

Appendix A – Operational Documentation

A.1 Introduction

The purpose of this appendix is to document operations under the Guidelines through a chronological review of operations from 2008 through 2019. Also provided each year is a comparison of the projected and actual conditions during that year. It begins with an overview of the 24-Month Study and how it is used to make projections that set operations at Lake Powell and Lake Mead. Next, each year from 2008 through 2019 is presented, including projections from key 24-Month Studies throughout the year, and summaries of major variables that affect the projections. To understand how the projections performed over the entire period, the appendix concludes with an analysis of the accuracy of the 24-Month Study projections of Lake Powell and Lake Mead elevations.

A.2 Overview of the 24-Month Study

A.2.1 24-Month Study Background

The 24-Month Study is Reclamation's monthly operational study that projects future reservoir operations by simulating 12 major reservoirs¹ in the Colorado River Basin (Basin) on a monthly time step for a period of 24 to 32 months. The Guidelines require Reclamation use the 24-Month Study projections of system storage and reservoir elevations to determine the operations of Lake Powell and Lake Mead. The model output is used for annual and monthly decision support for mid-term (one-two years) operations. Figure A1 shows Reclamation's tiered approach to operational decision making. Colorado River Simulation System (CRSS), Reclamation's long-term planning model, the 24-Month Study, and Mid-term Operations Probabilistic Model (MTOM) are the models used for mid-term operations, and various local basin and site-specific models are used to for short-term (four-six weeks) scheduling and real-time operations.

The 24-Month Study projects future reservoir conditions given initial reservoir conditions, inflow forecasts, and operational policies and guidelines. In accordance with the Guidelines, the projected January 1 reservoir conditions of Lake Powell and Lake Mead from the August 24-Month Study set the annual operation for the upcoming year and the April 24-Month Study is also used as the basis for potential adjustments (such as, equalizing or balancing) to Lake Powell's annual releases when Lake Powell is operating in the Upper Elevation Balancing Tier. The resulting annual operations for Lake Powell and Lake Mead are reported in the Annual Operating Plan for Colorado River Reservoirs (AOP) for the current year and projected for the upcoming year.

¹ These include nine reservoirs in the Upper Basin (Fontenelle, Flaming Gorge, Taylor Park, Blue Mesa, Morrow Point, Crystal, Vallecito, Navajo, and Lake Powell) and three reservoirs in the Lower Basin (Lake Mead, Lake Mohave, and Lake Havasu).

Figure A1. Reclamation's operational activity and decisions for different time horizons.

Spatial Resolution Time Horizon	Operational Activity	Guidance/ Documentation
Basin-wide over decades	Long-term Planning	Operating Criteria and Guidelines
Basin-wide over 1-2 years	Mid-term Operations	Annual Operating Plan
Sub-basin over 4-6 weeks	Short-term Scheduling	Water and Power Schedules
Single project over 1-7 days	Real-time Control	Unit Commitment Economic Dispatch Automatic Generation and Control

As inflow forecasts and reservoir conditions change throughout the year, operations of Lake Powell and Lake Mead are adjusted monthly to meet operating objectives within the annual operation and consistent with the Guidelines; reservoir operations for other Upper Basin and Lower Basin reservoirs are adjusted monthly to meet operating objectives (such as, water deliveries, environmental flows, water storage, and/or space objectives, etc.). The 24-Month Study model output (monthly projected reservoir parameters including elevations, releases, and power generation) provide important information upon which stakeholders in the Basin may make decisions. The model output is also an information source for Basin stakeholders who rely on it to advise residents, water users, and other partners and stakeholders of projected impacts at the local level.

The 24-Month Study is a deterministic model that uses a single forecasted inflow hydrology to generate a single set of model output. Results are posted on Reclamation's [Upper](#) and [Lower](#) Colorado Basin Region websites after each monthly study is complete (typically by the 15th of each month).

A.2.2 Key 24-Month Study Model Assumptions

As with any model, the 24-Month Study relies on assumptions and parameterization² of physical processes. The two key sources of uncertainty are future hydrology and future water demands; other sources of uncertainty exist, but are typically of a much smaller magnitude than hydrology or demands. Additionally, the operational policy at each reservoir is incorporated into the 24-Month Study, either via manual input from operator expertise, or via coding the operations into the model. This section describes how hydrology, water demands, and operational policies are incorporated into the model and also discusses other sources of uncertainty.

² Complex physical processes are represented in the model through a simplified process, for example, evaporation is modeled using monthly evaporation rates.

A.2.2.1 Hydrology

In the Upper Basin, consistent with the Guidelines and Annual Operating Plan process, Reclamation uses inflow forecasts for the current water year (WY) provided by the National Weather Service's Colorado Basin River Forecast Center (CBRFC). The CBRFC provides monthly unregulated inflow³ forecasts for the following reservoirs: Lake Powell, Fontenelle, Flaming Gorge, Blue Mesa, Morrow Point, Crystal, Taylor Park, Vallecito, and Navajo. The most probable forecast is provided every month, while minimum probable and maximum probable forecasts are also issued in January, April, August, and October.

To develop the minimum, most, and maximum probable forecasts, the CBRFC:

1. Creates an ensemble of inflow volumes based on current conditions and historical temperature and precipitation for each year over a specified calibration period using the Ensemble Streamflow Prediction (ESP) system.
2. Computes the 90th, 50th, and 10th percentile exceedance for the minimum, most, and maximum probable forecasts, respectively.
3. May make adjustments to the most probable (50 percent) forecast based on alternate guidance and/or rounding conventions.

The period that is used in the ESP system changes as additional historical data becomes available, and to be consistent with the World Meteorological Organization standard that climate normals are defined over a 30-year period. From 2008 through 2011, ESP used 1971 through 2000; from 2012 through 2016, ESP used 1981 through 2010; and from 2017 through the present, ESP uses 1981 through 2015⁴.

The CBRFC provides a forecast for the current WY; beginning in June of each year, the forecast includes both the remaining current WY and a forecast through the following end of water year (September 30; EOWY). For months beyond the forecast period, hydrologic inflows are based on statistical values for the period of record from 1981 through 2010.

In the Lower Basin, forecasted side inflows⁵ are based on historical data using the latest 5-year average, updated in February of each year, as calculated by Reclamation's Lower Colorado Basin Region. Currently, a 5-year average is used to represent Lower Basin inflows over the next 2 years in the 24-Month Study to better reflect recent drought conditions.

A.2.2.2 Water Demands

With the exception of three Upper Basin water uses⁶, Upper Basin water demands are not explicitly modeled in the 24-Month Study. The unregulated inflow forecast from the CBRFC incorporates Upper Basin water demands into the projections⁷. Water use by the Lower Division States is modeled in the 24-

³ Unregulated inflow adjusts for the effects of operations at upstream reservoirs. It is computed by adding the change in storage and the evaporation losses from upstream reservoirs to the observed inflow. Unregulated inflow is used because it provides an inflow time series that is not biased by upstream reservoir operations.

⁴ Even though 35 years are used in the present ESP forecasts, the inflow as a percent of average is reported using the 1981-2010 (30-year) average.

⁵ Side inflows are the total tributary inflow that occurs in a particular reach. There are five mainstream reaches in the Lower Basin: above Hoover Dam (Lake Mead); above Davis Dam (Lake Mohave); above Parker Dam (Lake Havasu); above Imperial Dam; and below Imperial Dam.

⁶ The Navajo Indian Irrigation Project, Azotea Tunnel, and Gunnison Tunnel are the three Upper Basin water uses explicitly modeled in the 24-Month Study.

⁷ Historical water use is used to calibrate the CBRFC's model. Water use is then incorporated into future projections as a function of temperature and irrigated acreage.

Month Study based on water user annual entitlements and approved water orders for the current year. These approved water orders take into consideration Lake Mead's operating condition and other factors such as Intentionally Created Surplus (ICS), system conservation, and payback obligations. Monthly schedules are provided by the water users. For upcoming calendar years (CY), the annual volume is based on the projected operating condition and monthly schedules are based on historical patterns. Water delivery to Mexico is based on the [*United States-Mexico Treaty on Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande signed February 3, 1944*](#) (1944 Water Treaty) and implementing Minutes. The flows to Mexico in excess of treaty requirements and the flows bypassed pursuant to Minute 242 are modeled as additional demands below Lake Mead. These two demands rely on recent historical averages for the assumed future demand in the 24-Month Study.

A.2.2.3 Operating Policies

Upper Basin reservoir operations are manually input to the 24-Month Study model to meet objectives as outlined by each project's purpose and consistent with individual environmental commitments. While Lake Powell's annual release is governed by the Guidelines, monthly operations for Lake Powell are based on the 2016 Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP) including, when applicable, experimental release requirements under LTEMP as coordinated through the Adaptive Management Work Group. Other Upper Basin reservoir's annual and monthly operations are based on authorized purposes and criteria outlined in each reservoir's Record of Decision (ROD), Standing Operating Procedures (SOPs), and/or water delivery requirements. To meet operational objectives (including water delivery requirements, environmental flows, and water storage objectives), reservoir operations are planned on hourly and/or daily time steps then aggregated to a monthly time step for input into the model. The model input may also reflect operations adjusted to reflect operations such as evacuation of reservoir space in order to capture runoff and reduction of bypass releases during high inflow years. Operations are adjusted each month as hydrology and reservoir conditions change.

Lower Basin reservoir operations are simulated using automated rules in the model. Lake Mead flood control supersedes all other operational conditions. When not in flood control, monthly releases are set to meet downstream demands; the annual volumes available to the Lower Division states are set by the Guidelines, while the annual volume available to Mexico is set by the 1944 Water Treaty and implementing Minutes. When Lake Mead is not in flood control, Lake Mohave and Lake Havasu annual and monthly operations are driven by downstream water use demands and monthly elevations follow seasonal guide curves. In general, elevations of Lake Mohave and Lake Havasu are set higher in spring and summer months to help meet peak water use demands and elevations are set lower in fall and winter months to help capture runoff during rain events.

A.2.2.4 Other Sources of Uncertainty

In addition to hydrology, demands, and operational policies, the 24-Month Study models several other physical processes, including reservoir evaporation, reservoir bank storage, and transmission and other losses due to native vegetation. Reservoir evaporation is modeled using historical evaporation rates, and the computed surface area based on reservoir storage in each month. Bank storage is modeled⁸ using assumed coefficients that represent the percentage of water that flows into or out of the banks as a function of the change in stage over a month. Finally, transmission and losses due to native vegetation in the Lower Basin are incorporated into the previously mentioned side inflows, that is, the side inflows implicitly subtract off these losses.

⁸ Bank storage is only modeled at Flaming Gorge, Lake Powell, and Lake Mead.

A.2.3 24-Month Study Operating Determination⁹

Consistent with the Guidelines, the August 24-Month Study projection of January 1 conditions at Lake Powell and Lake Mead is used to set the operating tier for the upcoming year (Figure A2). In a “tier determination” run, Lake Powell’s release in August and September is set to meet the release requirements for the current WY and the upcoming WY is set to an 8.23 million acre-feet (maf) release pattern which includes 2.0 maf total release in October, November, and December. Based on this tier determination projection, Lake Powell’s operating tier is determined for the upcoming WY. Then, Lake Powell’s releases are adjusted appropriately to reflect the upcoming year’s operating tier and corresponding monthly release pattern. The model is then rerun, if needed, to project Lake Mead’s January 1 elevation to determine Lake Mead’s operating condition in the upcoming year.

Figure A2. Lake Powell and Lake Mead operational diagram. Diagram not to scale.

Lake Powell			Lake Mead		
Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf)	Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf)
3,700	Equalization Tier Equalize, avoid spills, or release 8.23 maf	24.3	1,220	Flood Control Surplus or Quantified Surplus Condition Deliver > 7.5 maf	25.9
3,636-3,666 (2008-2026)		15.5-19.3 (2008-2026)	1,200 (approx.) ¹		22.9 (approx.) ¹
	Upper Elevation Balancing Tier² Release 8.23 maf; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf		1,145	Domestic Surplus or ICS Surplus Condition Deliver > 7.5 maf	15.9
3,575		9.5		Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf		1,075		9.4
3,525		5.9	1,050	Shortage Condition Deliver 7.167 ³ maf	7.5
	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	4.0	1,025	Shortage Condition Deliver 7.083 ⁴ maf	5.8
3,490			1,000		4.3
3,370		0	895	Shortage Condition Deliver 7.0 ⁵ maf Further measures may be undertaken ⁶	0

¹ This elevation is shown as approximate as it is determined each year by considering several factors including Lake Powell and Lake Mead storage, projected Upper Basin demands, and an assumed inflow.

² Subject to April adjustments which may result in a release according to the Equalization Tier.

³ Of which 2.48 maf is apportioned to Arizona, 4.4 maf to California, and 0.287 maf to Nevada.

⁴ Of which 2.40 maf is apportioned to Arizona, 4.4 maf to California, and 0.283 maf to Nevada.

⁵ Of which 2.32 maf is apportioned to Arizona, 4.4 maf to California, and 0.280 maf to Nevada.

⁶ Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division states and Mexico are likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with the Basin States, may result in the undertaking of further measures, consistent with applicable Federal law.

⁹ See Guidelines Section XI. G. 6. for further detail.

When Lake Powell is operating in the Upper Elevation Balancing Tier, there is the potential for an April (or mid-year) adjustment to either equalization or balancing releases based on EOWY projections in the Most Probable April 24-Month Study. This projection is based on a 24-Month Study run with an 8.23 maf release from Lake Powell programmed into the model for the current WY. If Lake Powell's EOWY elevation is projected to be at or above the equalization level, then Lake Powell's operation is governed by the Equalization Tier for the remainder of the WY. If Lake Powell's end of water elevation is projected to be below the equalization level and at or above elevation 3,575 feet, and Lake Mead is projected to be at or below elevation 1,075 feet, then Lake Powell's operation is governed by balancing releases for the remainder of the WY. If a shift to equalization or balancing is projected in this run, then Lake Powell's releases are adjusted and the model is rerun to determine the releases for the remainder of the year. If neither of these conditions are projected, Lake Powell's annual release remains 8.23 maf.

A.2.4 Incorporating Uncertainty

Lake Powell's operating tier is set based on its projected EOCY elevation and its WY release can be influenced by Lake Mead's EOCY elevation in some tiers. In each tier except for the Mid-Elevation Release Tier, intra annual operations are influenced by the inflow into Lake Powell, the EOWY projection of Lake Mead's elevation, and the EOWY projection of Lake Powell's elevation. Lake Mead's operations are influenced by Powell's release, Lower Basin hydrology (inflow between Lake Powell and Lake Mead, and side inflows below Lake Mead), Lower Basin water use, and other demands below Lake Mead. Forecasts for each of these variables that influence operations must be input when running the 24-Month Study. The most probable forecast provides a deterministic projection, which uses a single forecast of each of these variables, even though there is some level of uncertainty associated with each variable. To address this, Reclamation relies on additional model runs to provide bounds and probabilistic projections of future operations. These projections do not set operations as the August and April most probable 24-Month Study projections do, but provide additional information that helps show the broad range of future possibilities resultant from key uncertainties.

In January, April, August, and October, probable minimum and maximum 24-Month Study runs are also made and rely on the probable minimum and probable maximum forecasts from the CBRFC. As with the most probable runs, these are deterministic runs that rely on operator expertise to set input to the model. They result in an upper and lower bound on the most likely outcome over the following 24-months, though there is a 10 percent chance of ending up above the maximum probable outcome (the 10 percent exceedance), and 10 percent chance of ending up lower than the minimum probable outcome (the 90 percent exceedance).

To provide additional information regarding the chances of operating in the different conditions specified in the Guidelines, Reclamation relies on two probabilistic models to run many more possible future hydrology sequences: MTOM and CRSS¹⁰. These models can be used to estimate the chances that any given outcome occurs in any future year, for example, the chance Lake Mead will be in shortage conditions, or the chance that Lake Powell will fall to critically low elevations. These projections are updated 2 to 3 times per year, or as conditions warrant, and made available on [Reclamation's website](#). As with the 24-Month Study, these projections rely on assumptions for future hydrology, demands, and operations, and are initialized based on historical conditions. As initial conditions change and as assumptions for the other variables change, the chances of different conditions occurring also change. These projections are particularly sensitive to initial

¹⁰ Neither MTOM nor CRSS affect operations under the Guidelines. They solely provide information on the chances of reaching different reservoir levels and operating conditions.

conditions (as many other assumptions remain relatively stable between projections), thus as observed conditions change the future risks to the system also change.

A.2.5 24-Month Study Model Improvements

Reclamation continually updates and improves its modeling tools to better reflect new policies, better represent physical processes, and streamline the modeling process. Since 2008, the 24-Month Study model has been updated on numerous occasions. Some of the more noteworthy enhancements include:

- In January 2010, Reclamation adopted an expanded structure to the 24-Month Study. Prior to January 2010, the 24-Month study model included only three explicitly modeled water uses. The rest of the Lower Basin water uses were implicitly included in the model and were tracked in external spreadsheets. The new model structure explicitly models all mainstream water uses in the Lower Basin, including modeled state adjusted apportionments for transparency and accuracy of state water use modeling assumptions.
- In January 2012, the 24-Month Study was updated to include new [Lake Mead area and capacity tables](#).
- In January 2012, the approach to forecasting and calculating Lake Powell's unregulated inflow was updated to use a mass balance approach.
- In January 2017, the methods used in the 24-Month Study that compute energy generation from Hoover Dam were updated so that energy is produced until a Lake Mead elevation of approximately 950 feet. The previous minimum energy level was approximately 1,050 feet.

A.3 Review of Operations

This section includes a chronological review of operations from 2008 through 2019, documenting the operational experience in each year. It is intended to provide a review of operations, including how 24-Month Study projections varied during the year. As such, variables of particular interest to different parties may be aggregated together, as they are intended to provide a high-level view of how different types of variables, for example, water use or hydrology, affect 24-Month Study projections.

Each WY/CY is presented in an individual section, starting with the August 24-Month Study from the previous year, which sets operations for that WY/CY. There is a high-level summary of the resulting conditions throughout the year, along with details of key or distinct experiences during the year that affected projected and/or actual operations. Key agreements relating to Colorado River system operations that were reached during the year, and other related activities are also documented in the section. Additionally, each section includes seven tables and one figure to help summarize 24-Month Study projections and actual operations in that year. The first table in each section includes the operational projections that set the operating tier at Lake Powell and the Lake Mead operating condition each year. The remaining six tables include projections from January, April, and August 24-Month Studies and compare the projections to observed values. The second table summarizes the WY based hydrology and reservoir levels, while the next table summarizes CY based hydrology, reservoir levels, and Lower Basin use. The final four tables include details supporting the water use included in the previous table for Arizona, California, Nevada, and Mexico. These tables also note the total mainstream tribal consumptive use¹¹ for each state.

¹¹ The mainstream tribal use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Reservation.

Except for the projected water use modeled in the 24-Month Study projections, all data presented in the tables are publicly available in either past [24-Month Study reports](#)¹² or the *Colorado River Accounting and Water Use Report: Arizona, California, and Nevada* ([Water Accounting Reports](#)). Values displayed in this report may differ from those reflected in the Water Accounting Reports. This is primarily due to differences in the way data have been aggregated in this report. In instances where discrepancies between the two reports exist, the data in the Water Accounting Reports shall be considered the official record of Lower Basin water use and deliveries to Mexico that occurred in each year. The projected Lower Basin water uses in each 24-Month Study are documented and archived by the Lower Colorado Basin River Operations Group; these assumptions are developed in coordination with the Lower Division States, water users, and Mexico. Additional information about historical operations are available in the [Annual Operating Plans](#).

A.3.1 2008

To begin WY 2008, Lake Powell operated to release 8.23 maf. Upon adoption of the Guidelines (December 13, 2007) Lake Powell operated in the Upper Elevation Balancing Tier in WY 2008, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A1). The April 2008 24-Month Study projections resulted in Lake Powell operations shifting to Equalization for WY 2008 (Table A2) resulting in a total WY release of 8.98 maf from Lake Powell (Table A2). In the Lower Basin, a total of 7,520,961 acre-feet (af) was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. Lake Powell started WY 2008 at 3,601.87 feet and ended WY 2008 at 3,626.90 feet, with a total of 12.09 maf (112 percent average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2008 at 1,114.81 feet and ended the year at 1,110.97 feet.

Tables A2 through A7 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A3. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2007 – December 2008. includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2008.

In 2008:

- During March 2008 a spring High Flow Experiment (HFE) was conducted at Glen Canyon Dam with a peak release of 40,800 cfs and peak duration of 60 hours, with a powerplant capacity peak of 26,000 cfs. The total duration for the HFE was 3 days and 16 hours and total bypass was 92,991 af. This was the second spring HFE conducted with the first having been in 1996. There have been no spring HFEs since the 2008 event. Monthly flows were adjusted to maintain the set annual release.
- A five-year period of steady flow experimental releases in September and October of each year from Glen Canyon dam was implemented through the Glen Canyon Dam Adaptive Management Workgroup during the period of 2008 through 2012.
- In WY 2008, Lake Powell operated in the Upper Elevation Balancing Tier, and had an April adjustment to equalization. The governing driver of equalization releases was releasing water until Lake Mead reached an elevation of 1,105 feet by September 30, 2008.
 - A Steady Flow Experiment was implemented at Lake Powell during September and October 2008, resulting in adjustments to the scheduled Lake Powell releases in August and September 2008.

¹² 24-Month Studies from 2008 and 2009 are not available at the provided link, but they can be obtained by emailing bcoowaterops@usbr.gov.

- Once the flow and resulting release volume was set on September 1, it could not be changed during September if the month turned out to be wetter or drier than projected to better target a Lake Mead elevation of 1,105 feet at the end of the WY.
- The Glen Canyon release during September was 723 kaf, and Lake Mead ended the WY at elevation 1,105.76 feet.
- There was a change in crop patterns in the Lower Basin, which led to changes in projected overruns in the Lower Basin.
 - Eastern/Mid-western farmers switched from winter wheat to corn or soy for ethanol production.
 - Lower Basin farmers were contracted to grow winter wheat, a more water intensive crop, for 3-times the usual price. Over one-third of the acres in the Imperial Valley were growing winter wheat in early 2008 – over twice as many acres as in 2007.
 - Because of this, Lower Basin overruns were projected in 2008 starting in April. The projected overruns increased each month through August, after which the projected overruns decreased each month for the remainder of the CY.

Figure A3. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2007 – December 2008.

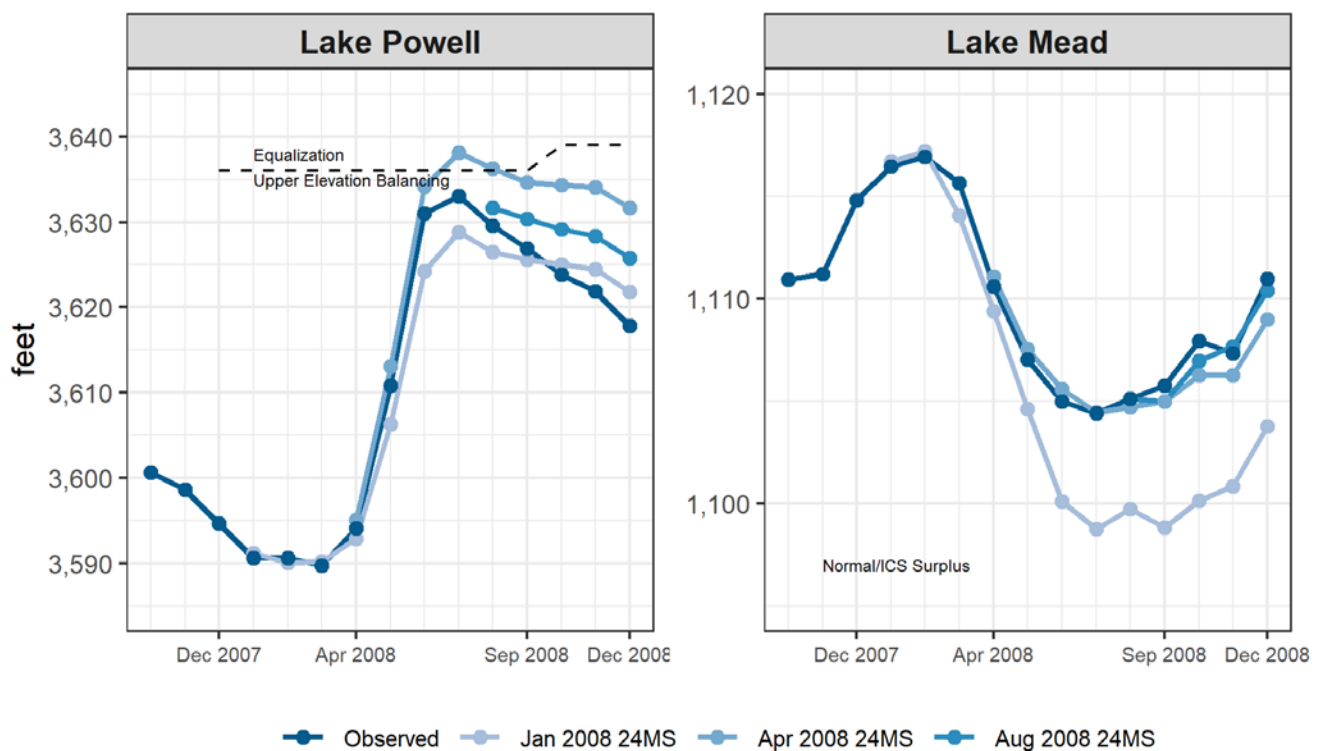


Table A1. Operational determination table for WY/CY 2008.

	Type of 24-Month Study Run	Aug 2007 ¹			Apr 2008 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2007 elevation (feet)	Tier Determination ⁴						
	Published Study	3,596.40	3,594.64	1.76			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2008 elevation (feet)	April Determination ⁵				3,639.81		
	Published Study				3,634.65	3,626.90	7.75
Lake Mead EOWY 2008 elevation (feet)	April Determination ⁵				1,098.27		
	Published Study				1,105.00	1,105.76	-0.76
Lake Powell Mid-Year Adjustment					Equalization		
Lake Mead EOCY 2007 elevation (feet)		1,114.73	1,114.81	-0.08			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ Releases from Lake Powell during WY 2008 were made to be consistent with Section 6 of the Guidelines. The year began by making releases consistent with Section 6.B.1 of the Guidelines, with a WY release of 8.23 maf. The Guidelines became effective December 13, 2007 and were used for CY 2008 operations. Consistent with the Guidelines, the August 2007 24-Month Study was used to forecast the system storage as of January 1, 2008. Based on this projected elevation of Lake Mead, the ICS Surplus Condition governed releases during CY 2008.

² April 2008 24-Month Study projections of September 30, 2008 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ Because the Guidelines were not effective until December 13, 2007, there was no Tier Determination run in August 2007.

⁵ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2008.

Table A2. January, April, and August 24-Month Study projections during WY 2008 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow ² (maf)	8.00	-0.82	9.70	0.88	NA	NA	8.82
April-July unregulated inflow (% avg)	112%		135%				123%
WY unregulated inflow ² (maf)	11.82	-0.27	13.35	1.26	12.64	0.55	12.09
WY unregulated inflow (% avg)	108%		123%		116%		112%
Lake Powell WY release (maf)	8.23	-0.75	8.88	-0.10	8.97	-0.01	8.98
Lake Powell EOWY elevation (feet)	3,625.63	-1.27	3,634.65	7.75	3,630.41	3.51	3,626.90
Lake Mead EOWY elevation (feet)	1,098.84	-6.92	1,105.00	-0.76	1,105.00	-0.76	1,105.76

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The actual unregulated inflow to Lake Powell shown in this table may not match the value in published 24-Month Studies due to the change in the method for computing Lake Powell inflow (Section A.2.5).

Table A3. January, April, and August 24-Month Study projections during CY 2008 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	935	35	952	52	934	34	900
Gains Below Hoover ² (kaf)	-226	-5	-337	-106	-352	-121	-231
Total Lower Basin and MX Use (af)	8,944,363	-76,598	9,042,850	21,889	9,133,475	112,514	9,020,961
AZ Consumptive Use (af)	2,761,607	9,110	2,814,245	61,748	2,761,607	9,110	2,752,497
CA Consumptive Use (af)	4,382,756	-116,054	4,443,605	-55,205	4,586,868	88,058	4,498,810
NV Consumptive Use (af)	300,000	30,346	285,000	15,346	285,000	15,346	269,654
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,621.84	3.95	3,631.68	13.79	3,625.75	7.86	3,617.89
Lake Mead EOCY elevation (feet)	1,103.79	-7.18	1,108.98	-1.99	1,110.41	-0.56	1,110.97

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A4. January, April, and August 24-Month Study projections during CY 2008 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,761,607	9,110	2,814,245	61,748	2,761,607	9,110	2,752,497
AZ Tribal Mainstream Consumptive Use ³ (af)							439,756
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	3,500	362	3,500	362	3,500	362	3,138
Other Water Left in Lake Mead ⁵ (af)	0	-15,681	0	-15,681	0	-15,681	15,681
Overrun (af)	0	0	52,638	52,638	0	0	0
Overrun Payback ⁶ (af)	9,893	9,651	9,893	9,651	9,893	9,651	242
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	25,000	-3,442	25,000	-3,442	25,000	-3,442	28,442
Other ICS Creation ⁷ (af)	0	-100,000	0	-100,000	0	-100,000	100,000

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the Central Arizona Water Conservation District (CAWCD) service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A5. January, April, and August 24-Month Study projections during CY 2008 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,382,756	-116,054	4,443,605	-55,205	4,586,868	88,058	4,498,810
CA Tribal Mainstream Consumptive Use ³ (af)							38,309
Total ICS Delivery (af)	0	-46,976	0	-46,976	80,170	33,194	46,976
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-185	45,759	45,574	108,926	108,741	185
Overrun Payback ⁶ (af)	42,244	20,070	42,244	20,070	42,300	20,126	22,174
Water Stored for NV (af)	0	-45,000	15,000	-30,000	15,000	-30,000	45,000
Recovered Water Stored in AZ (af)	25,000	-3,442	25,000	-3,442	25,000	-3,442	28,442
Other ICS Creation ⁷ (af)	0	-100,000	0	-100,000	0	-100,000	100,000

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A6. January, April, and August 24-Month Study projections during CY 2008 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	300,000	30,346	285,000	15,346	285,000	15,346	269,654
NV Tribal Mainstream Consumptive Use ³ (af)							3,771
Total ICS Delivery (af)	0	-9,638	0	-9,638	0	-9,638	9,638
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-5,016	0	-5,016	0	-5,016	5,016
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	0	-45,000	15,000	-30,000	15,000	-30,000	45,000
Other ICS Creation ⁶ (af)	0	-410,457	0	-410,457	0	-410,457	410,457
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A7. January, April, and August 24-Month Study projections during CY 2008 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2008		Apr 2008		Aug 2008		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ² (af)	-	-	-	-	-	-	-
Total MWR Creation ² (af)	-	-	-	-	-	-	-
Other MWR ³ (af)	-	-	-	-	-	-	-
Other Flows to Mexico ⁴ (af)	138,276	-68,537	148,142	-58,671	142,161	-64,652	206,813

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.2 2009

Based on the projections of the August 2008 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2009, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A8). The April 2009 24-Month Study projections resulted in no April adjustment for water year 2009 (Table A8) resulting in a total water year release of 8.24 maf from Lake Powell (Table A9). In the Lower Basin, a total of 7,438,398 af was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. Lake Powell started WY 2009 at 3,626.90 feet and ended WY 2009 at 3,635.37 feet, with a total of 10.22 maf (94 percent average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2009 at 1,110.97 feet and ended the year at 1,096.30 feet.

Tables A9 through A14 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A4 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2009.

In 2009:

- Steady flow experimental releases from Glen Canyon dam occurred during September-October 2008 (the end of the previous WY and the beginning of this WY).
- 24-Month Study projections in January, February, and March projected an April adjustment to equalization again in 2009.
- March was unusually dry and warm. March inflow was 107 kaf less than forecasted and the April-July inflow forecast for Lake Powell declined by approximately 600 kaf from March 1 to April 1.
 - As a result, the April 24-Month Study did not project equalization and Lake Powell's release was set to 8.23 maf in WY 2009.
 - This change in Lake Powell's operations had significant effects on Lake Mead's elevation during the remaining months in 2009. This affected Lake Mead NRA and the concessioners who were anticipating an increase, not a decrease, in water levels based on the previous months' projections.
 - This resulted in discussions and increased coordination among Reclamation, NPS, and the concessioners, which resulted in some adjustments in operations to keep Lake Mead near elevation 1,095 feet through the July 4th weekend.
 - This was accomplished by adjusting Lake Mohave and Lake Havasu's elevation targets and by CAWCD agreeing to decrease its diversion in June.
 - Since this time, Reclamation and NPS have conducted monthly coordination meetings with the concessioners, as well as annual meetings with LCB Region and Lake Mead NRA management and water planners.
- A Steady Flow Experiment was implemented during September and October 2009 at Lake Powell through the Glen Canyon Dam Adaptive Management Work Group, resulting in adjustments to the scheduled Lake Powell releases in August and September 2009.

Figure A4. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2008 – December 2009.

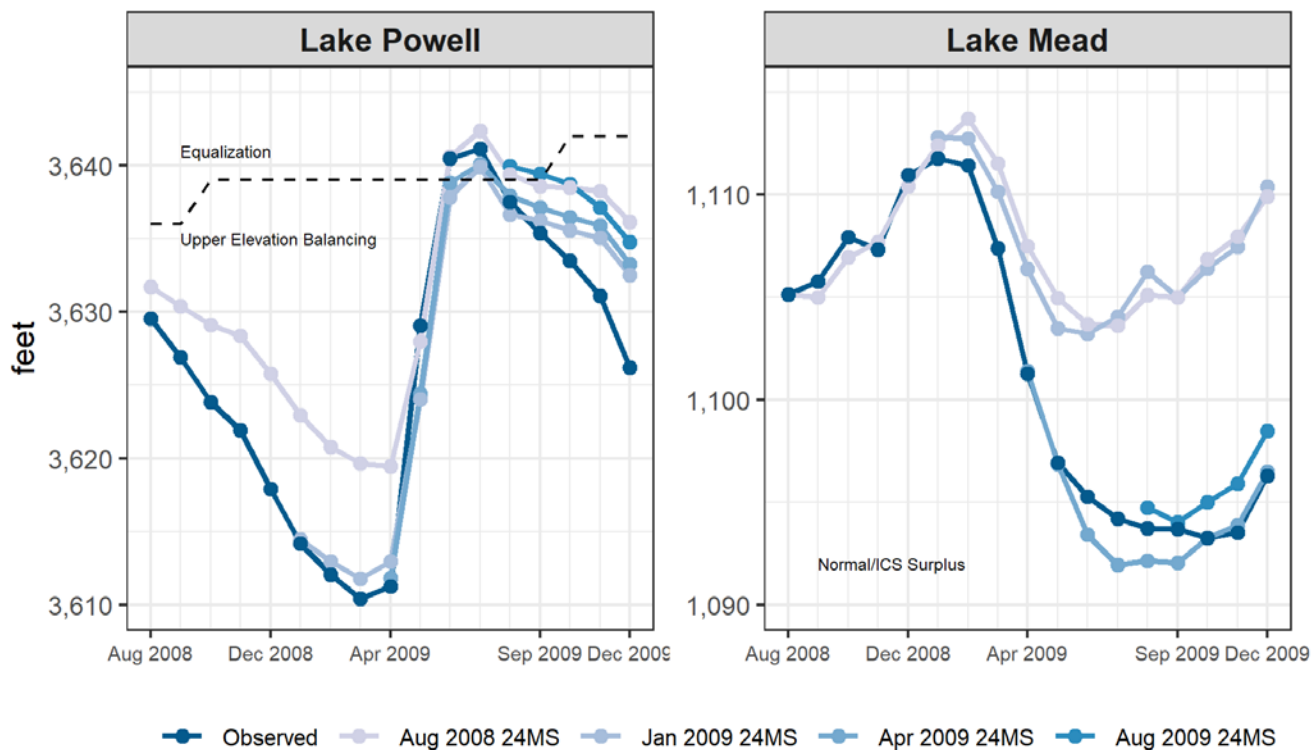


Table A8. Operational determination table for WY/CY 2009.

	Type of 24-Month Study Run	Aug 2008 ¹			Apr 2009 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2008 elevation (feet)	Tier Determination	3,625.75					
	Published Study	3,625.75	3,617.89	7.86			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2009 elevation (feet)	April Determination ⁴				3,637.13		
	Published Study				3,637.13	3,635.37	1.76
Lake Mead EOWY 2009 elevation (feet)	April Determination ⁴				1,092.04		
	Published Study				1,092.04	1,093.68	-1.64
Lake Powell Mid-Year Adjustment					No adjustment. Remain at 8.23 maf release.		
Lake Mead EOCY 2008 elevation (feet)		1,110.41	1,110.97	-0.56			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2008 24-Month Study projections of December 31, 2008 conditions set the operating tier for Lake Powell in WY 2009 and operating condition in the Lower Basin for CY 2009.

² April 2009 24-Month Study projections of September 30, 2009 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ Based on projections in the April 2009 24-Month Study with an 8.23 maf annual release from Lake Powell in WY 2009, no April adjustment occurred.

Table A9. January, April, and August 24-Month Study projections during WY 2009 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow ² (maf)	8.00	0.28	7.20	-0.52	NA	NA	7.72
April-July unregulated inflow (% avg)	112%		101%				108%
WY unregulated inflow ² (maf)	11.54	1.32	10.37	0.15	11.04	0.82	10.22
WY unregulated inflow (% avg)	105%		95%		100%		94%
Lake Powell WY release (maf)	9.33	1.09	8.23	-0.01	8.23	-0.01	8.24
Lake Powell EOWY elevation (feet)	3,636.21	0.84	3,637.13	1.76	3,639.43	4.06	3,635.37
Lake Mead EOWY elevation (feet)	1,105.00	11.32	1,092.04	-1.64	1,094.05	0.37	1,093.68

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The actual unregulated inflow to Lake Powell shown in this table may not match the value in published 24-Month Studies due to the change in the method for computing Lake Powell inflow (Section A.2.5).

Table A10. January, April, and August 24-Month Study projections during CY 2009 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	931	345	837	251	757	171	586
Gains Below Hoover ² (kaf)	-227	41	-337	-69	-289	-21	-268
Total Lower Basin and MX Use (af)	9,028,879	90,481	9,052,774	114,376	9,026,716	88,318	8,938,398
AZ Consumptive Use (af)	2,766,331	-65,380	2,766,331	-65,380	2,766,331	-65,380	2,831,711
CA Consumptive Use (af)	4,432,548	74,474	4,458,239	100,165	4,436,650	78,576	4,358,074
NV Consumptive Use (af)	330,000	81,387	328,204	79,591	323,735	75,122	248,613
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,632.53	6.31	3,633.25	7.03	3,634.76	8.54	3,626.22
Lake Mead EOCY elevation (feet)	1,110.38	14.08	1,096.50	0.20	1,098.47	2.17	1,096.30

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A11. January, April, and August 24-Month Study projections during CY 2009 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,766,331	-65,380	2,766,331	-65,380	2,766,331	-65,380	2,831,711
AZ Tribal Mainstream Consumptive Use ³ (af)							442,020
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	3,500	-162	3,500	-162	3,500	-162	3,662
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-11,659	0	-11,659	0	-11,659	11,659
Overrun Payback ⁶ (af)	169	0	169	0	169	0	169
Water Stored for NV (af)	0	-51,387	0	-51,387	0	-51,387	51,387
Water Recovered for CA (af)	30,000	2,496	30,000	2,496	30,000	2,496	27,504
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cdp-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A12. January, April, and August 24-Month Study projections during CY 2009 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,432,548	74,474	4,458,239	100,165	4,436,650	78,576	4,358,074
CA Tribal Mainstream Consumptive Use ³ (af)							34,053
Total ICS Delivery (af)	34,000	34,000	34,000	34,000	34,000	34,000	0
Total EC ICS Creation (af)	25,000	-42,836	0	-67,836	25,000	-42,836	67,836
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-2,132	0	-2,132	0	-2,132	2,132
Overrun Payback ⁶ (af)	6,530	2,779	5,839	2,088	5,100	1,349	3,751
Water Stored for NV (af)	0	0	0	0	0	0	0
Recovered Water Stored in AZ (af)	30,000	2,496	30,000	2,496	30,000	2,496	27,504
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A13. January, April, and August 24-Month Study projections during CY 2009 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	330,000	81,387	328,204	79,591	323,735	75,122	248,613
NV Tribal Mainstream Consumptive Use ³ (af)							3,252
Total ICS Delivery (af)	30,000	30,000	28,204	28,204	23,735	23,735	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	-51,387	0	-51,387	0	-51,387	51,387
Water Stored in CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁶ (af)	30,000	3,500	30,000	3,500	30,000	3,500	26,500
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A14. January, April, and August 24-Month Study projections during CY 2009 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2009		Apr 2009		Aug 2009		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ² (af)	-	-	-	-	-	-	-
Total MWR Creation ² (af)	-	-	-	-	-	-	-
Other MWR ³ (af)	-	-	-	-	-	-	-
Other Flows to Mexico ⁴ (af)	138,276	-41,418	143,881	-35,813	157,897	-21,797	179,694

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.3 2010

Based on the projections of the August 2009 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2010, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A15). The April 2010 24-Month Study projections resulted in no April adjustment for WY 2010 (Table A15) resulting in a total WY release of 8.23 maf from Lake Powell (Table A16). In the Lower Basin, a total of 7,378,643 af was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. Lake Powell started WY 2010 at 3,635.37 feet and ended WY 2010 at 3,633.66 feet, with a total of 8.43 maf (78 percent average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2010 at 1,096.30 feet and ended the year at 1,086.30 feet.

Tables A16 through A21 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A5 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2010.

In 2010:

- Steady flow experimental releases from Glen Canyon dam occurred during September-October 2009 (the end of the previous WY and the beginning of this WY).
- On April 4, 2010 there was a 7.2 magnitude earthquake in the Mexicali Valley, Baja California. This earthquake caused severe damage to water conveyance infrastructure in southern California and northern Baja California.
- In place through 2012, IBWC Minute No. 318 was signed on December 17, 2010 allowing Mexico to defer delivery and store water in U.S. reservoirs that could not be delivered because of the damage to water conveyance infrastructure in Mexico. The first year of deferred delivery pursuant to Minute 318 occurred in CY 2011.
- A Steady Flow Experiment was implemented at Lake Powell through the Glen Canyon Dam Adaptive Management Work Group resulting in adjustments to the scheduled Powell releases in August and September 2010.
- The Yuma Desalting Plant (YDP) pilot run began in May 2010 and ran through March 2011.
- In October 2010, construction on Warren H. Brock Reservoir finished, and operational testing began the same year.

Figure A5. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2009 – December 2010.

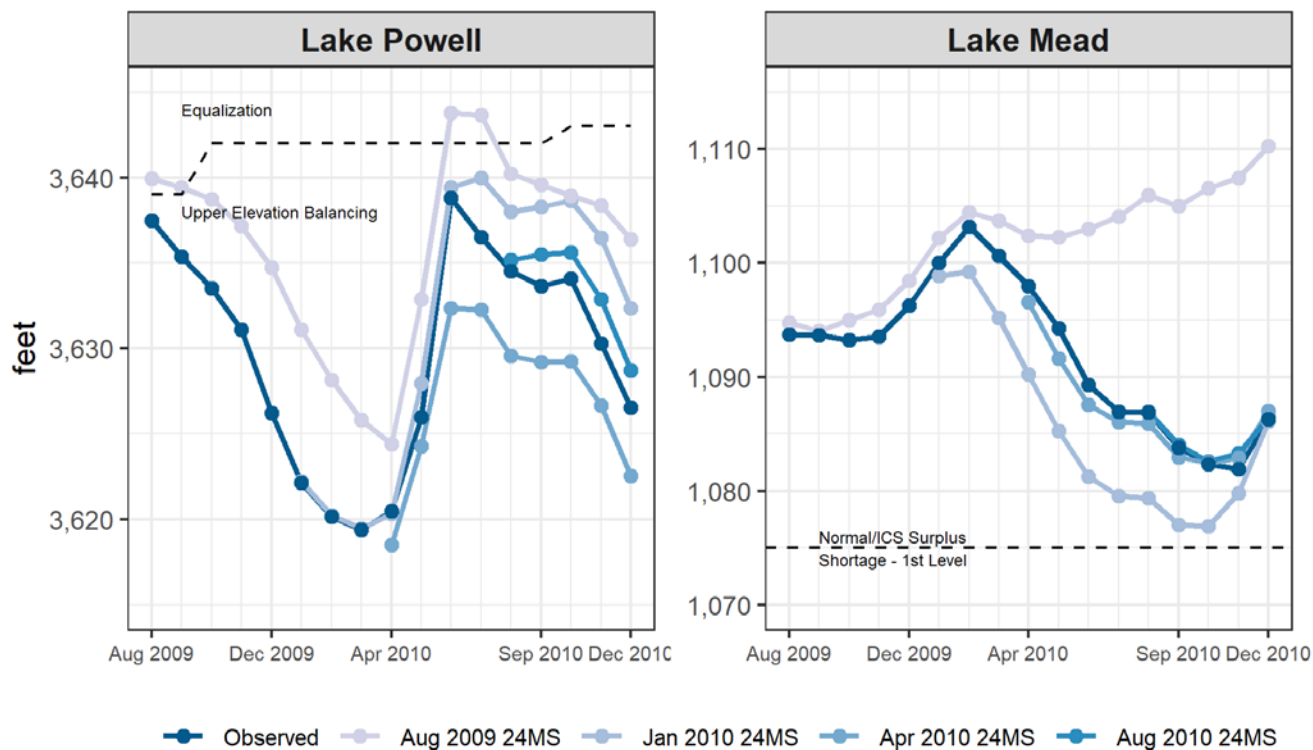


Table A15. Operational determination table for WY/CY 2010.

	Type of 24-Month Study Run	Aug 2009 ¹			Apr 2010 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2009 elevation (feet)	Tier Determination	3,634.76					
	Published Study	3,634.76	3,626.22	8.54			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2010 elevation (feet)	April Determination ⁴				3,629.20		
	Published Study				3,629.20	3,633.66	-4.46
Lake Mead EOWY 2010 elevation (feet)	April Determination ⁴				1,082.96		
	Published Study				1,082.96	1,083.81	-0.85
Lake Powell Mid-Year Adjustment					No adjustment. Remain at 8.23 maf release.		
Lake Mead EOCY 2009 elevation (feet)		1,098.47	1,096.30	2.17			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2009 24-Month Study projections of December 31, 2009 conditions set the operating tier for Lake Powell in WY 2010 and operating condition in the Lower Basin for CY 2010.

² April 2010 24-Month Study projections of September 30, 2010 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ Based on projections in the April 2010 24-Month Study with an 8.23 maf annual release from Lake Powell in WY 2010, no April adjustment occurred.

Table A16. January, April, and August 24-Month Study projections during WY 2010 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow ² (maf)	6.20	0.55	5.00	-0.65	NA	NA	5.65
April-July unregulated inflow (% avg)	87%		70%				79%
WY unregulated inflow ² (maf)	9.32	0.89	7.97	-0.46	8.99	0.56	8.43
WY unregulated inflow (% avg)	84%		72%		80%		78%
Lake Powell WY release (maf)	8.23	0.00	8.23	0.00	8.23	0.00	8.23
Lake Powell EOWY elevation (feet)	3,638.31	4.65	3,629.20	-4.46	3,635.52	1.86	3,633.66
Lake Mead EOWY elevation (feet)	1,077.02	-6.79	1,082.96	-0.85	1,084.07	0.26	1,083.81

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The actual unregulated inflow to Lake Powell shown in this table may not match the value in published 24-Month Studies due to the change in the method for computing Lake Powell inflow (Section A.2.5).

Table A17. January, April, and August 24-Month Study projections during CY 2010 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	988	-161	898	-251	950	-199	1,149
Gains Below Hoover ² (kaf)	-104	87	-130	61	-185	6	-191
Total Lower Basin and MX Use (af)	9,155,518	276,875	8,871,376	-7,267	8,922,092	43,449	8,878,643
AZ Consumptive Use (af)	2,790,668	10,301	2,818,172	37,805	2,817,533	37,166	2,780,367
CA Consumptive Use (af)	4,501,215	144,376	4,313,204	-43,635	4,364,559	7,720	4,356,839
NV Consumptive Use (af)	363,635	122,198	240,000	-1,437	240,000	-1,437	241,437
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,632.37	5.83	3,622.55	-3.99	3,628.73	2.19	3,626.54
Lake Mead EOCY elevation (feet)	1,086.12	-0.18	1,086.99	0.69	1,086.38	0.08	1,086.30

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A18. January, April, and August 24-Month Study projections during CY 2010 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,790,668	10,301	2,818,172	37,805	2,817,533	37,166	2,780,367
AZ Tribal Mainstream Consumptive Use ³ (af)							416,158
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	3,500	-205	3,500	-205	3,705	0	3,705
Other Water Left in Lake Mead ⁵ (af)	0	-7,432	0	-7,432	0	-7,432	7,432
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	169	-168	169	-168	603	266	337
Water Stored for NV (af)	0	0	30,000	30,000	30,000	30,000	0
Water Recovered for CA (af)	5,663	-2,496	8,159	0	8,159	0	8,159
Other ICS Creation ⁷ (af)	0	-2,094	0	-2,094	0	-2,094	2,094

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A19. January, April, and August 24-Month Study projections during CY 2010 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,501,215	144,376	4,313,204	-43,635	4,364,559	7,720	4,356,839
CA Tribal Mainstream Consumptive Use ³ (af)							29,990
Total ICS Delivery (af)	119,233	114,042	0	-5,191	0	-5,191	5,191
Total EC ICS Creation (af)	25,000	-75,864	123,494	22,630	69,530	-31,334	100,864
System Conservation Water (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-46,567	0	-46,567	0	-46,567	46,567
Overrun Payback ⁶ (af)	1,461	-753	1,461	-753	4,070	1,856	2,214
Water Stored for NV (af)	0	0	30,000	30,000	30,000	30,000	0
Recovered Water Stored in AZ (af)	8,163	4	8,159	0	8,159	0	8,159
Other ICS Creation ⁷ (af)	0	-16,750	0	-16,750	0	-16,750	16,750

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A20. January, April, and August 24-Month Study projections during CY 2010 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	363,635	122,198	240,000	-1,437	240,000	-1,437	241,437
NV Tribal Mainstream Consumptive Use ³ (af)							2,834
Total ICS Delivery (af)	63,635	63,635	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	-58,563	0	-58,563	0	-58,563	58,563
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	30,000	30,000	30,000	30,000	0
Water Stored in CA (af)	0	0	30,000	30,000	30,000	30,000	0
Other ICS Creation ⁶ (af)	0	-33,005	30,000	-3,005	30,000	-3,005	33,005
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A21. January, April, and August 24-Month Study projections during CY 2010 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2010		Apr 2010		Aug 2010		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ¹ (af)	-	-	-	-	-	-	-
Total MWR Creation ¹ (af)	-	-	-	-	-	-	-
Other MWR ² (af)	-	-	-	-	-	-	-
Other Flows to Mexico ³ (af)	137,442	-151,346	192,252	-96,536	212,408	-76,380	288,788

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.4 2011

Based on the projections of the August 2010 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2011, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A22). The April 2011 24-Month Study projections resulted in Lake Powell operations shifting to Equalization for WY 2011 (Table A22) resulting in a total WY release of 12.52 maf from Lake Powell (Table A23). In the Lower Basin, a total of 7,316,616 af was delivered to the Lower Division states, and 1,449,664 af was delivered to Mexico. Lake Powell started WY 2011 at 3,633.66 feet and ended WY 2011 at 3,653.01 feet, with a total of 15.97 maf (147 percent average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2011 at 1,086.30 feet and ended the year at 1,132.83 feet.

Tables A23 through A28 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A6 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2011.

In 2011:

- Steady flow experimental releases from Glen Canyon dam occurred during September-October 2010 (the end of the previous WY and the beginning of this WY).
- Lake Powell operations in WY 2011 were based on the Upper Elevation Balancing Tier and by January, forecasts indicated that it was likely that an April adjustment to the Equalization Tier would occur. Because of the high likelihood of an April adjustment to equalization, additional releases above the standard MLFF¹³ pattern were scheduled as early as January 2011.
 - Based on the April 2011 24-Month Study, Lake Powell operation had an April adjustment to equalization and operation switched to the Equalization Tier for the remainder of the WY. The initial governing driver of equalization releases was releasing water until Lake Mead reached an elevation of 1,105 feet by September 30, 2011.
 - Beginning in May, forecasts of inflow to Lake Powell increased significantly causing the governing driver of operations to change. At this time, the new governing driver of Equalization releases was releasing to achieve the Lake Powell equalization elevation of 3,643 feet (16.36 maf in storage) on September 30, 2011. The forecast had increased so much by May that Reclamation no longer projected that required equalization releases could be achieved by the end of the EOWY (September 30, 2011).
 - Consistent with Section II. 4. of the Long-Range Operating Criteria, Reclamation released the remainder of the water through the Glen Canyon Powerplant as soon as practicable to equalize the active storage in Lake Powell and Lake Mead.
- At the end of WY 2011, Lake Powell elevation was 3,653.01 ft with a corresponding storage of 17.593 maf. The water year release was 12.52 maf.
 - This left an equalization release of 1.23 maf to be carried over into WY 2012 based on the governing driver of equalizing to Lake Powell's WY 2011 equalization elevation of 3,643 feet.
 - All carry-over WY 2011 equalization releases were completed by the end of December 2011.
- Later analysis by the USGS Grand Canyon Monitoring and Research Center indicated that the high equalization releases scoured foundational sediment in the Grand Canyon, which provided additional concerns about how to implement equalization releases in future years.

¹³ In 2011, intra-annual operations at Lake Powell were based on the 1996 ROD for Operations of Glen Canyon Dam. This ROD implemented Modified Low Fluctuating Flows (MLFF) to guide monthly and daily releases.

- The YDP pilot run concluded in March 2011.
- A Steady Flow Experiment was implemented at Lake Powell through the Glen Canyon Dam Adaptive Management Work Group resulting in adjustments to the scheduled Lake Powell releases in August and September 2011.

Figure A6. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2010 – December 2011.

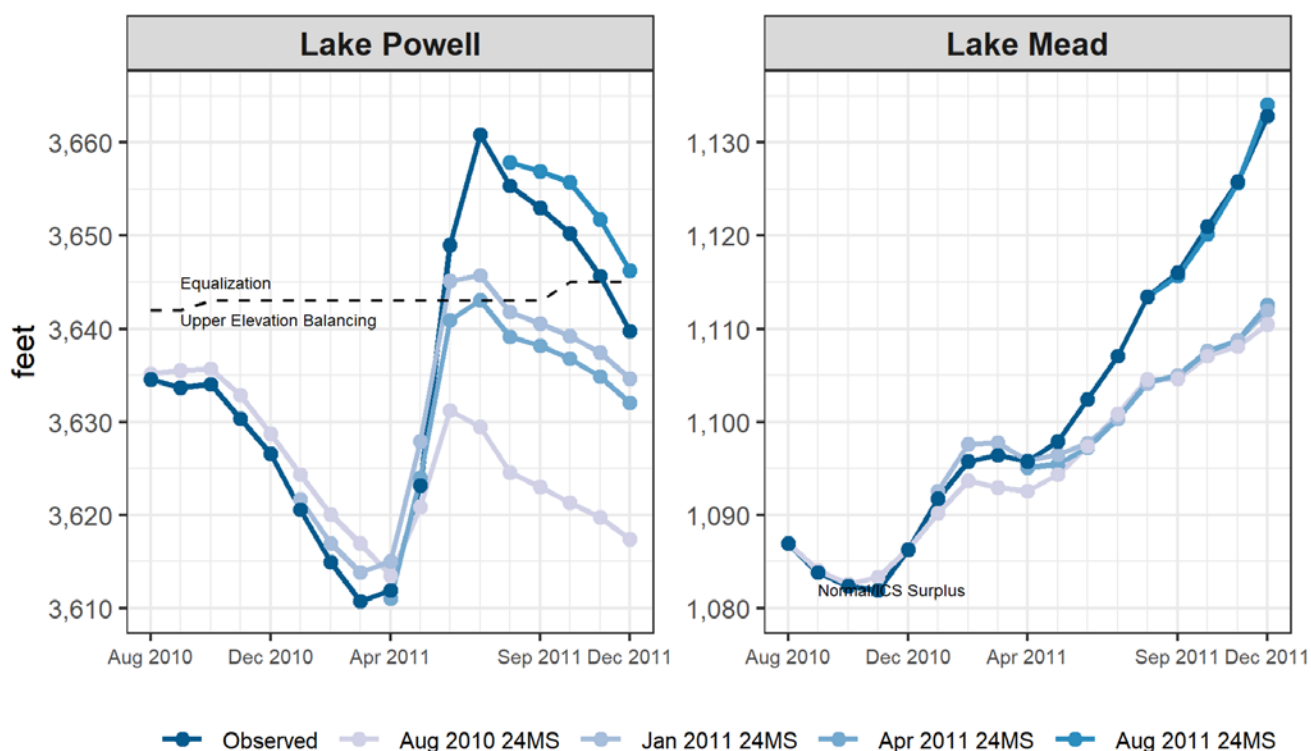


Table A22. Operational determination table for WY/CY 2011.

	Type of 24-Month Study Run	Aug 2010 ¹			Apr 2011 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2010 elevation (feet)	Tier Determination	3,628.73					
	Published Study	3,628.73	3,626.54	2.19			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2011 elevation (feet)	April Determination ⁴				3,662.63		
	Published Study				3,638.16	3,653.01	-14.85
Lake Mead EOWY 2011 elevation (feet)	April Determination ⁴				1,068.39		
	Published Study				1,105.00	1,116.04	-11.04
Lake Powell Mid-Year Adjustment					Equalization		
Lake Mead EOCY 2010 elevation (feet)		1,086.38	1,086.30	0.08			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2010 24-Month Study projections of December 31, 2010 conditions set the operating tier for Lake Powell in WY 2011 and operating condition in the Lower Basin for CY 2011.

² April 2011 24-Month Study projections of September 30, 2011 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2011.

Table A23. January, April, and August 24-Month Study projections during WY 2011 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow ² (maf)	9.50	-3.05	9.50	-3.05	NA	NA	12.55
April-July unregulated inflow (% avg)	133%		133%				175%
WY unregulated inflow ² (maf)	13.19	-2.78	13.11	-2.86	17.08	1.11	15.97
WY unregulated inflow (% avg)	122%		119%		153%		147%
Lake Powell WY release (maf)	11.36	-1.16	11.56	-0.96	12.45	-0.07	12.52
Lake Powell EOWY elevation (feet)	3,640.52	-12.49	3,638.16	-14.85	3,656.91	3.90	3,653.01
Lake Mead EOWY elevation (feet)	1,105.00	-11.04	1,105.00	-11.04	1,115.64	-0.40	1,116.04

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The actual unregulated inflow to Lake Powell shown in this table may not match the value in published 24-Month Studies due to the change in the method for computing Lake Powell inflow (Section A.2.5).

Table A24. January, April, and August 24-Month Study projections during CY 2011 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	946	-58	803	-201	1,012	8	1,004
Gains Below Hoover ² (kaf)	-140	85	-265	-40	-272	-47	-225
Total Lower Basin and MX Use (af)	9,062,128	295,848	8,862,502	96,222	8,765,270	-1,010	8,766,280
AZ Consumptive Use (af)	2,788,341	7,233	2,788,341	7,233	2,788,341	7,233	2,781,108
CA Consumptive Use (af)	4,473,787	161,126	4,334,161	21,500	4,236,929	-75,732	4,312,661
NV Consumptive Use (af)	300,000	77,153	240,000	17,153	240,000	17,153	222,847
MX Delivery (af)	1,500,000	50,336	1,500,000	50,336	1,500,000	50,336	1,449,664
Lake Powell EOCY elevation (feet)	3,634.64	-5.11	3,632.01	-7.74	3,646.26	6.51	3,639.75
Lake Mead EOCY elevation (feet)	1,112.00	-20.83	1,112.52	-20.31	1,134.12	1.29	1,132.83

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A25. January, April, and August 24-Month Study projections during CY 2011 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,788,341	7,233	2,788,341	7,233	2,788,341	7,233	2,781,108
AZ Tribal Mainstream Consumptive Use ³ (af)							389,447
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	-7,233	0	-7,233	0	-7,233	7,233
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	11,659	0	11,659	0	11,659	0	11,659
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	-956	0	-956	0	-956	956

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cwp-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A26. January, April, and August 24-Month Study projections during CY 2011 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,473,787	161,126	4,334,161	21,500	4,236,929	-75,732	4,312,661
CA Tribal Mainstream Consumptive Use ³ (af)							34,343
Total ICS Delivery (af)	100,000	100,000	0	0	0	0	0
Total EC ICS Creation (af)	25,000	-160,704	124,626	-61,078	161,858	-23,846	185,704
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-99,467	0	-99,467	0	-99,467	99,467
Overrun Payback ⁶ (af)	1,213	111	1,213	111	1,213	111	1,102
Water Stored for NV (af)	0	0	60,000	60,000	0	0	0
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	-7,647	0	-7,647	0	-7,647	7,647

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A27. January, April, and August 24-Month Study projections during CY 2011 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	300,000	77,153	240,000	17,153	240,000	17,153	222,847
NV Tribal Mainstream Consumptive Use ³ (af)							3,175
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	-77,153	0	-77,153	60,000	-17,153	77,153
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	0	0	60,000	60,000	0	0	0
Other ICS Creation ⁶ (af)	44,000	9,256	43,000	8,256	43,000	8,256	34,744
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A28. January, April, and August 24-Month Study projections during CY 2011 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2011		Apr 2011		Aug 2011		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	50,336	1,500,000	50,336	1,500,000	50,336	1,449,664
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	50,336	0	50,336	0	50,336	-50,336
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	123,442	-85,135	155,683	-52,894	177,736	-30,842	208,577

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.5 2012

Based on the projections of the August 2011 24-Month Study, Lake Powell operated in the Equalization tier in WY 2012, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A29). The total WY 2012 release from Lake Powell was 9.47¹⁴ maf (Table A30). In the Lower Basin, a total of 7,443,546 af was delivered to the Lower Division states, and 1,367,023 af was delivered to Mexico. Lake Powell started WY 2012 at 3,653.01 feet and ended WY 2012 at 3,621.56 feet, with a total of 4.91 maf (45 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2012 at 1,132.83 feet and ended the year at 1,120.36 feet.

Tables A30 through A35 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A7 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2012.

In 2012:

- Steady flow releases from Glen Canyon dam occurred during September-October 2010 (the end of the previous WY and the beginning of this WY).
- WY 2012 began the year in Equalization with an anticipated release of 13.57 maf. The hydrologic conditions in 2012 deteriorated and the WY total unregulated inflow was 4.91 maf (45 percent of average). This decreased the Equalization release to a total of 9.47 maf; 1.23 maf was WY 2011 equalization water carried over to WY 2012 bringing the WY 2012 release to 8.23 maf; a WY 2012 equalization volume of 0 af.
- Lake Powell's actual end of CY 2011 elevation was below the equalization level.
 - This was due to a combination of slightly drier than forecasted conditions during August-December 2011 and because the "3-gage" method for forecasting Powell's inflow was biased high. The "mass balance" method for forecasting Powell's inflow was in development during this time and was implemented in January 2012 (Section A.2.5).
- Warren H. Brock Reservoir became fully operational.
- Minute No. 319 of the IBWC was signed on November 20, 2012.
- A Steady Flow Experiment was implemented at Lake Powell through the Glen Canyon Dam Adaptive Management Work Group resulting in adjustments to the scheduled Powell releases in August and September 2012. This was the last year of the Steady Flow Experiment.

¹⁴ Although Lake Powell operated in the Equalization Tier in 2012, 8.23 maf was released in WY 2012 due to dry conditions; the additional 1.23 maf was WY 2011 equalization water carried over to WY 2012.

Figure A7. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2011 – December 2012.

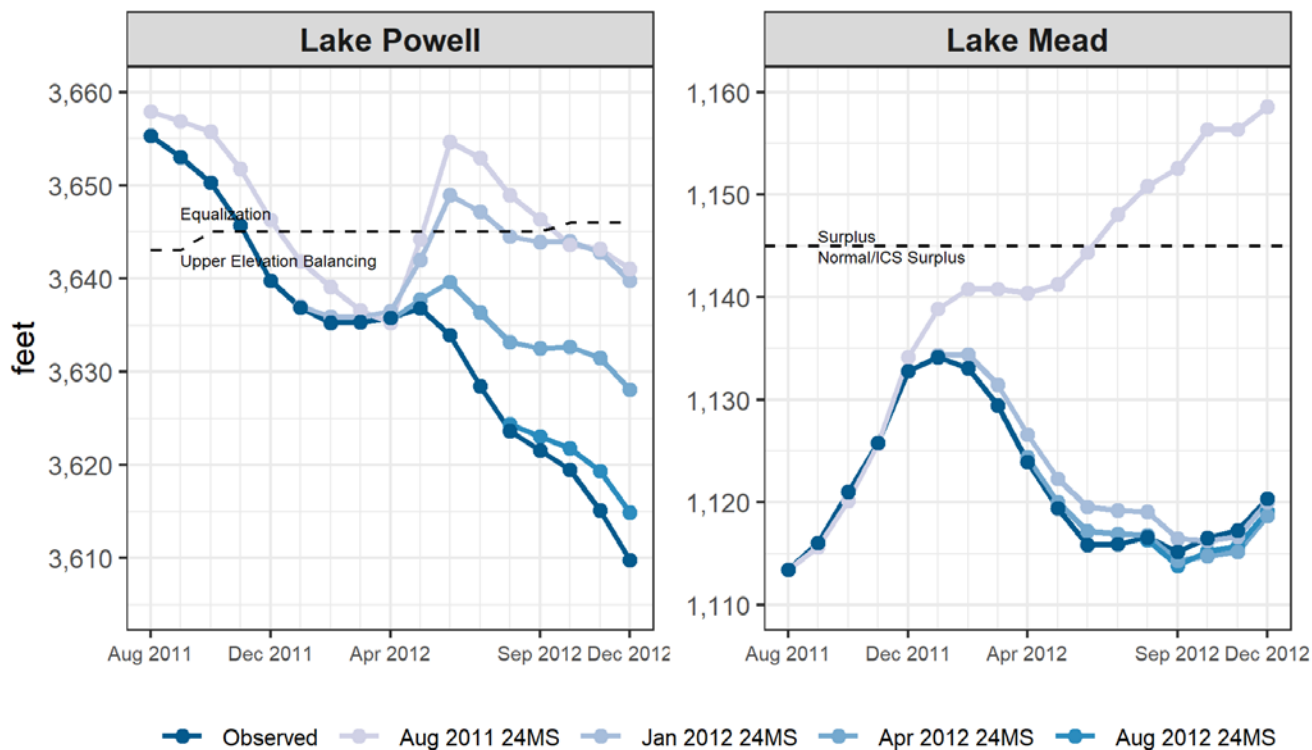


Table A29. Operational determination table for WY/CY 2012.

	Type of 24-Month Study Run	Aug 2011 ¹			Apr 2012		
		Projected	Actual	Difference ²	Projected	Actual	Difference ²
Lake Powell EOCY 2011 elevation (feet)	Tier Determination	3,646.26					
	Published Study	3,646.26	3,639.75	6.51			
Lake Powell Operating Tier		Equalization					
Lake Powell EOWY 2012 elevation (feet)	April Determination ³						
	Published Study				3,632.55	3,621.56	10.99
Lake Mead EOWY 2012 elevation (feet)	April Determination ³						
	Published Study				1,114.30	1,115.16	-0.86
Lake Powell Mid-Year Adjustment					N/A		
Lake Mead EOCY 2011 elevation (feet)		1,134.12	1,132.83	1.29			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2011 24-Month Study projections of December 31, 2011 conditions set the operating tier for Lake Powell in WY 2012 and operating condition in the Lower Basin for CY 2012.

² Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

³ There is no option for an April adjustment in the Equalization tier.

Table A30. January, April, and August 24-Month Study projections during WY 2012 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	5.05	2.99	3.50	1.44	NA	NA	2.06
April-July unregulated inflow (% avg)	71%		49%				29%
WY unregulated inflow (maf)	8.55	3.64	6.79	1.88	5.15	0.24	4.91
WY unregulated inflow (% avg)	79%		63%		48%		45%
Lake Powell WY release ² (maf)	9.46	-0.01	9.46	-0.01	9.46	-0.01	9.47
Lake Powell EOWY elevation (feet)	3,643.92	22.36	3,632.55	10.99	3,623.08	1.52	3,621.56
Lake Mead EOWY elevation (feet)	1,116.43	1.27	1,114.30	-0.86	1,113.80	-1.36	1,115.16

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Although Lake Powell operated in the Equalization Tier in 2012, 8.23 maf was released in WY 2012 due to dry conditions; the additional 1.24 maf was WY 2011 equalization water carried over to WY 2012.

Table A31. January, April, and August 24-Month Study projections during CY 2012 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	815	105	750	40	662	-48	710
Gains Below Hoover ² (kaf)	-239	14	-314	-61	-261	-8	-253
Total Lower Basin and MX Use (af)	8,900,743	90,174	8,882,917	72,348	8,827,604	17,035	8,810,569
AZ Consumptive Use (af)	2,800,000	10,333	2,800,000	10,333	2,800,000	10,333	2,789,667
CA Consumptive Use (af)	4,350,743	-65,975	4,332,917	-83,801	4,409,834	-6,884	4,416,718
NV Consumptive Use (af)	250,000	12,839	250,000	12,839	250,000	12,839	237,161
MX Delivery (af)	1,500,000	132,977	1,500,000	132,977	1,367,770	747	1,367,023
Lake Powell EOCY elevation (feet)	3,639.75	29.92	3,628.08	18.26	3,614.89	5.07	3,609.82
Lake Mead EOCY elevation (feet)	1,120.00	-0.36	1,118.66	-1.70	1,119.14	-1.22	1,120.36

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A32. January, April, and August 24-Month Study projections during CY 2012 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,800,000	10,333	2,800,000	10,333	2,800,000	10,333	2,789,667
AZ Tribal Mainstream Consumptive Use ³ (af)							368,343
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	-10,507	0	-10,507	0	-10,507	10,507
Overrun (af)	0	-174	0	-174	0	-174	174
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cwp-az.com/departments/water-operations/deliveries>.

⁴ Positive values indicate ICS deliveries while negative values indicate ICS creation.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Positive values indicate storage; negative values indicate recovery of previously stored water.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A33. January, April, and August 24-Month Study projections during CY 2012 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,350,743	-65,975	4,332,917	-83,801	4,409,834	-6,884	4,416,718
CA Tribal Mainstream Consumptive Use ³ (af)							34,757
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	49,257	-130,420	131,666	-48,011	145,466	-34,211	179,677
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	-134,076	64,583	-69,493	155,300	21,224	134,076
Overrun Payback ⁶ (af)	0	-448	0	-448	0	-448	448
Water Stored for NV (af)	0	-62,839	0	-62,839	0	-62,839	62,839
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A34. January, April, and August 24-Month Study projections during CY 2012 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	250,000	12,839	250,000	12,839	250,000	12,839	237,161
NV Tribal Mainstream Consumptive Use ³ (af)							3,128
Total ICS Delivery (af)	0	-1,000	0	-1,000	0	-1,000	1,000
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	50,000	49,000	50,000	49,000	50,000	49,000	1,000
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	0	-62,839	0	-62,839	0	-62,839	62,839
Other ICS Creation ⁶ (af)	44,000	8,640	44,000	8,640	44,000	8,640	35,360
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A35. January, April, and August 24-Month Study projections during CY 2012 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2012		Apr 2012		Aug 2012		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	132,977	1,500,000	132,977	1,367,770	747	1,367,023
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	-132,977	0	-132,977	132,230	-747	132,977
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	137,442	-83,609	133,428	-87,623	153,141	-67,910	221,051

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.6 2013

Based on the projections of the August 2012 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2013, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A36). The April 2013 24-Month Study projections resulted in no mid-year adjustment for WY 2013 (Table A36) resulting in a total WY release of 8.23 maf from Lake Powell (Table A37). In the Lower Basin, a total of 7,478,219 af was delivered to the Lower Division states, and 1,373,818 af was delivered to Mexico. Lake Powell started WY 2013 at 3,621.56 feet and ended WY 2013 at 3,591.25 feet, with a total of 5.12 maf (47 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2013 at 1,120.36 feet and ended the year at 1,106.73 feet.

Tables A37 through A42 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A8 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2013.

In 2013:

- During November 2012 an HFE was conducted at Glen Canyon Dam with a peak release of 43,000 cfs and peak duration of 240 hours, including a powerplant capacity peak release of 28,000 cfs. The total duration for the HFE was 3 days and 19 hours and total bypass was 77,755 af.
- Total unregulated inflow during WY 2013 was 5.12 maf (47 percent of average). The two-year period of 2012 and 2013 was one of the driest consecutive two years on record, with only 2001-2002 and 2002-2003 drier. From the start of WY 2012 to the end of WY 2013 Lake Powell storage decreased by 6.66 maf (62 feet) over 27 percent of its total live capacity of 24.32 maf.
- While Lake Powell released 8.23 maf in WY 2013, the back-to-back dry years greatly reduced Lake Powell's storage by the end of WY 2013 and set up the conditions for Lake Powell's 7.48 maf release in WY 2014.

Figure A8. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2012 – December 2013.

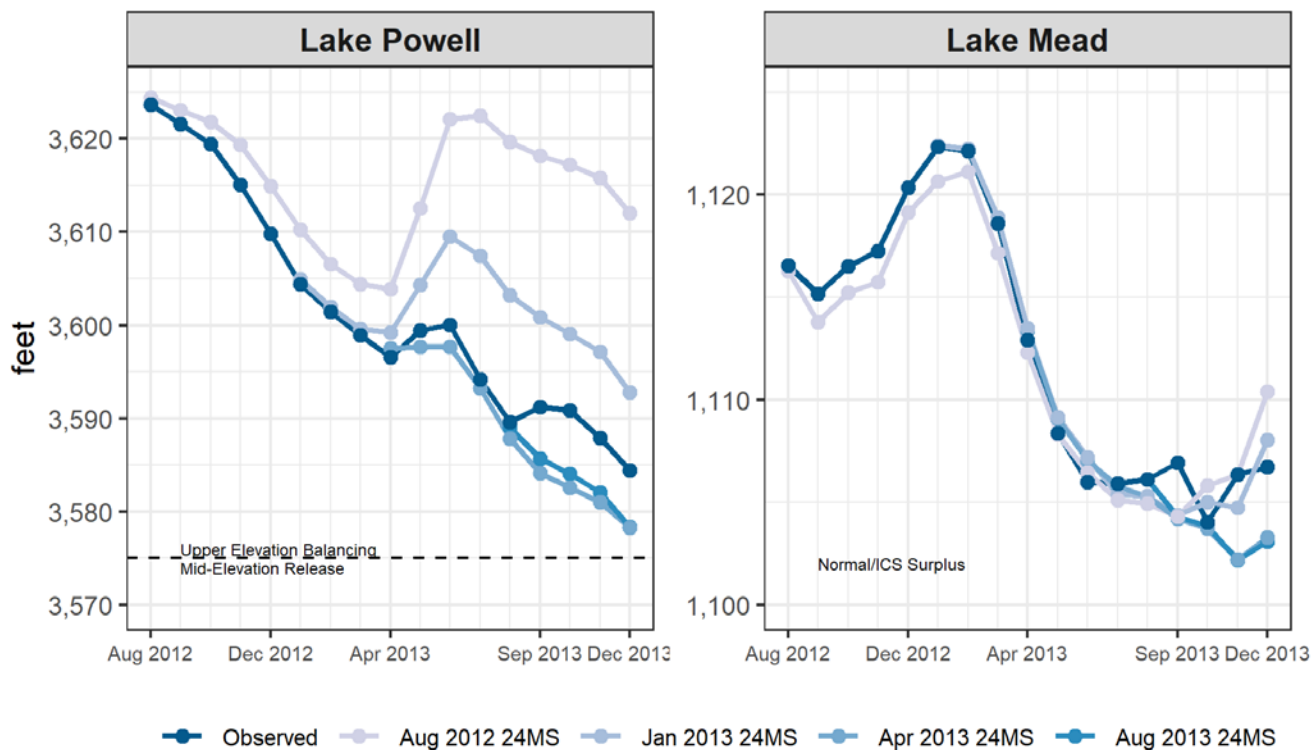


Table A36. Operational determination table for WY/CY 2013.

	Type of 24-Month Study Run	Aug 2012 ¹			Apr 2013 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2012 elevation (feet)	Tier Determination	3,614.89					
	Published Study	3,614.89	3,609.82	5.07			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2013 elevation (feet)	April Determination ⁴				3,584.13		
	Published Study				3,584.13	3,591.25	-7.12
Lake Mead EOWY 2013 elevation (feet)	April Determination ⁴				1,104.18		
	Published Study				1,104.18	1,106.92	-2.74
Lake Powell Mid-Year Adjustment					No adjustment. Remain at 8.23 maf release.		
Lake Mead EOCY 2012 elevation (feet)		1,119.14	1120.36	-1.22			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2012 24-Month Study projections of December 31, 2012 conditions set the operating tier for Lake Powell in WY 2013 and operating condition in the Lower Basin for CY 2013.

² April 2013 24-Month Study projections of September 30, 2013 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ Based on projections in the April 2013 24-Month Study with an 8.23 maf annual release from Lake Powell in WY 2013, no April adjustment occurred.

Table A37. January, April, and August 24-Month Study projections during WY 2013 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	4.40	1.84	2.70	0.14	NA	NA	2.56
April-July unregulated inflow (% avg)	61%		38%				36%
WY unregulated inflow (maf)	6.58	1.46	4.53	-0.59	4.33	-0.79	5.12
WY unregulated inflow (% avg)	61%		42%		40%		47%
Lake Powell WY release (maf)	8.23	0.00	8.23	0.00	8.23	0.00	8.23
Lake Powell EOWY elevation (feet)	3,600.84	9.59	3,584.13	-7.12	3,585.70	-5.55	3,591.25
Lake Mead EOWY elevation (feet)	1,104.36	-2.56	1,104.18	-2.74	1,104.29	-2.63	1,106.92

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A38. January, April, and August 24-Month Study projections during CY 2013 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	861	20	809	-32	761	-80	841
Gains Below Hoover ² (kaf)	-233	-6	-229	-2	-218	-9	-228
Total Lower Basin and MX Use (af)	8,976,221	124,184	8,983,479	131,442	8,988,981	136,944	8,852,037
AZ Consumptive Use (af)	2,799,621	20,754	2,799,621	20,754	2,799,621	20,754	2,778,867
CA Consumptive Use (af)	4,431,600	-44,189	4,449,573	-26,216	4,542,348	66,559	4,475,789
NV Consumptive Use (af)	245,000	21,437	245,000	21,437	245,000	21,437	223,563
MX Delivery (af)	1,500,000	126,182	1,489,285	115,467	1,402,012	28,194	1,373,818
Lake Powell EOCY elevation (feet)	3,592.82	8.39	3,578.29	-6.14	3,578.32	-6.11	3,584.43
Lake Mead EOCY elevation (feet)	1,108.04	1.31	1,103.29	-3.44	1,103.08	-3.65	1,106.73

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A39. January, April, and August 24-Month Study projections during CY 2013 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,799,621	20,754	2,799,621	20,754	2,799,621	20,754	2,778,867
AZ Tribal Mainstream Consumptive Use ³ (af)							359,810
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	-20,674	0	-20,674	0	-20,674	20,674
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	379	-79	379	-79	379	-79	458
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A40. January, April, and August 24-Month Study projections during CY 2013 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,431,600	-44,189	4,449,573	-26,216	4,542,348	66,559	4,475,789
CA Tribal Mainstream Consumptive Use ³ (af)							36,071
Total ICS Delivery (af)	63,685	-30,172	68,010	-25,847	157,582	63,725	93,857
Total EC ICS Creation (af)	25,000	25,000	25,000	25,000	25,000	25,000	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	13,646	13,646	10,559	10,559	0
Overrun Payback ⁶ (af)	62,085	-31,055	62,083	-31,057	55,793	-37,347	93,140
Water Stored for NV (af)	55,000	-20,000	55,000	-20,000	55,000	-20,000	75,000
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A41. January, April, and August 24-Month Study projections during CY 2013 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	245,000	21,437	245,000	21,437	245,000	21,437	223,563
NV Tribal Mainstream Consumptive Use ³ (af)							3,425
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	-1,437	0	-1,437	0	-1,437	1,437
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	55,000	-20,000	55,000	-20,000	55,000	-20,000	75,000
Other ICS Creation ⁶ (af)	46,000	12,800	46,000	12,800	30,000	-3,200	33,200
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A42. January, April, and August 24-Month Study projections during CY 2013 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2013		Apr 2013		Aug 2013		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	126,182	1,489,285	115,467	1,402,012	28,194	1,373,818
Net MWR Delivery ² (af)	0	0	0	0	0	0	0
Net MWR Creation ² (af)	0	-126,812	10,715	-116,097	97,988	-28,824	126,812
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	137,442	-45,451	164,919	-17,974	164,769	-18,123	182,893

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.7 2014

Based on the projections of the August 2013 24-Month Study, Lake Powell operated in the Mid-Elevation Release tier in WY 2014, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A43). The total WY 2014 release from Lake Powell was 7.48 maf (Table A44). In the Lower Basin, a total of 7,649,011 af was delivered to the Lower Division states, and 1,549,059 af was delivered to Mexico. Lake Powell started WY 2014 at 3,591.25 feet and ended WY 2014 at 3,605.53 feet, with a total of 10.38 maf of unregulated inflow (96 percent of average) to Lake Powell during the WY. Lake Mead began CY 2014 at 1,106.73 feet and ended the year at 1,087.79 feet.

Tables A44 through A49 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A9 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2014.

In 2014:

- While the August 2013 24-Month Study project Lake Powell to be below 3,575 feet (with an 8.23 maf release pattern for October-December 2013) at the end of CY 2013, it was estimated that the actual end of year elevation would have been slightly above 3,575 feet with an 8.23 maf release pattern. This was due to an unusually wet September and October 2013 in the Upper Basin.
- During November 2013 an HFE was conducted at Glen Canyon Dam with a peak release of 37,000 cfs and peak duration of 96 hours, with a powerplant capacity peak release of 20,000 cfs. The total duration for the HFE was 5 days and 5 hours and total bypass was 143,930 af.
- In 2014, pursuant to Minute 319, there was an environmental pulse flow with water generated from Mexico's deferred delivery and stored in U.S. Lower Basin reservoirs, resulting in the delivery of 105,068 af of environmental flows to the Colorado River riparian corridor in Mexico. The peak of the pulse flow took place during late March and early April and the descending limb of the hydrograph extended into mid-May.
 - Releases for the pulse flow were partially offset by deferred delivery by Mexico later in the year (56,009 af).
- Operational challenges for meeting the delivery plan at the peak of the pulse flow included the following:
 - Do not exceed the maximum daily and monthly flows as set in the 1944 Water Treaty.
 - Do not exceed the maximum flow that can be released through the four hydropower turbines at Parker Dam; ensure all four hydropower turbines are available to deliver water. Ensure that all five hydropower turbines at Davis Dam are available to maintain Lake Havasu's elevation during the peak of the pulse.
 - Maintain capacity at Parker Dam for potential increases in water orders during the peak of the flow (the flow occurred during the peak water demand season).
 - Do not exceed the flow capacity of the All American Canal. Maintain capacity for potential increases in water orders.
 - Eliminate/minimize the potential for flooding along the river channel in the Yuma area.
- Operations staff at Boulder Canyon Operations Office and Yuma Area Office analyzed the pulse flow hydrograph, taking into consideration the operational constraints above, and provided recommendations to Regional management. These recommendations were presented to the Minute 319 Environmental Work Group.

- LC Dams office condensed their annual maintenance schedules in order to have all units available to pass all water through the turbines at Davis and Parker Dams to maximize hydropower generation.
- Reclamation's Yuma Area Office coordinated with the City of Yuma to minimize potential impacts due to anticipated higher flows in the river channel.
- An agreement for a [Basin-wide pilot program for System Conservation](#) was signed on July 30, 2014 among Reclamation and four municipal funding partners. A [Memorandum of Understanding for Lower Basin Pilot Drought Response Actions](#) was signed among Reclamation and Lower Basin partners on December 10, 2014. These agreements provided additional opportunity and incentive for voluntary conservation of Colorado River system water and improved operational efficiency in upcoming years.

Figure A9. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2013 – December 2014.

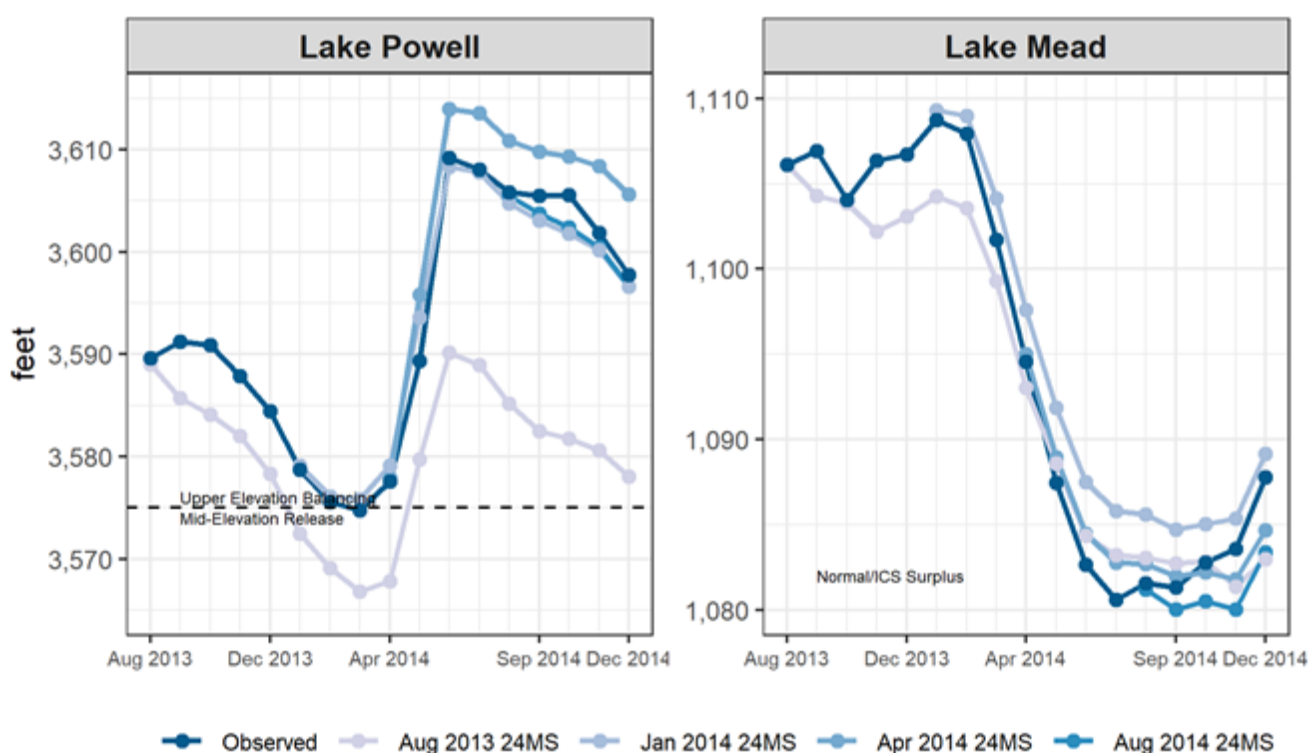


Table A43. Operational determination table for WY/CY 2014.

	Type of 24-Month Study Run	Aug 2013 ¹			Apr 2014		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2013 elevation (feet)	Tier Determination	3,573.69					
	Published Study	3,578.32	3,584.43	-6.11			
Lake Powell Operating Tier		Mid-Elevation Release					
Lake Powell EOWY 2014 elevation (feet)	April Determination ⁴						
	Published Study				3,609.82	3,605.53	4.29
Lake Mead EOWY 2014 elevation (feet)	April Determination ⁴						
	Published Study				1,081.97	1,081.33	0.64
Lake Powell Mid-Year Adjustment					N/A		
Lake Mead EOCY 2013 elevation (feet)		1,103.08	1,106.73	-3.65			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2013 24-Month Study projections of December 31, 2013 conditions set the operating tier for Lake Powell in WY 2014 and operating condition in the Lower Basin for CY 2014.

² Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

³ There is no option for an April adjustment in the Mid-Elevation Release tier.

Table A44. January, April, and August 24-Month Study projections during WY 2014 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	6.81	-0.11	7.85	0.93	NA	NA	6.92
April-July unregulated inflow (% avg)	95%		110%				97%
WY unregulated inflow (maf)	10.09	-0.29	11.11	0.73	10.15	-0.23	10.38
WY unregulated inflow (% avg)	93%		103%		94%		96%
Lake Powell WY release (maf)	7.48	0	7.48	0	7.48	0.00	7.48
Lake Powell EOWY elevation (feet)	3,603.06	-2.47	3,609.82	4.29	3,603.75	-1.78	3,605.53
Lake Mead EOWY elevation (feet)	1,084.71	3.38	1,081.97	0.64	1,080.03	-1.30	1,081.33

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A45. January, April, and August 24-Month Study projections during CY 2014 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	870	205	793	128	659	-6	665
Gains Below Hoover ² (kaf)	-232	-67	-262	-97	-256	-91	-165
Total Lower Basin and MX Use (af)	8,993,177	-204,893	9,298,688	100,618	9,283,395	85,325	9,198,070
AZ Consumptive Use (af)	2,790,672	16,011	2,790,672	16,011	2,779,734	5,073	2,774,661
CA Consumptive Use (af)	4,470,505	-179,229	4,690,073	40,339	4,695,489	45,755	4,649,734
NV Consumptive Use (af)	232,000	7,384	232,000	7,384	232,000	7,384	224,616
Lake Powell EOCY elevation (feet)	3,596.62	-1.13	3,605.67	7.92	3,596.62	-1.13	3,597.75
Lake Mead EOCY elevation (feet)	1,089.17	1.38	1,084.69	-3.10	1,083.37	-4.42	1,087.79

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A46. January, April, and August 24-Month Study projections during CY 2014 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,790,672	16,011	2,790,672	16,011	2,779,734	5,073	2,774,661
AZ Tribal Mainstream Consumptive Use ³ (af)							364,989
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	9,000	2,173	9,000	2,173	9,000	2,173	6,827
Other Water Left in Lake Mead ⁵ (af)	0	-18,290	0	-18,290	11,000	-7,290	18,290
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	328	106	328	106	266	44	222
Water Recovered for CA (af)	0	0	0	0	0	0	0
Water Stored for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A47. January, April, and August 24-Month Study projections during CY 2014 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,470,505	-179,229	4,690,073	40,339	4,695,489	45,755	4,649,734
CA Tribal Mainstream Consumptive Use ³ (af)							38,788
Total ICS Delivery (af)	182,243	-138,749	376,811	55,819	344,880	23,888	320,992
Total EC ICS Creation (af)	25,000	6,133	0	-18,867	0	-18,867	18,867
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	154,738	37,347	154,738	37,347	117,391	0	117,391
Water Stored for NV (af)	68,000	3,000	68,000	3,000	68,000	3,000	65,000
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A48. January, April, and August 24-Month Study projections during CY 2014 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	232,000	7,384	232,000	7,384	232,000	7,384	224,616
NV Tribal Mainstream Consumptive Use ³ (af)							2,594
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	-10,384	0	-10,384	0	-10,384	10,384
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	68,000	3,000	68,000	3,000	68,000	3,000	65,000
Other ICS Creation ⁶ (af)	30,000	700	30,000	700	30,000	700	29,300
System Conservation Water ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A49. January, April, and August 24-Month Study projections during CY 2014 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2014		Apr 2014		Aug 2014		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	-49,059	1,585,943	36,884	1,576,172	27,113	1,549,059
Total MWR Delivery ² (af)	0	-105,068	105,069	1	105,069	1	105,068
Total MWR Creation ² (af)	0	-56,009	19,126	-36,883	28,897	-27,112	56,009
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	150,903	-25,850	152,559	-24,194	169,909	-6,844	176,753

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.8 2015

Based on the projections of the August 2014 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2015, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A50). The April 2015 24-Month Study projections resulted in Lake Powell operations shifting to Balancing for WY 2015 (Table A50) resulting in a total WY release of 9.00 maf from Lake Powell (Table A51). In the Lower Basin, a total of 7,448,217 af was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. In the Upper Basin, the System Conservation Pilot Program (SCPP) was estimated to yield 2,707 af of water conservation in CY 2015. Lake Powell started WY 2015 at 3,605.53 feet and ended WY 2015 at 3,606.01 feet, with a total of 10.17 maf (94 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2015 at 1,087.79 feet and ended the year at 1,080.91 feet.

Tables A51 through A56 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A10 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2015.

In 2015:

- During November 2014 an HFE was conducted at Glen Canyon Dam with a peak release of 37,500 cfs and peak duration of 96 hours, with a powerplant capacity peak release of 23,000 cfs. The total duration for the HFE was 5 days and 5 hours and total bypass was 132,030 af.
- Snowpack continued to erode over the accumulation period followed with sharply declining inflow forecasts throughout the winter and spring months. April-July forecasts of most-probable inflow to Lake Powell beginning with January were: 91 percent, February: 73 percent, March: 71 percent, April: 52 percent, May: 42 percent, June: 70 percent, July: 88 percent. Starting in May, significant convective storm systems occurred causing continued precipitation over the Upper Colorado Basin that completely changed the forecast for 2015 – deeming this “Miracle May”. Six weeks of continuing precipitation in the second half of May and early June (Figure A11) increased the observed April-July runoff volume to 6.71 maf (94 percent of average), saving the WY and forestalling another precipitous drop in Lake Powell elevation.
 - In the Lower Basin, the chance of shortage in 2016 increased to 33 percent in 2016 and to 75 percent in 2017. The chance of shortage in 2016 appeared to increase significantly again by early May.
 - Shortage in 2016 was prevented by 1) a 9.0 maf balancing release from Powell in WY 2015 and 2) a switch from the anticipated Mid-Elevation Release Tier to Upper Elevation Balancing Tier in WY 2016, which increased the October through December release from Lake Powell by 420 kaf.
- This was the first of five consecutive years of 9.0 maf balancing releases from Lake Powell.

Figure A10. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2014 – December 2015.

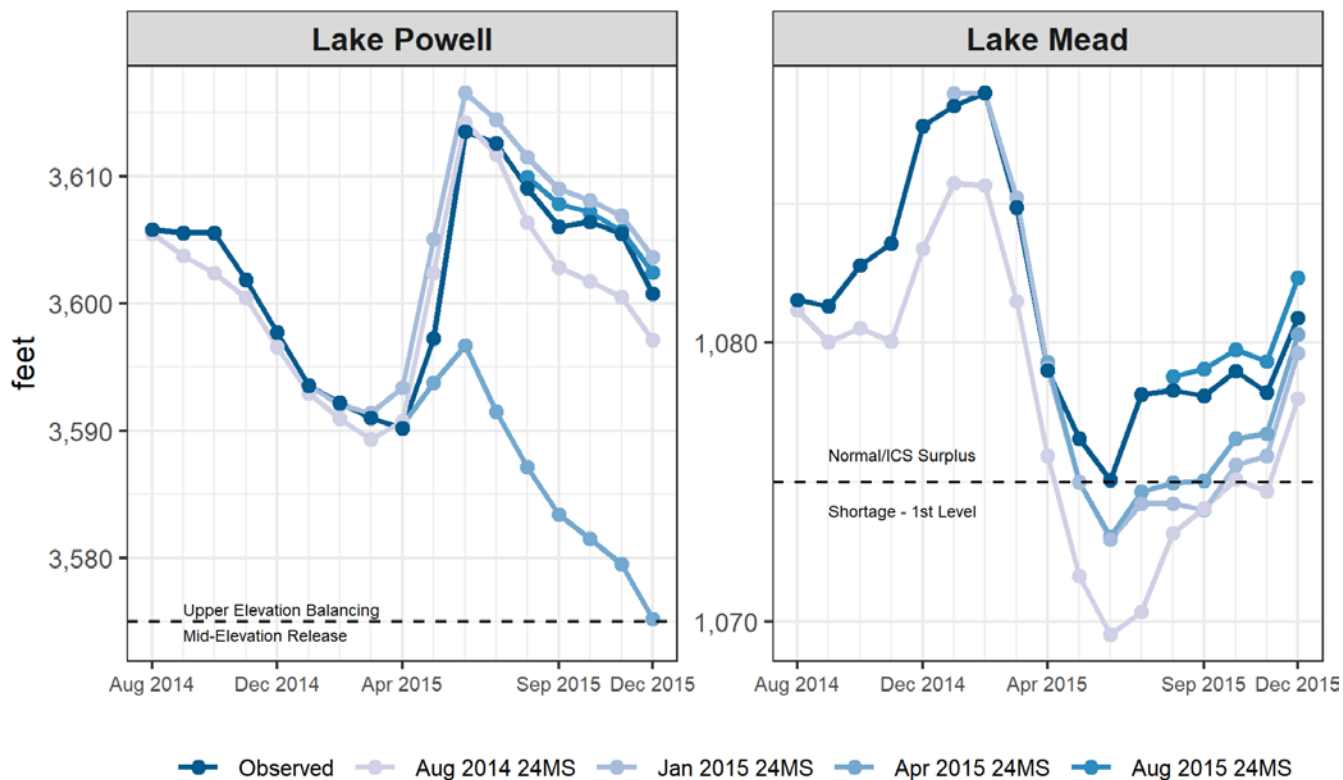


Figure A11. May and June 2015 Basin-wide precipitation as a percent of average.

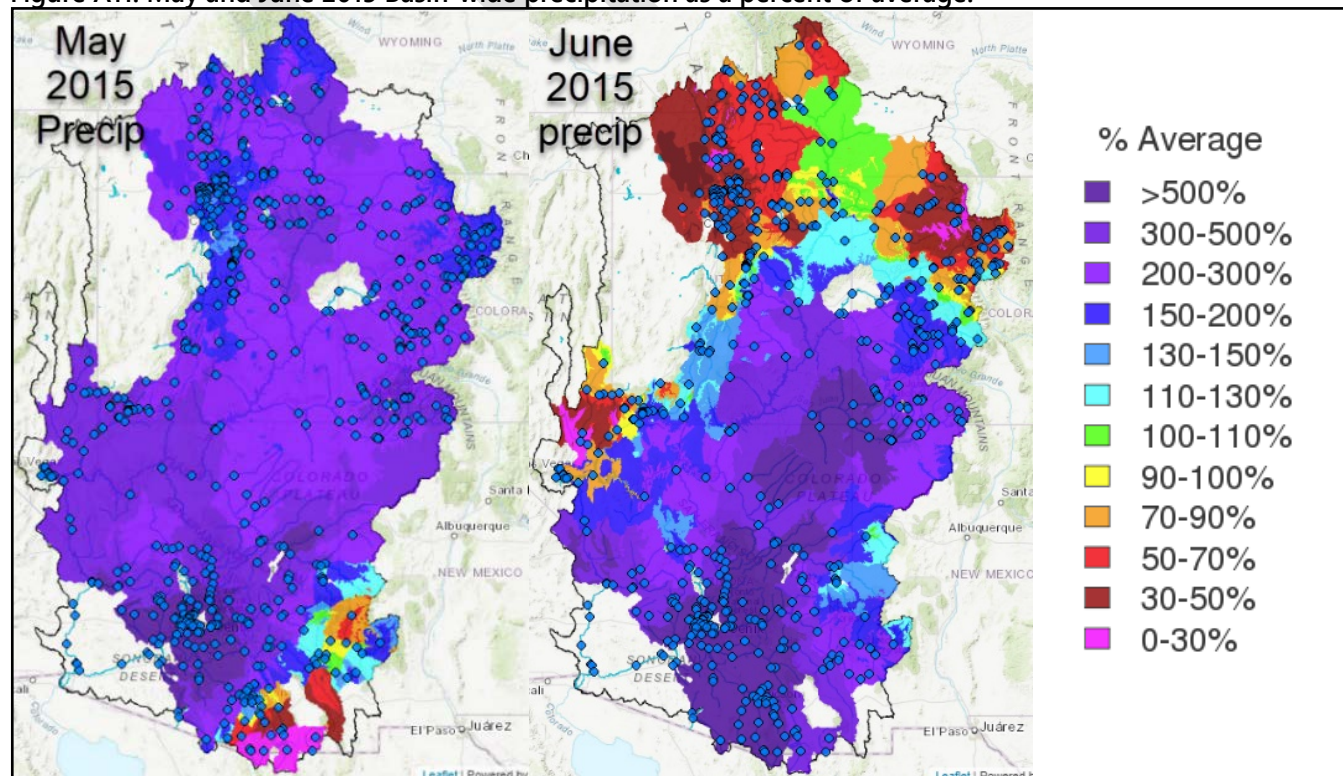


Table A50. Operational determination table for WY/CY 2015.

	Type of 24-Month Study Run	Aug 2014 ¹			Apr 2015 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2014 elevation (feet)	Tier Determination	3,596.62					
	Published Study	3,596.62	3,597.75	-1.13			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2015 elevation (feet)	April Determination ⁴				3,591.34		
	Published Study				3,583.43	3606.01	-22.58
Lake Mead EOWY 2015 elevation (feet)	April Determination ⁴				1,066.05		
	Published Study				1,075.05	1,078.10	-3.05
Lake Powell Mid-Year Adjustment					Balancing		
Lake Mead EOCY 2014 elevation (feet)		1,083.37	1,087.79	-4.42			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2014 24-Month Study projections of December 31, 2014 conditions set the operating tier for Lake Powell in WY 2015 and operating condition in the Lower Basin for CY 2015.

² April 2015 24-Month Study projections of September 30, 2015 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2015.

Table A51. January, April, and August 24-Month Study projections during WY 2015 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	6.50	-0.21	3.75	-2.96	NA	NA	6.71
April-July unregulated inflow (% avg)	91%		52%				94%
WY unregulated inflow (maf)	10.08	-0.09	7.18	-2.99	10.33	0.16	10.17
WY unregulated inflow (% avg)	93%		66%		95%		94%
Lake Powell WY release (maf)	9.00	0.00	9.00	0.00	9.00	0.00	9.00
Lake Powell EOWY elevation (feet)	3,609.01	3.00	3,583.43	-22.58	3,607.82	1.81	3,606.01
Lake Mead EOWY elevation (feet)	1,074.01	-4.09	1,075.05	-3.05	1,079.07	0.97	1,078.10

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A52. January, April, and August 24-Month Study projections during CY 2015 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	861	105	883	127	817	61	756
Gains Below Hoover ² (kaf)	-230	-78	-216	-64	-135	17	-152
Total Lower Basin and MX Use (af)	9,080,868	132,651	9,044,816	96,599	8,896,996	-51,221	8,948,217
AZ Consumptive Use (af)	2,764,319	159,587	2,728,267	123,535	2,617,835	13,103	2,604,732
CA Consumptive Use (af)	4,581,549	-39,207	4,581,549	-39,207	4,551,161	-69,595	4,620,756
NV Consumptive Use (af)	235,000	12,271	235,000	12,271	228,000	5,271	222,729
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,603.66	2.86	3,575.21	-25.59	3,602.46	1.66	3,600.80
Lake Mead EOCY elevation (feet)	1,079.63	-1.28	1,080.30	-0.61	1,082.33	1.42	1,080.91

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A53. January, April, and August 24-Month Study projections during CY 2015 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,764,319	159,587	2,728,267	123,535	2,617,835	13,103	2,604,732
AZ Tribal Mainstream Consumptive Use ³ (af)							340,836
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	7,000	-10,260	7,000	-10,260	7,000	-10,260	17,260
Other Water Left in Lake Mead ⁵ (af)	28,559	-149,284	64,611	-113,232	175,000	-2,843	177,843
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	122	-43	122	-43	165	0	165
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A54. January, April, and August 24-Month Study projections during CY 2015 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,581,549	-39,207	4,581,549	-39,207	4,551,161	-69,595	4,620,756
CA Tribal Mainstream Consumptive Use ³ (af)							34,588
Total ICS Delivery (af)	139,821	69,065	139,821	69,065	111,161	40,405	70,756
Total EC ICS Creation (af)	0	0	0	0	25,000	25,000	0
System Conservation Water ⁴ (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	23,272	23,272	23,272	23,272	0	0	0
Water Stored for NV (af)	65,000	-85,000	65,000	-85,000	65,000	-85,000	150,000
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A55. January, April, and August 24-Month Study projections during CY 2015 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	235,000	12,271	235,000	12,271	228,000	5,271	222,729
NV Tribal Mainstream Consumptive Use ³ (af)							3,137
Total ICS Delivery (af)	0	-75,000	0	-75,000	0	-75,000	75,000
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	0	-2,271	0	-2,271	7,000	4,729	2,271
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	65,000	-85,000	65,000	-85,000	65,000	-85,000	150,000
Other ICS Creation ⁶ (af)	30,000	4,853	30,000	4,853	22,500	-2,647	25,147
System Conservation Water ⁷ (af)	0	-7,500	0	-7,500	7,500	0	7,500

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A56. January, April, and August 24-Month Study projections during CY 2015 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2015		Apr 2015		Aug 2015		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	0	0	0	0	0	0
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	152,272	-14,548	162,871	-3,949	171,747	4,927	166,820

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.9 2016

Based on the projections of the August 2015 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2016, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A57). The April 2016 24-Month Study projections resulted in Lake Powell operations shifting to Balancing for WY 2016 (Table A57) resulting in a total WY release of 9.00 maf from Lake Powell (Table A58). In the Lower Basin, a total of 7,232,260 af was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. In the Upper Basin, the SCPP was estimated to yield 7,852 af of water conservation in CY 2016. Lake Powell started WY 2016 at 3,606.01 feet and ended WY 2016 at 3,610.93 feet, with a total of 9.62 maf (89 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2016 at 1,080.91 feet and ended the year at 1,080.82 feet.

Tables A58 through A63 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A12 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2016.

In 2016:

- The Department of the Interior decided not to conduct an HFE under the 2012 High-Flow Experiment Protocol (Protocol) at Glen Canyon Dam in the fall of 2015. Although sediment inflows in the Grand Canyon were of sufficient mass to trigger an HFE, a high abundance of green sunfish - invasive to the area - was discovered in a back-water slough downstream of Glen Canyon Dam. There was concern that an HFE could disperse these harmful nonnative fish downstream into the Colorado River, posing a threat to native endangered species in the Grand Canyon. While response actions were undertaken to address the green sunfish problem, the time required to address the problem precluded conducting an HFE in the fall of 2015.
- Lake Mead reached its historic low elevation, since initially filling in the 1930s, of 1,071.6 feet on June 30 and July 1, 2016.
 - Because Lake Mead had never been this low previously, there was a lot of uncertainty for Lake Mead NRA operations.
 - Public Affairs outreach regarding this low water mark included a press release clarifying that this mid-year decline in Lake Mead's elevation did not trigger a shortage condition.
- The LTEMP Record of Decision was signed on December 15, 2016.

Figure A12. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2015 – December 2016.

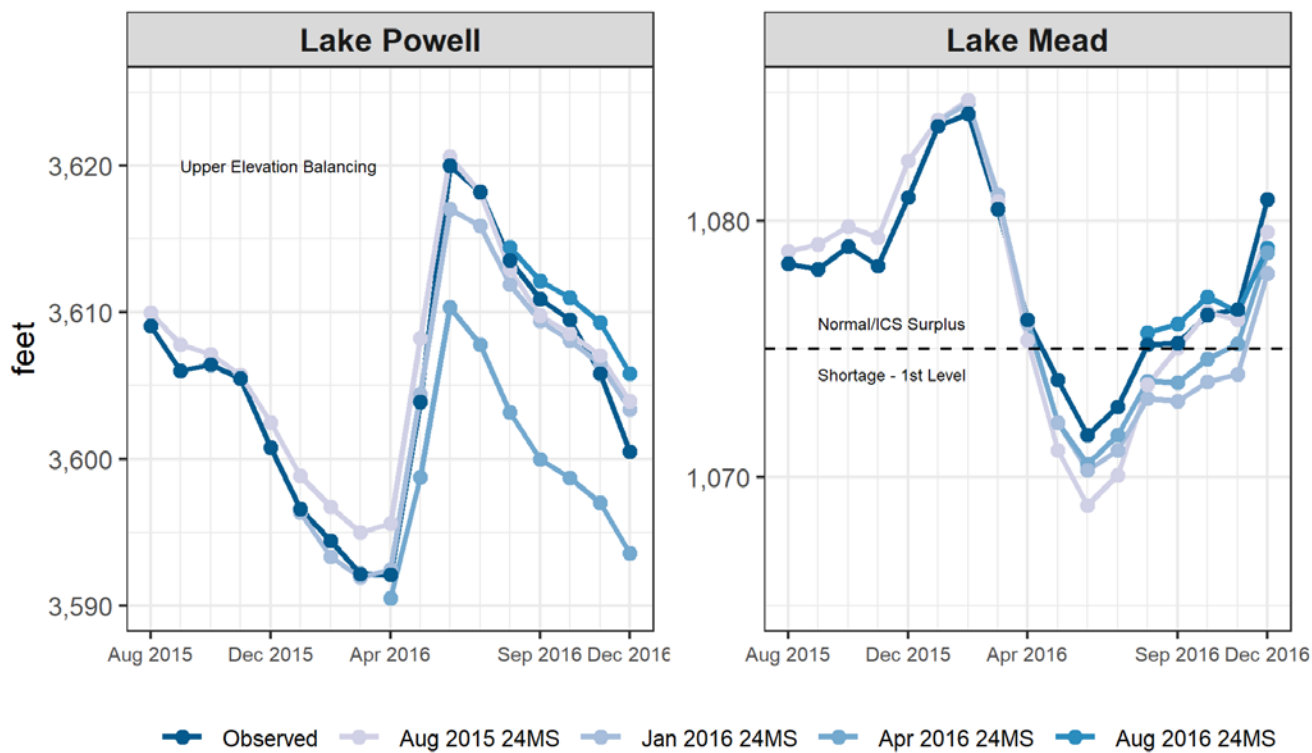


Table A57. Operational determination table for WY/CY 2016.

	Type of 24-Month Study Run	Aug 2015 ¹			Apr 2016 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2012 elevation (feet)	Tier Determination	3,602.46					
	Published Study	3,602.46	3,600.80	1.66			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2013 elevation (feet)	April Determination ⁴				3,607.25		
	Published Study				3,599.97	3,610.93	-10.96
Lake Mead EOWY 2013 elevation (feet)	April Determination ⁴				1,064.61		
	Published Study				1,073.69	1,075.23	-1.54
Lake Powell Mid-Year Adjustment					Balancing		
Lake Mead EOCY 2012 elevation (feet)		1,082.33	1,080.91	1.42			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2015 24-Month Study projections of December 31, 2015 conditions set the operating tier for Lake Powell in WY 2016 and operating condition in the Lower Basin for CY 2016.

² April 2016 24-Month Study projections of September 30, 2016 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2016.

Table A58. January, April, and August 24-Month Study projections during WY 2016 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	6.40	-0.21	5.30	-1.31	NA	NA	6.61
April-July unregulated inflow (% avg)	89%		74%				92%
WY unregulated inflow (maf)	9.59	-0.03	8.44	-1.18	9.78	0.16	9.62
WY unregulated inflow (% avg)	89%		78%		90%		89%
Lake Powell WY release (maf)	9.00	0.00	9.00	0.00	9.00	0.00	9.00
Lake Powell EOWY elevation (feet)	3,609.38	-1.55	3,599.97	-10.96	3,612.13	1.20	3,610.93
Lake Mead EOWY elevation (feet)	1,072.96	-2.27	1,073.69	-1.54	1,075.98	0.75	1,075.23

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A59. January, April, and August 24-Month Study projections during CY 2016 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	874	57	806	-11	820	3	817
Gains Below Hoover ² (kaf)	-212	52	-179	85	-189	75	-264
Total Lower Basin and MX Use (af)	8,902,241	169,981	8,839,397	107,137	8,790,000	57,740	8,732,260
AZ Consumptive Use (af)	2,684,067	71,234	2,630,000	17,167	2,630,000	17,167	2,612,833
CA Consumptive Use (af)	4,486,174	105,073	4,481,397	100,296	4,432,000	50,899	4,381,101
NV Consumptive Use (af)	232,000	-6,326	228,000	-10,326	228,000	-10,326	238,326
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,603.36	2.87	3,593.57	-6.92	3,605.83	5.34	3,600.49
Lake Mead EOCY elevation (feet)	1,077.93	-2.89	1,078.75	-2.07	1,078.93	-1.89	1,080.82

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A60. January, April, and August 24-Month Study projections during CY 2016 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,684,067	71,234	2,630,000	17,167	2,630,000	17,167	2,612,833
AZ Tribal Mainstream Consumptive Use ³ (af)							344,536
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	7,000	-60,661	32,265	-35,396	32,265	-35,396	67,661
Other Water Left in Lake Mead ⁵ (af)	108,933	-10,573	137,735	18,229	137,735	18,229	119,506
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A61. January, April, and August 24-Month Study projections during CY 2016 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,486,174	105,073	4,481,397	100,296	4,432,000	50,899	4,381,101
CA Tribal Mainstream Consumptive Use ³ (af)							32,461
Total ICS Delivery (af)	58,174	58,174	49,397	49,397	0	0	0
Total EC ICS Creation (af)	25,000	6,267	25,000	6,267	25,000	6,267	18,733
System Conservation Water ⁴ (af)	0	-166	0	-166	0	-166	166
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	53,000	53,000	57,000	57,000	57,000	57,000	0
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A62. January, April, and August 24-Month Study projections during CY 2016 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	232,000	-6,326	228,000	-10,326	228,000	-10,326	238,326
NV Tribal Mainstream Consumptive Use ³ (af)							3,349
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	15,000	-46,674	15,000	-46,674	15,000	-46,674	61,674
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	53,000	53,000	57,000	57,000	57,000	57,000	0
Other ICS Creation ⁶ (af)	22,500	-2,530	22,500	-2,530	22,500	-2,530	25,030
System Conservation Water ⁷ (af)	7,500	-188	7,500	-188	7,500	-188	7,688

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A63. January, April, and August 24-Month Study projections during CY 2016 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2016		Apr 2016		Aug 2016		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	0	0	0	0	0	0
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	156,371	-3,050	156,594	-2,827	156,013	-3,408	159,421

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.10 2017

Based on the projections of the August 2016 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2017, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A64). The April 2017 24-Month Study projections resulted in Lake Powell operations shifting to Balancing for WY 2017 (Table A64) resulting in a total WY release of 9.00 maf from Lake Powell (Table A65). In the Lower Basin, a total of 6,779,443 af was delivered to the Lower Division states, and 1,500,000 af was delivered to Mexico. In the Upper Basin, the SCPP was estimated to yield 12,690 af of water conservation in CY 2017. Lake Powell started WY 2017 at 3,610.93 feet and ended WY 2017 at 3,628.31 feet, with a total of 11.90 maf (110 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2017 at 1,080.82 feet and ended the year at 1,082.52 feet.

Tables A65 through A70 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A13 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2017.

In 2017:

- During November 2016 an HFE was conducted at Glen Canyon Dam with a peak release of 36,500 cfs and peak duration of 96 hours, with a powerplant capacity peak release of 21,300 cfs. The total duration for the HFE was 5 days and total bypass was 126,436 af.
- During 2017, MWD submitted a mid-year change to its ICS creation plan, which requested an increase in the volume of ICS that could be created to near the maximum annual creation limit for California in the Guidelines (400 kaf). There were a number of concerns because the Guidelines do not allow for the increase of an approved ICS creation plan during the current operating year.
 - The Water Accounting and Verification Group underwent additional consultation with the Lower Division and Upper Division states. After Reclamation received concurrence from all seven Basin States, a letter of recommendation in support of the revised ICS creation plan signed by the seven Basin States was submitted to the Secretary. Permission to approve the revised plan was granted by the Secretary via a memorandum signed by the Acting Assistant Secretary of Water and Science on September 26, 2017.
 - Given the time it takes to go through the process of approving the plan, the additional ICS creation was not modeled in the August 2017 24-Month Study. The August 2017 Most Probable 24-Month Study projected Lake Mead to end CY 2017 at elevation 1083.46.
 - In October 2017, the volume of ICS creation modeled in the 24-Month Study was increased to reflect MWD's revised ICS creation plan.
- Through the combination of ICS creation, System Conservation, and other water left in Lake Mead, 720 kaf of stored and conserved water was left in Lake Mead in CY 2017. At the time, this was most conserved water and other water left in Lake Mead since the Guidelines were implemented and second most to only CY 2019. This resulted in an 8.73 maf release from Lake Mead, which was the third lowest since 2000 (only CY 2005 and 2019 were lower).
- Minute No. 323 of the IBWC was signed on September 27, 2017.
- Pursuant to Section III.6.e.iii of IBWC Minute No. 319, 124,000 af of water previously deferred by Mexico were provided to the United States, of which 95,000 af were converted to Binational ICS and credited to CAWCD, MWD, IID, and SNWA (23,750 af each); the remaining 29,000 af were left in Lake Mead for the benefit of the system.

Figure A13. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2016 – December 2017.

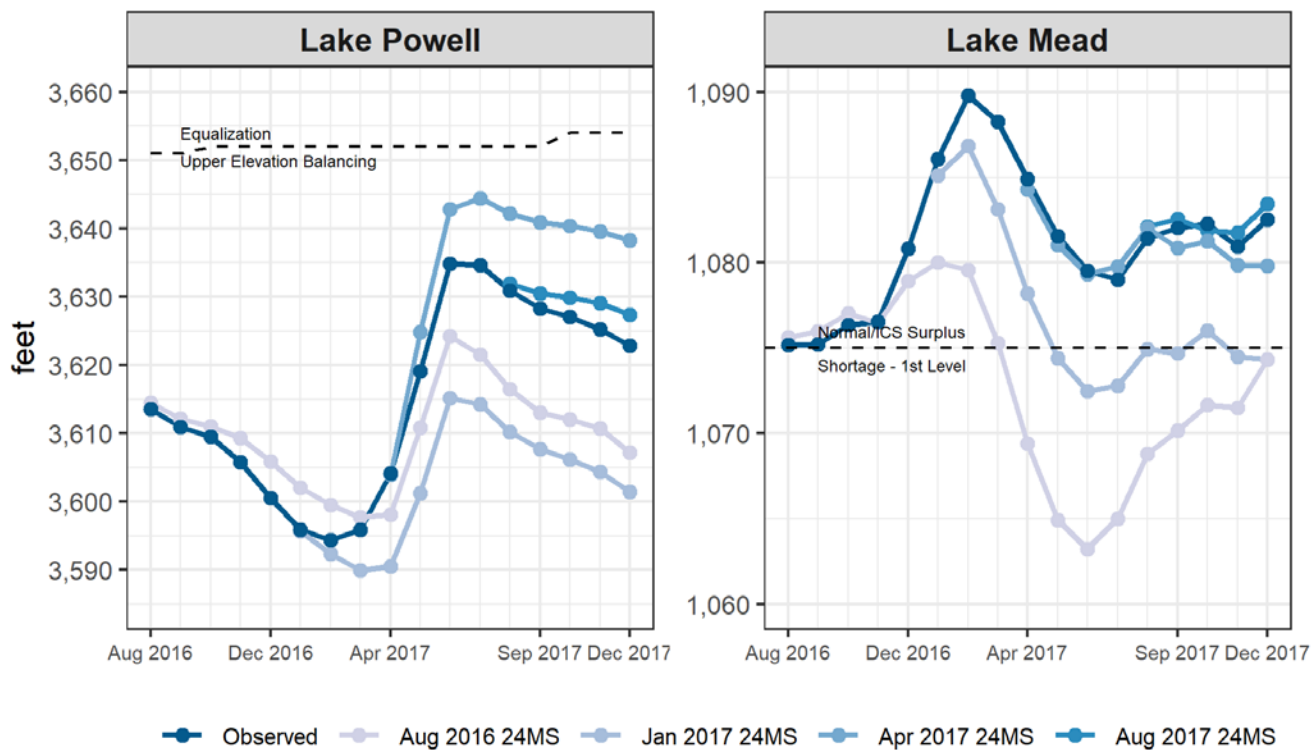


Table A64. Operational determination table for WY/CY 2017.

	Type of 24-Month Study Run	Aug 2016 ¹			Apr 2017 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2016 elevation (feet)	Tier Determination	3,605.83					
	Published Study	3,605.83	3,600.49	5.34			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2017 elevation (feet)	April Determination ⁴				3,646.82		
	Published Study				3,640.95	3,628.31	12.64
Lake Mead EOWY 2017 elevation (feet)	April Determination ⁴				1,072.07		
	Published Study				1,080.87	1,082.05	-1.18
Lake Powell Mid-Year Adjustment					Balancing		
Lake Mead EOCY 2016 elevation (feet)		1,078.93	1,080.82	-1.89			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2016 24-Month Study projections of December 31, 2016 conditions set the operating tier for Lake Powell in WY 2017 and operating condition in the Lower Basin for CY 2017.

² April 2017 24-Month Study projections of September 30, 2017 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2017.

Table A65. January, April, and August 24-Month Study projections during WY 2017 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	6.50	-1.67	9.30	1.13	NA	NA	8.17
April-July unregulated inflow (% avg)	91%		130%				114%
WY unregulated inflow (maf)	9.51	-2.39	13.47	1.57	12.23	0.33	11.90
WY unregulated inflow (% avg)	88%		124%		113%		110%
Lake Powell WY release (maf)	9.00	0.00	9.00	0.00	9.00	0.00	9.00
Lake Powell EOWY elevation (feet)	3,607.70	-20.61	3,640.95	12.64	3,630.49	2.18	3,628.31
Lake Mead EOWY elevation (feet)	1,074.70	-7.35	1,080.87	-1.18	1,082.55	0.50	1,082.05

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A66. January, April, and August 24-Month Study projections during CY 2017 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	795	-107	952	50	1,036	134	902
Gains Below Hoover ² (kaf)	-204	77	-171	110	-190	91	-281
Total Lower Basin and MX Use (af)	8,975,178	695,735	8,678,565	399,122	8,443,565	164,122	8,279,443
AZ Consumptive Use (af)	2,791,465	281,962	2,751,465	241,962	2,516,465	6,962	2,509,503
CA Consumptive Use (af)	4,452,713	426,198	4,174,100	147,585	4,174,100	147,585	4,026,515
NV Consumptive Use (af)	231,000	-12,425	253,000	9,575	253,000	9,575	243,425
MX Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Lake Powell EOCY elevation (feet)	3,601.41	-21.44	3,638.27	15.42	3,627.34	4.49	3,622.85
Lake Mead EOCY elevation (feet)	1,074.31	-8.21	1,079.83	-2.69	1,083.46	0.94	1,082.52

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A67. January, April, and August 24-Month Study projections during CY 2017 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,791,465	281,962	2,751,465	241,962	2,516,465	6,962	2,509,503
AZ Tribal Mainstream Consumptive Use ³ (af)							338,707
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
System Conservation Water ⁴ (af)	8,535	-90,157	48,535	-50,157	98,615	-77	98,692
Other Water Left in Lake Mead ⁵ (af)	0	-191,805	0	-191,805	185,000	-6,805	191,805
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	-23,750	0	-23,750	0	-23,750	23,750

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A68. January, April, and August 24-Month Study projections during CY 2017 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,452,713	426,198	4,174,100	147,585	4,174,100	147,585	4,026,515
CA Tribal Mainstream Consumptive Use ³ (af)							33,721
Total ICS Delivery (af)	25,000	25,000	0	0	0	0	0
Total EC ICS Creation (af)	25,000	-312,632	225,000	-112,632	225,000	-112,632	337,632
System Conservation Water ⁴ (af)	1,287	989	900	602	900	602	298
Other Water Left in Lake Mead ⁵ (af)	0	-35,399	0	-35,399	0	-35,399	35,399
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	54,000	54,000	0	0	0	0	0
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	-47,500	0	-47,500	0	-47,500	47,500

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A69. January, April, and August 24-Month Study projections during CY 2017 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	231,000	-12,425	253,000	9,575	253,000	9,575	243,425
NV Tribal Mainstream Consumptive Use ³ (af)							3,111
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	0	0	0	0	0	0
Other Water Left in Lake Mead ⁴ (af)	15,000	-41,575	47,000	-9,575	47,000	-9,575	56,575
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	54,000	54,000	0	0	0	0	0
Other ICS Creation ⁶ (af)	29,140	-27,045	29,140	-27,045	29,140	-27,045	56,185
System Conservation Water ⁷ (af)	860	116	860	116	860	116	744

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A70. January, April, and August 24-Month Study projections during CY 2017 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2017		Apr 2017		Aug 2017		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	0	1,500,000	0	1,500,000	0	1,500,000
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	0	0	0	0	0	0
Other MWR ³ (af)	0	124,000	0	124,000	0	124,000	-124,000
Other Flows to Mexico ⁴ (af)	156,371	12,982	152,163	8,774	149,207	5,818	143,389

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.11 2018

Based on the projections of the August 2017 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2018, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A71). The April 2018 24-Month Study projections resulted in Lake Powell operations shifting to Balancing for WY 2018 (Table A71) resulting in a total WY release of 9.00 maf from Lake Powell (Table A72). In the Lower Basin, a total of 7,141,888 af was delivered to the Lower Division states, and 1,493,327 af was delivered to Mexico. In the Upper Basin, the SCPP was estimated to yield 27,804 af of water conservation in CY 2018. Lake Powell started WY 2018 at 3,628.31 feet and ended WY 2018 at 3,592.28 feet, with a total of 4.61 maf (43 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2018 at 1,082.52 feet and ended the year at 1,081.46 feet.

Tables A72 through A77 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the projections change through time, Figure A14 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2018.

In 2018:

- The first year of the experimental macroinvertebrate releases or “bug flows” under the LTEMP EIS were conducted during WY2018. From May 1 through August 31, the LTEMP experiment adjusted the Saturday and Sunday weekend releases to low, steady flows, while weekday operations remained normal to meet hydropower demands. The bug flows did not affect monthly release volumes.
- Following above average inflow in WY 2017 (110 percent of average), inflow into Lake Powell was only 43 percent of average in WY 2018, the second lowest inflow since the drought started in 2000.
 - The return of dry conditions set the stage for the final steps towards completing the DCP.
 - Operations were otherwise uneventful in 2018.

Figure A14. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2017 – December 2018.

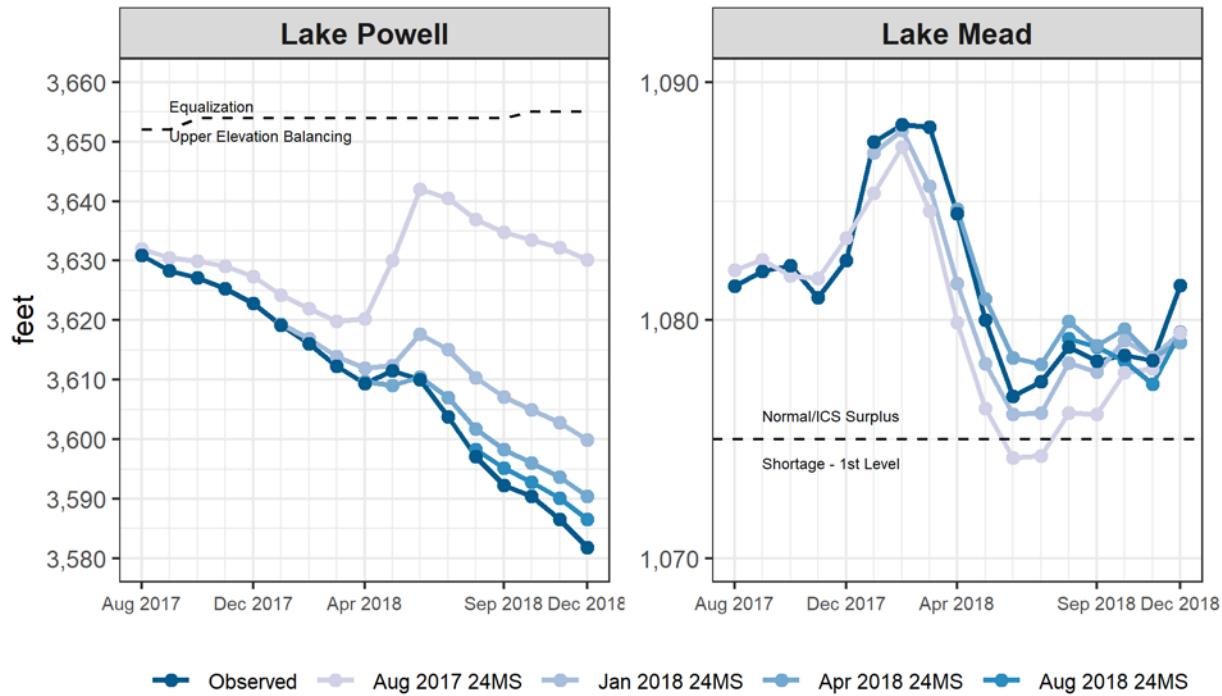


Table A71. Operational determination table for WY/CY 2018.

	Type of 24-Month Study Run	Aug 2017 ¹			Apr 2018 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2017 elevation (feet)	Tier Determination	3627.34					
	Published Study	3627.34	3,622.85	4.49			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2018 elevation (feet)	April Determination ⁴				3,605.64		
	Published Study				3,598.30	3,592.28	6.03
Lake Mead EOWY 2018 elevation (feet)	April Determination ⁴				1,070.07	-	-
	Published Study				1,078.94	1,078.29	0.65
Lake Powell Mid-Year Adjustment					Balancing		
Lake Mead EOCY 2017 elevation (feet)		1,083.46	1,082.52	0.94			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2017 24-Month Study projections of December 31, 2017 conditions set the operating tier for Lake Powell in WY 2018 and operating condition in the Lower Basin for CY 2018.

² April 2018 24-Month Study projections of September 30, 2018 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2018.

Table A72. January, April, and August 24-Month Study projections during WY 2018 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	3.90	1.30	3.10	0.50	NA	NA	2.60
April-July unregulated inflow (% avg)	54%		43%				36%
WY unregulated inflow (maf)	6.75	2.14	5.62	1.01	4.97	0.36	4.61
WY unregulated inflow (% avg)	62%		52%		46%		43%
Lake Powell WY release (maf)	9.00	0.00	9.00	0.00	9.00	0.00	9.00
Lake Powell EOWY elevation (feet)	3,607.09	14.81	3,598.30	6.03	3,595.13	2.86	3,592.28
Lake Mead EOWY elevation (feet)	1,077.83	-0.46	1,078.94	0.65	1,078.87	0.58	1,078.29

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A73. January, April, and August 24-Month Study projections during CY 2018 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	757	-26	778	-5	800	17	783
Gains Below Hoover ² (kaf)	-209	86	-179	116	-233	62	-295
Total Lower Basin and MX Use (af)	8,834,165	198,950	8,930,240	295,025	8,871,240	236,025	8,635,215
AZ Consumptive Use (af)	2,790,365	158,105	2,803,865	171,605	2,632,386	126	2,632,260
CA Consumptive Use (af)	4,243,800	-21,725	4,346,548	81,023	4,459,027	193,502	4,265,525
NV Consumptive Use (af)	300,000	55,897	286,500	42,397	286,500	42,397	244,103
MX Delivery (af)	1,500,000	6,673	1,493,327	0	1,493,327	0	1,493,327
Lake Powell EOCY elevation (feet)	3,599.85	18.00	3,590.43	8.58	3,586.55	4.70	3,581.85
Lake Mead EOCY elevation (feet)	1,079.47	-1.99	1,079.08	-2.38	1,079.50	-1.96	1,081.46

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A74. January, April, and August 24-Month Study projections during CY 2018 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,790,365	158,105	2,803,865	171,605	2,632,386	126	2,632,260
AZ Tribal Mainstream Consumptive Use ³ (af)							321,287
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	-47,013	0	-47,013	0	-47,013	47,013
System Conservation Water ⁴ (af)	9,635	-15,858	9,635	-15,858	32,109	6,616	25,493
Other Water Left in Lake Mead ⁵ (af)	0	-108,734	0	-108,734	149,005	40,271	108,734
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	-13,500	13,500	0	13,500	0	13,500
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A75. January, April, and August 24-Month Study projections during CY 2018 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,243,800	-21,725	4,346,548	81,023	4,459,027	193,502	4,265,525
CA Tribal Mainstream Consumptive Use ³ (af)							31,432
Total ICS Delivery (af)	0	0	0	0	62,697	62,697	0
Total EC ICS Creation (af)	155,300	22,775	52,552	-79,973	1,579	-130,946	132,525
System Conservation Water ⁴ (af)	900	-1,199	900	-1,199	2,091	-8	2,099
Other Water Left in Lake Mead ⁵ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	0	0	0	0	0	0
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A76. January, April, and August 24-Month Study projections during CY 2018 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	300,000	55,897	286,500	42,397	286,500	42,397	244,103
NV Tribal Mainstream Consumptive Use ³ (af)							3,416
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	-42,397	0	-42,397	0	-42,397	42,397
Other Water Left in Lake Mead ⁴ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	-13,500	13,500	0	13,500	0	13,500
Water Stored in CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁶ (af)	29,140	-2,860	29,140	-2,860	29,140	-2,860	32,000
System Conservation Water ⁷ (af)	860	0	860	0	860	0	860

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A77. January, April, and August 24-Month Study projections during CY 2018 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2018		Apr 2018		Aug 2018		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	6,673	1,493,327	0	1,493,327	0	1,493,327
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	6,673	-6,673	0	-6,673	0	-6,673
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	156,370	26,385	142,720	12,735	127,814	-2,171	129,985

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.3.12 2019

Based on the projections of the August 2018 24-Month Study, Lake Powell operated in the Upper Elevation Balancing tier in WY 2019, while Lake Mead operated in the Normal/ICS Surplus Condition (Table A78). The April 2019 24-Month Study projections resulted in Lake Powell operations shifting to Balancing for WY 2019 (Table A78) resulting in a total WY release of 9.00 maf from Lake Powell (Table A79). In the Lower Basin, a total of 6,566,389 af was delivered to the Lower Division states, and 1,463,062 af was delivered to Mexico. Lake Powell started WY 2019 at 3,592.28 feet and ended WY 2019 at 3,615.36 feet, with a total of 12.95 maf (120 percent of average) of unregulated inflow to Lake Powell during the WY. Lake Mead began CY 2019 at 1,081.46 feet and ended the year at 1,090.49 feet.

Tables A79 through A84 provide details on how projections of hydrology, reservoir conditions, and water use vary during the year and compare projections to actual values. To illustrate how the 24-Month Study projections change through time, Figure A15 includes monthly projections of Lakes Powell and Mead from the key 24-Month Studies during operations for CY/WY 2019.

In 2019:

- During November 2018 an LTEMP HFE was conducted at Glen Canyon Dam with a peak release of 38,100 cfs and peak duration of 60 hours, with a powerplant capacity peak release of 23,000 cfs. The total duration for the HFE was 5 days and 5 hours and total bypass was 132,030 af.
- For the second year, macroinvertebrate releases or “bug flows” were conducted during WY 2019. From May 1 through August 31, the LTEMP experiment adjusted the Saturday and Sunday weekend releases to low, steady flows, while weekday operations remained normal to meet hydropower demands.
- Following the extremely dry year in 2018, the inflow forecasts were below average at the beginning of the WY. Balancing releases under Section 6.B.4 of the Guidelines were projected to be between 8.23 maf and 9.0 maf to balance the contents of Lakes Powell and Mead in the October 2018 through February 2019 24-Month Studies. The anticipated annual release volume varied by month to balance the reservoirs through changing conditions. The monthly release volumes were altered to meet the LTEMP patterns as closely as possible within the changing annual release volumes. Significant improvements in forecasted April through July runoff increased the projected elevations at Lake Powell and by April the annual balancing release shifted to a 9.0 maf release for the WY.
 - Based on 24-Month Study projections in late 2018 and early 2019, a Level 1 Shortage Condition was projected to occur in CY 2020.
 - After projections shifted to a 9.0 maf balancing release from Lake Powell in WY 2019 and from Mid-Elevation Release Tier operations to Upper Elevation Balancing Tier operations in WY 2020, a shortage condition was no longer projected to occur in CY 2020.
- In May 2019, the [Drought Contingency Plans](#) (DCPs) were implemented. The completion of the DCP triggered a process to complete Mexico’s Binational Water Scarcity Contingency Plan (BWSCP; part of Minute No. 323), which included a [Joint Report of the IBWC Principal Engineers](#). This report was completed in July 2019.
- With the implementation of the Lower Basin DCP, new ICS exhibits were approved. With this, additional ICS creations plans for CY 2019 were submitted in July and following consultation with the Upper and Lower Basin states were approved later in 2019.
 - Following technical review of these plans by Reclamation, these plans for ICS creation were incorporated into 24-Month Study modeling in August.

- The August 2019 Most Probable 24-Month Study projected Lake Mead to end CY 2019 at elevation 1,089.40 feet, just 0.60 feet below the 1090.0 feet trigger elevation for requiring DCP and Mexico's water savings contributions to Lake Mead during CY 2020.
- Beginning in late November 2019 and continuing into mid-December 2019, the Lower Basin experienced an unusually wet period. There were a series of rainstorms resulting in large decreases in water demands downstream of Parker Dam. Additionally, storms produced runoff upstream of Lake Mead resulting in intervening flows of 169 percent of the projected value in November and 184 percent of the projected value in December.
 - Lake Mead ended CY 2019 at elevation 1090.49 feet. Based on the actual Lake Mead elevation on January 1, 2020, Section III.E.3. of Exhibit 1 to the Lower Basin Drought Contingency Plan Agreement went into effect in CY 2020.
- Through the combination of ICS creation, water for Mexico's Water Reserve, System Conservation, and other water left in Lake Mead, 971 kaf of stored and conserved water (934 kaf by the Lower Division states and 37 kaf by Mexico) was left in Lake Mead in CY 2019. This is the most conserved water and other water left in Lake Mead since the Guidelines were implemented. This resulted in an 8.51 maf release from Lake Mead, which was the second lowest since 2000 (only CY 2005 was lower).

Figure A15. 24-Month Study projections and actual end-of-month elevation at Lake Powell and Lake Mead for August 2018 – December 2019.

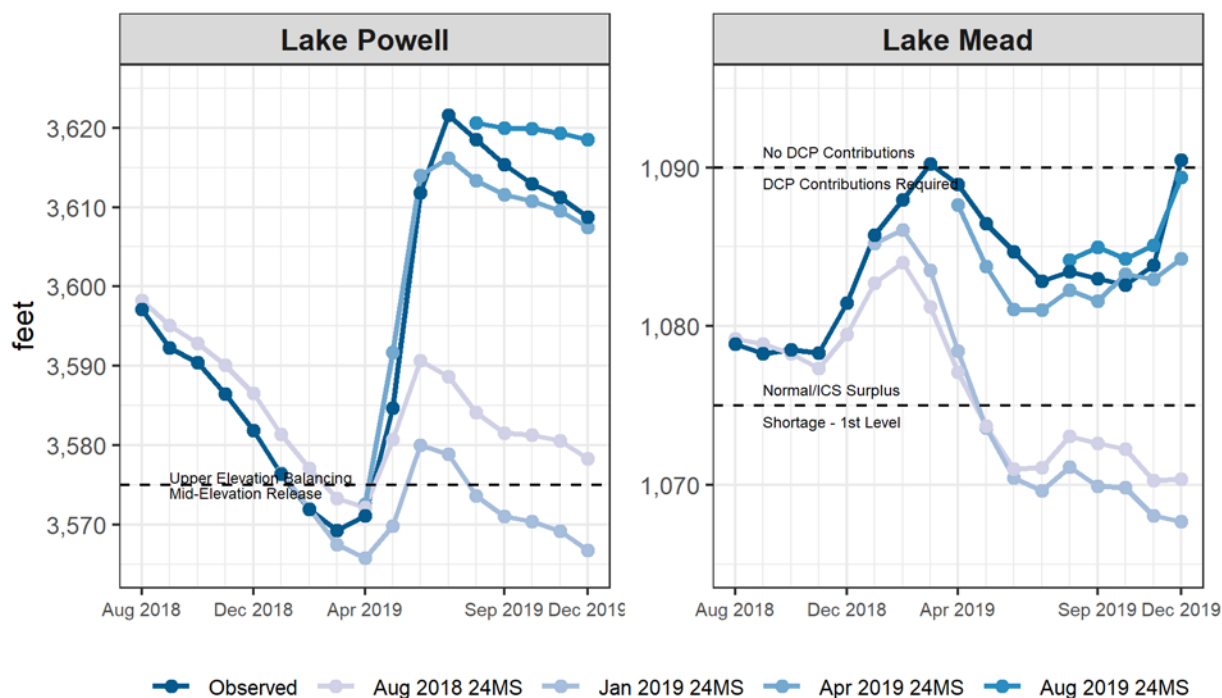


Table A78. Operational determination table for WY/CY 2019.

	Type of 24-Month Study Run	Aug 2018 ¹			Apr 2019 ²		
		Projected	Actual	Difference ³	Projected	Actual	Difference ³
Lake Powell EOCY 2018 elevation (feet)	Tier Determination	3,586.55					
	Published Study	3,586.55	3,581.85	4.70			
Lake Powell Operating Tier		Upper Elevation Balancing					
Lake Powell EOWY 2019 elevation (feet)	April Determination ⁴				3,618.44		
	Published Study				3,611.59	3,615.36	-3.77
Lake Mead EOWY 2019 elevation (feet)	April Determination ⁴				1,072.84		
	Published Study				1,081.60	1,083.00	-1.40
Lake Powell Mid-Year Adjustment					Balancing		
Lake Mead EOCY 2018 elevation (feet)		1,079.50	1,081.46	-1.96			
Lake Mead Operating Condition		Normal/ICS Surplus					

¹ August 2018 24-Month Study projections of December 31, 2017 conditions set the operating tier for Lake Powell in WY 2019 and operating condition in the Lower Basin for CY 2019.

² April 2019 24-Month Study projections of September 30, 2019 conditions determine if an April adjustment at Lake Powell is necessary.

³ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

⁴ The April determination run was based on an 8.23 maf annual release from Lake Powell in WY 2019.

Table A79. January, April, and August 24-Month Study projections during WY 2019 for key hydrologic and reservoir variables. Unless otherwise noted, all variables are either WY totals or EOWY elevations.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
April-July unregulated inflow (maf)	4.55	-5.86	9.20	-1.21	NA	NA	10.41
April-July unregulated inflow (% avg)	64%		128%				145%
WY unregulated inflow (maf)	6.98	-5.97	12.11	-0.84	13.54	0.59	12.95
WY unregulated inflow (% avg)	64%		112%		125%		120%
Lake Powell WY release (maf)	8.62	-0.38	9.00	0.00	9.00	0.00	9.00
Lake Powell EOWY elevation (feet)	3,571.07	-44.29	3,611.59	-3.77	3,620.02	4.66	3,615.36
Lake Mead EOWY elevation (feet)	1,069.93	-13.07	1,081.60	-1.40	1,084.96	1.96	1,083.00

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A80. January, April, and August 24-Month Study projections during CY 2019 for key hydrologic, reservoir, and water use variables. All variables are either CY totals or EOCY elevations.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Gains Glen to Hoover (kaf)	796	-339	988	-147	1,126	-9	1,135
Gains Below Hoover ² (kaf)	-217	-69	-184	-36	-206	-58	-148
Total Lower Basin and MX Use (af)	8,981,778	952,327	8,554,764	525,313	8,213,797	184,346	8,029,451
AZ Consumptive Use (af)	2,776,160	284,453	2,758,672	266,965	2,522,672	30,965	2,491,707
CA Consumptive Use (af)	4,405,618	564,932	3,996,092	155,406	3,996,121	155,435	3,840,686
NV Consumptive Use (af)	300,000	66,004	300,000	66,004	225,000	-8,996	233,996
MX Delivery (af)	1,500,000	36,938	1,500,000	36,938	1,470,004	6,942	1,463,062
Lake Powell EOCY elevation (feet)	3,566.75	-41.99	3,607.49	-1.25	3,618.56	9.82	3,608.74
Lake Mead EOCY elevation (feet)	1,067.68	-22.81	1,084.27	-6.22	1,089.40	-1.09	1,090.49

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² The gains below Hoover include inflows below Hoover as well as phreatophyte and other losses, which is why they are negative.

Table A81. January, April, and August 24-Month Study projections during CY 2019 for Arizona water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
AZ Consumptive Use ² (af)	2,776,160	284,453	2,758,672	266,965	2,522,672	30,965	2,491,707
AZ Tribal Mainstream Consumptive Use ³ (af)							285,113
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	-147,557	0	-147,557	150,000	2,443	147,557
System Conservation Water ⁴ (af)	23,840	-16,954	41,328	534	41,328	534	40,794
Other Water Left in Lake Mead ⁵ (af)	0	-119,942	0	-119,942	86,000	-33,942	119,942
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	0	0	0	0	0	0
Water Stored for NV (af)	0	0	0	0	0	0	0
Water Recovered for CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Arizona's Consumptive Use can be computed as: 2,800,000 af (Arizona's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV – Water Recovered for CA. There may be minor differences between this calculation and the value reported above as Actual Arizona Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Arizona tribal mainstream use includes use by Fort Mojave Indian Tribe, Colorado River Indian Tribes, Quechan Indian Tribe, and Cocopah Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections. Tribal use within the CAWCD service area is available at <https://www.cap-az.com/departments/water-operations/deliveries>.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A82. January, April, and August 24-Month Study projections during CY 2019 for California water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
CA Consumptive Use ² (af)	4,405,618	564,932	3,996,092	155,406	3,996,121	155,435	3,840,686
CA Tribal Mainstream Consumptive Use ³ (af)							28,114
Total ICS Delivery (af)	11,105	11,105	0	0	0	0	0
Total EC ICS Creation (af)	1,579	-409,860	400,000	-11,439	400,000	-11,439	411,439
System Conservation Water ⁴ (af)	3,908	16	3,908	16	3,879	-13	3,892
Other Water Left in Lake Mead ⁵ (af)	0	-97,444	0	-97,444	0	-97,444	97,444
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁶ (af)	0	-46,546	0	-46,546	0	-46,546	46,546
Water Stored for NV (af)	0	0	0	0	0	0	0
Recovered Water Stored in AZ (af)	0	0	0	0	0	0	0
Other ICS Creation ⁷ (af)	0	0	0	0	0	0	0

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² California's Consumptive Use can be computed as: 4,400,000 af (California's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – System Conservation Water – Other Water Left in Lake Mead + Overrun – Overrun Payback + Water Stored for NV + Recovered Water Stored in AZ. There may be minor differences between this calculation and the value reported above as Actual California Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ California tribal mainstream use includes use by Fort Mojave Indian Tribe, Chemehuevi Indian Tribe, Colorado River Indian Tribes, and Quechan Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

⁵ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁶ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁷ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

Table A83. January, April, and August 24-Month Study projections during CY 2019 for Nevada water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
NV Consumptive Use ² (af)	300,000	66,004	300,000	66,004	225,000	-8,996	233,996
NV Tribal Mainstream Consumptive Use ³ (af)							3,022
Total ICS Delivery (af)	0	0	0	0	0	0	0
Total EC ICS Creation (af)	0	-66,004	0	-66,004	75,000	8,996	66,004
Other Water Left in Lake Mead ⁴ (af)	0	0	0	0	0	0	0
Overrun (af)	0	0	0	0	0	0	0
Overrun Payback ⁵ (af)	0	0	0	0	0	0	0
Water Stored in AZ (af)	0	0	0	0	0	0	0
Water Stored in CA (af)	0	0	0	0	0	0	0
Other ICS Creation ⁶ (af)	30,000	-4,929	30,000	-4,929	30,000	-4,929	34,929
System Conservation Water ⁷ (af)	645	89	645	89	645	89	556

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² Nevada's Consumptive Use can be computed as: 300,000 af (Nevada's basic apportionment) + Total ICS Delivery – Total EC ICS Creation – Other Water Left in Lake Mead + Overrun – Overrun Payback – Water Stored in AZ – Water Stored in CA. There may be minor differences between this calculation and the value reported above as Actual Nevada Consumptive Use. Please see the [Water Accounting Report](#) for more information.

³ Nevada tribal mainstream use includes use by Fort Mojave Indian Tribe. Projections of tribal use in the 24-Month Study are included in the state projections.

⁴ Includes unused apportionment, other conserved water, and voluntary contributions to benefit system storage.

⁵ Values shown only include payback amounts that affect a state's consumptive use; paybacks from application of ICS credits are not reflected in these values.

⁶ Includes ICS creation from: System Efficiency ICS; BICS converted from MWR; Nevada's creation of Tributary Conservation (TC) ICS and Imported ICS; and the conversion of Nevada's TC and Imported ICS to Extraordinary Conservation (EC) ICS because these ICS creation amounts are not incorporated into the calculation of the state's consumptive use.

⁷ Includes water conserved pursuant to agreements executed under the Pilot System Conservation Program and other system conservation agreements.

Table A84. January, April, and August 24-Month Study projections during CY 2019 for Mexico water use. All variables are CY totals.

	24-Month Study						Actual
	Jan 2019		Apr 2019		Aug 2019		
	Projection	Difference ¹	Projection	Difference ¹	Projection	Difference ¹	
Mexico Delivery (af)	1,500,000	36,938	1,500,000	36,938	1,470,004	6,942	1,463,062
Total MWR Delivery ² (af)	0	0	0	0	0	0	0
Total MWR Creation ² (af)	0	-36,938	0	-36,938	29,996	-6,942	36,938
Other MWR ³ (af)	0	0	0	0	0	0	0
Other Flows to Mexico ⁴ (af)	155,342	-27,341	146,350	-36,333	139,404	-43,279	182,683

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

² For the purpose of these tables, MWR includes delivery deferred under Minutes 318, 319, and 323.

³ Other MWR includes activity that does not affect the mass balance at Lake Mead, i.e., BICS converted from MWR and system water provided to the United States.

⁴ Includes flows to Mexico in excess of Treaty requirements and water bypassed pursuant to IBWC Minute 242.

A.4 24-Month Study Accuracy

The previous section documents the projections and observed values for key hydrologic and water use variables used in the 24-Month Study and the resulting elevation projections at Lake Powell and Lake Mead. Each year posed its own unique challenges and events that had to be dealt with while operating Lake Powell and Lake Mead. Forecasts may not have anticipated unusually wet or dry conditions and operations had to adapt to the changing conditions. While individual years may have large errors in projected EOWY/EOCY elevations, it is useful to summarize the accuracy of the 24-Month Study projections across all years (2008 through 2019). Figure A16 and Figure A17 present how the error in projected elevation at Lake Powell and Lake Mead change throughout the year. EOCY projections are shown starting in January and going through December, while EOWY projections are shown starting in October and going through September. Lake Powell and Lake Mead elevations are provided because these variables directly influence the determinations made by in response to the 24-Month Study projections, and since they integrate all the other variables included in the previous section. In figures A16 and A17 the box and whiskers show how the errors are distributed in 2008 through 2019, and clearly show how errors decrease as the lead time gets shorter, for example, the errors for October's projection of EOCY elevation are much smaller than the errors in the April projections.

These results are further summarized in Table A85 and Table A86, which compute the average error and the mean absolute error (MAE) for each month across all years. The average error shows that there are some biases in the projections – for example Lake Powell's EOCY elevation is typically over-projected (the average error is always greater than zero). Similarly, Lake Mead's EOCY elevation is typically under-projected, though these biases decrease as the projection lead time gets shorter. The EOWY projections of Lake Powell elevation show the opposite, where the elevation is typically under projected for October through May. Again, Lake Mead's EOWY elevation has a bias towards being under projected in most months.

The MAE provides insights about the overall magnitude of projection errors. Generally speaking, the MAE decreases monotonically through time, as expected. There are some instances where this is not the case, for example, Lake Mead's EOCY elevation error increases from February to March, which is likely due to a few outliers that still strongly influence the MAE. For Lake Powell EOCY projections, there is no month-to-month decrease in MAE that is marginally larger than other month-to-month differences. Contrarily, the MAE decreases substantially for Lake Mead EOCY projections from March to April compared to other month-to-month changes in MAE. This is likely due to the certainty in Lake Powell's release that is provided in the April 24-Month Study. Similar trends are observed in the month-to-month changes in MAE for the EOWY projections. Overall, the MAE at Lake Mead is lower than Lake Powell's particularly after April.

Figure A16. EOY Lake Powell and Lake Mead projection errors for all 24-Month Studies from January 2008 – December 2019. (A) and (C) show the statistics of the errors as box and whisker plots where the horizontal line marks the median; the box extends to the 25th and 75th percentiles, the whiskers extend to 1.5 * the inner quartile range, and points represent outliers. (B) and (D) present the errors for each year through time.

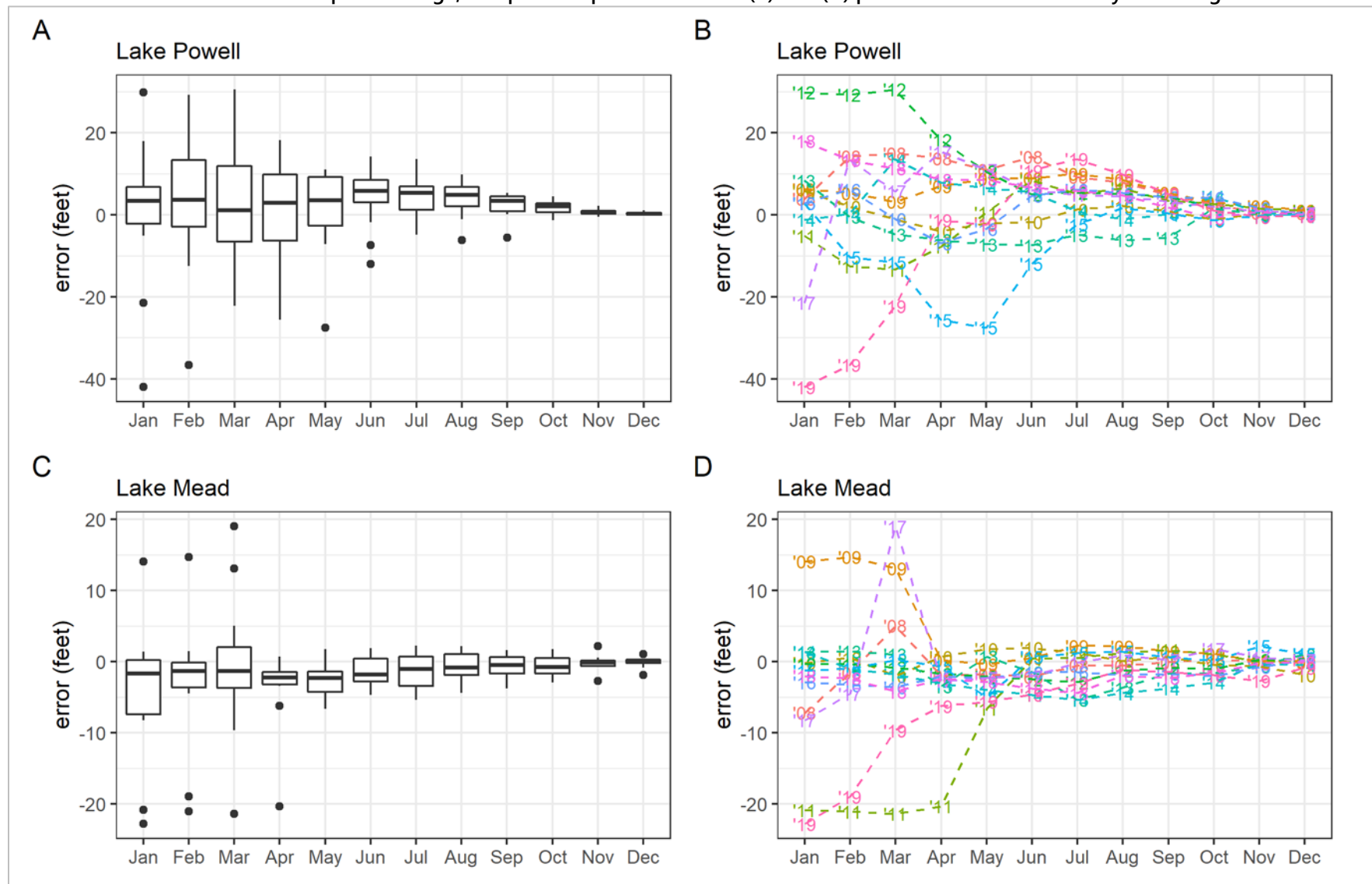


Figure A17. EOWY Lake Powell and Lake Mead projection errors for all 24-Month Studies from January 2008 – December 2019. (A) and (C) show the statistics of the errors as box and whisker plots where the horizontal line marks the median; the box extends to the 25th and 75th percentiles, the whiskers extend to 1.5 * the inner quartile range, and points represent outliers. (B) and (D) present the errors for each year through time.

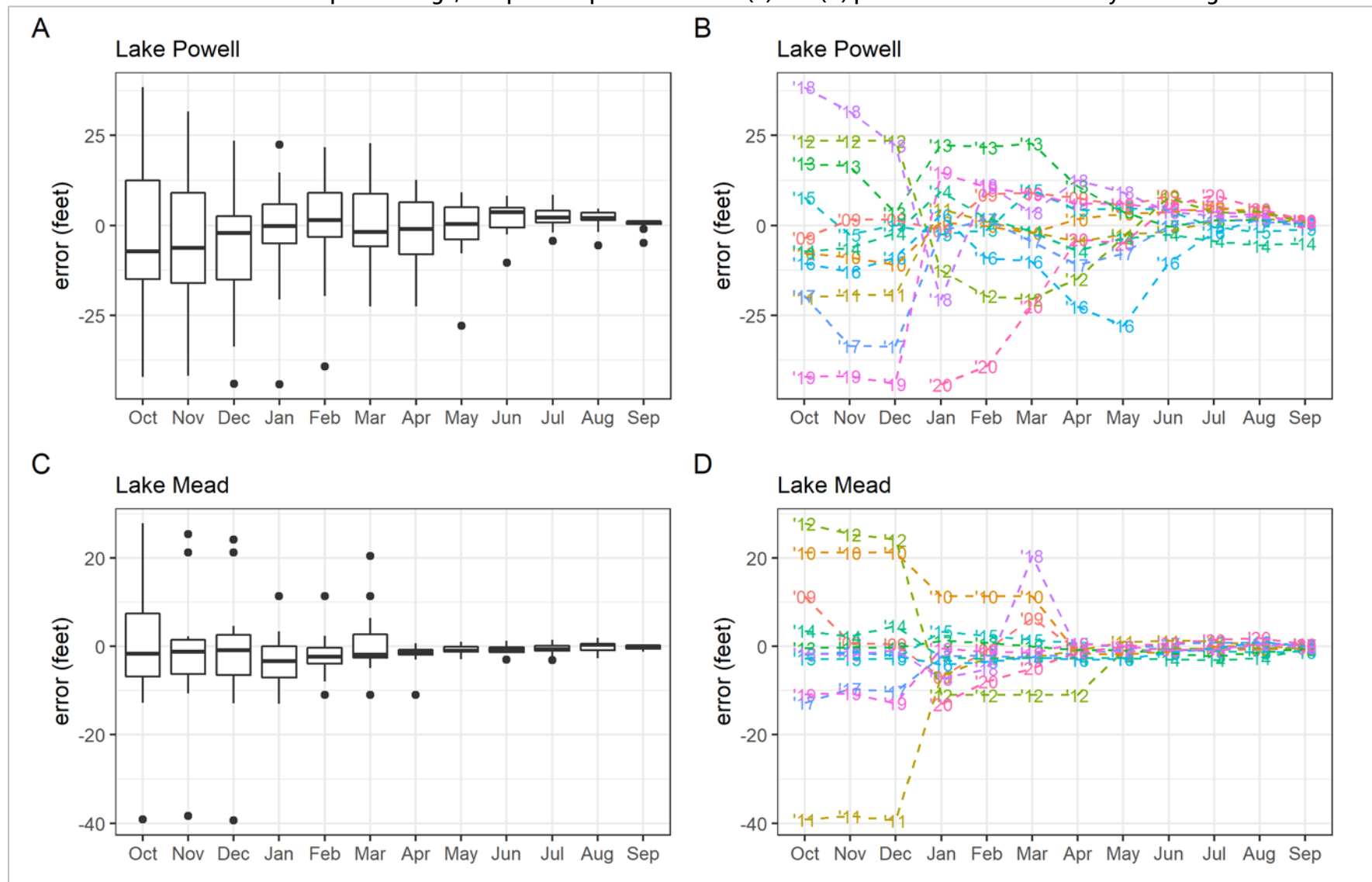


Table A85. Average and mean absolute error for monthly EOCY projections of Lake Powell and Lake Mead elevation.

	Lake Powell		Lake Mead	
	Average Error ¹ (feet)	MAE (feet)	Average Error ¹ (feet)	MAE (feet)
Jan	0.70	12.32	-4.08	6.87
Feb	2.01	11.99	-3.11	5.90
Mar	2.13	11.13	-0.42	6.82
Apr	1.61	10.22	-3.63	3.78
May	1.22	8.28	-2.53	2.95
Jun	4.11	7.62	-1.59	2.18
Jul	4.63	5.82	-1.49	2.37
Aug	4.08	5.28	-0.74	1.72
Sep	2.37	3.31	-0.59	1.37
Oct	1.73	2.24	-0.60	1.34
Nov	0.68	0.81	-0.17	0.69
Dec	0.31	0.41	-0.04	0.54

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.

Table A86. Average and mean absolute error for monthly EOWY projections of Lake Powell and Lake Mead elevation.

	Lake Powell		Lake Mead	
	Average Error ¹ (feet)	MAE (feet)	Average Error ¹ (feet)	MAE (feet)
Oct	-2.15	17.96	-0.51	12.13
Nov	-4.72	18.04	-1.39	10.40
Dec	-6.19	15.47	-1.66	10.83
Jan	-2.29	11.49	-3.22	5.88
Feb	-1.01	10.54	-1.89	4.30
Mar	-0.73	9.77	1.01	5.59
Apr	-1.69	8.93	-1.98	2.20
May	-1.42	6.91	-0.95	1.13
Jun	1.95	4.43	-0.71	1.11
Jul	2.19	3.28	-0.56	1.12
Aug	1.69	2.91	-0.09	0.99
Sep	0.26	1.22	-0.23	0.48

¹ Differences are computed as projected minus actual; positive values indicate an over-projection while negatives indicate an under-projection.