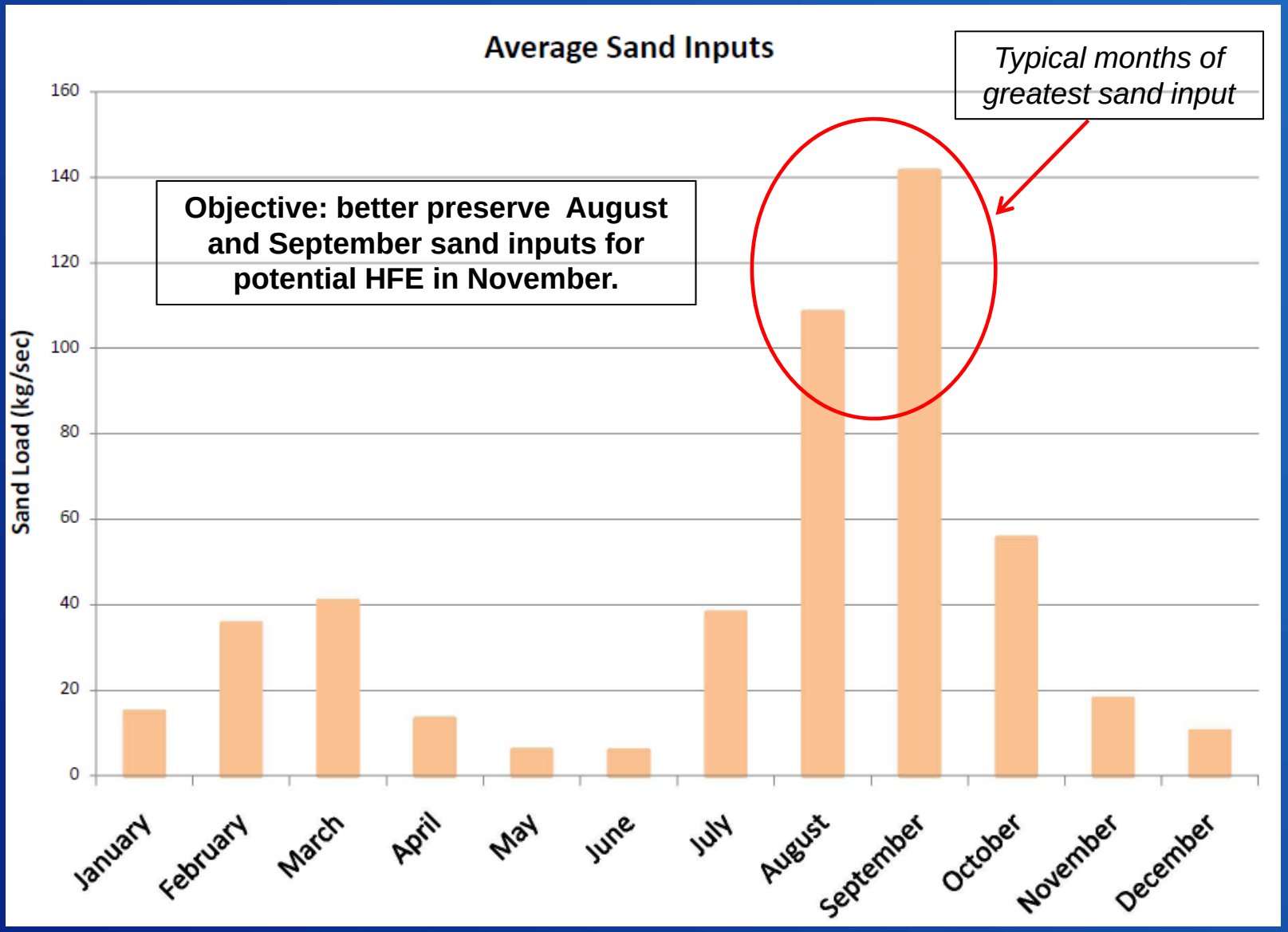
- Start 2012, 2013, and 2014 hydrograph
  - "Targeted Approach"
- Consider operating experiences and input
- Continue to work within existing environmental compliance

RECLAMATION

2015 Hydrograph Concepts

- Objective: retain sand inputs high in the system in anticipation of a potential HFE in fall 2015

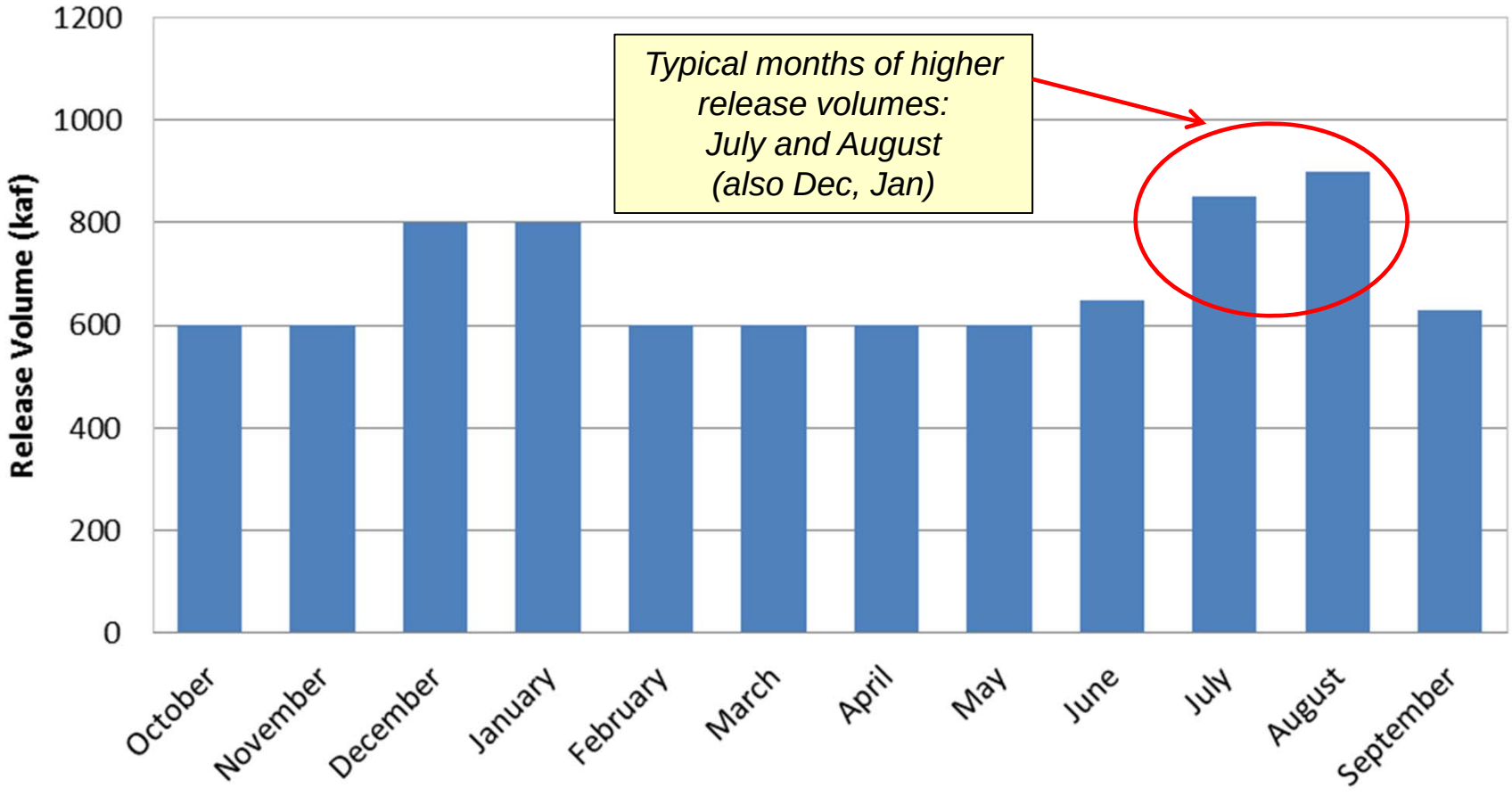
- Target lower August through October releases
- Avoid shifting “extra” water to June (which cools temperatures at the mouth of the LCR)
- Move water from August to other equal value months for hydropower (Dec/Jan, Jul)



RECLAMATION

Typical Annual Release Pattern

8.23 maf year



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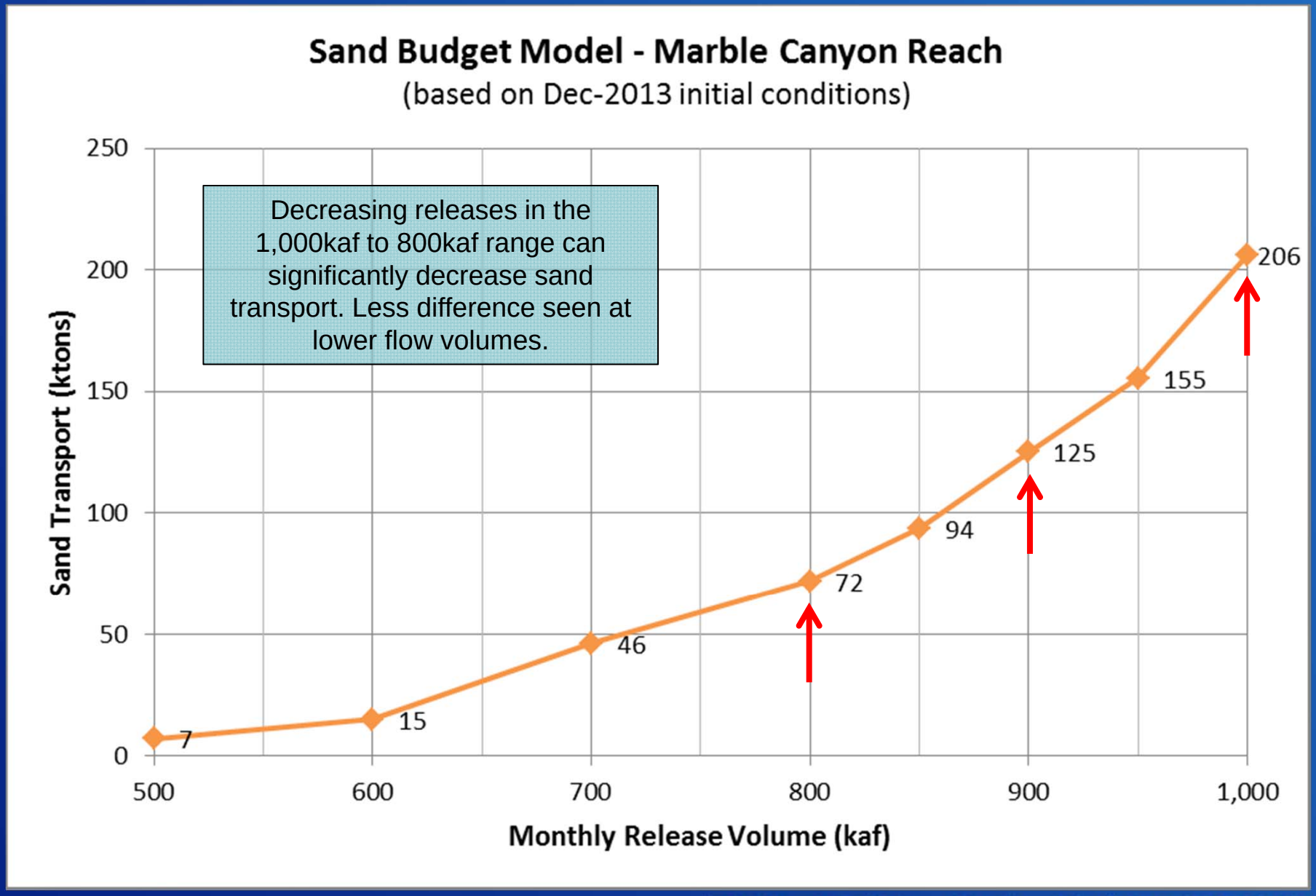


RECLAMATION

Temperature Considerations

- Last year (2013) FWS suggested we look at ways to improve temperatures at the mouth of the LCR early in the season (June)
- LCR temperatures were found to drop by about 0.5 deg C as releases are increased from 600 to 800 kaf
- Avoid shifting “extra” water into June
- June release target will be:
  - 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

RECLAMATION

2015 Targeted Release Volumes

- August releases targeting 800kaf, and adjusted to account for hydrologic uncertainty.
  - If there is a HFE in November 2014, August 2015 releases that were scheduled above 800 kaf may be reallocated to November
- September releases adjusted to the forecast as follows:
  - 600 kaf/month for annual releases below 9.0 maf
  - 700 kaf/month for annual release from 9.0 maf up to 10.0 maf
  - 800 kaf/month for annual release from 10.0 maf up to 11.0 maf
  - 900 kaf/month for annual release from11.0 maf up to 12.0 maf
  - Up to powerplant capacity for high equalization releases

NOTE: Propose similar release targets and language as 2013 hydrograph (last time GCD was in Upper Elevation Balancing Tier), also accounting for powerplant capacity constraints.

2015 Projected Annual Release

(Based on April and June 2014 modeling)

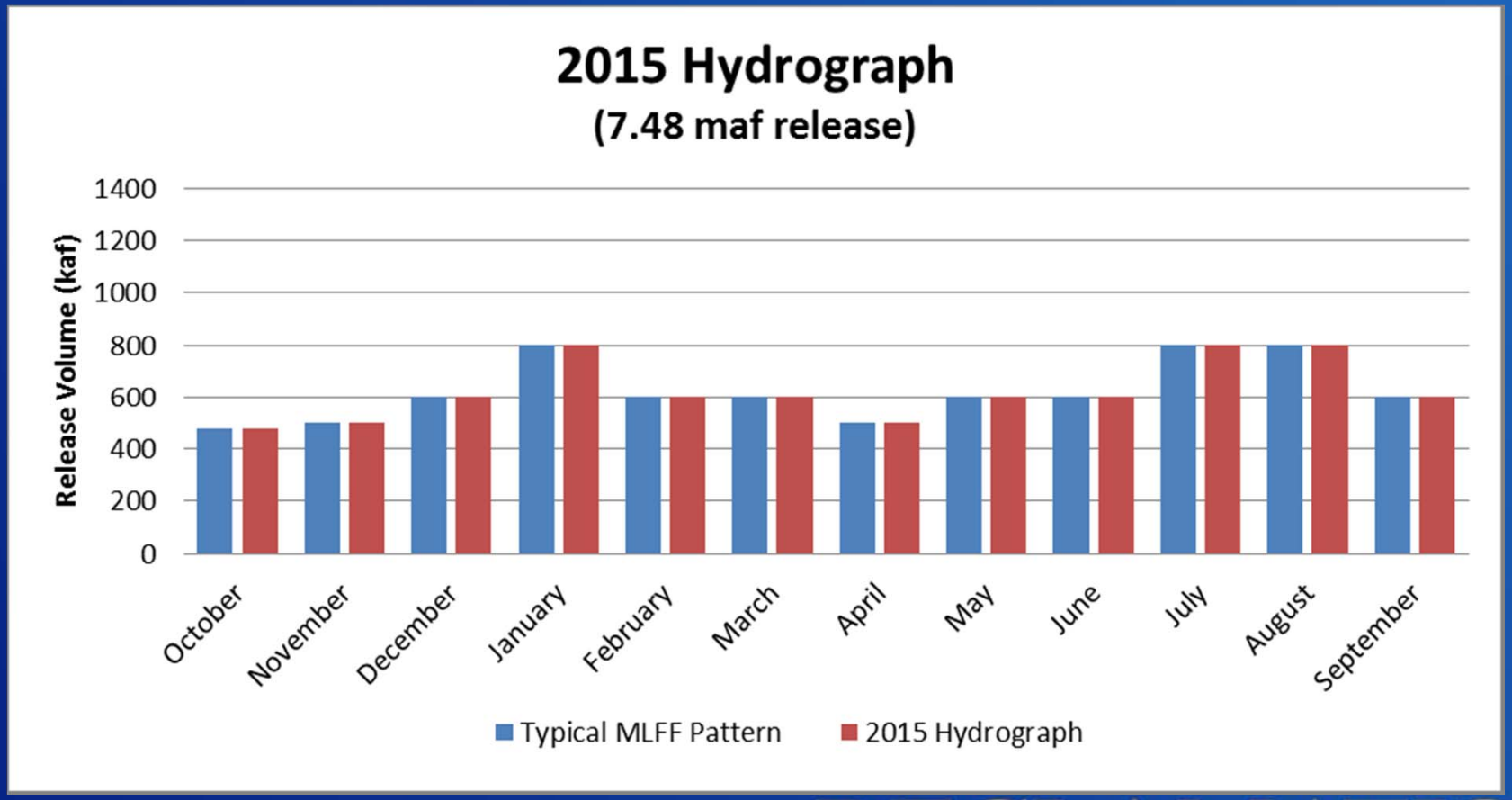
- Minimum probable: 9.0 maf release
  Upper Elevation Balancing, with 9.0 release; extremely small chance of 8.23 or 7.48
- Most probable: 9.0 maf release
  Upper Elevation Balancing, with 9.0 release
- Maximum probable: ~11 maf release
  Upper Elevation Balancing, with April adjustment to equalization

- GCD Operating Tier will be determined in August
- If Upper Elevation Balancing Tier, potential for April adjustment to equalization.

RECLAMATION

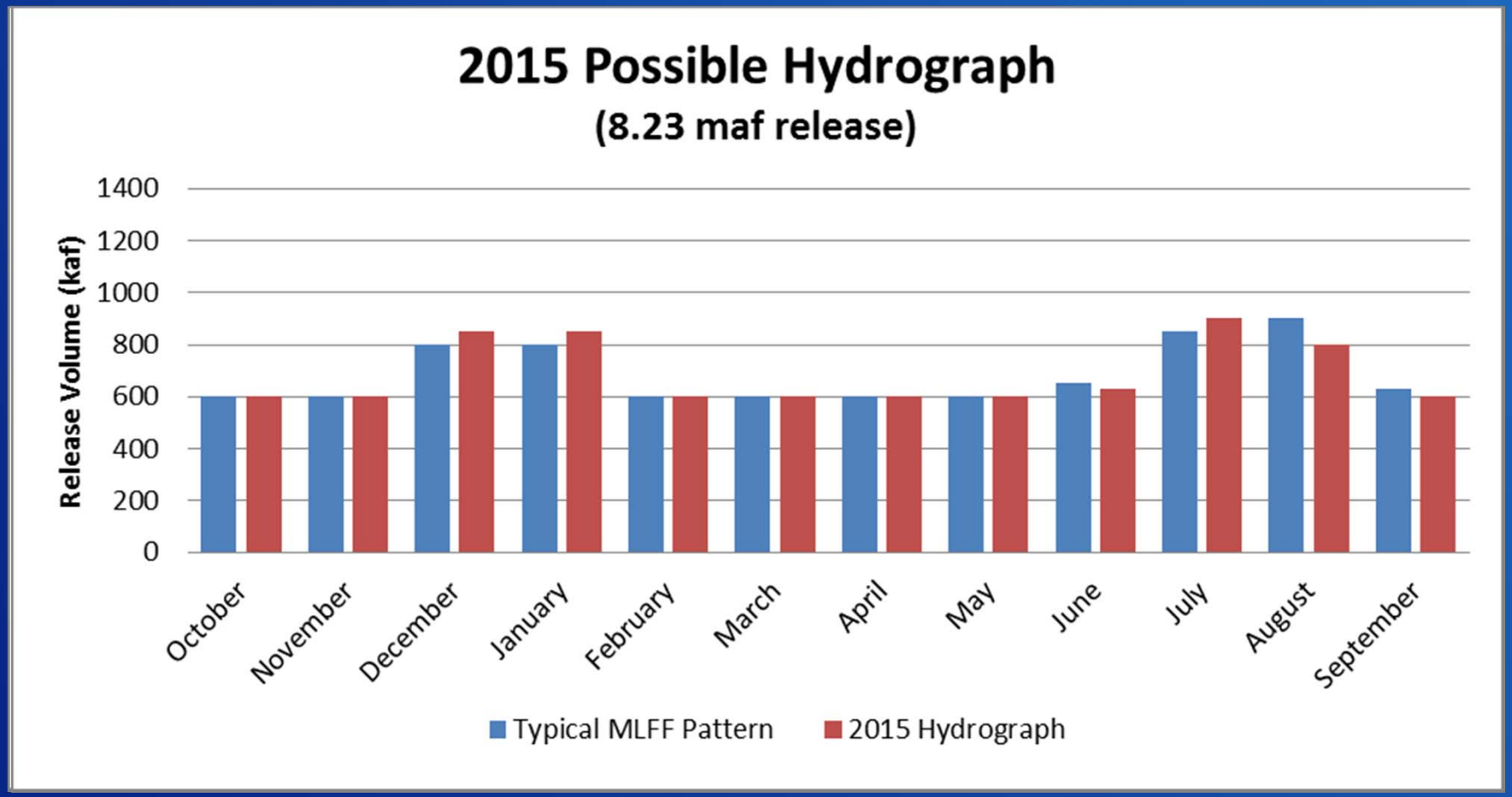
2015 Possible Hydrograph
7.48 maf release

- **Flows are already low – no difference from typical MLFF**



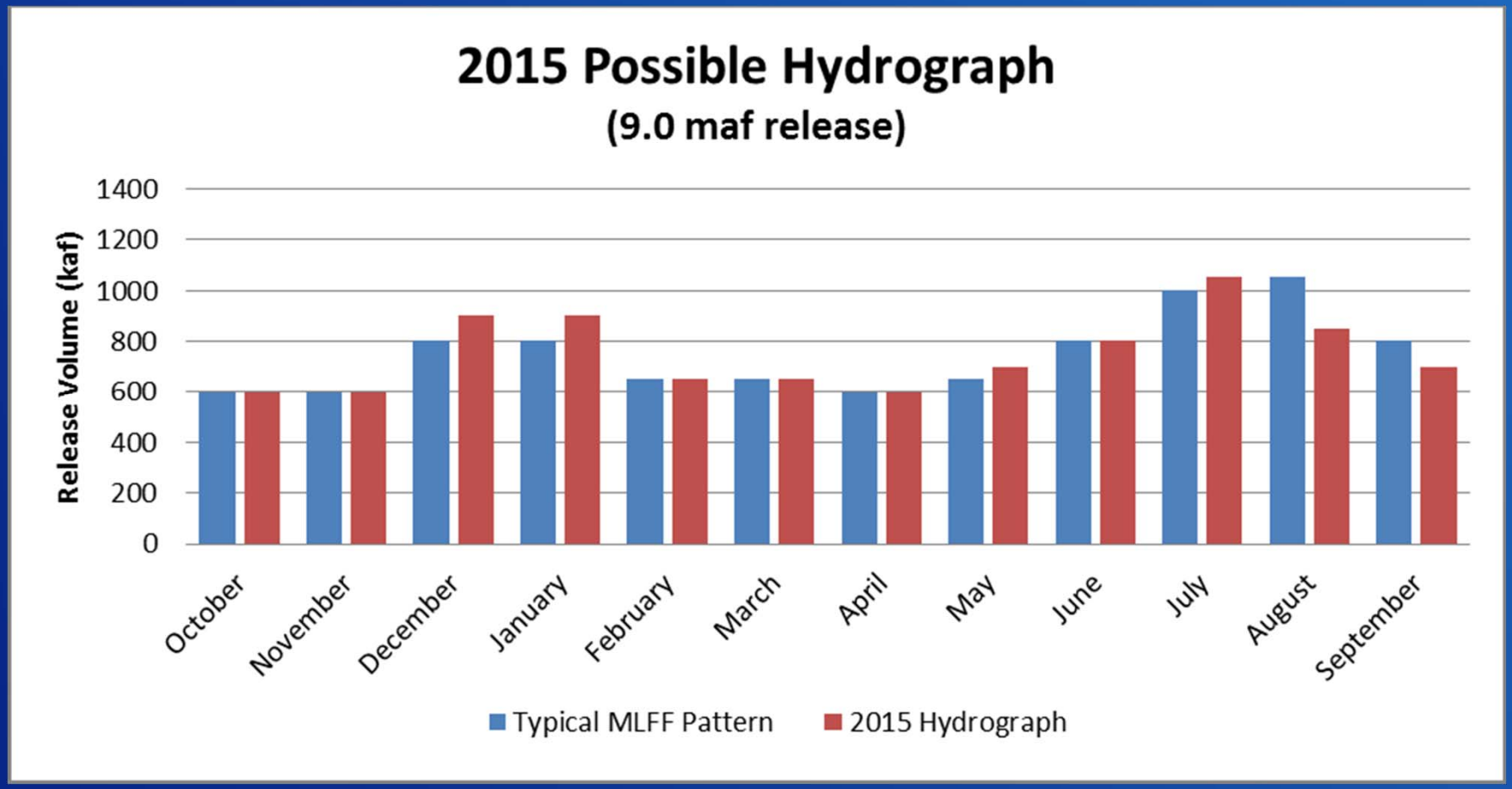
RECLAMATION

2015 Possible Hydrograph
8.23 maf release



RECLAMATION

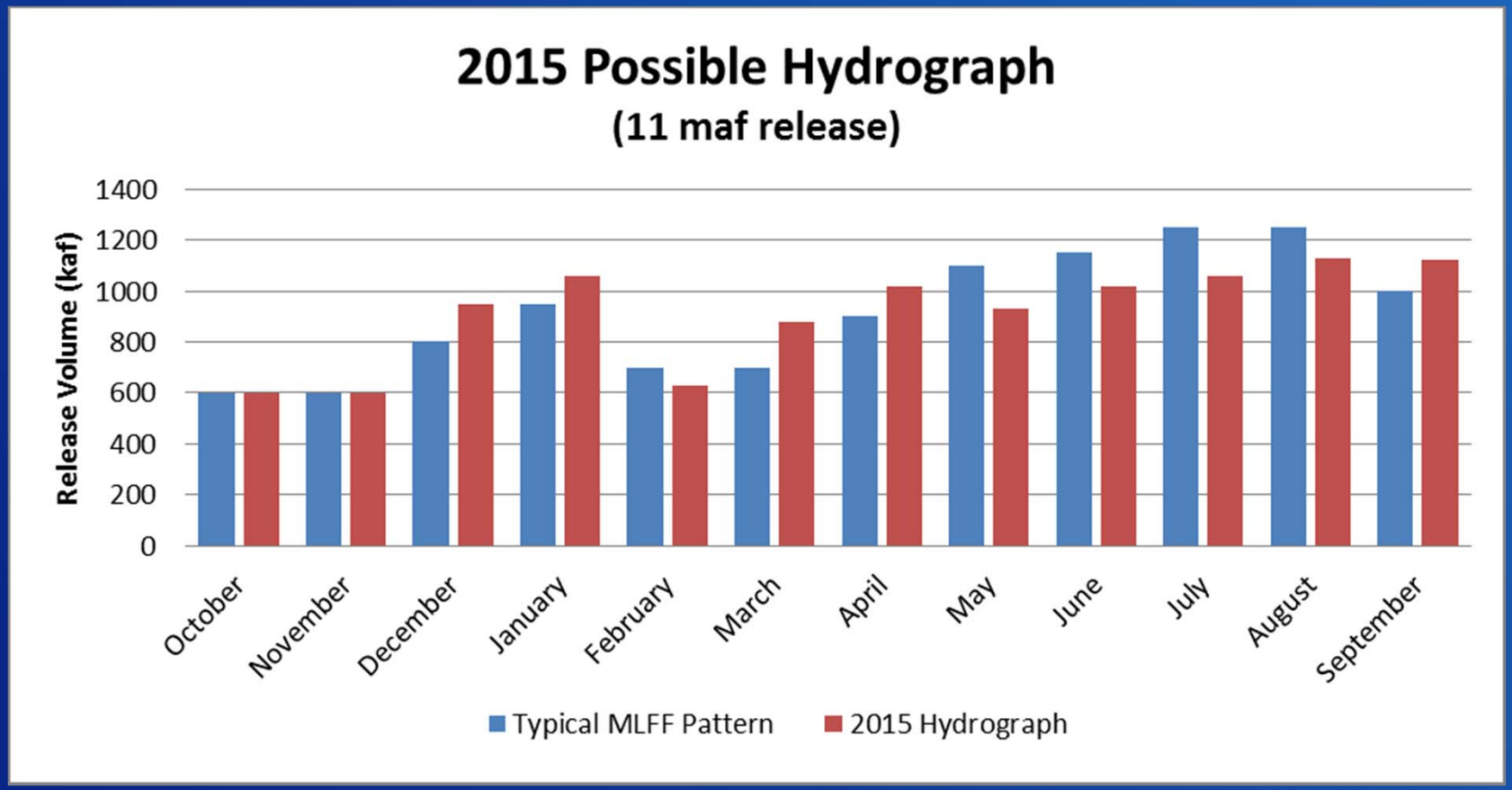
2015 Possible Hydrograph
9.0 maf release



RECLAMATION

2015 Possible Hydrograph
11 maf release

- Lots of water to move: limited flexibility, powerplant capacity limits anticipated, minimal ability to affect sand retention or temperature



RECLAMATION

2015 Hydrograph Next Steps

- Continue to coordinate with DOI-DOE Agencies
- No additional modeling for 2015
  - We have already analyzed the range of annual release volumes in past years:
    - Projected hydropower impacts: GTMax
    - Projected sediment retention: Sand Budget model
    - Projected temperature impacts
- If acceptable to TWG, TWG will move to AMWG for recommendation to Secretary at August 2014 AMWG meeting.

RECLAMATION

Questions?

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Hydraulic Engineer, Glen Canyon
Reclamation, Upper Colorado Region
Resource Management Division
Water Resources Group

RECLAMATION

2015 Proposed Language

- Annual Release Volumes will be determined by the 2007 Interim Guidelines and shall be reviewed and adopted through the normal annual operating plan process.
-
- Monthly Release Volumes will be adjusted each month based on the most current inflow forecast, the projected Annual Release Volume, powerplant capacity, and the magnitude of a potential High Flow Experiment.
-
- Release objective for June is to avoid reallocating releases from August into June and is intended to provide warmer river temperatures at the mouth of the Lower Colorado River early in the season for endangered fish. The 2015 June release target volume will be adjusted with the projected annual release volume to:
  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 of 800 kaf is intended to reduce the erosion of August sediment inputs in anticipation of a potential HFE. However, due to hydrologic uncertainty and powerplant capacity constraints in other months, the August 2015 release target volume may be adjusted. Should a HFE be conducted in November 2014, August 2015 releases scheduled above 800 kaf may be reallocated to November.
-
- Release objective for September is intended to reduce the erosion of August sediment inputs in anticipation of a potential HFE. The 2015 September release target volume will be adjusted with the projected annual release volume to:
- 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 greater than 10.0 maf; 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 December/January and July/August timeframes to meet Western's minimum power needs.
-
- 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 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.

RECLAMATION

2012 Hydrograph Language

AMWG recommends to the Secretary of the Interior his approval of the DOI-DOE Proposed Hydrograph for Water Year 2012 as follows:

- Monthly Release Volumes will be adjusted each month based on the most current forecast of the annual release required by the 2007 Interim Guidelines.
- Monthly Release Volumes are anticipated to vary within the targets identified for each month as set forth below. This 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. The targeted operation will also be adjusted as necessary to accommodate a targeted release volume for the month of August 2012 based on the schedule below:
    - January: August 2012 Volume target set to greater of 800 kaf or 10% remaining annual release volume.
    - February: August 2012 Volume target set to greater of 800 kaf or 10% remaining annual release volume.
    - March: August 2012 Volume target set to greater of 800 kaf or 12% remaining annual release volume.
    - April: August 2012 Volume target set to greater of 800 kaf or 15% remaining annual release volume.
    - May: August 2012 Volume target set to greater of 800 kaf or 20% remaining annual release volume.
    - June: August 2012 Volume target set to greater of 800 kaf or 25% remaining annual release volume.
    - July: August 2012 Volume target set to greater of 800 kaf or 40% remaining annual release volume.
    - August: Release volume established as 100% of remaining annual release volume (release could be less than 800 kaf in some cases).
- In some Equalization release scenarios, the release volume required in August could be as high as the full capacity of the power plant.

- Steady flows will occur in September 2012 (and October 2012) per the 2008 HFE Environmental Assessment (EA).
- Monthly release volumes will be modified each month in consultation with Western Area Power Administration.
- The remaining annual release volume will be computed as the projected WY2012 annual release volume pursuant to the Interim Guidelines less volume already released in WY2012 less the September 2012 projected Steady Flow Experiment release volume.
- 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 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.

FY 2013 Hydrograph

Reclamation proposes to use a similar design to FY 2012 Hydrograph developed by DOI Team and recommended by AMWG, the "Targeted Method":

- August releases are limited using percentage method to conserve sediment inputs with an emphasis on the primary sediment input period of August-October.
- Only September and October would differ from the 2012 Hydrograph because they will not be steady, but will revert to ROD fluctuations.
- September and October releases would be adjusted to the forecast as follows:
  - 600 kaf/month for annual releases below 9.0 maf
  - 700 kaf/month for annual release from 9.0 maf up to 10.0 maf
  - 800 kaf/month for annual release from 10.0 maf up to 11.0 maf
  - 900 kaf/month for annual release from11.0 maf up to 12.0 maf
  - Up to powerplant capacity for high equalization releases

2014 Hydrograph language

- **Annual Release Volumes will be determined in compliance with the 2007 Interim Guidelines (in consultation with the Basin States as appropriate).**
- **Monthly release Volumes are anticipated to shift depending upon: (1) the Annual Release Volume, and (2) 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).**
- **Release objective for June is 600 kaf to 650 kaf .**
- **Release objective for August is 800 kaf.**
- **Release objective for September and October is 600 kaf to 630 kaf (or less).**

- **Monthly Release Volumes will generally strive to maintain 600 kaf levels in the spring/fall timeframe and 800 kaf in 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 after 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.**

RECLAMATION

RECLAMATION