Colorado River Board of California

November 3, 2015

NOTICE OF REGULAR MEETING OF THE COLORADO RIVER BOARD

NOTICE IS HEREBY GIVEN pursuant to the call of the Chairperson, Dana B. Fisher, Jr., by the undersigned Executive Director of the Colorado River Board of California that a regular meeting of the Board Members is to be held as follows:

Date: Wednesday, November 18, 2015
Time: 1:00 p.m.
Place: Imperial Irrigation District
William R. Condit Auditorium
1285 Broadway Ave.
El Centro, CA 92243
(760) 339-9477

The Colorado River Board of California welcomes any comments from members of the public pertaining to items included on this agenda and related topics. Oral comments can be provided at the beginning of each Board meeting; while written comments may be sent to Mr. Dana B. Fisher, Jr., Chairperson, Colorado River Board of California, 770 Fairmont Avenue, Suite 100, Glendale, California, 91203-1068.

An Executive Session may be held in accordance with provisions of Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3 of Title 2 of the Government Code and in accordance with Sections 12516 and 12519 of the Water Code to discuss matters concerning interstate claims to the use of Colorado River System waters in judicial proceedings, administrative proceedings, and/or negotiations with representatives from other states or the federal government.

Requests for additional information may be directed to: Ms. Tanya M. Trujillo, Executive Director, Colorado River Board of California, 770 Fairmont Avenue, Suite 100, Glendale, CA 91203-1068, or 818-500-1625. A copy of this Notice and Agenda may be found on the Colorado River Board's web page at www.crb.ca.gov.

A copy of the meeting agenda, showing the matters to be considered and transacted, is attached.

Tanya M. Trujillo
Executive Director

attachment: Agenda

Regular Meeting
COLORADO RIVER BOARD OF
CALIFORNIA
Wednesday, November 18, 2015
1:00 p.m.

William R. Condit Auditorium

1285 Broadway Ave.
El Centro, CA 92243
(760) 339-9477

At the discretion of the Board, all items appearing on this agenda, whether or not expressly listed for action, may be deliberated upon and may be subject to action by the Board. Items may not necessarily be taken up in the order shown.

1. Call to order

2. Welcome by the Imperial Irrigation District

3. Opportunity for the Public to Address the Board as required by Government Code, Section 54954.3(a) (limited to 5 minutes)

4. Administration
   a. Consideration and Approval of the Minutes of the Meeting held October 14, 2015 **(Action)**

5. Colorado River Basin Water Reports
   a. Reports on current reservoir storage, reservoir releases, projected water use, and forecasted river flows
   b. State and Local Water Reports

6. Imperial Irrigation District Water Conservation and Management Status Report

7. Update regarding the California Drought

8. Presentation from Jeanine Jones regarding upcoming seasonal precipitation forecasting and interstate irrigation management information system (CIMIS) workshops

9. Staff Reports regarding the Colorado River Basin Programs
   a. Review status of the Basin States Drought Contingency Programs
   b. Review status of the Colorado River Basin Water Supply and Demand Study
   c. Review status of the implementation of Minute 319
   d. Review status of the Salinity Control Forum, Workgroup, and Advisory Council
   e. Review status of the Glen Canyon Dam Adaptive Management Work Group and Long-Term Experimental and Management Plan EIS
   f. Review Status of the Lower Colorado River Multi-Species Conservation Program

10. Announcements/Notices

11. Executive Session

An Executive Session may be held by the Board pursuant to provisions of Article 9 (commencing with Section 11120) of Chapter 1 of Part 1 of Division 3 of Title 2 of the Government Code and Sections 12516 and 12519 of the Water Code to discuss matters concerning interstate claims to the use of Colorado River system waters in judicial proceedings, administrative proceedings, and/or negotiations with representatives from other states or the federal government.

12. Other Business

a. Next Board Meeting: December 16, 2015
3:00 p.m.
Caesar's Palace
(Colorado River Water Users Association)
3570 South Las Vegas Blvd.
Las Vegas, NV 89109
(702) 731-7110

Minutes of Meeting
COLORADO RIVER BOARD OF CALIFORNIA
Wednesday, October 14, 2015

A meeting of the Colorado River Board of California was held on Wednesday, October 14, 2015.

Board Members and Alternates Present

Brian Brady
Dana Bart Fisher, Jr., Chairman
Glen Peterson
James Hanks
Michael Touhey
Jack Seiler

David Vigil, Alternate Designee
Department of Fish and Wildlife
Doug Wilson
Jeanine Jones, Designee
Department of Water Resources

Board Members and Alternates Absent

Stephen Benson
Henry Kuiper
Peter Nelson
John Powell Jr.

David Pettijohn
Chris Hayes, Designee
Department of Fish and Wildlife

Others Present

Steve Abbott
Brian Brady
Robert Cheng
Allison Ellingson
Karen Donovan
Jack Hartman
Bill Hasencamp
Michael Hughes
Eric Katz
Lisa Johansen
Tom Levy
Lindia Liu
Kara Mathews

Jan Matusak
Doug Mcpherson
Jessica Neuwerth
Vic Nguyen
Autumn Plourd
Angela Rashid
Tom Ryan
Suzanna Sexton
Mark Stuart
Tanya Trujillo
Mark VanVlack
Jerry Zimmerman

CALL TO ORDER

Chairman Fisher announced the presence of a quorum and called the meeting to order at 10:01 A.M.

OPPORTUNITY FOR THE PUBLIC TO ADDRESS THE BOARD

Chairman Fisher asked if there was anyone in the audience who wished to address the Board on items on the agenda or matters related to the Board. Hearing none, Chairman Fisher moved to the next agenda item.

ADMINISTRATION

Consideration and Approval of the Minutes

Chairman Fisher asked for a motion to approve the August 12, 2015 and September 9, 2015 meeting minutes. Mr. Wilson moved that the minutes be approved, seconded by Ms. Jones, and by unanimous support, the August 12, 2015 and September 9, 2015 meeting minutes were approved.

Consideration of Application for an Allocation of Water from the Lower Colorado Water Supply Project

Ms. Trujillo reported that the CRB technical staff reviewed an application from an individual residing in San Bernardino County. The applicant owns a single-family dwelling and is seeking to utilize up to one acre-foot of water per year. The CRB technical staff recommended that the Board adopt a resolution in support of the application.

MOTION: Chairman Fisher asked for a motion to approve the resolution. Mr. Peterson moved that the resolution be approved, seconded by Ms. Jones. By unanimous support, the resolution was approved.

Colorado River Basin Water Reports and State and Local Water Reports

Ms. Trujillo reported that October 1, 2015, marked the beginning of the 2016 Water Year. She reported that after a series of lower predictions for Water Year 2015, the final inflow into Lake Powell was 94% of average. Ms. Trujillo also noted the release from Lake Powell for Water Year 2015 of 9.0 million acre-feet. Ms. Trujillo stated that Reclamation has forecasted a zero percent probability for a shortage in the Lower Basin in 2016 and an 18% probability in 2017.

Ms. Trujillo reported that as of October 5, 2015, the water level at Lake Powell was at 3,606 feet with 12.3 million acre-feet, or 51% of capacity, while the water level at Lake Mead was at 1,078 feet with 9.98 million acre-feet, or 38% of capacity. Total

system storage was at 51% of capacity. Several Upper Basin reservoirs remain close to full capacity.

Brock Reservoir has stored a cumulative total of 116,000 acre-feet. Senator Wash has stored a cumulative total of 93,000 acre-feet of water. Ms. Trujillo noted that the reservoirs are helpful tools for maintaining Lower Basin water supplies and decreasing the amount of water released from Lake Mead. Through October 2015, excess flows to Mexico have been approximately 13,800 acre-feet. Ms. Trujillo reported that the Bypass flows, which is water required to be released to address Minute 242 salinity concerns, have been approximately 106,000 acre-feet. Ms. Trujillo stated that the final numbers will be finalized in connection with the Decree Accounting Report process at the end of the year.

Ms. Trujillo reported that precipitation in August and September was below average for most places in the Basin. Although most places in the Basin have experienced improved drought conditions, in California, 46% of the state continues to be in the exceptional drought category. The State Water Resources Control Board has issued reports indicating that on a statewide basis, Californians have been able to meet the Governor's April 1st Executive Order water conservation mandates. On a statewide basis, water reductions have been at 27% on average as of the month of August. Approximately, 600,000 acre-feet of water has been conserved during the June to August timeframe. Ms. Trujillo also noted that Water Year 2015 was the warmest year on record. One impact associated with drought and high temperatures is the increase in forest fires. To date, California firefighters responded to over 7,000 fires that burned over 800,000 acres of land. Ms. Jones reported that the Department of Water Resources is in the process of removing a temporary rock barrier that was installed in May to protect water quality in the Delta. The fisheries agencies had required that the barrier be removed by November 15, 2015. Ms. Jones also noted that due to the impending El Nino predictions, DWR has also been focusing on flood preparedness in some counties.

Mr. Stuart reported that Los Angeles Civic Center precipitation to date is 15 inches or 70% of average, noting that the area received a 2.4 inches of rainfall in September. As of October 5, 2015, the Northern Sierra Precipitation Eight Station Index was at 80% of average. The San Joaquin Precipitation Index was 47% of average. The Southern Sierras Precipitation Index was 47% of average. Regarding the State Water Project, Mr. Stuart reported that total reservoir storage is 1.9 million acre-feet, or 34% of capacity. The State Water Project's largest reservoir, Lake Oroville is almost at a historic low at 1.0 million acre-feet, or 30% of capacity.

Mr. Peterson reported that MWD's conservation in the region has reduced water deliveries by 27%, noting that his region has conserved 36%. Vice Chairman Wilson reported that in the San Diego region, conservation has been about 27% through the last four months, exceeding the Governor's mandatory conservation target for the State. Mr. Hanks reported that IID is predicting a 136,000 acre-feet underrun. In addition, IID is on target in working with growers for the on-farm conservation efforts. Chairman Fisher stated that as of August 1, 2015, 29% of the acres within PVID service area are fallowed

as part of the fallowing agreement with MWD. Mr. Seiler, from PVID, provided an update regarding the on-going maintenance and gate replacement at the Palo Verde Diversion Dam. Chairman Fisher added that PVID took possession of the dam a few years ago but realized there were significant maintenance obligations that had to be addressed.

Review Status of the Basin States Drought Contingency Programs

Ms. Trujillo reported that the Central Arizona Project (CAP) is currently seeking approval of its new Intentionally Created Surplus proposal. CAP has received feedback regarding the proposal from IID and has been working with IID staff and Reclamation to try to address IID's concerns. CAP will present a revised plan that will highlight the verification steps they intend to follow to verify the amount of conservation that will take place in their program. Ms. Trujillo stated that CAP's proposal is designed to generate 95,000 acre-feet in 2015 and 2016. Ms. Trujillo noted that the Board Packet included a letter from Reclamation authorizing a Water Conservation Program in Arizona that is designed to leave approximately 14,000 acre-feet of water in Lake Mead in 2016 from the Fort McDowell Yavapai Nation. Ms. Trujillo stated that this is an example of water users in Arizona receiving compensation to contribute water for the benefit of Lake Mead, which will be accounted for in the Decree Accounting Report.

Ms. Trujillo reported that Reclamation is continuing to implement the Pilot System Conservation Program for Lower Basin Projects. Contracts for two projects, in Coachella and City of Needles, are in the process of being finalized. Both programs will be documented and facilitated through Reclamation's Decree Accounting process. The Upper Colorado River Commission is coordinating a similar review and proposal process for Upper Basin contracts. Reclamation received congressional authorization to participate in the Upper Basin System Conservation Pilot Program. In 2018, Reclamation is required to submit a report to Congress documenting the results of the pilot program and to provide recommendations as to whether the program should be continued. Ms. Trujillo stated that the Lower Basin applications for the program will fully utilize the existing amount of funding contributed to the program and the next round of potential funding is underway. The existing funding agreement may be modified to include additional funding from the program's existing funders or additional sources.

Ms. Trujillo stated that the Bypass Flows Workgroup continues its efforts to evaluate options to increase efficiencies in the Yuma area. The next meeting of the Workgroup is scheduled for October 26, 2015. Ms. Trujillo stated that the Workgroup will continue to refine and evaluate the suite of proposals aimed at maximizing conservation of water for use in the US. The Workgroup has targeted 100,000 acre-feet per year of additional water that could be saved and used for the benefit of the Lower Basin system. Some of the potential proposals that could be implemented range from operation of the Yuma De-salting Plant to pumping additional water from the Minute 242 well field. Ms. Trujillo stated that a major component to the success of this project is receipt of additional federal funding.

Review status of the implementation of Minute 319

Ms. Trujillo reported that, as the five-year pilot program Minute 319 continues to be implemented through 2017, small group bi-national meetings occurred in September in Tijuana and last week in New Mexico with a focus on creating a framework for the potential successor Minute, which is targeted to be completed within the next couple of years. The first task is to develop workgroups that can provide assistance and guidance with respect to positions relating to additional bi-national projects that could be funded and/or to have more flexibility with respect to the salinity requirement at the border. The Mexican delegation is interested in continuing to develop environmental programs for the Delta and the Cienega area in Mexico. A tour planned for November 5 will highlight some of the results of last year's pulse flow event and review how some of the restoration areas have progressed since the adoption of Minute 319. A follow-up meeting of the bi-national negotiating group is scheduled for November in Mexicali.

Ms. Trujillo reported that the International Boundary Water Commission has completed Minute 320 with Mexico. It provides a framework for dealing with the border water issues in the Tijuana River area. The Minute was executed on October 5 in Tijuana and is available on IBWC's website.

Review status of the Salinity Control Forum, Workgroup, and Advisory Council

Board staff Lindia Liu reported that the Paradox Cooperating Agencies met on September 21 in Reclamation's office in Grand Junction, Colorado. At the meeting, Reclamation reported that the Paradox well surface injection pressure has been steady for the past two years and no major seismic events in the past twelve months. Ms. Liu reported that Reclamation is initiating studies recommended by the Evaporation Pond Consulting Review Board, including a hydrogen sulfide management study, a pond optimization study, which would determine whether there is a need to do a pilot pond, salt disposal options, and an ecological risk assessment for the birds. Reclamation also did a cost estimate for assessing topographies for evaporation ponds on how topography impacts earth work and thus the cost. The take away message was that topography is not a restricting factor in determining where to put the ponds in the valley. Reclamation is still reviewing that estimate to see what else is not included.

Ms. Liu reported that Reclamation is evaluating issues associated with surface infrastructure, drilling, and ranking of potential sites for the second well alternative. The sites are expected to be ranked by fall 2016. Reclamation is also currently reviewing a proposal received for the Request For Proposal they put out for the commercial use of the brine.

Ms. Liu reported that Reclamation walked through a process flowchart, with a contingency plan laid out in case the well fails. If the well fails and the EIS Record of Decision has not been completed, Reclamation will consult with the Salinity Control Forum, and it may be appropriate to start construction on a second well. The flowchart

helps visualize the EIS process. Reclamation will present an updated schedule at the Forum meeting at the end of October based on this flowchart.

The Work Group met on September 22-24 in Colorado Springs. Ms. Liu reported that Reclamation continues their efforts on updating the damages model, and is working to get data from Arizona and Nevada, as well as from areas outside of MWD service area. The Work Group chairman walked through the triennial review and identified sections that will be updated. Ms. Liu presented a map of the salinity project areas. She reported that the salinity coordinators for the Lower Gunnison and the Uinta Basin project areas updated the Work Group on some of the challenges they have had in working with the landowners. The Forum and Advisory Council are scheduled to meet on October 28 and 29 in Tucson, Arizona.

Mr. Wilson commented that he was happy to hear about the contingency plan in case of an emergency but was concerned that the well is running at a lower capacity. Ms. Trujillo responded that we continue to push for the completion of the EIS to bring the project back to its optimal design and increase salt reductions associated with the operation. Ms. Trujillo added that the disposal rate has dropped around ten percent. Ms. Liu added that the well was disposing about 110,000 tons per year and now about 100,000 tons per year. Ms. Trujillo further added that the upside of the reduced operations is the lack of earthquakes but the downside is less productivity out of that project.

Glen Canyon Dam Adaptive Management Work Group and Long-Term Experimental and Management Plan EIS

Staff member Jessica Neuwerth reported that scientists and members of the Glen Canyon Dam Adaptive Management Program (GCDAMP) had been evaluating the feasibility of carrying out a high flow experiment (HFE) in November of 2015. Although the sediment necessary to implement the HFE was available, biological concerns had led to a recommendation that an HFE not be implemented. Ms. Neuwerth reported that green sunfish, a non-native predatory fish, had been found downstream of Glen Canyon Dam, and the HFE was disallowed over worries that an HFE would encourage the sunfish to spread before they could be eradicated.

Ms. Neuwerth stated that Board staff had submitted cooperating agency comments on the Long-Term Experimental and Management Plan (LTEMP) EIS on September 30. A public draft is expected in mid-December, with a 60-day comment period. A Record of Decision and Biological Opinion for the EIS are expected by late spring or early summer of 2016. Finally, Ms. Neuwerth reported that the Technical Work Group would be meeting on October 20 and 21 in Phoenix, AZ.

Ms. Trujillo noted that the recent HFE process was an example of how interests and resource concerns are balanced in the GCDAMP and of how complex decisions are being made in the upcoming LTEMP EIS.

In response to a question from Board Member Peterson, Ms. Neuwerth explained that the green sunfish probably came through Glen Canyon Dam from the established population in Lake Powell. Ms. Neuwerth also noted that efforts were underway to contain and remove the fish, including sealing off the backwater from the main channel and planning the application of rotenone to the area. Vice Chairman Wilson inquired how the fish were being removed. Ms. Neuwerth and Board Member Vigil described the potential processes used to capture the fish, including netting and electrofishing. Mr. Vigil explained that electrofishing used a DC current to immobilize fish so they could be netted more easily. Ms. Neuwerth noted that the removal or killing of fish in the Grand Canyon was a sensitive issue for some Native American tribes and that coordination with tribes over the removal of green sunfish was ongoing.

Lower Colorado River Multi-Species Conservation Program

Ms. Neuwerth reported that the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Work Group had met on September 30 in Las Vegas, NV. Among the topics of discussion was the new Fish Augmentation Plan, which will guide native fish stocking from 2015 to 2020. The group also discussed the threatened northern Mexican gartersnake, which Ms. Neuwerth noted is known to inhabit the Bill Williams River near the Planet Ranch property the group is attempting to acquire, and which was also recently found at the LCR MSCP's Beal Lake Conservation Area. The work group discussed the snake and is currently evaluating how the snake could be added to the LCR MSCP permit as a covered species.

Ms. Neuwerth reported that a hearing before the Arizona Supreme Court was held on October 13. The hearing addressed the sever and transfer of water rights at the Planet Ranch property that the LCR MSCP has been attempting to acquire as a habitat restoration area. In addition to Planet Ranch, the group is also moving forward with restoration at several other sites. LCR MSCP staff are currently creating habitat designs for Parker Dam Camp, Mojave Valley, Palo Verde Ecological Reserve South, and Three Fingers Lake.

Finally, Ms. Neuwerth noted that the LCR MSCP steering committee would meet on October 28 in Las Vegas, NV.

ANNOUNCEMENTS

Ms. Trujillo reported that Governor Brown signed legislation that authorized actions for Salton Sea restoration that outlined targets of restoring 12,000 acres of shoreline habitat over the next five years and up to 25,000 additional acres of shoreline by 2020. The Little Hoover Commission also prepared a report similar to the legislation signed by Governor Brown on Salton Sea restoration. The report included a recommendation that the State should transfer the mitigation water that's currently being sent to the Salton Sea to MWD in exchange for funding that could be used for additional restoration projects. The Little Hoover Commission recommended the expedition of

permits and to allow for construction as soon as possible for projects that have already received permits and funding.

Ms. Trujillo also reported that there was a hearing before the Senate Energy and Natural Resources Committee in Washington, DC on pending drought legislation bills, including the Senate bill from Senators Feinstein and Boxer relating to California drought issues and the previously passed House bill that has been sent over to the Senate for consideration. The committee did not take any action on those bills, and did not announce the date when the committee would be officially marking up or authorizing the bills to move forward. Ms. Trujillo explained that the mark-up hearing would be an opportunity for amendments or potential consolidation of the two bills.

Ms. Trujillo reported that during the hearing, Senator Flake, from Arizona, a member of the Energy and Natural Resources Committee asked Mike Connor, who was testifying for the Administration on behalf of all of the bills, about the availability of unused apportionment from one State's allocation to be used or transferred to another State for use. Mike Connor responded that based on the agreement of the states and, in particular, since the 2007 Interim Guidelines had been adopted, the Secretary has not allocated any unused apportionment from one State to another State. Ms. Trujillo reported that Mike Connor cautioned that no such determination would be made without involvement and consultation with the States.

Ms. Trujillo reported that the Colorado River Basin Forecast Center will be holding a stakeholder forum/webinar on October 20-21, 2015.

Ms. Trujillo reported that David Palumbo, an Assistant Regional Director of the Bureau of Reclamation's Lower Colorado Region, has been selected to be the new Deputy Commissioner for operations at the Bureau of Reclamation in Washington D.C.

Ms. Trujillo reported that Anne Castle, former Assistant Secretary for Water and Science, has a new position with the University of Colorado, School of Law.

Chairman Fisher reported that a prospective list of Board meeting dates for 2016 was circulated during the Board meeting for review. If agencies are interested in hosting meetings next year should let Ms. Trujillo know.

Chairman Fisher reported that the November 2015 Board meeting will be held at Imperial Irrigation District at the William Condit Auditorium at their office on Broadway in El Centro, California.

ADJOURNMENT

With no further items to be brought before the Board, Chairman Fisher asked for a motion to adjourn the meeting. Upon the motion of Ms. Jones, seconded by Mr. Peterson, and unanimously carried, the meeting was adjourned at 11:03 a.m.

Nov 09, 2015

LOWER COLORADO WATER SUPPLY REPORT

River Operations

Bureau of Reclamation

Questions: BCOOWaterops@usbr.gov

(702)293-8373

http://www.usbr.gov/lc/region/g4000/weekly.pdf

CURRENT STORAGE	PERCENT FULL	Content 1000 ac-ft (kaf)	Elev. (Feet above mean sea level)	7-Day Release (CFS)
LAKE POWELL	51%	12,366	3606.35	9,600
* LAKE MEAD	38%	9,940	1079.14	8,900
LAKE MOHAVE	82%	1,484	634.92	10,000
LAKE HAVASU	89%	550	446.41	7,600
TOTAL SYSTEM CONTENTS **	51%	30,115		
As of 11/08/2015				
SYSTEM CONTENT LAST YEAR	50%	29,899		

* Percent based on capacity of 26,120 kaf or elevation 1219.6 feet.

** TOTAL SYSTEM CONTENTS includes Upper & Lower Colorado River Reservoirs, less Lake Mead exclusive flood control space.

Salt/Verde System	49%	1,112		
Painted Rock Dam	0%	0	535.14	0
Alamo Dam	5%	53	1,088.24	10

Forecasted Water Use for Calendar Year 2015 (as of 11/09/2015) (values in kaf)

NEVADA	234	
SOUTHERN NEVADA WATER SYSTEM		207
OTHERS		27
CALIFORNIA	4,415	
METROPOLITAN WATER DISTRICT OF CALIFORNIA		1,031
IRRIGATION DISTRICTS		3,245
OTHERS		139
ARIZONA	2,592	
CENTRAL ARIZONA PROJECT		1,508
OTHERS		1,084
TOTAL LOWER BASIN USE		7,240
DELIVERY TO MEXICO - 2015 (Mexico Scheduled Delivery + Preliminary Yearly Excess[1])		1,518

OTHER SIGNIFICANT INFORMATION

UNREGULATED INFLOW INTO LAKE POWELL - NOVEMBER FINAL FORECAST DATED 11/02/2015

	MILLION ACRE-FEET	% of Normal
OBSERVED WATER YEAR 2015	10.174	94%
OBSERVED APRIL-JULY 2015	6.713	94%
OCTOBER OBSERVED INFLOW	0.535	104%
NOVEMBER INFLOW FORECAST	0.400	85%

	Upper Colorado Basin	Salt/Verde Basin
WATER YEAR 2016 PRECIP TO DATE[2]	94% (3.2")	186% (4.7")
CURRENT BASIN SNOWPACK	NA% (NA)	NA% (NA)

[1] Delivery to Mexico forecasted yearly excess calculated using year-to-date observed and projected excess.

[2] Precipitation values may vary significantly from week-to-week this early in the water year.

Nov 06, 2015 09:19:48 AM

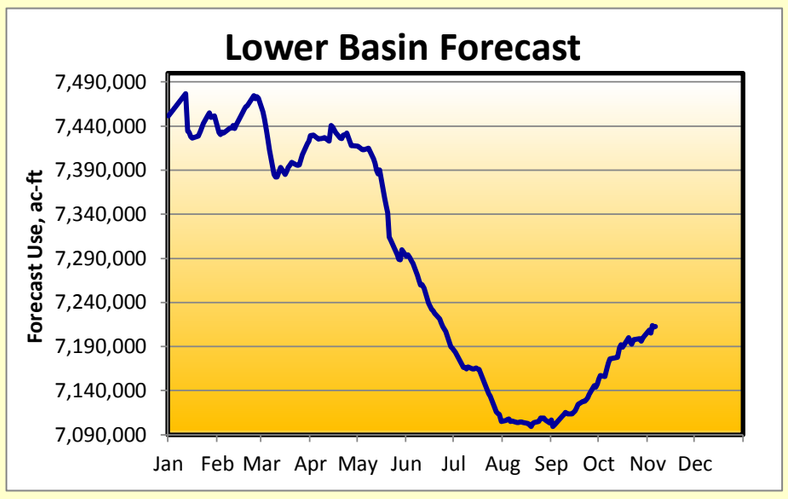
U.S. BUREAU OF RECLAMATION
LOWER COLORADO REGION
CY 2015

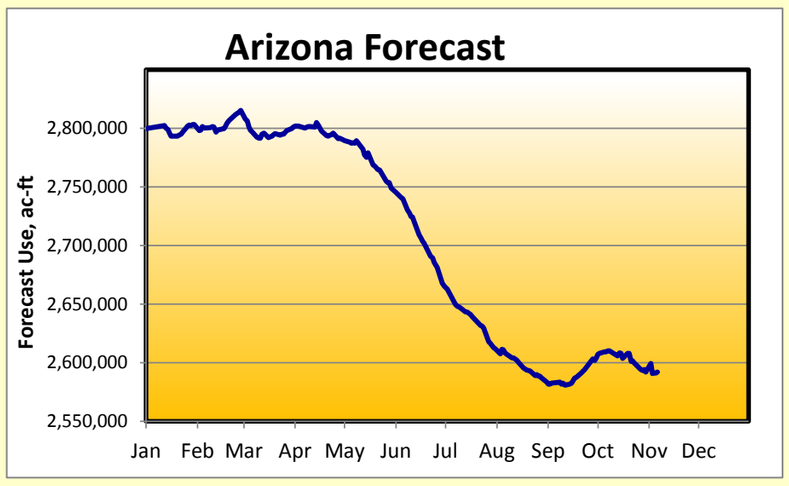
ARIZONA, CALIFORNIA, NEVADA, MEXICO
FORECAST OF END OF YEAR CONSUMPTIVE USE
FORECAST BASED ON USE TO DATE AND APPROVED ANNUAL WATER ORDERS [1]
(ACRE-FEET)

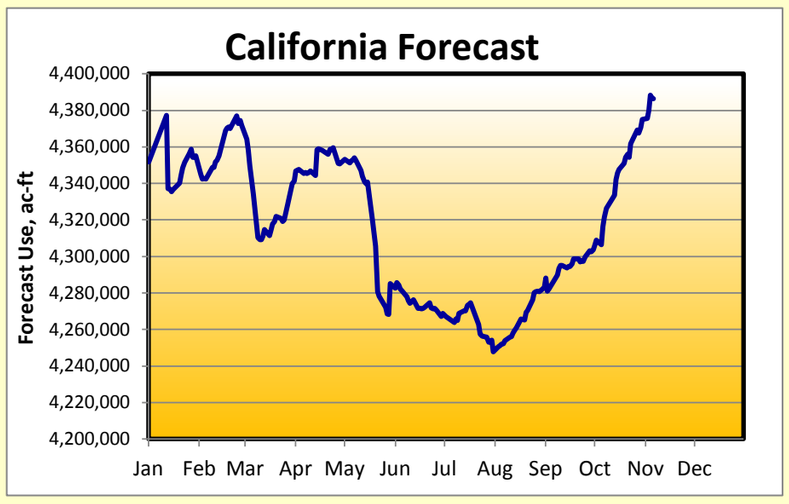
WATER USE SUMMARY	Use To Date CY2015	Forecast Use CY2015	Approved Use [2] CY2015	Excess to Approval CY2015
ARIZONA	2,288,768	2,591,941	2,792,835	-200,894
CALIFORNIA	4,049,496	4,386,479	4,351,727	**34,752**
NEVADA	206,275	234,109	300,000	-65,891
STATES TOTAL [3]	6,544,539	7,212,529	7,444,562	-232,033
MEXICO IN SATISFACTION OF TREATY (Including downward delivery)	1,325,794	1,518,428	1,500,000	**18,428**
TO MEXICO AS SCHEDULED	1,311,950	1,500,000		
MEXICO IN EXCESS OF TREATY	13,844	18,428		
BYPASS PURSUANT TO MINUTE 242	121,721	146,523		
TOTAL LOWER BASIN & MEXICO	7,992,054	8,877,480		

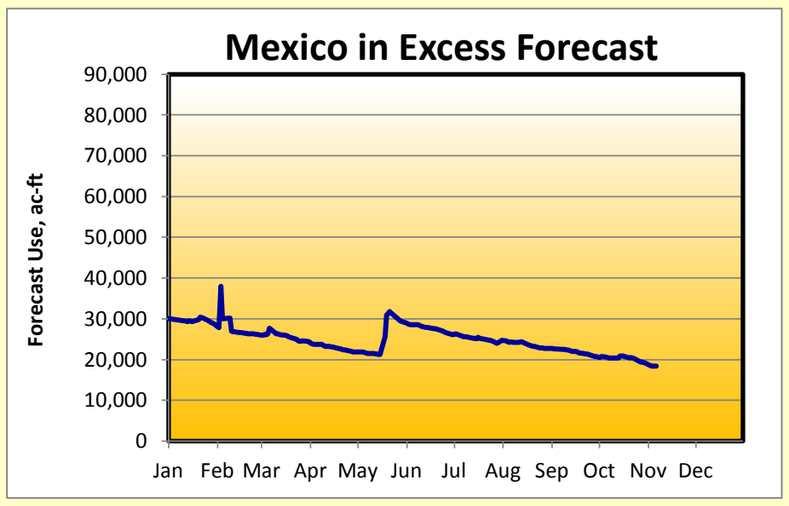
1/ Incorporates Jan-Sep USGS monthly data and 80 daily reporting stations which may be revised after provisional data reports are distributed by the USGS. Use to date estimated for users reporting monthly and annually.
2/ These values reflect adjusted apportionments. See Adjusted Apportionment calculation on each state page.
3/ Includes unmeasured returns based on estimated consumptive use/diversion ratios by user from studies provided by Arizona Department of Water Resources, Colorado River Board of California, and Reclamation.

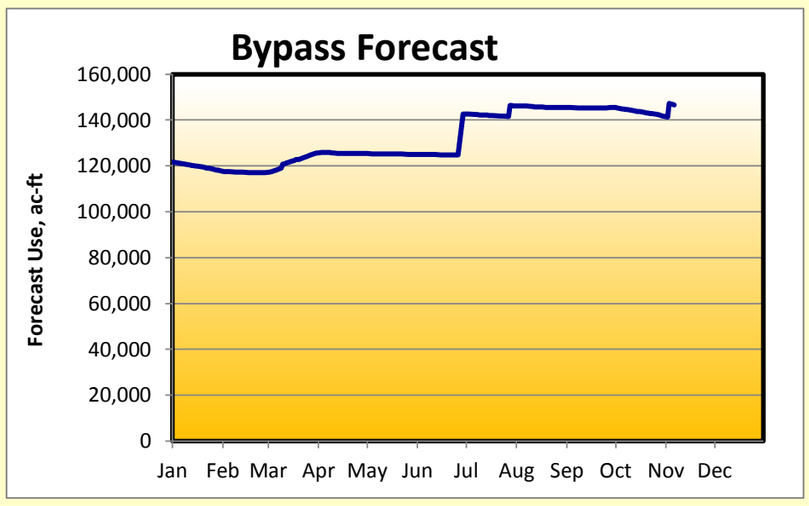
NOTE: Use to date values have been updated with September USGS Provisional data as well as monthly reported data. [11-02-2015]

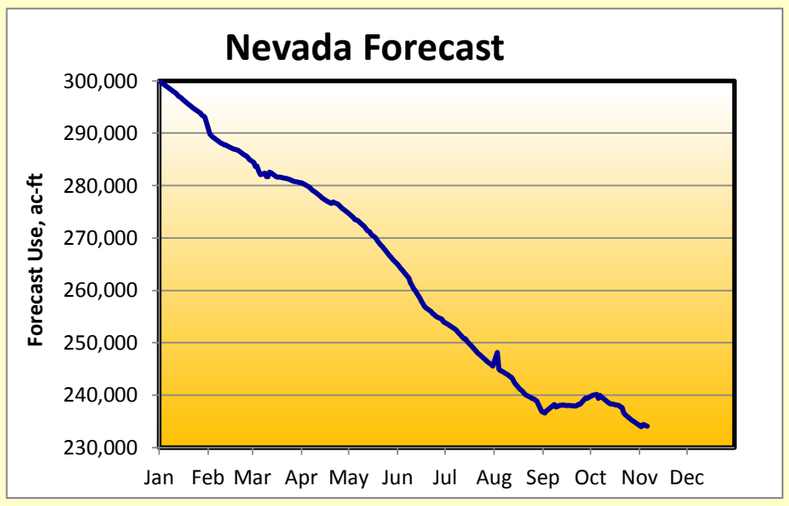


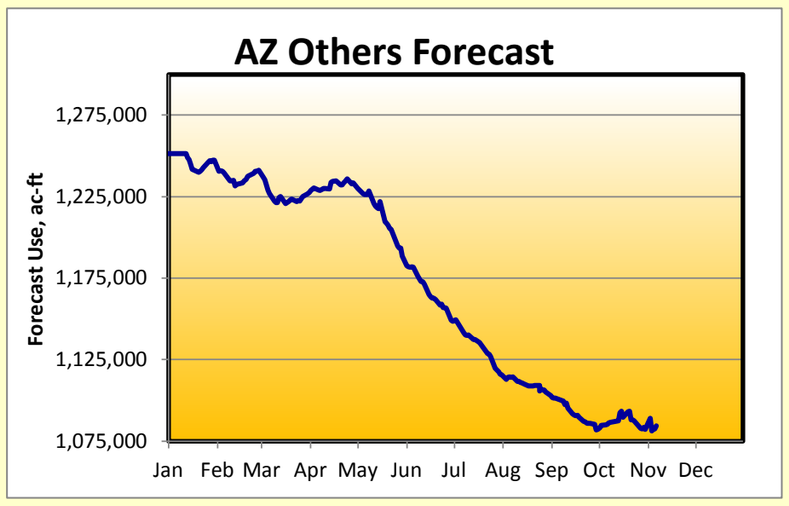


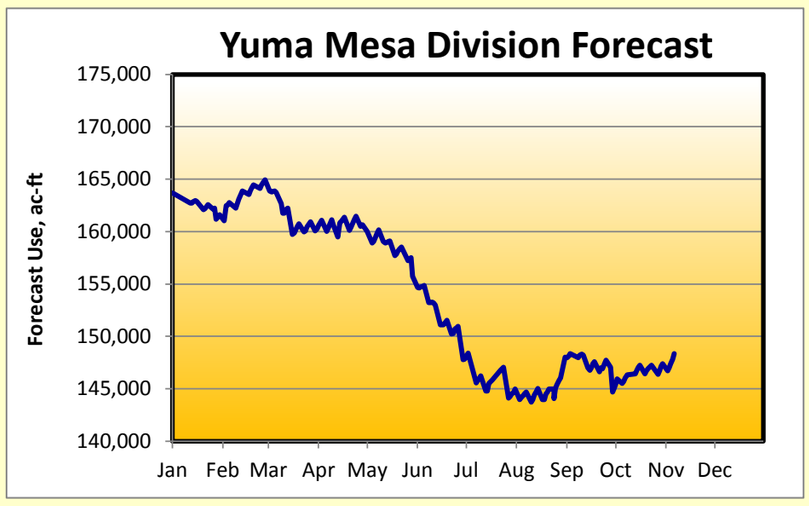


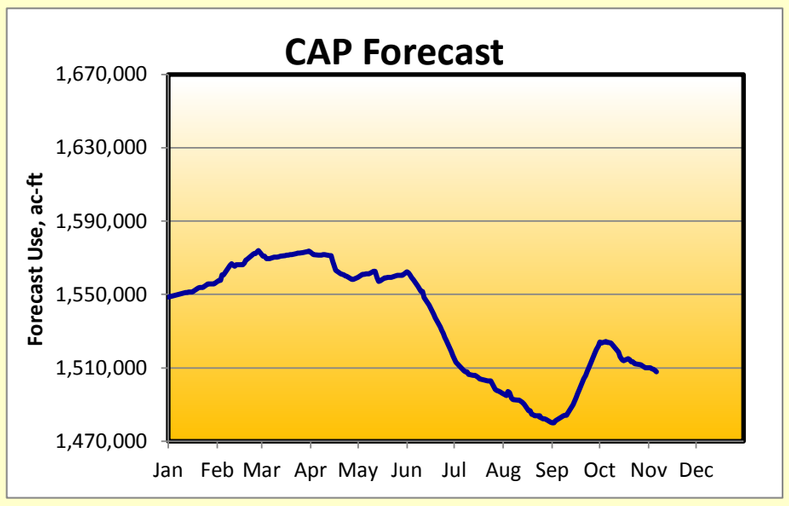


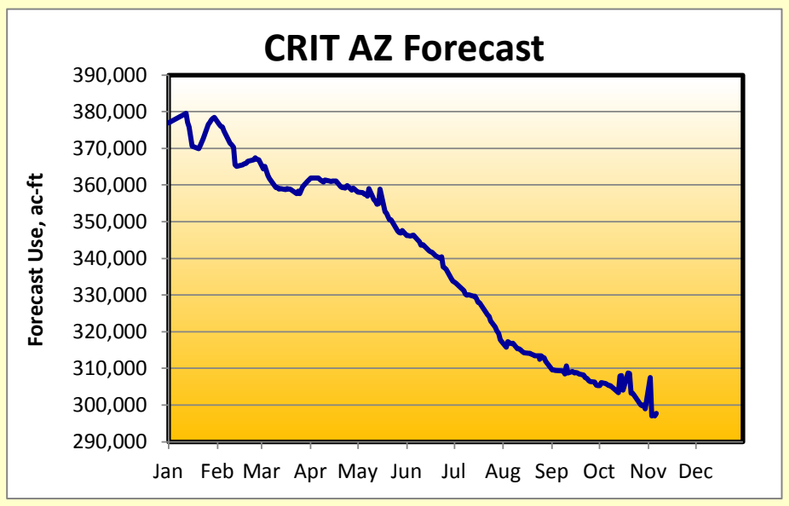


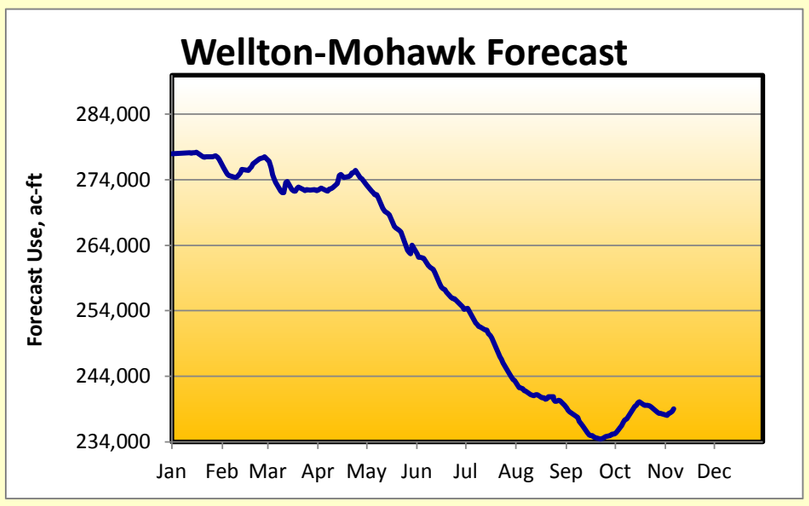


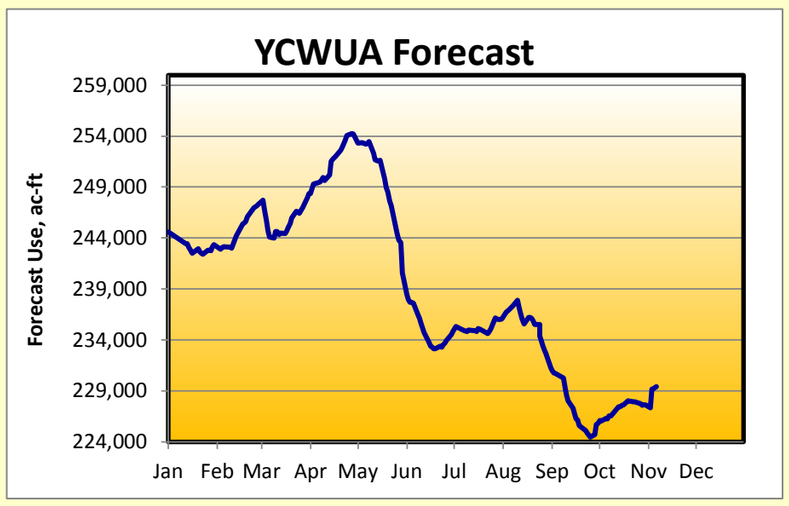












Graph notes: Jan 1 forecast use is scheduled use in accordance with the Annual Operating Plan's state entitlements, available unused entitlements, and over-run paybacks. A downward sloping line indicates use at a lower rate than scheduled, upward sloping is above schedule, and a flat line indicates a use rate equal to schedule. Lower priority users such as CAP, MWD, and Robt.B.Griffith may adjust use rates to meet state entitlements as higher priority use deviates from schedule. Abrupt changes in the forecast use line may be due to a diversion schedule change or monthly updating of provisional realtime diversions.

Nov 06, 2015 09:19:48 AM

U.S. BUREAU OF RECLAMATION
LOWER COLORADO REGION
CY 2015

NOTE:
- Diversions and uses that are pending approval are noted in *red italics*.
- Water users with a consumptive use entitlement - **Excess to Estimated Use** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a diversion entitlement.
- Water user with a diversion entitlement - **Excess to Approved Diversion** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a consumptive use entitlement.

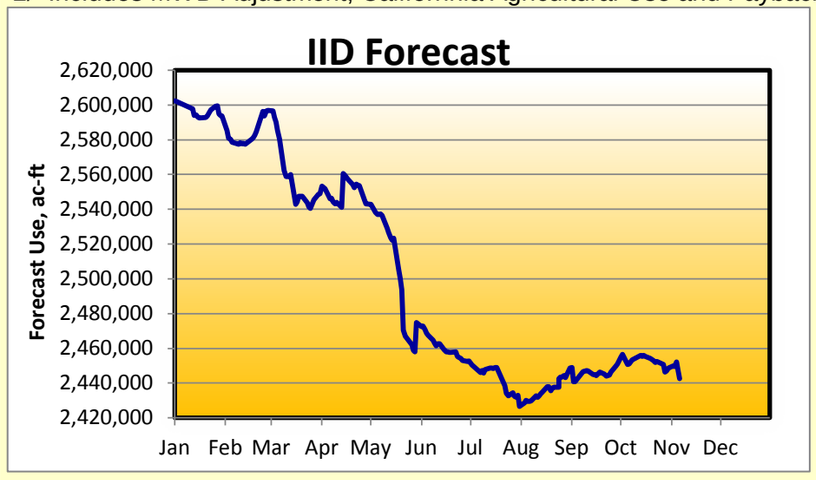
CALIFORNIA WATER USERS
FORECAST OF END OF YEAR CONSUMPTIVE USE
FORECAST BASED ON USE TO DATE AND APPROVED ANNUAL WATER ORDERS
California Schedules and Approvals
Historic Use Records (Water Accounting Reports)

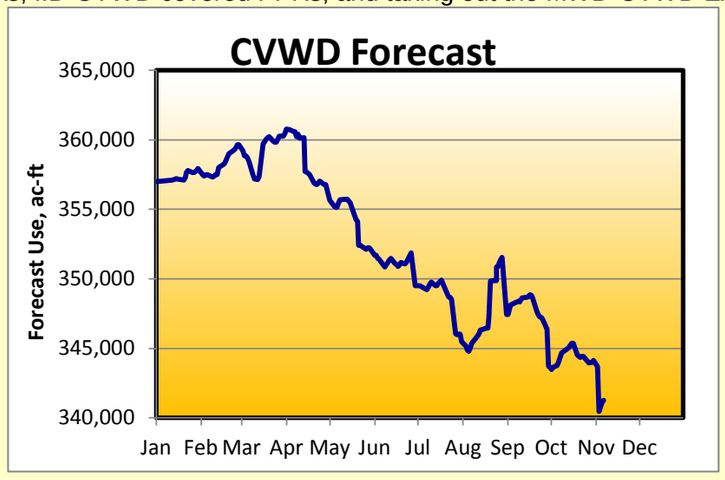
WATER USER	Use To Date CY2015	Forecast Use CY2015	Estimated Use CY2015	Excess to Estimated Use CY2015	Diversion To Date CY2015	Forecast Diversion CY2015	Approved Diversion CY2015	Excess to Approved Diversion CY2015
CALIFORNIA PUMPERS	1,532	1,680	1,680	---	2,779	3,047	3,047	0
FORT MOJAVE INDIAN RESERVATION, CA	7,927	8,655	8,996	---	14,736	16,089	16,720	-631
CITY OF NEEDLES (includes LCWSP use)	1,761	1,931	1,931	0	2,480	2,720	2,720	0
METROPOLITAN WATER DISTRICT	994,755	1,022,349	768,208	---	997,230	1,025,316	771,299	---
COLORADO RIVER INDIAN RESERVATION, CA	2,960	3,246	3,246	---	4,904	5,378	5,378	0
PALO VERDE IRRIGATION DISTRICT	379,459	391,067	395,806	---	780,739	859,906	874,000	-14,094
YUMA PROJECT RESERVATION DIVISION	42,023	45,883	48,586	---	83,722	95,589	104,200	-8,611
YUMA PROJECT RESERVATION DIVISION - INDIAN UNIT	---	---	---	---	40,564	46,497	50,200	-3,703
YUMA PROJECT RESERVATION DIVISION - BARD UNIT	---	---	---	---	43,158	49,091	54,000	-4,909
YUMA ISLAND PUMPERS	4,254	4,665	4,665	---	7,707	8,452	8,452	0
FORT YUMA INDIAN RESERVATION - RANCH 5	616	675	675	---	1,113	1,221	1,221	0
IMPERIAL IRRIGATION DISTRICT	2,202,519	2,442,597	2,602,481	-159,884	2,185,074	2,436,581	2,706,070	---
SALTON SEA SALINITY MANAGEMENT	112,169	121,636	121,636	0	117,614	126,826	126,826	---
COACHELLA VALLEY WATER DISTRICT	298,754	341,254	357,000	-15,746	312,053	356,620	371,671	---
OTHER LCWSP CONTRACTORS	612	671	671	---	972	1,066	1,066	0
CITY OF WINTERHAVEN	62	68	68	---	94	103	103	0
CHEMEHUEVI INDIAN RESERVATION	93	102	102	---	10,341	11,340	11,340	0
TOTAL CALIFORNIA	4,049,496	4,386,479			4,521,558	4,950,254	5,004,113	

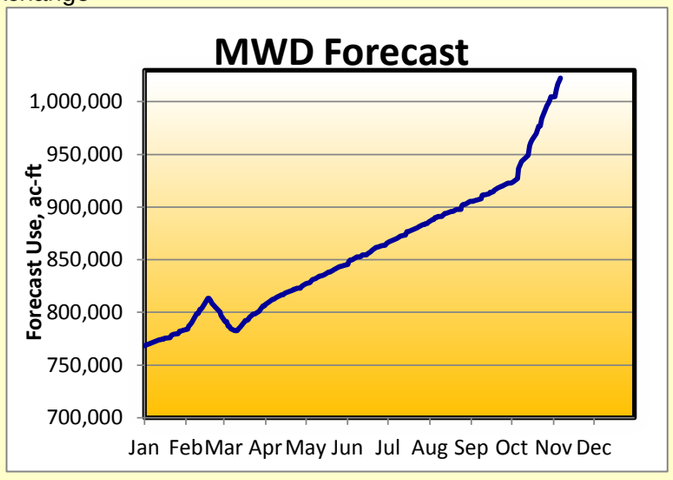
CALIFORNIA ADJUSTED APPORTIONMENT CALCULATION	
California Basic Apportionment	4,400,000
Conservation for Salton Sea Restoration - 2010 [1]	-23,273
Creation of Extraordinary Conservation ICS (IID)	-25,000
Creation of Extraordinary Conservation ICS (MWD)	
Total State Adjusted Apportionment	4,351,727
Excess to Total State Adjusted Apportionment	34,752

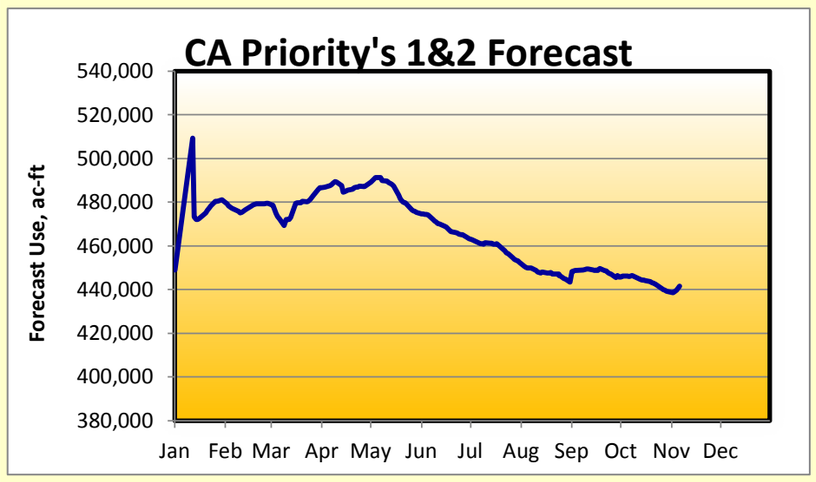
ISG ANNUAL TARGET COMPARISON CALCULATION	
Priorities 1, 2, 3b Use (PVID+YPRD+Island+PVID Mesa)	441,615
MWD Adjustment	-21,615
Total California Agricultural Use (PVID+YPRD+Island+IID+CVWD)	3,225,466
California Agricultural Paybacks	23,273
Misc. PPRs Covered by IID and CVWD	14,500
California ICS Creation (IID ICS)	25,000
Total Use for Target Comparison [2]	3,266,624
ISG Annual Target (Exhibit B)	3,448,000
Amount over/(under) ISG Annual Target	-181,376

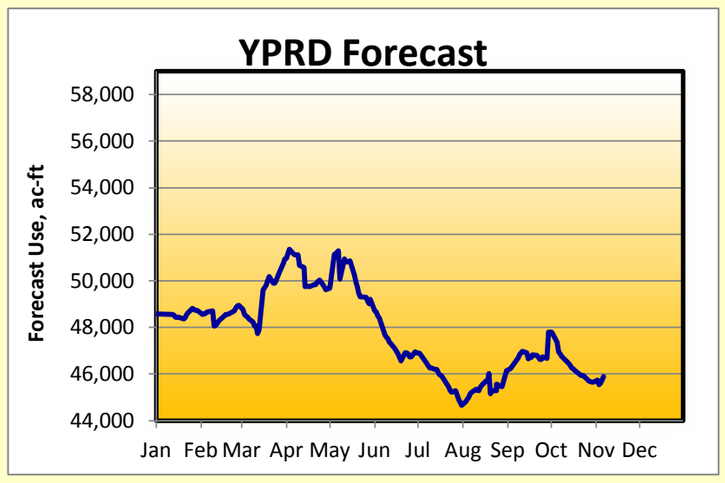
NOTES: Click on California Schedules and Approvals above for incoming diversion schedules and approvals.
1/ Pending approval by Imperial Irrigation District's Board of Directors.
2/ Includes MWD Adjustment, Californnia Agricultural Use and Paybacks, IID-CVWD covered PPRs, and taking out the MWD-CVWD Exchange

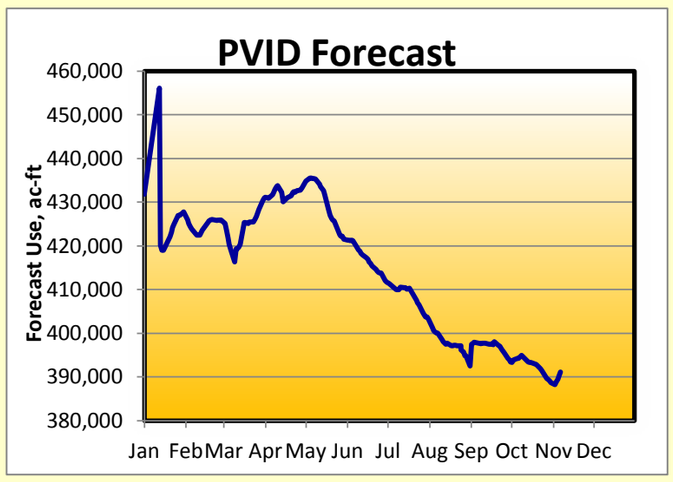












Nov 06, 2015 09:19:48 AM

U.S. BUREAU OF RECLAMATION
LOWER COLORADO REGION
CY 2015

NOTE:
● Diversions and uses that are pending approval are noted in *red italics*.
● Water users with a consumptive use entitlement - **Excess to Estimated Use** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a diversion entitlement.
● Water user with a diversion entitlement - **Excess to Approved Diversion** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a consumptive use entitlement.

ARIZONA WATER USERS
FORECAST OF END OF YEAR CONSUMPTIVE USE
FORECAST BASED ON USE TO DATE AND APPROVED ANNUAL WATER ORDERS
Arizona Schedules and Approvals
Historic Use Records (Water Accounting Reports)

WATER USER	Use To Date CY2015	Forecast Use CY2015	Estimated Use CY2015	Excess to Estimated Use CY2015	Diversion To Date CY2015	Forecast Diversion CY2015	Approved Diversion CY2015	Excess to Approved Diversion CY2015
ARIZONA PUMPERS	15,972	17,515	17,515	---	24,726	27,115	27,115	0
LAKE MEAD NRA, AZ - Diversions from Lake Mead	136	156	156	---	136	156	156	0
LAKE MEAD NRA, AZ - Diversions from Lake Mohave	160	184	184	---	160	184	184	0
DAVIS DAM PROJECT	2	2	2	---	68	75	75	0
BULLHEAD CITY	5,937	7,178	8,523	---	8,859	10,711	12,720	-2,009
MOHAVE WATER CONSERVATION	507	556	556	---	758	831	831	0
BROOKE WATER LLC	189	207	207	---	284	311	311	0
MOHAVE VALLEY IDD	16,396	19,142	22,260	---	30,363	35,448	41,220	-5,772
FORT MOJAVE INDIAN RESERVATION, AZ	34,999	37,429	42,390	---	64,813	69,313	78,500	-9,187
GOLDEN SHORES WATER CONSERVATION DISTRICT	288	316	316	---	431	473	473	0
HAVASU NATIONAL WILDLIFE REFUGE	4,017	4,194	3,563	---	28,910	30,991	41,820	-10,829
LAKE HAVASU CITY	6,375	7,449	8,928	---	10,284	12,017	14,400	-2,383
CENTRAL ARIZONA PROJECT	1,287,646	1,507,684		---	1,287,646	1,507,684		
TOWN OF PARKER	311	337	352	---	731	839	920	-81
COLORADO RIVER INDIAN RESERVATION, AZ	280,088	297,748	376,964	---	537,327	589,475	662,402	-72,927
EHRENBURG IMPROVEMENT ASSOCIATION	233	256	256	---	329	361	361	0
CIBOLA VALLEY IRRIGATION DISTRICT	15,458	16,951	16,951	---	21,618	23,707	23,707	0
CIBOLA NATIONAL WILDLIFE REFUGE	11,619	12,741	12,741	0	18,740	20,550	20,550	0
IMPERIAL NATIONAL WILDLIFE REFUGE	2,386	2,616	2,616	0	3,852	4,224	4,224	0
YUMA PROVING GROUND	470	521	550	---	470	521	550	-29
GILA MONSTER FARMS	3,029	3,474	5,244	---	5,227	6,195	9,156	-2,961
WELLTON-MOHAWK IDD	223,292	239,002	278,000	-38,998	332,647	372,322	424,350	
CITY OF YUMA	11,808	14,150	17,051	-2,901	20,436	24,650	27,318	-2,668
MARINE CORPS AIR STATION YUMA	1,205	1,371	1,500	---	1,205	1,371	1,500	-129
UNION PACIFIC RAILROAD	20	24	24	---	41	48	48	0
UNIVERSITY OF ARIZONA	692	764	764	---	692	764	764	0
YUMA UNION HIGH SCHOOL DISTRICT	99	119	151	---	133	159	200	-41
DESERT LAWN MEMORIAL	83	91	91	---	118	129	129	0
NORTH GILA VALLEY IDD	11,483	11,605	10,099	---	38,912	43,262	41,000	**2,262**
YUMA IRRIGATION DISTRICT	34,730	37,824	42,581	---	61,821	69,504	75,900	-6,396
YUMA MESA IDD	92,821	98,933	111,022	---	161,748	182,679	204,904	-22,225
UNIT "B" IRRIGATION DISTRICT	17,828	18,649	17,330	---	25,234	27,667	28,050	-383
FORT YUMA INDIAN RESERVATION	1,273	1,396	1,396	---	1,960	2,149	2,149	0
YUMA COUNTY WATER USERS' ASSOCIATION	206,026	229,425	244,599	---	314,843	359,010	388,000	-28,990
COCOPAH INDIAN RESERVATION	1,084	1,816	6,457	---	1,161	2,294	9,840	-7,546
RECLAMATION-YUMA AREA OFFICE	106	116	116	---	106	116	116	0
RETURN FROM SOUTH GILA WELLS								
TOTAL ARIZONA	2,288,768	2,591,941	2,792,850		3,006,789	3,427,305	3,685,338	
CAP	1,287,646	1,507,684				1,507,684		
ALL OTHERS	1,001,122	1,084,257	1,251,455			1,919,621	2,143,943	
YUMA MESA DIVISION, GILA PROJECT	139,034	148,362	350,000	-201,638		295,445		

ARIZONA ADJUSTED APPORTIONMENT CALCULATION	
Arizona Basic Apportionment	2,800,000
Payback of IOPP overruns - (Cocopah and Beattie)	-165
CAWCD/YMIDD Pilot Conservation Program [1]	-7000
Total State Adjusted Apportionment	2,792,835
Excess to Total State Adjusted Apportionment	-200,894
Estimated Allowable Use for CAP	1,712,034

1/ in 2013 CAWCD and YMIDD entered into a Pilot Fallowing Agreement. In 2015, it is estimated that 7,000 AF of water will be conserved by the program and that volume of water will remain in Lake Mead to benefit system storage.
NOTES: Click on Arizona Schedules and Approvals above for incoming diversion schedules and approvals.

Nov 06, 2015 09:19:48 AM

U.S. BUREAU OF RECLAMATION
LOWER COLORADO REGION
CY 2015

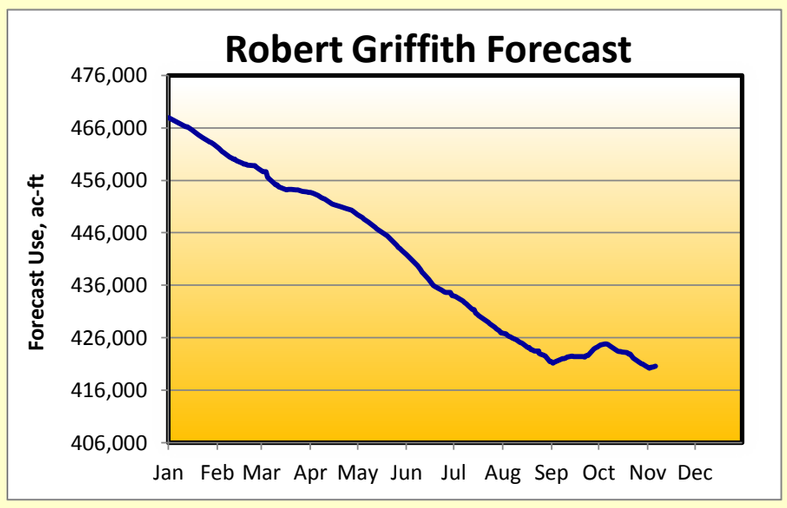
NOTE:
- Diversions and uses that are pending approval are noted in *red italics*.
- Water users with a consumptive use entitlement - **Excess to Estimated Use** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a diversion entitlement.
- Water user with a diversion entitlement - **Excess to Approved Diversion** column indicates overrun/underrun of entitlement. Dash in this column indicates water user has a consumptive use entitlement.

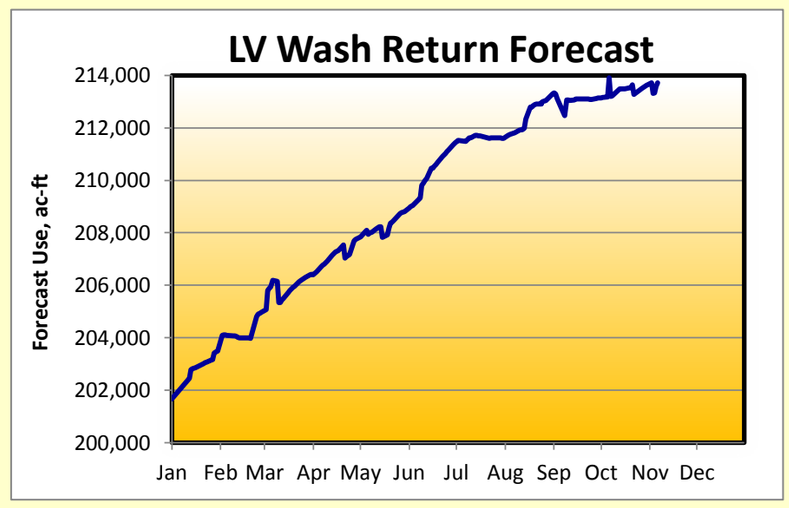
NEVADA WATER USERS
FORECAST OF END OF YEAR CONSUMPTIVE USE
FORECAST BASED ON USE TO DATE AND APPROVED ANNUAL WATER ORDERS

Nevada Schedules and Approvals
Historic Use Records (Water Accounting Reports)

WATER USER	Use To Date CY2015	Forecast Use CY2015	Estimated Use CY2015	Excess to Estimated Use CY2015	Diversion To Date CY2015	Forecast Diversion CY2015	Approved Diversion CY2015	Excess to Approved Diversion CY2015
ROBERT B. GRIFFITH WATER PROJECT (SNWS)	366,812	420,549	467,935	-47,386	366,812	420,549	467,935	-47,386
LAKE MEAD NRA, NV - Diversions from Lake Mead	341	393	422	---	341	393	422	-29
LAKE MEAD NRA, NV - Diversions from Lake Mohave	156	176	166	---	156	176	166	**10**
BASIC MANAGEMENT INC.	5,165	6,380	8,211	---	5,165	6,380	8,211	-1,831
CITY OF HENDERSON (BMI DELIVERY)	12,374	14,503	15,878	---	12,374	14,503	15,878	-1,375
NEVADA STATE DEPT. OF FISH & GAME	9	11	12	-1	419	474	363	---
PACIFIC COAST BUILDING PRODUCTS INC.	812	939	923	---	812	939	923	**16**
BOULDER CANYON PROJECT	159	174	174	---	275	302	302	0
BIG BEND WATER DISTRICT	1,719	2,328	4,061	---	3,944	5,117	10,000	-4,883
FORT MOJAVE INDIAN TRIBE	2,131	2,376	3,886	---	3,183	3,549	5,800	-2,251
LAS VEGAS WASH RETURN FLOWS	-183,403	-213,720	-201,668	---				
TOTAL NEVADA	206,275	234,109	300,000	-47,387	393,481	452,382	510,000	-57,729
SOUTHERN NEVADA WATER SYSTEM (SNWS)	183,409	206,829					420,549	
ALL OTHERS	22,866	27,280					31,833	
NEVADA USES ABOVE HOOVER	202,425	229,405					443,716	
NEVADA USES BELOW HOOVER	3,850	4,704					8,666	

Tributary Conservation & Imported Intentionally Created Surplus	
Total Requested Tributary Conservation Intentionally Created Surplus	29,500
Total Requested Imported Conservation Intentionally Created Surplus	9,000
5% System Cut for Creation of Intentionally Created Surplus	-1,925
Total Intentionally Created Surplus Left in Lake Mead	36,575
Pilot System Conservation Program	
Tributary Conservation - Left in Lake Mead [1]	7,500
NEVADA ADJUSTED APPORTIONMENT CALCULATION	
Nevada Basic Apportionment	300,000
Excess to Total State Adjusted Apportionment	-65,891





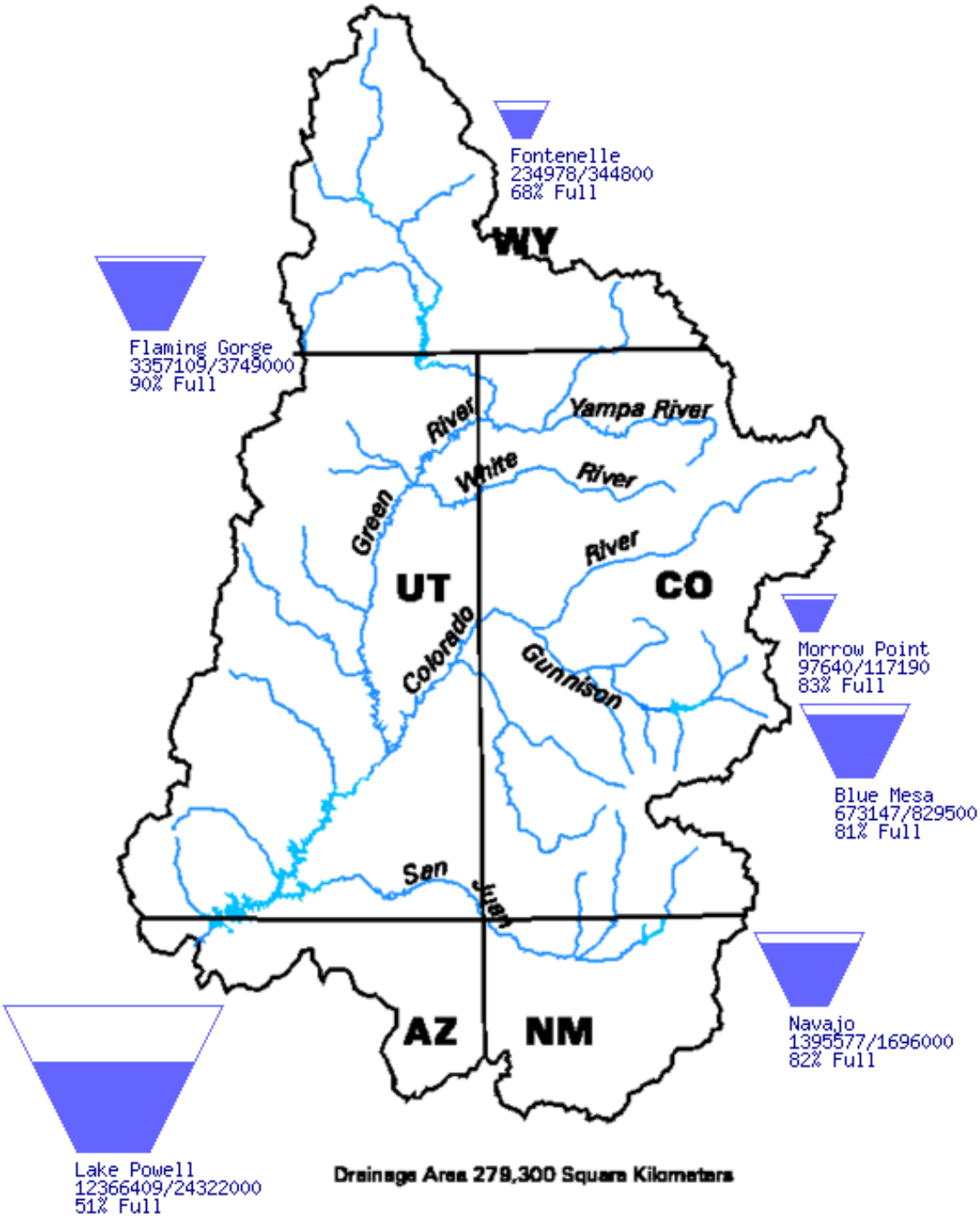
1/ On June 4, 2015, Reclamation and SNWA entered into a System Conservation Implementation Agreement in which SNWA agreed to conserve 7.500 AF of Colorado River water from its Tributary Conservation projects to create System Conservation Water.
NOTES: Click on Nevada Schedules and Approvals above for incoming diversion schedules and approvals.

Upper Colorado Region Water Resources Group

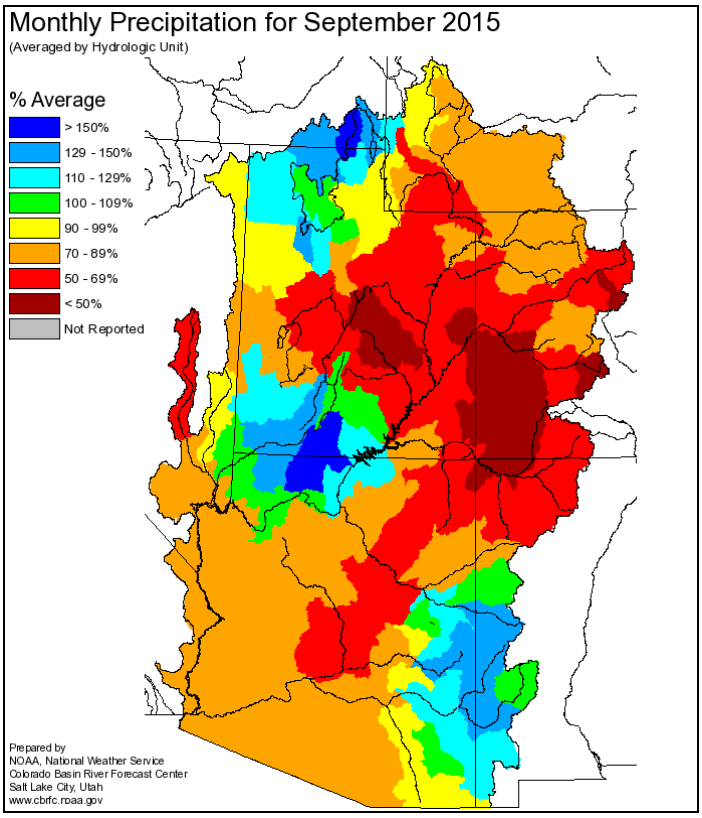
River Basin Tea-Cup Diagrams

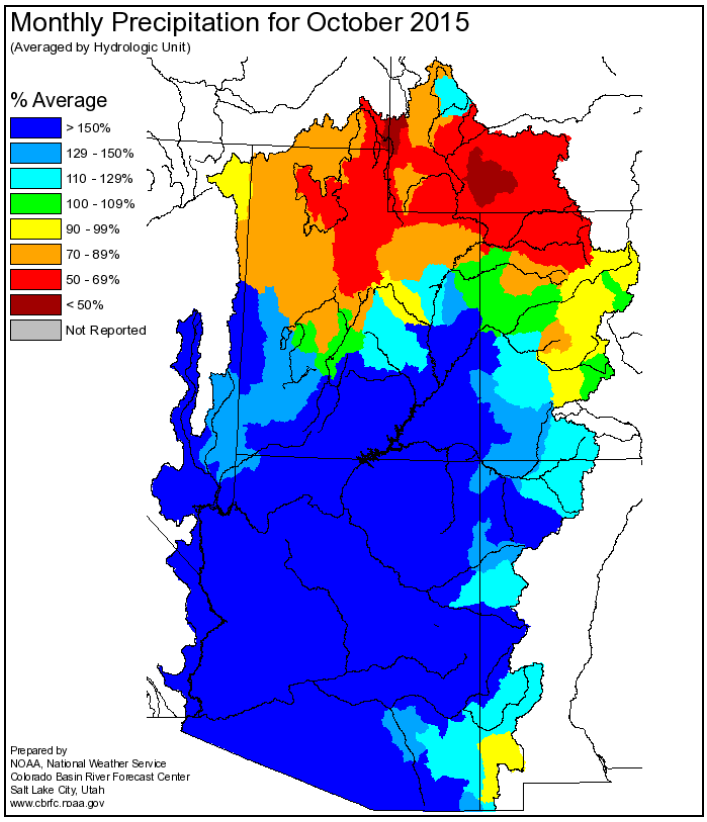
Data Current as of:
11/08/2015

Upper Colorado River Drainage Basin

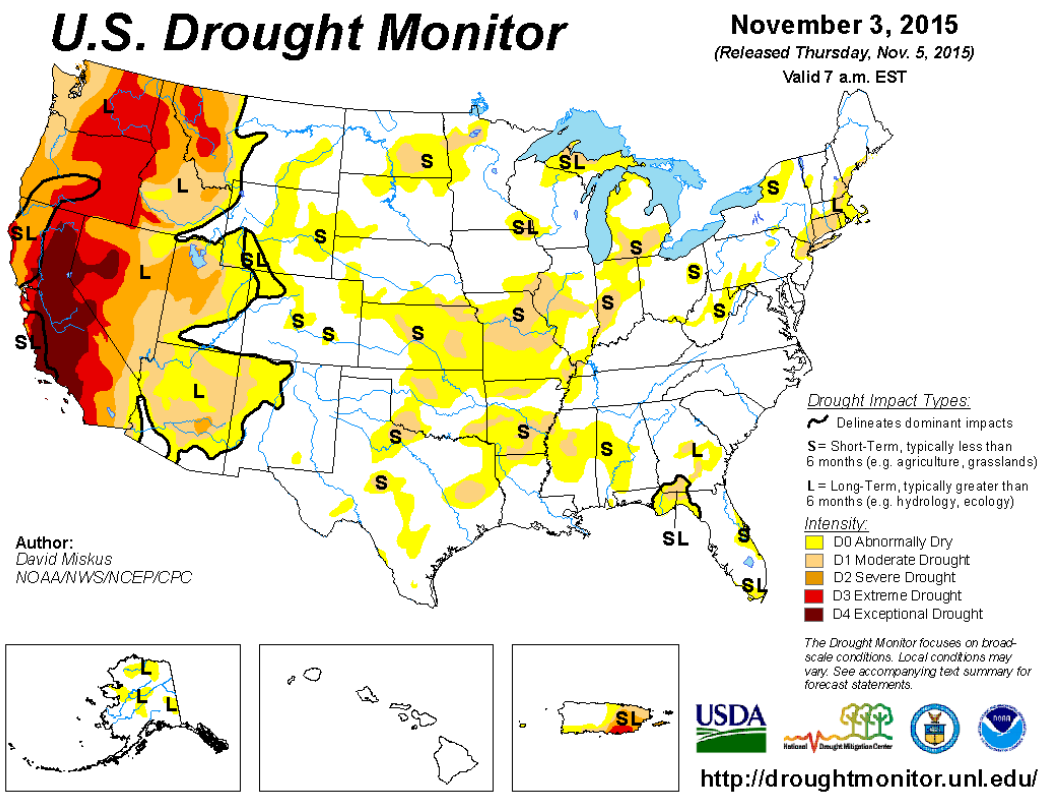


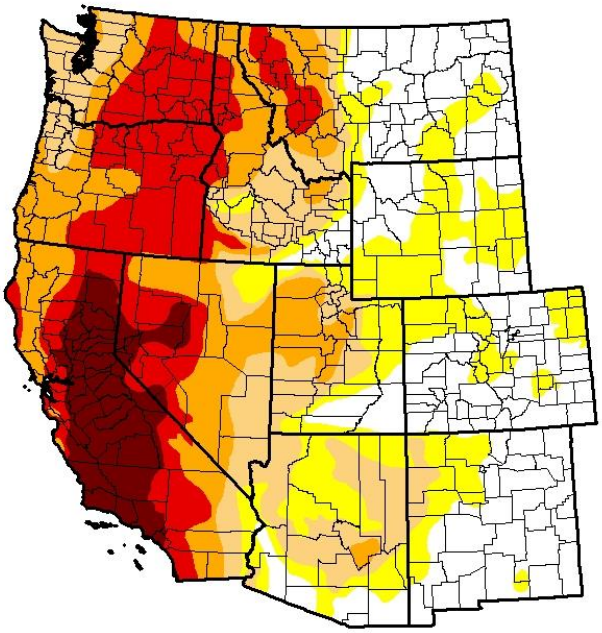
NOAA National Weather Service Monthly Precipitation Maps for September and October 2015





USDA United States Drought Monitor Map





U.S. Drought Monitor
West

November 3, 2015
(Released Thursday, Nov. 5, 2015)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	27.09	72.91	54.45	39.19	22.42	6.90
Last Week 10/27/2015	26.79	73.21	55.42	41.21	26.23	7.62
3 Months Ago 8/4/2015	26.53	73.47	60.09	42.99	22.24	7.17
Start of Calendar Year 12/30/2014	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year 9/29/2015	22.77	77.23	57.81	42.42	26.50	7.62
One Year Ago 11/4/2014	34.59	65.41	54.48	34.16	18.75	8.45

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

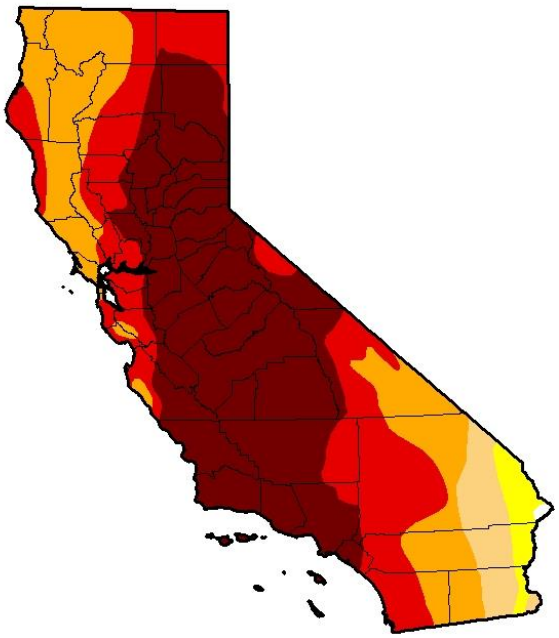
Author:
David Miskus
NOAA/NWS/NCEP/CPC

USDA

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

California



November 3, 2015

(Released Thursday, Nov. 5, 2015)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.14	99.86	97.33	92.27	70.55	44.84
Last Week *10/27/2015*	0.14	99.86	97.33	92.27	71.08	46.00
3 Months Ago *8/4/2015*	0.14	99.86	97.35	94.59	71.08	46.00
Start of Calendar Year *12/30/2014*	0.00	100.00	98.12	94.34	77.94	32.21
Start of Water Year *9/29/2015*	0.14	99.86	97.33	92.36	71.08	46.00
One Year Ago *11/4/2014*	0.00	100.00	99.71	94.42	79.69	55.08

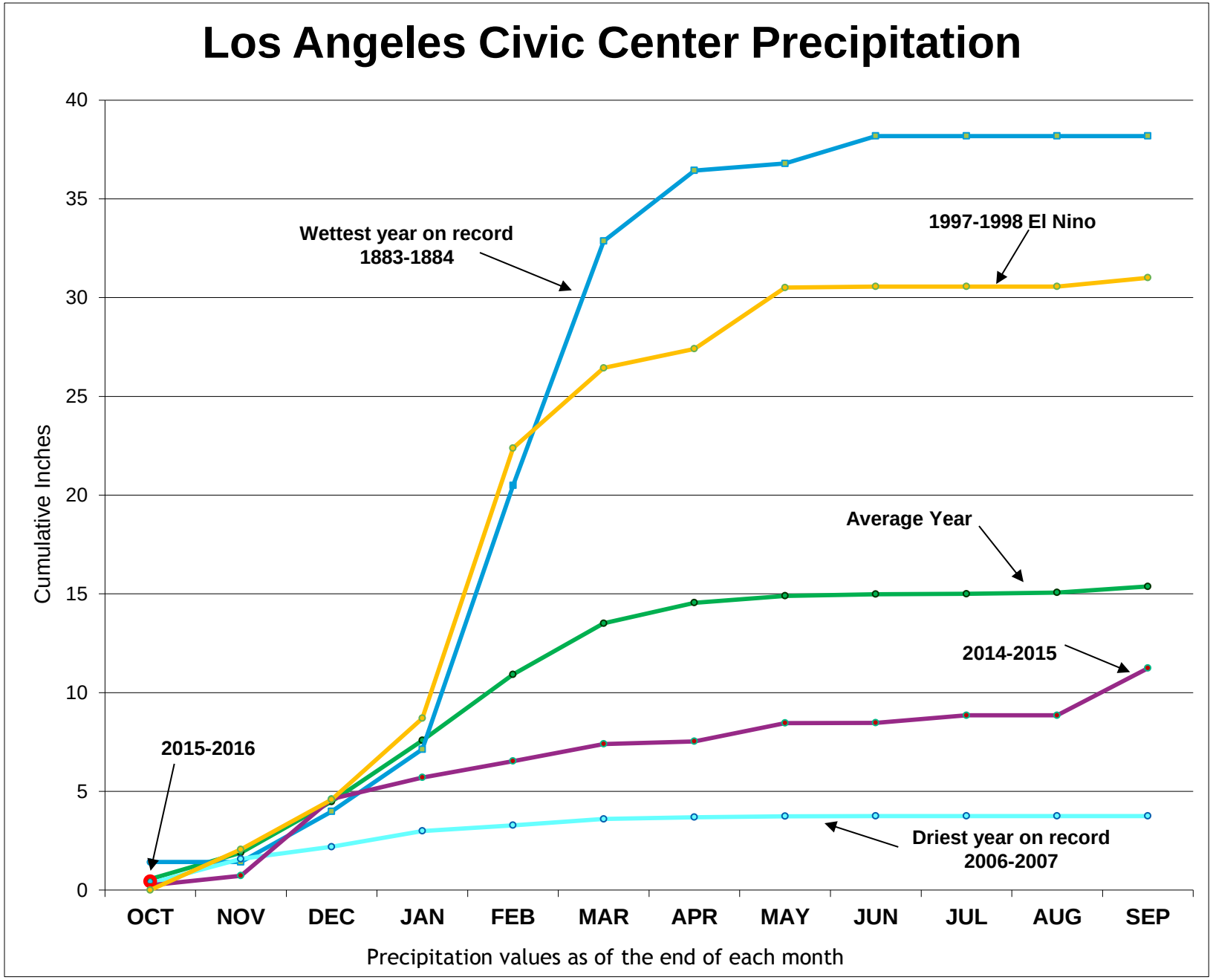
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/


Los Angeles Civic Center Precipitation
Cumulative Inches
40
35
30
25
20
15
10
5
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Precipitation values as of the end of each month
Wettest year on record
1883-1884
1997-1998 El Nino
Average Year
2014-2015
2015-2016
Driest year on record
2006-2007

Precipitation at Six Major Stations in Southern California

From October 1, 2015 to November 1, 2015

Station	Precipitation in inches Oct	Oct 1 to Nov 1	Average to Date	Percent of Average
San Luis Obispo	0.03	0.03	0.91	3%
Santa Barbara	0.48	0.48	0.69	70%
Los Angeles	0.45	0.45	0.56	80%
San Diego	0.43	0.43	0.51	84%
Blythe	0.84	0.84	0.27	311%
Imperial	0.02	0.02	0.25	8%

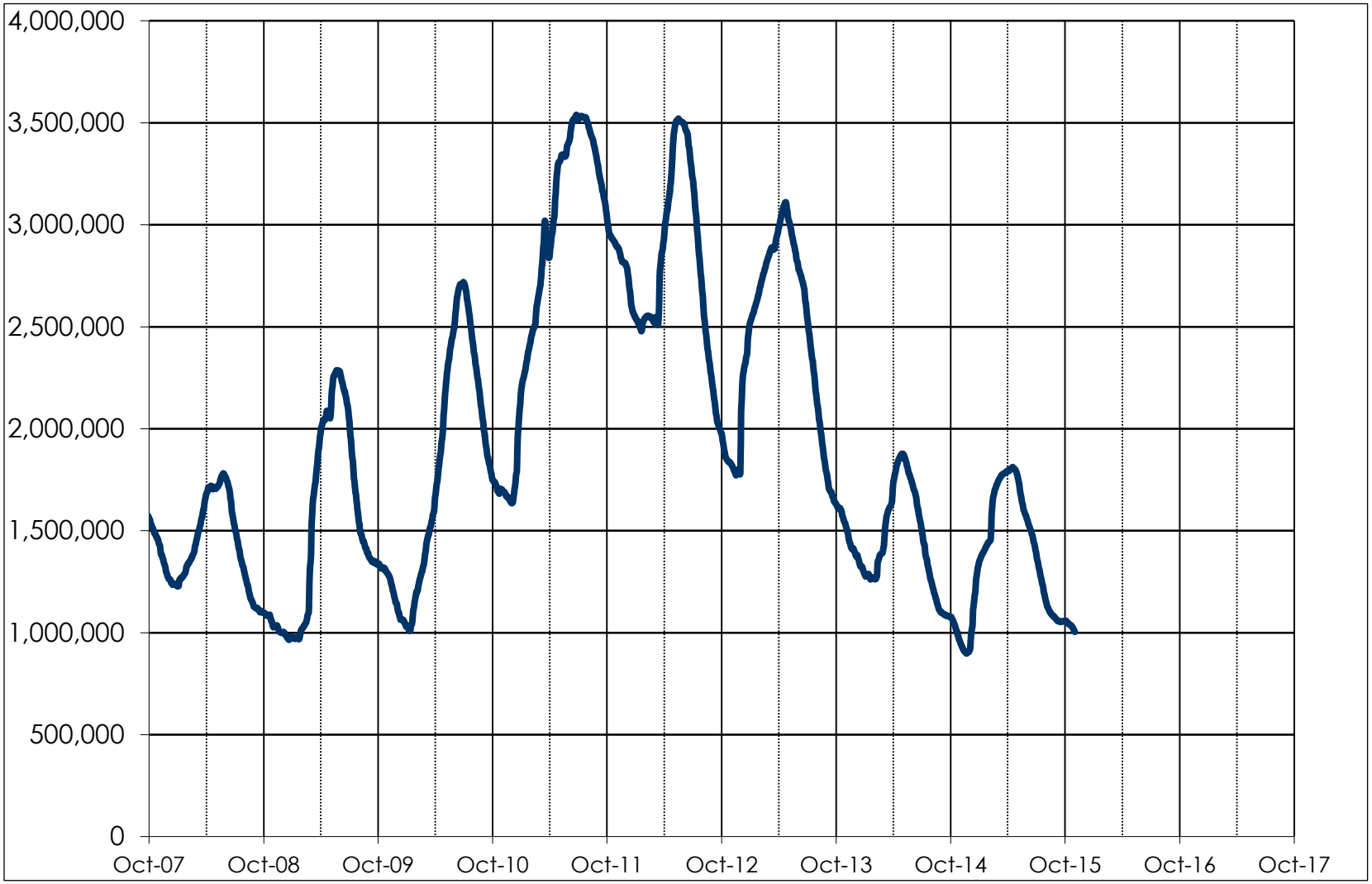
Comparison of SWP Water Storage

Reservoir	Capacity	2014 Storage (acre-feet) As of Nov 1	2014 Storage (acre-feet) % of Cap.	2015 Storage (acre-feet) As of Nov 1	2015 Storage (acre-feet) % of Cap.
Frenchman	55,475	19,271	35%	12,061	22%
Lake Davis	84,371	43,721	52%	36,618	43%
Antelope	22,564	16,038	71%	16,398	73%
Oroville	3,553,405	950,820	27%	1,004,369	28%
TOTAL North	3,715,815	1,029,850	28%	1,069,446	29%
Del Valle	39,914	29,927	75%	29,712	74%
San Luis (DWR)	1,062,180	197,284	19%	287,242	27%
Pyramid	169,901	168,164	99%	169,166	100%
Castaic	319,247	96,274	30%	103,437	32%
Silverwood	74,970	72,532	97%	58,978	79%
Perris	126,841	50,648	40%	46,698	37%
TOTAL South	1,793,053	614,829	34%	695,233	39%
TOTAL SWP	5,508,868	1,644,679	30%	1,764,679	32%

State Water Project Projected Deliveries:
As of March 2, 2015, the Table-A allocations for 2015 is 20%

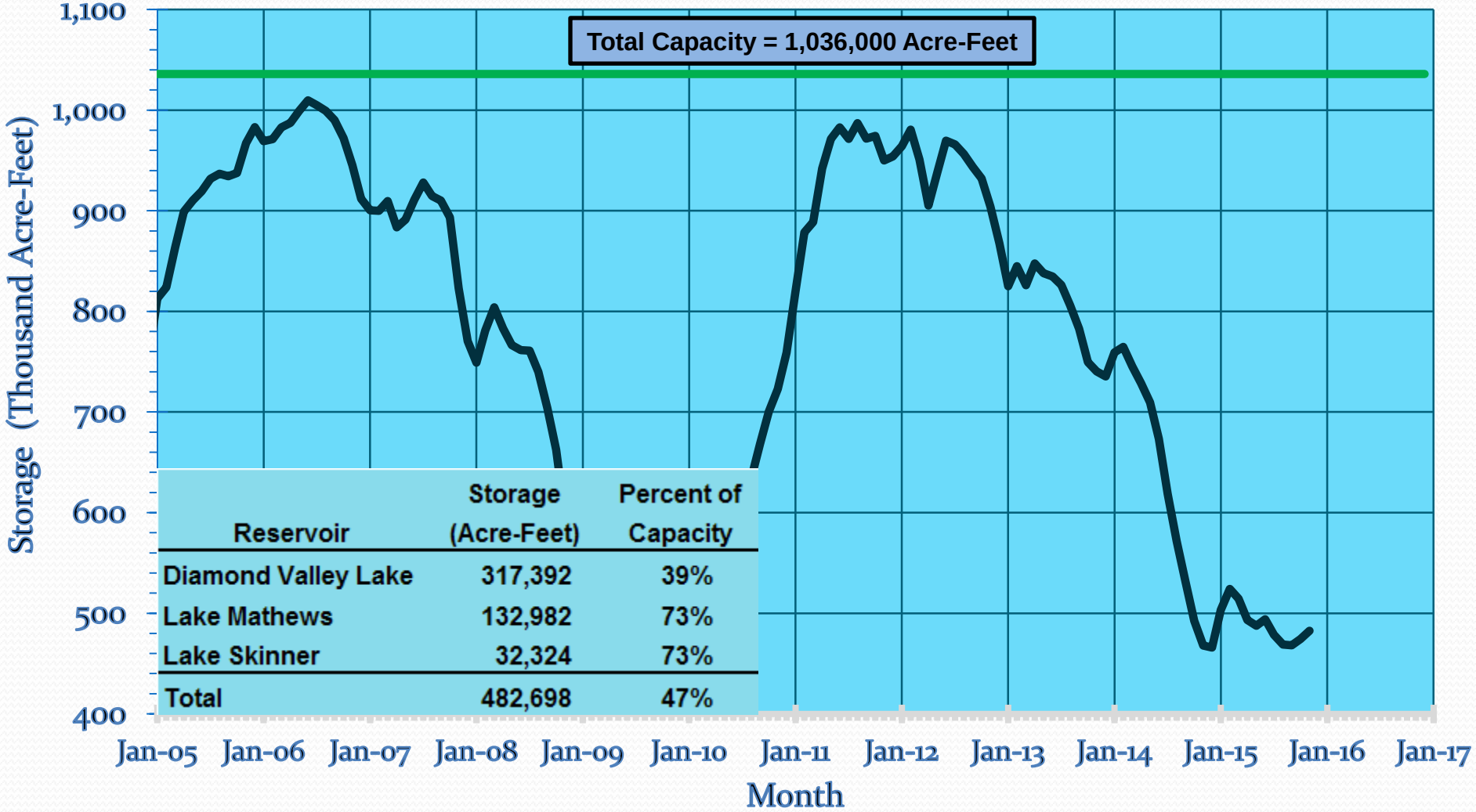
Oroville Storage (acre-feet)

October 1, 2005 – November 1, 2015



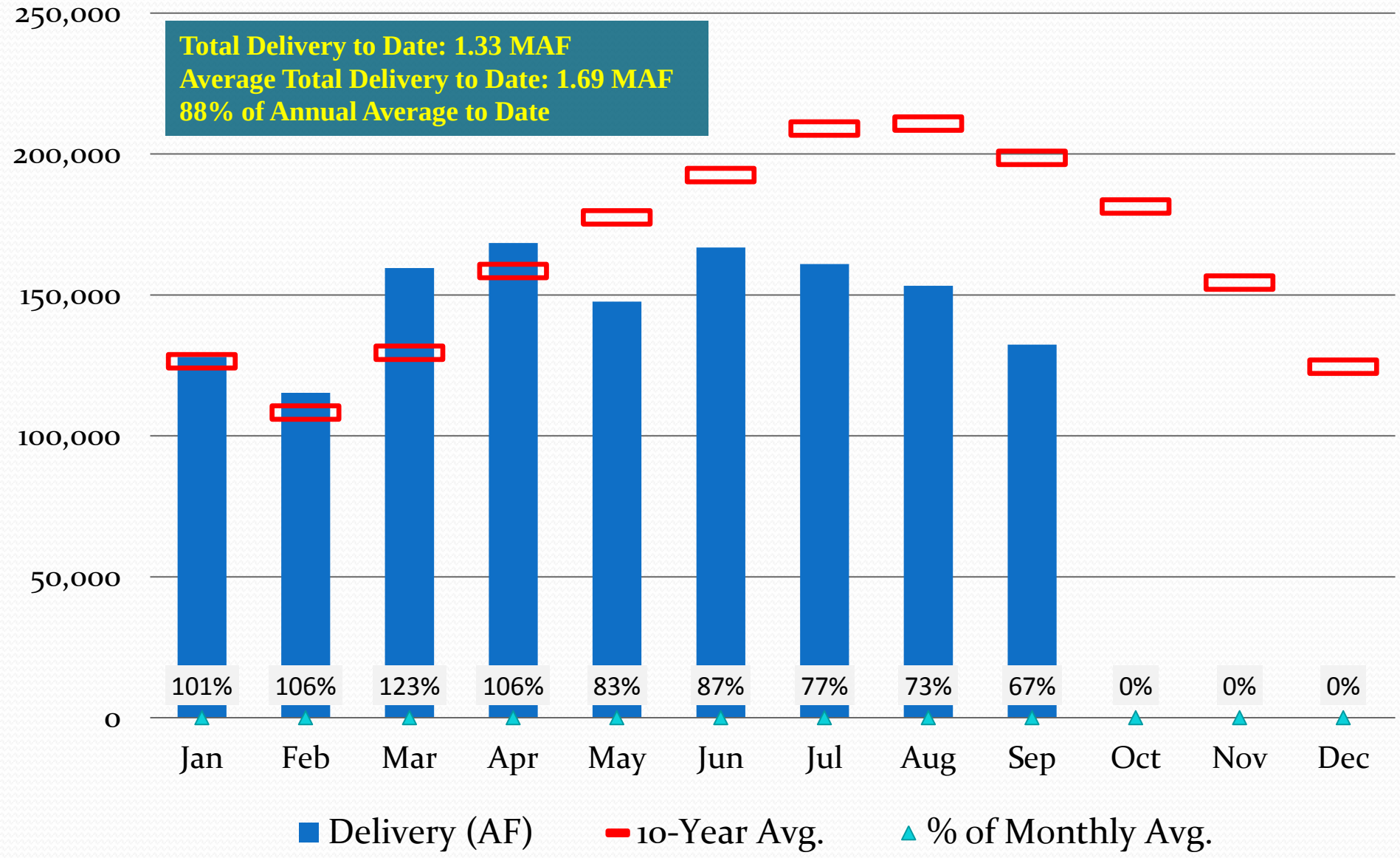
MWD's Combined Reservoir Storage as of November 1, 2015

Lake Skinner, Lake Mathews, and Diamond Valley Lake

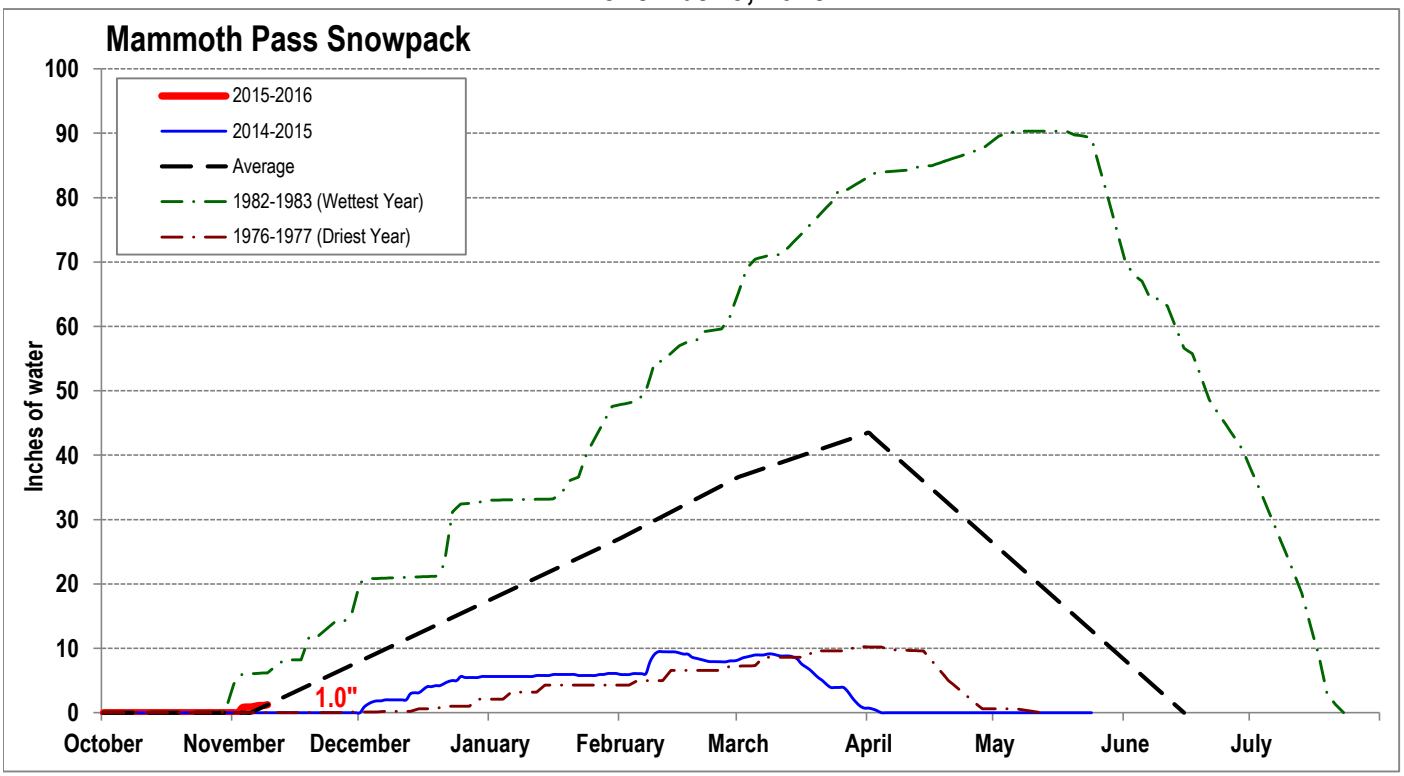


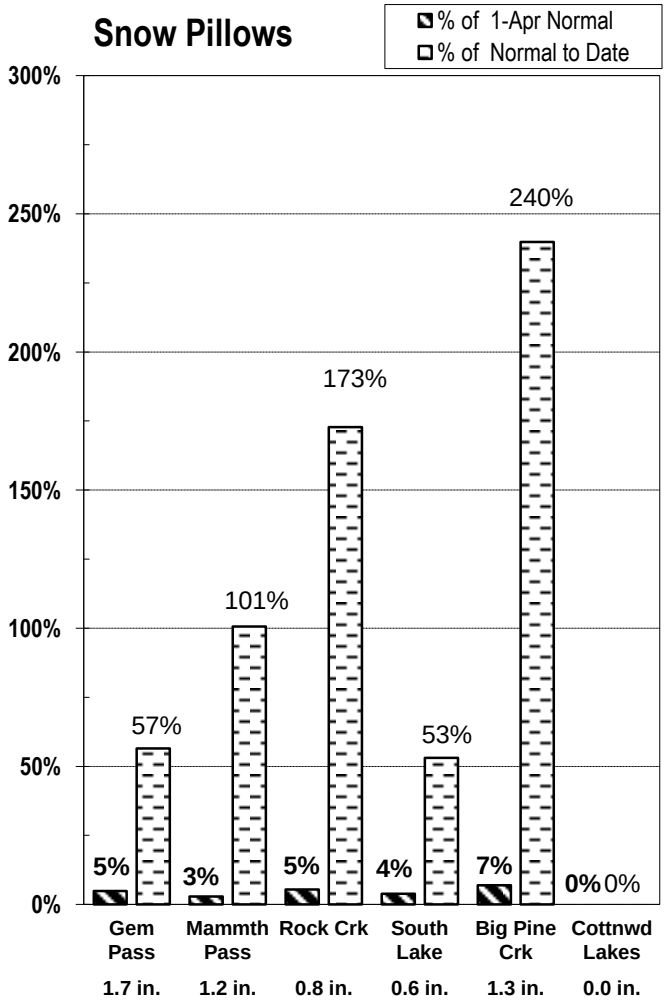
Reservoir	Storage (Acre-Feet)	Percent of Capacity
Diamond Valley Lake	317,392	39%
Lake Mathews	132,982	73%
Lake Skinner	32,324	73%
Total	482,698	47%

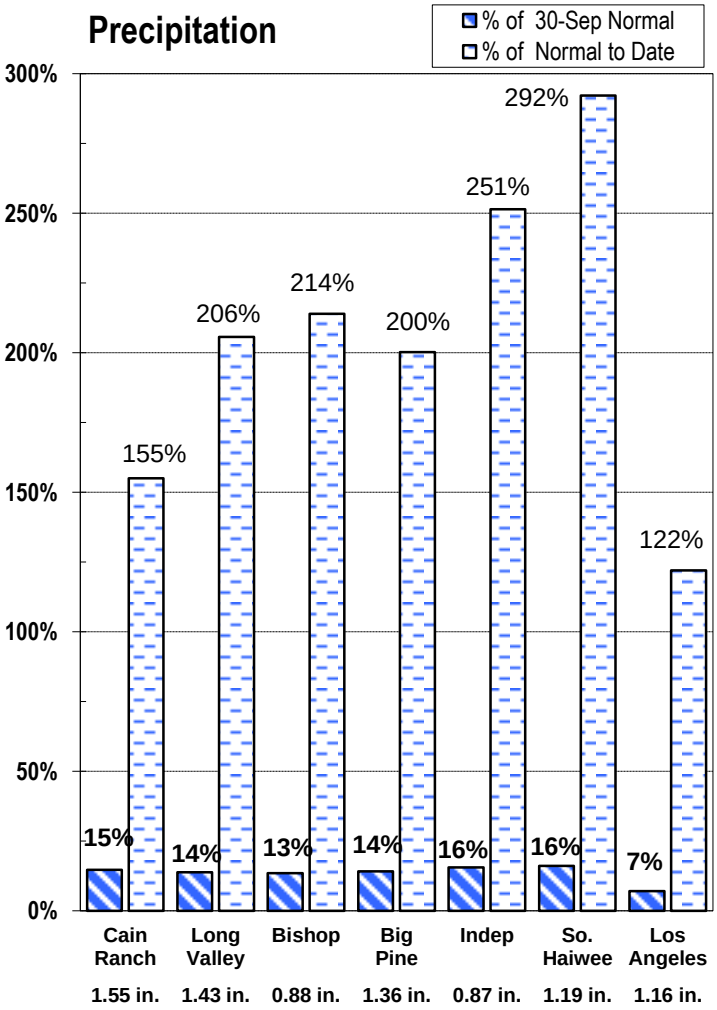
2015 Water Deliveries to Member Agencies (AF)



EASTERN SIERRA
CURRENT PRECIPITATION CONDITIONS
November 9, 2015







Measurement as Inches Water Content; Precipitation totals are cumulative for water year beginning Oct 1

PROPOSED AGENDA
COLORADO RIVER BASIN SALINITY CONTROL FORUM
Ninety-third Meeting

Embassy Suites – Paloma Village
3110 E. Skyline Drive
Tucson, Arizona

October 28-29, 2015

Beginning time: Wednesday, October 28, 8:30 a.m.
Conducting: Chairman David Robbins

I.	Introductions	**(2015-62, 2015-47)**	Robbins
	A. Recognitions	**(2015-51)**	
II.	Approval of proposed agenda	**(2015-63, 2015-69)**	Robbins
III.	Welcome to Arizona		Arizona Delegation
IV.	Approval of Salt Lake City minutes	**(2015-53)**	Robbins
V.	Changes in Agency Personnel		
	A. NRCS		James/Rose
	B. Reclamation		Jacobson/Eastland
	C. BLM		Boyd/Stith
	D. USGS		Susong
	E. EPA		Monahan
VI.	2017 Review	**(2015-59)**	Dent
	A. Purpose of Review/Nature of Standard		J. Barnett
	B. Schedule		
	C. Modeling runs/assumptions		
	D. Subjects/Issues		
	E. Direction from Forum		
VII.	Forum Policies Committee	**(2015-16, 2015-56)**	Taunt
VIII.	NRCS Washington Report	**(2015-68)**	Rose

BREAK

IX.	Program Funding Requests	**(2015-61)**	Robbins/Barnett
	A. Basinwide Program		
	B. NRCS (3-year plan)		
	C. BLM Activities		
X.	Paradox Valley Unit		Jacobson/Uilenberg/Norman
	A. Operations		
	B. EIS status		
	1. Follow-up on evaporation pond CRB	**(2015-65)**	
	2. Schedule		
	3. Reclamation/FWS Meeting		
	4. FWS PEIS Migratory Birds	**(2015-67, 2015-36)**	Barnett
	C. Road Maps		
XI.	Items to take to the Advisory Council		Trujillo

LUNCH

Luncheon Presentation: "CAP's Tucson Aqueduct" **(2015-58)** Darrin Francom, P.E.

Anticipated Recess to Advisory Council Meeting

RECONVENE MEETING – Thursday, October 29, 10:30 a.m.

XII. Items from the Advisory Council — Trujillo

XIII. Report of the Program Funding Subcommittee — Buschatzke/Tyrrell

XIV. Upper Basin Benefits Report **(2015-66)** — Barnett/Dent

XV. System Conservation Pilot Agreement — Hasencamp/Tyrrell

XVI. NRCS
- A. Colorado River Basin CCA RCPP **(2015-64)** — James/Evans
  - 1. 2014/2015 Project
  - 2. 2016 Proposals
- B. Other **(2015-55)** — State Conservationists

XVII. Reclamation
- A. 2015 FOA **(2015-45)** — Jacobson/Esplin
- B. Other

XVIII. BLM – Funding BLM Salinity Control **(2015-57)** — Stith

BREAK

XIX. Work Group Report/Tasks — Dent
- A. FOA/ARC Execution
- B. Water Supply Implications of Practices
- C. Grand Valley Wildlife Project
- D. Lower Gunnison and Uinta Basins Salinity Coordinators' Efforts
- E. Salinity Control Program Video **(2015-60)**

XX. Report from Executive Director — Barnett

XXI. Report from Management Committee — Robbins

XXII. Additional items — Robbins

XXIII. Public comment — Robbins

XXIV. Next meeting (Colorado, June 2016) — Robbins

Anticipated Adjournment: 1:30 p.m.

AGENDA
COLORADO RIVER BASIN SALINITY CONTROL ADVISORY COUNCIL

Embassy Suites – Paloma Village Hotel
3110 East Skyline Drive
Tucson AZ

Advisory Council Beginning Time: **Wednesday, October 28, 2015, 1:00 p.m.**

Designated Federal Officer: Kib Jacobson

Presiding: Chairman Dave Robbins

I.	Welcome, Introductions		Robbins
II.	Opening Comments, Acceptance of letters of substitute members		Jacobson
III.	Review and Approval of Agenda	**(email Jacobson 10/7/2015)**	Robbins
IV.	Draft Minutes of 2015 Spring Council Meeting – Salt Lake City, UT		
	A. Review	**(email Jacobson 10/9/2015**	Jacobson
	B. Action		Robbins
V.	Charter Renewal	**(email Jacobson 10/7/2015)**	Jacobson
VI.	Items from the Forum		Tanya Trujillo
VII.	Agency Reports (about 20 minutes each)	**(email Jacobson 10/16/2015)**	
	A. USGS		Dave Susong
	B. USDA-NRCS		Travis James
	C. FWS		Barb Osmundson
	D. BLM		Bob Boyd
VIII.	Public Comment		Robbins

Recess Meeting: **Approximately 3:30 p.m.**

Agenda Continued on Next Page

DRAFT

Reconvene Meeting: **Thursday, October 29, 2015, 8:30 a.m.**

IX. Agency Reports (about 20 minutes each)
- A. EPA — Peter Monahan
- B. Reclamation — Rich Eastland/Jacobson

X. Basin States Program (BSP)
- A. Basin Funds Status and Accounting **(2015-39)** — Parry/Eastland
- B. Update on State Ag Agreements projects — Mark Quilter/Cindy Lair
- C. Status of Basin States Program — Marcie Bainson
  - a. State Ag Agreements
  - b. NRCS Agreements
  - c. SIR (studies, investigations, research) agreements
  - d. Other
- D. Funding Recommendations from TAG **(email Barnett 10/6/2015)** — Robbins/Patrick Dent
  - a. Funding for Economic Damages Study — Jacobson/Harry Ruzgerian
- E. Lower Gunnison and Uinta Basins Planning Studies / Teams — Jacobson/Jack Barnett

XI. Allocation of Payments between Upper and Lower Basin Funds — Parry

XII. Basin Fund Payments / Accrual — Parry

XIII. Direction to the Technical Advisory Group (TAG) — Robbins/Dent

XIV. 2015 Advisory Council Report — Robbins
- A. Program Funding Recommendations — Robbins
- B. Discussion of Items for Report — Dent

XV. Items for the Forum — Trujillo

XVI. Other Business/Actions — Robbins

XVII. Public Comment — Robbins

Adjourn Meeting: **Approximately 11:00 a.m.**

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

OCT 19 2015

To: Brent Rhees
Regional Director, Upper Colorado Region, Bureau of Reclamation

From: Jennifer Gimbel
Chair, Glen Canyon Leadership Team
Principal Deputy Assistant Secretary for Water and Science

Subject: Approval of Recommendation for No Experimental High-Flow Release from Glen Canyon Dam, November 2015

On October 16, 2015, the Glen Canyon Technical Team (Technical Team) recommended against conducting a high-flow experimental (HFE) release from Glen Canyon Dam (Attachment 1, Technical Team Final Recommendation to Not Implement a Fall 2015 High Flow Experiment at Glen Canyon Dam) in accordance with the Development and Implementation of a Protocol for High-Flow Experimental Releases from Glen Canyon Dam, Arizona, 2011 through 2020 (HFE Protocol) Environmental Assessment (EA) and Finding of No Significant Impact (FONSI). The Glen Canyon Leadership Team (Leadership Team) has carefully reviewed and considered the Technical Committee's recommendation.

The Leadership Team agrees with the Technical Team's recommendation not to conduct an HFE in 2015. Basin States' representatives participated in the development of this recommendation and concur with it. As described in the Technical Team recommendation, concerns for biological resources warrant a cautious approach of not conducting an HFE, even though the sediment trigger has been met. Specifically, the presence of green sunfish, an invasive and predaceous nonnative fish, in Glen Canyon indicates that a fall 2015 HFE could have the negative effect of dispersing these nonnative fish into new habitats downstream. Dispersal of green sunfish could then have a negative effect on downstream populations of native, endangered fish species including the humpback chub and razorback sucker. Efforts are underway to swiftly address the green sunfish problem, but these efforts will not be complete in time to conduct a fall HFE within the timeframe established by the HFE Protocol. Accordingly, the risk of green sunfish dispersal during the timeframe for a fall 2015 HFE is high enough such that a fall 2015 HFE should not be conducted.

The Leadership Team would like to thank the Technical Team for the sustained hard work that has led to this recommendation. The Leadership Team would also like to recognize and thank the Basin States for their counsel and participation in the Technical Team. The individual efforts from members of the Technical Team and coordination of the team as a whole has made this process a success that will ensure benefits to the incomparable resources of Grand Canyon National Park and Glen Canyon National Recreation Area and effective and coordinated research to benefit the adaptive management process.

Attachment

cc:

Glen Canyon Leadership Team
Lori Caramanian, Department of the Interior
Bob Snow, Office of the Solicitor
Ramsey Kropf, Office of the Solicitor
Rod Smith, Office of the Solicitor
Brent Rhees, Bureau of Reclamation
Daniel Picard, Bureau of Reclamation
Sue Masica, National Park Service
Lindy Mihata, National Park Service
Ray Sauvajot, National Park Service
David Uberuaga, National Park Service
David Lytle, U.S. Geological Survey
Scott Vanderkooi, U.S. Geological Survey
Steve Spangle, U.S. Fish and Wildlife Service
Benjamin Tuggle, U.S. Fish and Wildlife Service
Bryan Bowker, Bureau of Indian Affairs
Chip Lewis, Bureau of Indian Affairs
Lynn Jeka, Western Area Power Administration
Vineetha Kartha, Arizona Department of Water Resources
Karen Kwon, Colorado Water Conservation Board

Glen Canyon Technical Team
Lori Caramanian, Department of the Interior
Sarah Rinkevich, Department of the Interior
Bob Snow, Office of the Solicitor
Ron Anderson, Bureau of Reclamation
Mary Barger, Bureau of Reclamation
Jane Blair, Bureau of Reclamation
Bill Chada, Bureau of Reclamation
Rick Clayton, Bureau of Reclamation
Chris Cutler, Bureau of Reclamation
Chad Douglas, Bureau of Reclamation
Katrina Grantz, Bureau of Reclamation
Glen Knowles, Bureau of Reclamation
Kerri Stout, Bureau of Reclamation
Jason Tucker, Bureau of Reclamation
Malcolm Wilson, Bureau of Reclamation
Jan Balsom, National Park Service
Rob Billerbeck, National Park Service
Melissa Tramell, National Park Service
Lesley Fitzpatrick, U.S. Fish and Wildlife Service
Scott Vanderkooi, U.S. Geological Survey
Garry Cantley, Bureau of Indian Affairs
Shane Capron, Western Area Power Administration
Chrystal Dean, Western Area Power Administration
Paul Harms, New Mexico State Engineer's Office
Vineetha Kartha, Arizona Department of Water Resources
Robert King, Utah Division of Water Resources
Ted Kowalski, Colorado Water Conservation Board
Jessica Neuwerth, Colorado River Board of California
Don Ostler, Upper Colorado River Commission
Colby Pellegrino, Southern Nevada Water Authority
Steve Wolff, Wyoming State Engineer's Office

October 15, 2015

To: Department of the Interior (DOI) Glen Canyon Leadership Team for the High Flow Experimental Protocol (HFE Protocol) and Non-Native Fish Control (NNFC)

From: DOI Glen Canyon Technical Team

Re: Final Recommendation to Not Implement a Fall 2015 High Flow Experiment at Glen Canyon Dam

I. Introduction

The DOI Glen Canyon Dam Technical Team (Team) has worked during the past several months to evaluate existing data and is recommending to the Leadership Team that no High Flow Experiment (HFE) be conducted in fall 2015. Although sediment conditions support conducting a 96-hr HFE in November 2015, the assessment of biological resources has raised serious concerns that a fall 2015 HFE could have negative impacts in the Canyon. Specifically, the detection of large numbers of invasive green sunfish in Glen Canyon and the risk of dispersal and subsequent establishment in the Colorado River and its tributaries have led the Technical Team to recommend that no HFE take place until the green sunfish have been eradicated.

The purpose of this memorandum is to transmit this recommendation to the Glen Canyon Dam Leadership Team in accordance with the May 23, 2012, Secretarial Directive on the Implementation of Research to Improve Conditions in the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area. The Team includes representatives from the National Park Service (NPS), the Fish and Wildlife Service (FWS), the Bureau of Indian Affairs (BIA), the United States Geological Survey (USGS) and its Grand Canyon Monitoring and Research Center (GCMRC), the Bureau of Reclamation (Reclamation), Western Area Power Administration (Western), the seven Basin States (States) and the Upper Colorado River Commission (UCRC).

The Team has met several times in recent weeks. Resource and communications specialists have been coordinating with the Team as necessary. The Team incorporated the latest data from agency experts in making this final recommendation. In making this recommendation, the Team considered multiple issues, as summarized below. The Team also considered the Sept 30, 2015 green sunfish risk assessment memorandum prepared by GCMRC as well as additional technical information and operating experience developed as a result of implementation of the 2012, 2013 and 2014 HFEs.

The Team recommends that no HFE at Glen Canyon Dam be conducted in fall 2015.

II. HFE Protocol

As explained in the Development and Implementation of a Protocol for High-Flow Experimental Releases from Glen Canyon Dam, Arizona, 2011 through 2020 Environmental Assessment (HFE EA; Reclamation 2011), the HFE Protocol is experimental in nature and is designed to achieve a better understanding of whether, how, and when to incorporate high releases into future dam operations in a manner that effectively conserves natural resources that are intimately connected to the distribution, size, and characteristics of fine-sediment deposits. Fine sediment is sand, silt, and clay; the deposits of the Colorado River in Grand Canyon are primarily composed of sand. The HFE Protocol establishes a decision-making framework consisting of three components: (1) planning and budgeting, (2) modeling, and (3) decision and implementation.

The Protocol uses predictive models to make recommendations for specific HFEs using real-time measurements and models of the rate of sand inflow from the Paria River and forecasted hydrologic data to determine whether suitable sediment and hydrology conditions exist for a high-flow experimental release.

A sand transport/budget model was used to predict the mass of sand that would be transported by an HFE and to estimate if a proposed HFE would transport more or less sand than had been delivered to the Colorado River during the fall accounting period (July 1 to November 30). Only HFEs that removed and/or redistributed slightly less sand than had been delivered from the Paria River during the fall accounting period (a “positive sand balance”) were considered. Output of the modeling runs provides the initial recommendation for the magnitude and duration of the HFE. However, because modeling only considers a simple range of possible HFE peak magnitudes and durations, the Protocol includes a review of the model output that may modify the recommended HFE to benefit relevant resources.

Throughout the summer and fall, Reclamation regularly updated its modeling estimates based on ever increasing sediment inputs. The modeled HFE shape was based on past years’ input from scientists at GCMRC designed meet the twin objectives of providing the greatest resource benefit and developing scientific information that will help better inform future decision making.

Review of model output as well as an assessment of other relevant resources raised key concerns for biological resources. Thus, the Team also considered the status of resources and consideration of HFE effects on key resources in making the recommendation described here.

Sand Budget Model

Because sand transport can be reliably predicted, a sand transport/budget model was used to determine the largest and longest HFE that could be conducted that still yielded a positive sand balance in Marble Canyon for the accounting period, (given the mass of sand delivered by the Paria River since July 1 of any given year). Model runs iteratively cycled through the different HFE types until HFE types were identified that did not result in a negative sand balance. Following several storm events in the Paria River watershed, September 2015 model results predicted there was sufficient sediment for implementation of an HFE under the Protocol.

The sediment modeling component uses the sand transport/budget numerical model developed by the GCMRC.

Model Inputs

Model predictions require estimation of the following:

- Antecedent conditions
- Hydrographs including the potential HFE
- Sand input from the Paria River

Antecedent Conditions

The antecedent conditions required for the sand budget model are bed thickness, in meters, and median particle size, in millimeters. The most recent values represented May 2002 bed conditions. These values were updated to July 2015 by running the sand budget model for the period from 2002 to 2015 and using the results of that simulation as the antecedent conditions of the 2015 HFE model simulations.

Hydrology Input

Hydrology inputs were provided as hourly releases from Glen Canyon Dam in cubic feet per second (cfs). During the modeled period, a combination of historic hourly releases and forecasted releases were used as the hydrology inputs.

Sand Input

Sand inputs to the sand budget model were provided as hourly loads in kilograms per second (kg/sec). During the modeled period, observed sand loads were used as input up to the date of the simulation. From the simulation date forward, zero future sand input was assumed through the end of the modeled period.

Sand inputs were measured and estimated by GCMRC. Data were made available in real-time to Reclamation through the Paria River USGS/GCMRC water quality website (www.gcmrc.gov/discharge_qw_sediment/station/GCDAMP/09382000#). Estimates of sand inflow were regularly adjusted by GCMRC as field samples were processed in the USGS/GCMRC laboratory.

Paria River sand inputs were increased to account for inputs from other tributaries in Upper Marble Canyon. Inputs from these tributaries are monitored and measured but estimates are not available in real-time. The historic average of these inputs is equal to approximately 10% of the Paria River loads, and is always a very small proportion of the amount delivered by the Paria River. Thus, Paria River sand input values were increased by 10% to account for these contributions from the lesser tributaries as was done for the HFE EA.

In real time, GCMRC provides estimates of the mass of sand delivered by the Paria River. Monthly, GCMRC provides estimates of the mass of sand that remains on the channel bed and in eddies in Marble Canyon. Initially, estimates are ±40%, because they are only based on modeling predictions. However, the uncertainty in these estimates progressively is reduced, because laboratory analysis of physical samples allows calibration of the model predictions. The range of uncertainty in estimates is reported by GCMRC as an upper and lower bound. For purposes of estimating the amount of newly delivered sand that is available for downstream transport and building of eddy sandbars, Reclamation used GCMRC's lower bound estimate. Thus, Reclamation's assessment of the amount of sand that is available for transport by the HFE is the minimum amount about which the GCMRC has a very high degree of confidence (i.e., a conservative estimate). Although the uncertainty associated with GCMRC's estimate of the actual amount of sand available for transport will inevitably be reduced, use of the lower bound during the HFE planning process ensures that there is minimal risk that the HFE will entrain more sand than is actually available to be transported. Subsequent to the 2012 and 2013 HFEs, analyses demonstrated that each controlled flood actually transported much less sand than was available to build new eddy sandbars or be transported downstream.

Therefore, while the use of the lower bound during the initial planning process may be appropriate, for some future HFEs, the Technical Team may wish to evaluate whether other decision criteria, such as the total sand accumulated in previous years, should also be considered in recommendations concerning the magnitude and duration of future HFEs. This consideration may also inform potential protocol design refinements pursuant to the ongoing work in the LTEMP process.

The sand mass balance for Upper Marble Canyon, where virtually all of the available sand is presently stored, was estimated by GCMRC and provided to Reclamation. The latest estimates available were for the period July 1 to September 28, 2015 (the last update available for this Technical Team report and recommendation). The estimates for the lower and upper bounds were, respectively, 678,000 and 960,000 metric tons.

HFE Types

Appendix E of the HFE EA listed 13 possible HFE types ranging from a peak magnitude of 31,500 to 45,000 cfs and ranging in peak duration from 1 to 96 hours. Although the HFE Protocol model evaluates performance of 13 possible types of HFEs (Table 1), the HFE Protocol decision and implementation phase allows for modifications based on resource conditions and predicted benefits to resources. Thus the HFE Protocol allows for HFEs from 1 to 96 hours in duration, 31,500 to 45,000 cfs in magnitude, and utilizing the rate limits of 4,000 cfs/hour increasing and 1,500 cfs/hour decreasing as defined in the HFE Protocol Finding of No Significant Impact (FONSI; Bureau of Reclamation 2012a) and the operating criteria for Glen Canyon Dam (62 FR 9447).

The modeling for this HFE used a peak magnitude of 37,600 cfs rather than 45,000 cfs due to expected maintenance at Glen Canyon Dam and other limitations due to reservoir head and power regulation. To assist with creating additional generation at Glen Canyon Dam, Western offered to move power reserves off of Glen Canyon Dam during a potential fall 2015 HFE, thus

decreasing their normal 67 megawatts (MW) of regulation/reserve requirement to 40 MW and increasing the maximum possible peak magnitude of a potential HFE.

Table 1. The 13 HFE types tested in model runs.

HFE No.	**Peak Magnitude (cfs)**	**Peak Duration (hrs)**
1	37,600	96
2	37,600	72
3	37,600	60
4	37,600	48
5	37,600	36
6	37,600	24
7	37,600	12
8	37,600	1
9	36,350	1
10	35,100	1
11	33,850	1
12	32,600	1

All HFEs tested assumed a ramp-up rate of 4,000 cfs/hr from baseflow to powerplant capacity, a rate of half a bypass tube (~1,875 cfs) every hour up to peak magnitude, and a ramp-down rate of 1,500 cfs/hr to baseflow. These ramp rates are in accordance with the HFE Protocol EA and FONSI, 1995 EIS, 1996 Record of Decision, and the Operating Criteria for Glen Canyon Dam (62 FR 9447).

HFE Model Results

The model simulation for the lower bound estimate for Paria River sand input and the HFE hydrograph completed October 7, 2015 estimated 534,330 metric tons of sand supply in all of Marble Canyon (i.e the Upper and Lower parts) on November 8, 2015 prior to the start of a potential HFE and an estimated 67,000 metric tons on November 30, 2015 following a potential HFE and at the end of the accounting period.

Sand budget model results through October 7, 2015, determined an HFE with a peak magnitude of 37,600 cfs and a peak duration of 96 hours.

HFE Recommendation

Although sediment conditions support a 96-hour duration HFE, the Team is recommending that no HFE take place in fall 2015 due to concerns for biological resources (discussed below).

III. Assessment of Resources

In making this recommendation, the Team completed an assessment of key resources that may be impacted or affected by a 2015 HFE based on the most recent information, and in particular, information collected since the fall 2012, 2013 and 2014 HFEs. This assessment focuses on recent findings and key resources and an evaluation of these resources relative to the proposed timing, duration, and magnitude of the potential fall 2015 HFE as described above using the best available science.

Three HFEs have been conducted under the HFE Protocol: a fall 2012 HFE November 18-23 2012 with a maximum magnitude of approximately 44,700 cfs for 24 hours followed by a slow down-ramp rate of 200 cfs per hour for 30 hours, a fall 2013 HFE November 11-16, 2013 with a maximum magnitude of approximately 37,500 cfs for 96 hours, and a fall 2014 November 10-15, 2014 with a maximum magnitude of approximately 37,500 cfs for 96 hours. The following resource assessment summarizes the results of these first three HFEs, in relation to prior HFE tests, and in developing a recommendation for a 2015 HFE.

The Team refers to Reclamation (2011) and Melis (2011) for more complete summaries of resource effects from HFEs. The following key resources were considered:

- Sediment Resources
  - In-channel sediment storage
  - Sandbar campable area
  - High-elevation sand deposits

- Cultural Resources
  - Archaeological site condition and stability
  - Access to archaeological sites by tribes

- Biological Resources
  - Aquatic food base
  - Lees Ferry trout population
  - Lees Ferry fishery recreation experience quality
  - Endangered humpback chub and other fish abundance
  - Riparian vegetation
  - Endangered Kanab ambersnail

- Hydropower and water delivery
  - Water quality
  - Water delivery
  - Dam maintenance
  - Hydropower production and marketable capacity

In our resource assessment, we found key information, specifically the presence of green sunfish in a backwater slough in Glen Canyon, that indicates a fall 2015 HFE could have potential adverse effects. This information has lead the Team to recommend that no HFE take place in fall

2015. Concern related to green sunfish as well as several additional issues that warranted further consideration are described in this section.

Sediment Resources: See discussion in Section II for current sediment conditions relative to the HFE Protocol. Responses to the first three HFEs under the HFE Protocol in 2012, 2013, and 2104 were similar to previous HFEs. All resulted in substantial deposition followed by erosion of about half the new deposits within 6 months. Response immediately after the 2014 HFE based on digital camera images of sandbars from Lees Ferry to Diamond Creek indicated that there was a substantial gain (deposition) for 22 sandbars (58% of sites), no substantial change for 11 sandbars (29% of sites), and substantial loss (erosion) for 5 sandbars (13% of sites). Annual topographic surveys of sandbars were conducted between September 23 and October 9, 2015. These data have not been processed, but preliminary field observations indicate significant erosion of sand deposited by the fall 2014 HFE occurred during summer 2015.

The aggregate sand mass balance conditions since inception of the HFE Protocol, i.e. for the period between July 1, 2012, and September 28, 2015 for the different segments of the Colorado River are:

Upper Marble Canyon: + 1.00 million metric tons (the range of this estimate is between -0.48 and + 2.50 million metric tons)

Lower Marble Canyon: + 2.00 million metric tons (the range of this estimate is between +1.60 and + 2.50 million metric tons)

Thus, there was more sand in the Colorado River corridor in Marble Canyon on September 28, 2015, than there was on July 1, 2012 when the HFE Protocol was first implemented.

Cultural Resources: Reclamation (2011) determined that the HFE Protocol could, through multiple HFEs, potentially affect historic properties and the effect would be adverse per 36 CFR 800.5(2)(iv). Reclamation also found that adverse effects to sacred sites could result from the HFE Protocol, primarily from limitation of access of tribes to sacred sites during the period of HFE releases. Reclamation completed the HFE Protocol Memorandum of Agreement (MOA; Reclamation 2012b) with affected tribes and other parties to address these effects. Effects of HFEs to cultural resources are primarily from erosion and redistribution of sediment. Inundation can directly adversely affect sites through erosion, but deposition may help protect sites directly or by providing sources of sand that can bury historic properties via aeolian transport (Reclamation 2011, Schmidt and Grams 2011). HFEs also may affect access of tribes to historic properties and alter visitation patterns to historic properties (Reclamation 2011).

The MOA has a stipulation, Stipulation 2c, that requires a meeting be conducted with the parties after each HFE event, to review the effects of the HFE, and use the results of the meeting to inform monitoring for future HFEs, and to design and implement any measures necessary to prevent or control adverse effects of future HFEs. Reclamation held an HFE Workshop on February 27, 2015 in Salt Lake City, Utah, and that meeting also served as the HFE MOA meeting to review the results of the 2014 HFE. No adverse effects to historic properties from the 2012, 2013, or 2014 HFEs were identified.

The MOA also includes a stipulation, Stipulation 2b, that requires all the parties be notified at least 30-days in advance of any planned HFEs, and consult with tribes to resolve any conflicts with tribal access to or uses of the Colorado River. DOI began notifying the parties of the potential for an HFE in early September, and the parties were also officially notified of a potential HFE in fall 2015 on September 30, 2015 via letter.

Biological Resources: HFEs can affect aquatic biological resources in Glen, Marble, and Grand Canyons as well as Lake Mead by changing the physical template of the ecosystem. HFEs scour the river bed, primarily in Glen Canyon, removing algae and aquatic plants and animals, which alters the distribution and abundance of aquatic animals, particularly in benthic habitats, and can result in changes to the aquatic food base for fish (Kennedy and Ralston 2011).

Controlled floods have been released from Glen Canyon Dam on the Colorado River six times since 1996. Research conducted around the March 2008 flood demonstrated that this pulse disturbance reduced biomass and cover of aquatic macrophytes, and restructured invertebrate assemblages by favoring fast-growing insect taxa (midges and blackflies) that prefer bare substrates and disadvantaging non-native and non-insect taxa such as mudsnails that prefer macrophyte beds (Cross et al. 2011). These shifts in the invertebrate assemblage and increases in drift concentrations led to dramatic increases in rainbow trout biomass. In the years after this controlled flood (2009-2012), aquatic macrophytes returned, large bodied mudsnails came to dominate, and fast-growing midges and blackflies declined (GCMRC unpublished data).

Controlled floods were again conducted in November 2012, 2013, and 2014, but long-term drift monitoring indicates these fall-timed floods did not restructure invertebrate assemblages, likely due to the seasonal scouring potential of aquatic macrophytes (GCMRC unpublished data). Specifically, primary production monitoring indicates that although these fall-timed floods temporarily reduce macrophyte cover (i.e., lower primary production) these negative effects are not persistent, and macrophyte biomass and production recovers the following spring thereby providing low-velocity habitat that favors mudsnail production. The 2008 spring-timed floods appeared to have a persistent and long-term effect (i.e., >1 yr) on macrophyte production, because this disturbance occurred at the onset of the growing season. Fall-timed floods occur at the end of the growing season at a time when macrophytes are already in the process of shunting biomass and preparing to overwinter. Thus, the timing, rather than simply the magnitude, of controlled floods on the Colorado River appears to affect food web response.

Investigations into the effects of HFEs on key fish species, namely nonnative rainbow trout and native humpback chub, indicate these events do not appear to affect young fish of either species through displacement to downstream habitats or increased mortality (Kennedy and Ralston 2011). For example, trout in Glen Canyon moved very little over intervals that included the 2012, 2013, and 2014 HFEs (GCMRC unpublished data). Furthermore, juvenile humpback chub survivorship in the mainstem Colorado River at the Little Colorado River was actually higher over the 2012-2013 and 2013-2014 periods that included HFEs relative to 2011-2012 that did not include an HFE (GCMRC unpublished data). Other fish species present in Glen or Grand Canyons may, however, respond differently. A recent risk assessment of green sunfish in Glen Canyon (Ward 2015) concluded that HFEs pose a risk to spread this invasive species from Glen Canyon to downstream areas in Grand Canyon.

HFEs may improve spawning habitat for rainbow trout in Glen Canyon by scouring fine sediment and cleaning gravel beds used for spawning. HFEs also alter the distribution of fine sediment resulting in changes in aquatic habitat, for example the creation of backwaters (Kennedy and Ralston 2011). HFEs also change the water quality in the river and in Lake Mead downstream by increasing turbidity and altering water quality, in particular, temperature, dissolved oxygen, and specific conductance (Reclamation 2011, Southern Nevada Water Authority unpublished data).

Rainbow trout densities have been decreasing in Glen and Marble Canyons since early 2012. Densities just above and below the Little Colorado River confluence increased until early 2014 then decreased sharply into late 2014 and early 2015 (GCMRC unpublished data). These changes do not appear to be a result of the fall 2012, 2013, or 2014 HFEs, but there is uncertainty in this regard, and this is a cause for concern for endangered humpback chub. Monitoring indicates that rainbow trout in Glen Canyon moved very little during the intervals that included the fall 2012, 2013, and 2014 HFEs. Approximately 90% of age-0 rainbow trout were recaptured within 0.25 miles of their initial release locations (GCMRC unpublished data). There is some evidence, based on year class structure, of local rainbow trout recruitment in Marble Canyon; although it is unclear that this has been caused directly by HFEs, it is possible, and we are uncertain whether a fall 2015 HFE would exacerbate this. Over this same period, brown trout catches at the LCR have been low. Brown trout are a highly piscivorous species known to eat humpback chub and other native species. So far, monitoring of juvenile and subadult humpback chub has not indicated that rainbow or brown trout are having an adverse effect, and humpback chub status appears stable or increasing across all age classes for the Little Colorado River aggregation (GCMRC unpublished data). Continuation of the trout monitoring program now in place will provide an assessment of the effects from a 2015 HFE, if it occurs.

HFEs have had no measurable direct effects, positive or negative, on humpback chub or other native fish, although their populations have increased significantly over the last decade, a period that included HFEs in 2004, 2008, 2012, 2013 and 2014 (Kennedy and Ralston 2011, GCMRC unpublished data). HFEs may indirectly affect humpback chub through increases in rainbow trout populations, which can prey on young humpback chub. While increases in rainbow trout abundance have been observed following the spring flows of 2008 which included an HFE in March, no positive trout response has been observed following fall HFEs in 2012, 2013 or 2014 (GCMRC unpublished data). Based on provisional unpublished data, humpback chub were apparently unaffected by the 2012 and 2013 HFEs, with adult and juvenile populations appearing stable over the period of these HFEs. The spring population estimate for adult (> 200 mm) humpback chub in the Little Colorado River was lower in 2015 relative to 2014 (USFWS unpublished data). While this data may represent a population decline, evidence indicates that the relative condition of humpback chub in the Colorado River near the confluence of the Little Colorado River was low in late 2014 and early 2015 (GCMRC unpublished data). This data supports the hypothesis that low spring catches were due to skipped spawning as a result of less energy available for fish to devote to reproduction. A complete analysis of humpback chub data from monitoring trips in September and October 2015 was not available in time to be considered in this report, but preliminary results suggest catches of various size classes of humpback chub were relatively high both in the Colorado River and Little Colorado River (USFWS and GCMRC unpublished data) suggesting that there are no issues of concern relative to a fall 2015 HFE.

A small reproducing population of endangered razorback sucker occurs downstream in Lake Mead, and recent monitoring data indicated that razorback sucker occupy and spawn in western Grand Canyon as far upstream as Lava Falls. A single adult was caught in October 2012 near Spencer Canyon in the riverine part of Lake Mead that is within western Grand Canyon. Two adults, one untagged and one sonic tagged, were captured in the same area in 2013 (Arizona Game and Fish Department (AGFD unpublished data). Sonic-tagged adults have also been remotely detected as far upstream as Lava Falls. Razorback sucker larvae were captured just downstream of Lava Falls in 2014 and preliminary data indicates they were also collected in 2015 (NPS unpublished data). Changes in flows are unlikely to have any significant effect to razorback suckers in the Colorado River inflow area since effects of those releases are attenuated by the time the water reaches what is likely to be occupied habitat, and razorback sucker are rare in the area. The HFE flows could have some effect to spawning and recruitment if conducted during the spring, but a fall HFE will not have this effect, as spawning does not occur during this timeframe.

As described in the 2011 U.S. Fish and Wildlife Service biological opinion, endangered Kanab ambersnail would be adversely affected by HFEs (U.S. Fish and Wildlife Service 2011). HFEs will scour snail habitat resulting in loss of some snails at Vasey's Paradise. FWS found in its 2011 biological opinion that this loss of snails and snail habitat would not jeopardize the continued existence of the Kanab ambersnail. A recent report by the USGS found that Kanab ambersnails are part of a much more widespread species of snail and may not qualify as an endangered species (Culver et al. 2013).

Whirling disease, a serious disease of trout species, was detected in Glen Canyon in 2011 by AGFD. Although there is no data on how HFEs affect whirling disease, GCMRC completed an assessment of the potential for HFEs to spread whirling disease in 2012 that concluded HFEs pose little risk of spreading whirling disease, and that HFEs may reduce the prevalence of the disease by removing tubificid worms from sediments in Glen Canyon (tubificid worms are hosts to this myxosporean parasite). The AGFD has not specifically monitored for the disease in Marble and Grand Canyons. However annual monitoring of rainbow trout in Glen, Marble, and Grand Canyons did not detect symptoms of the disease in 2014 or 2015, since the 2013 and 2014 HFEs.

In July 2015, an unusually large number of nonnative green sunfish were discovered in a large backwater in the Lees Ferry Reach (AGFD unpublished data). Agency biologists agreed that elimination of this invasive species from the backwater sloughs is necessary and urgent due to the risk of negative interactions with native fish, particularly the humpback chub. Two subsequent removal trips in August 2015 using electrofishing, seining and trapping failed to deplete the population despite removing over 3000 fish (AGFD unpublished data). Agency biologists conferred and agreed that these methods were not likely to successfully eradicate this species from the area. While additional methods of removal and control were considered, an immediate need to contain the green sunfish was recognized. On Oct 7, 2015 biologists from NPS and AGFD constructed and installed a large block net at the downstream end of the main slough to minimize escapement of green sunfish until a more complete removal can be effected. Potential methods to eradicate green sunfish from Glen Canyon include mechanical approaches like electrofishing, netting, or concussive methods and chemical treatments such as piscicides or carbon dioxide. Of the methods evaluated to remove these fish, chemical treatments provide the

greatest likelihood of success (Ward 2015). NPS and AGFD, with assistance from GCMRC and Reclamation, are working towards a chemical treatment solution; however, the likelihood of a chemical treatment being completed and determined to be fully successful before a fall 2015 HFE can be implemented in November is very low, due to the high level of planning and State and Federal regulatory compliance that is necessary before initiating treatment. The risk of dispersal of this invasive species must be taken into account as the HFE is considered, since this species is adapted to using floods as a means of dispersing to new habitats and colonizing them. Bathymetric maps of the slough area and preliminary results from flow modeling indicate the area becomes a flowing side channel at flows between 20,000 and 30,000 cubic feet per second (cfs), while the minimum flows for HFEs are 31,500 cfs. The temporary block net installed at the mouth of the slough will not be adequate to contain the green sunfish if the side channel begins to flow. Eradication of green sunfish from Glen Canyon before any HFE is necessary to eliminate the risk of dispersal and subsequent establishment of this harmful nonnative in the Colorado River or any of its tributaries in Grand Canyon.

Hydropower and Water Delivery: Throughout the HFE planning process Reclamation and Western have coordinated to ensure that the maximum possible release from the dam could be achieved. While there are a number of unknown factors that might impact the maximum release rate that can be made during the HFE, Reclamation anticipates that a release of approximately 37,600 cfs would achievable.

The best estimate for total release from Glen Canyon Dam for a HFE in November 2015 is 37,600 cfs (22,600 cfs through the powerplant and 15,000 cfs of bypass). This estimate is based on the most recent unit testing completed in September 2015, a maintenance assumption that seven of the eight units at Glen Canyon Powerplant would be available November 9-14, 2015, and an approximately 90% gate opening on the available seven units. In addition, this estimate assumes that 40MW (approximately 1,200 cfs) of system regulation will be maintained at Glen Canyon.

Western has completed an analysis of the financial costs of running the experimental flows during the fall 2012 and 2013 HFEs. Western estimates that the 2012 HFE cost approximately $1.1 million and that the 2013 HFE cost approximately $2.6 million. These are good bookends for the likely cost of running a similar HFE in 2015. The financial implications of the HFE occurs over a few months. Initially there tends to be a financial gain in November due to the increased generation, but is offset by a financial loss that occurs in December through April from water that is needed to support the experimental releases in November. In addition, water that is bypassed (or spilled) does not generate any power and thus represents lost revenue.

The release volume required in November for the modeled HFE is approximately 770,000 acre feet. The October 24-Month Study projected 600,000 acre feet release volume in November, therefore it would be necessary to reallocate approximately 170,000 acre feet from months later in the 2015 water year. Approximately 130,000 acre feet of water would be bypassed during the modeled HFE. If the HFE were to take place, Western and Reclamation would coordinate on the scheduled reallocation of monthly release volumes with the goal of protecting minimum MLFF monthly thresholds whenever practicable as described in the EA as well as maximizing the

economic value of hydropower. Hourly releases for the days prior to and after the proposed HFE in November were modeled as fluctuating between 6,500 to 9,000 cfs.

Reclamation thoroughly evaluated the effect of conducting the modeled fall 2015 HFE on the annual release volume from Lake Powell in compliance with the 2007 Interim Guidelines. Reclamation currently projects the annual release volume for water year 2016 will be 9.0 million acre feet under the minimum and most probable hydrology inflow scenarios and 11.4 million acre feet under the maximum probable hydrology inflow scneario. An HFE in November 2015 would not affect the annual release volume from Lake Powell nor the Operational Tier in accordance with the 2007 Interim Guidelines. In the HFE FONSI, Reclamation also committed to consulting with the Basin States prior to conducting an HFE as to the issue of compliance with the 2007 Interim Guidelines. Because the Team is recommending that no HFE be conducted in fall 2015, no consultation related to compliance with the 2007 Interim Guidelines was undertaken. In fall 2015, Basin State representatives participated in the development of this recommendation and concur with it.

The Pueblo of Zuni, in a letter dated September 20, 2012 expressed concern that successive iterations of HFEs under the HFE Protocol could have cumulative negative impacts on power generation and a resultant effect on raising the cost of purchasing power for individual rate payers, and that this is especially of concern to economically disadvantaged minority communities such as Zuni. The Pueblo of Zuni requested that Reclamation provide a detailed description on how the economic effects of successive HFEs on power rate payers will be monitored. Though no HFE is recommended for fall 2015, Reclamation continues to work with Western to carefully assess this issue and provide for post-HFE monitoring that will analyze, to the extent possible, effects to ratepayers from HFEs conducted under the HFE Protocol. At this time, Western does not anticipate that the cost of HFEs will cause near-term changes in power rates.

IV. SAFETY CONSIDERATIONS

As identified in the HFE Protocol EA and FONSI, potential effects on public health and safety could occur in conjunction with an HFE, primarily impacting recreational anglers and boaters. All daily fluctuations, minimum flows and maximum flows associated with any proposed HFE are within the range experienced by recreational users in the past. Reclamation and NPS continue to work together to ensure that safety measures are implemented, including restricting access to the river immediately below the dam during proposed HFEs, and as noted below, providing public notice about the timing of the HFE implementation. NPS Boating Safety Rules always apply to all boaters using the river.

Day raft trips from Glen Canyon Dam to Lees Ferry, conducted under contract by Colorado River Discovery (CRD), cannot operate during HFEs because flow into the Colorado River uses the bypass tubes at Glen Canyon Dam near the launch point for these trips. NPS would notify CRD of a potential HFR so that the company can prepare to move boats and associated infrastructure out of the river to the Lees Ferry launch ramp. Revenue losses for the period of time associated with six-day HFE are estimated at $14,000 to $16,000, with and additional costs of $600 for NPS amenities revenues, and $1,620 concession franchise fees. Given that no HFE is being recommended for fall 2015, the primary concessionaire on the Glen Canyon reach,

Colorado River Discovery (CRD), will be unaffected, notifications will not need to be made, and there is no anticipated loss of revenue.

Reclamation and NPS coordinate to address safety and security issues related to HFEs. Additionally, the NPS units work to maximize continuity of efforts and resources, particularly in those areas where responsibilities are shared, specifically Lees Ferry and Pearce Ferry. The parks have coordinated communications plans, medical plans and resource capabilities for search and rescue responses.

If an HFE were to occur, GCNP would communicate with permitted Colorado River trip permit holders that have the potential to be impacted by the HFE while rafting the Colorado River within GRCA and Lake Mead National Recreation Area. Given that an HFE is unlikely to occur, no active planning is underway to provide alternative trip dates for trips potentially affected by an HFE.

If an HFE were to occur, GCNRA would communicate with the holders of commercial use authorizations for commercial services (primarily fishing guides) on the Colorado River within GCNRA to provide information on the time and duration of the HFE. Given that an HFE is unlikely, no additional informational messaging has been developed.

V. COMMUNICATIONS PLAN

If an ultimate decision is made not to conduct a fall 2015 HFE, DOI, NPS, USGS and Reclamation public affairs officers will develop appropriate communication strategies and FAQ's to address commonly asked questions and provide outreach and education to the public. This outreach will include updates to all relevant agency web sites and media outlets as requested.

VI. POST HFE-REPORTING AND FEEDBACK

Reclamation committed in the HFE EA and FONSI to provide reports on effects of HFEs conducted in a given year. Although we are not recommending a fall 2015 HFE, if a fall 2015 HFE were conducted, the Technical Team would coordinate to report initial findings at the 2016 Glen Canyon Dam Adaptive Management Program (GCDAMP) Annual Reporting Meeting in January 2016.

Members of the Technical Team will schedule additional meetings as necessary and will also report ongoing findings at meetings of the GCDAMP Technical Work Group and Adaptive Management Work Group. Reclamation also has a commitment to provide an annual monitoring report to the FWS Arizona Ecological Services Office (AESO) in compliance with the 2011 Biological Opinion; this report will also include a summary of effects of HFEs conducted under the protocol. Also, under the HFE Protocol MOA, Reclamation will conduct a reporting meeting with the signatories to that agreement, describing the effects of the HFE. Reclamation will use the monitoring information and feedback from AESO and the MOA signatories to inform monitoring for future HFEs, and to design and implement any measures necessary to address any adverse effects that may occur due to future HFEs.

There are two similar commitments in the HFE Protocol FONSI that Reclamation addressed in 2015, after the 2014 HFE. The first commitment was to undertake a review in 2014 of the first two years of implementation of the HFE Protocol through a workshop with scientists to assess what has been learned. This commitment is part of the FWS 2011 Biological Opinion on the HFE Protocol. The second commitment, from the HFE Protocol FONSI, was to conduct a comprehensive review of the HFE Protocol after multiple events (at least 3) have occurred, with GCDAMP stakeholders, to document and standardize planning tools and information sharing approaches as part of the implementation of the HFE Protocol. As a result of consultation with FWS, Reclamation combined these two commitments and conducted a workshop on February 27, 2015, in Salt Lake City, Utah, with GCDAMP stakeholders and MOA signatories to evaluate the results of the first three HFEs, and completed and submitted to FWS a draft written report of the biological opinion reporting results in 2015.

In addition, GCMRC developed a science plan for the HFE Protocol that describes a program of monitoring and research activities that support ongoing information needs associated with implementation of the HFE Protocol. The approach described in this science plan relies on water quality, sediment, aquatic biology, and other resource monitoring and research projects funded in the GCDAMP Fiscal Year (FY) 2015-17 Triennial Budget and Work Plan (TWP, Reclamation and GCMRC 2014). These projects will inform the effect of future HFEs on the downstream resources of Glen, Marble, and Grand Canyons. These projects from the TWP are further discussed below.

Project 2, Streamflow, Water Quality, and Sediment Transport in the Colorado River Ecosystem, and Project 3, Sandbars and Sediment Storage Dynamics: Long-term Monitoring and Research at the Site, Reach, and Ecosystem Scales, are essential components to implementation of the HFE Protocol because the protocol calls for high flow releases from Glen Canyon Dam whenever a specified minimum amount of fine sediment delivered from the Paria River is exceeded. Project 2 is the measurement program needed to document the HFE Protocol. Project 3 supports the direct measurements of the volume of fine sediment, especially sand, that is stored on the bed of the Colorado River, in its eddies, or at higher elevation along the river's banks; these measurements allow assessment of the effectiveness of the HFE Protocol. A significant accomplishment of these programs in FY13–14 was the development of web-based interfaces to serve sediment transport and water quality data, calculate fine sediment mass balances, and to serve photographs of approximately 50 sandbars located from Lees Ferry to Diamond Creek. The latter data allow stakeholders to evaluate the effects of controlled floods implemented under the HFE Protocol.

As described in the HFE Protocol EA, the HFE planned for fall 2015 would not be an isolated event, but as a component of a longer-term experiment to restore and maintain sandbars with multiple high flows over a period of several years. The monitoring data that are needed to assess the outcome of this multi-year experiment include annual sandbar monitoring at selected long-term monitoring sites, periodic monitoring of changes in sand storage in the river channel, and measurements of sandbar size at more than 1,000 sites based on aerial photographs that are collected approximately every 4 years. These activities are described in detail in the TWP. It is also important, however, to evaluate the sandbar building response of each high flow to assess whether the sandbar building objectives are being achieved incrementally. This evaluation will

be based on sites that are monitored by remotely deployed digital cameras and repeat topographic surveys of sites that will occur in spring and fall 2016.

GCMRC scientists have installed digital cameras that capture 5 images every day at 43 sandbar monitoring sites throughout Marble and Grand Canyon between Lees Ferry and Diamond Creek. The images acquired by these cameras will be used to evaluate both the magnitude and spatial distribution of sandbar building caused by the HFE. They will also be used to assess the rate of post-HFE sandbar erosion. GCMRC scientists tested the effectiveness of this monitoring method based on images collected at 22 sites, from Lees Ferry to Diamond Creek, for the 2008 HFE. The assessment of sandbar gains and losses based on a categorical ranking of changes from the images agreed with the changes detected by detailed topographic surveys at 86% of the sites. Because the remote cameras are monitoring the same sites that are monitored by the annual surveys and the same sites that were monitored during the previous high flows, it will be possible to evaluate sandbar-building effectiveness of the planned 2015 HFE relative to the previous HFEs. NPS will also be providing post-HFE monitoring of sandbars using photography.

All of the long-term sandbar monitoring sites, located between Lees Ferry and Diamond Creek, were surveyed between September 22 and October 9, 2015. This assessment of the size and distribution of HFE deposits approximately 11 months following the 2014 HFE provide the most informative assessment of sandbar-building effectiveness. These measurements, now being analyzed, will indicate the degree to which deposits created by the fall 2014 HFE provide enhanced sandbars for use in the following summer recreation season and whether the HFE Protocol is resulting in cumulative increases in sandbar size.

Project 4, Connectivity along the Fluvial-Aeolian-Hillslope Continuum: Quantifying the Relative Importance of River-related Factors that Influence Upland Geomorphology and Archaeological Site Stability (called Project J in the FY13–14 Work Plan) is focused on monitoring and research concerning geomorphic and weather processes that affect cultural resources above the active channel of the Colorado River. This project seeks to address longstanding issues associated with monitoring of landscape change near archaeological sites and other culturally significant properties. The project directly supports evaluation of the HFE Protocol effects to cultural resources by measuring deposition and erosion of river-derived sediment (sandbars) and consequent aeolian sand transport and efficacy of these processes in *in situ* preservation and impacts of archaeological sites.

Projects 5 (Food base Monitoring and Research), 6 (Mainstem Colorado River humpback chub aggregations and fish community dynamics), 7 (Population Ecology of Humpback Chub in and around the Little Colorado River), 8 (Management Actions to Increase Abundance and Distribution of Native Fishes in Grand), 9 (Understanding the Factors Determining Recruitment, Population Size, Growth, and Movement of Rainbow Trout in Glen and Marble Canyons), and 10 (Where does the Glen Canyon Dam rainbow trout tailwater fishery end?- Integrating Fish and Channel Mapping Data below Glen Canyon Dam) concern the fishes of the Colorado River and its tributaries, the food base on which those fish depend, and the habitats in which the food base and fishes occur. Project 5 is a new stand-alone effort designed to continue monitoring of the aquatic food base and to conduct research to resolve questions about the current condition of the aquatic invertebrate community in Glen Canyon. Many of the research and monitoring projects on native and nonnative fish in the mainstem Colorado River are included in Project 6.

Project 7 is a research project intended to resolve uncertainties about humpback chub and their life history in the Little Colorado River and near its confluence with the mainstem Colorado River. Management actions focused on benefitting native fish and funded by the GCDAMP are included in Project 8, as is a proposed review of the fisheries program by an external protocol evaluation panel (PEP). Project 9 concerns the rainbow trout fishery of Glen Canyon as well as the factors influencing the distribution and movement of rainbow trout in Marble Canyon. Project 10 focuses on improving understanding of the relationships between physical habitat in Glen Canyon and Marble Canyon and rainbow trout recruitment and distribution. These projects work in concert to maintain long-term monitoring data sets of key aquatic resources in the Colorado River ecosystem while also looking to minimize redundancy and increase efficiency and to continue addressing persistent scientific uncertainties that have plagued management of the aquatic ecosystem. These projects work directly to evaluate the HFE Protocol through a set of monitoring and research efforts designed to evaluate the effect of HFEs on the physical habitat of the aquatic ecosystem, the aquatic food base, and concomitant changes in the nonnative fishery (predominantly rainbow trout in Glen and Marble canyons), the native fishery downstream, including endangered humpback chub, and the interactions between the native and nonnative fishery, in particular the effect of predation and competition from rainbow trout on humpback chub.

VII. CONSULTATION

Reclamation and GCMRC presented much of the information in this report that was available at that time to the Adaptive Management Work Group at its August 27-28, 2015 meeting. Representatives of the Colorado River Basin states participated in the development of this recommendation and concur with it. Reclamation also intends to present the findings and recommendation of this report to the Technical Work Group (TWG) on October 20-21, 2015. On September 30, 2015, the required 30-day advance notification was given to the MOA signatories, including the tribes, of the potential for an HFE in November 2015.

VIII. CONCLUSION

Determining whether to recommend an HFE required coordination of many details and effective communication amongst technical staff of multiple agencies. The Team members relied heavily on the staff in each of the agencies in making this recommendation. The Team has thoroughly evaluated the issues discussed above, and has taken into consideration the information and analysis included in the HFE Protocol EA and FONSI. The Team's recommendation to not implement a HFE in fall 2015 is based on the careful assessment of resources and best available science. In particular, the Team is recommending that no HFE be conducted in fall 2015 because of the detection of green sunfish and the concern that an HFE could disperse this harmful nonnative downstream into the Colorado River. The Team recognizes the need to eradicate the species prior to conducting an HFE and the timeline for doing so is not feasible within the fall 2015 HFE window (October through November 2015). The success of this important initiative is in large part due to the commitment of the Team to ensuring that the HFE Protocol is a success.

References Cited

Bureau of Reclamation. 2007a. Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead, Final Environmental Impact Statement. Bureau of Reclamation, Upper and Lower Colorado Regions. http://www.usbr.gov/lc/region/programs/strategies/FEIS/index.html

Bureau of Reclamation. 2007b. Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead, Record of Decision. Bureau of Reclamation, Upper and Lower Colorado Regions. http://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

Bureau of Reclamation. 2011. The Development and Implementation of a Protocol for High-Flow Experimental Releases from Glen Canyon Dam, Arizona, 2011 through 2020 Environmental Assessment. Bureau of Reclamation, Upper Colorado Region. http://www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol/index.html.

Bureau of Reclamation. 2012a. Finding of No Significant Impact for the Environmental Assessment for Development and Implementation of a Protocol for High-Flow Experimental Releases from Glen Canyon Dam, Arizona through 2020. Bureau of Reclamation, Upper Colorado Region. http://www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol/FINAL-FONSI.pdf.

Bureau of Reclamation. 2012b. High Flow Protocol Memorandum of Agreement. Bureau of Reclamation, Upper Colorado Region. http://www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol/FINAL-FONSI.pdf.

Bureau of Reclamation and U.S. Geological Survey Grand Canyon Monitoring and Research Center. 2014. Glen Canyon Dam Adaptive Management Program Triennial Budget and Work Plan—Fiscal Years 2015–2017. Prepared by Bureau of Reclamation Upper Colorado Regional Office Salt Lake City, Utah and U.S. Geological Survey Southwest Biological Science Center Grand Canyon Monitoring and Research Center, Flagstaff, Arizona. Approved by the Secretary of the Interior September 29, 2014.

Cross, W.F., Baxter, C.V., Donner, K.C., Rosi-Marshall, E.J., Kennedy, T.A., Hall, R.O. Jr., Wellard Kelly, H.A. and R.S. Rogers. 2011. Ecosystem ecology meets adaptive management: food web response to a controlled flood on the Colorado River, Glen Canyon. Ecological Applications 21(6): 2016–33.

Culver, M., Herrmann, H.W., Miller, M., Roth, B. and J. Sorenson. 2013. Anatomical and genetic variation of western Oxyloma (Pulmonata: Succineidae) concerning the endangered Kanab ambersnail (Oxyloma haydeni kanabense) in Arizona and Utah. USGS Scientific Investigations Report 2013–5164. http://pubs.usgs.gov/sir/2013/5164/,

Kennedy, T.A. and B.E. Ralston. 2011. Biological responses to high-flow experiments at Glen Canyon Dam. Pages 93-125 *in* Melis, T.S. (ed.). Effects of three high-flow experiments on the Colorado River ecosystem downstream from Glen Canyon Dam, Arizona. U.S. Geological Survey Circular 1366, 147 p.

Melis, T.S., ed. 2011. Effects of three high-flow experiments on the Colorado River ecosystem downstream from Glen Canyon Dam, Arizona. U.S. Geological Survey Circular 1366, 147 p. https://www.usbr.gov/uc/rm/amp/twg/mtgs/11jan20/Attach_03b.pdf.

Schmidt, J.C., and P.E. Grams. 2011. The high flows – physical science results. Pages 53-92 *in* Melis, T.S. (ed.). Effects of three high-flow experiments on the Colorado River ecosystem downstream from Glen Canyon Dam, Arizona. U.S. Geological Survey Circular 1366, 147 p.

U.S. Fish and Wildlife Service. 2011. Final Biological Opinion on the Operation of Glen Canyon Dam including High Flow Experiments and Non-Native Fish Control. http://www.usbr.gov/uc/envdocs/ea/gc/HFEProtocol/Appdx-H.pdf.

Ward, David. Sept 30, 2015. Green Sunfish *Lepomis cyanellus*; Risk Assessment for the Colorado River ecosystem (CRe), U.S. Geological Survey Southwest Biological Science Center, Grand Canyon Monitoring and Research Center Memorandum.

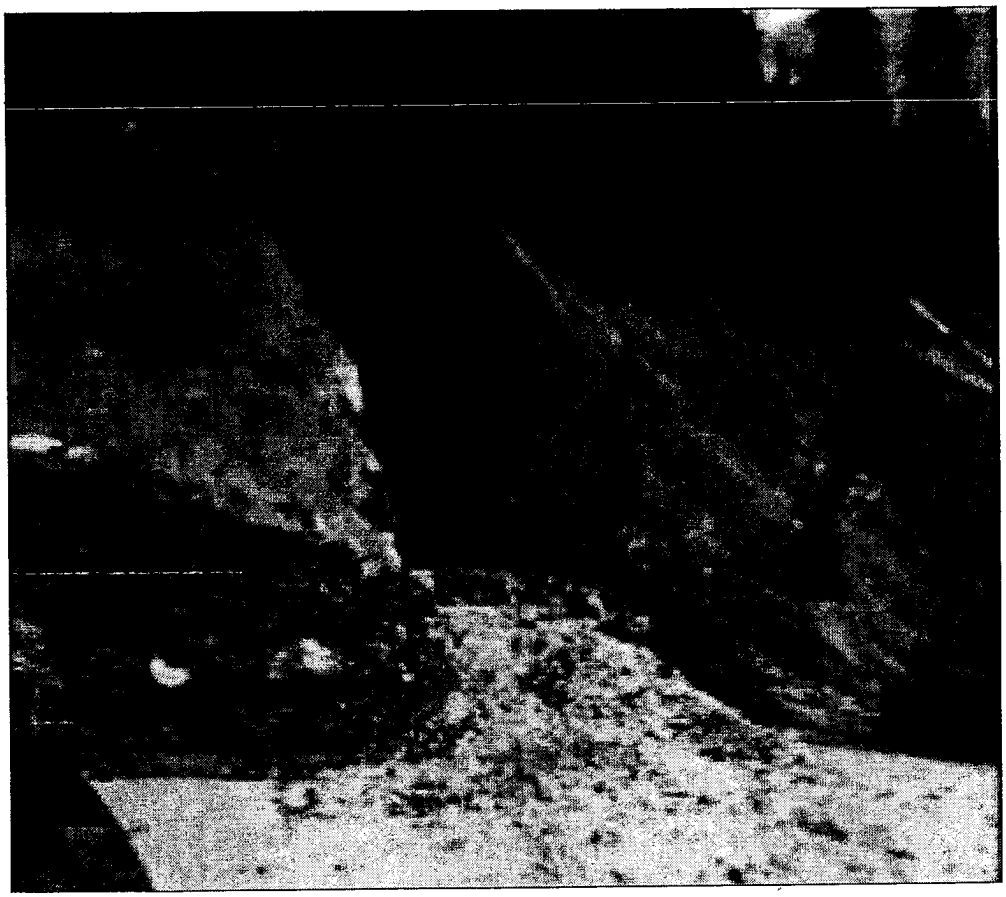
Wright, S.A. and T.A. Kennedy. 2011. Science-Based Strategies for Future High-Flow Experiments at Glen Canyon Dam. Pages 127-147 *in* Melis, T.S. (ed.). Effects of three high-flow experiments on the Colorado River ecosystem downstream from Glen Canyon Dam, Arizona. U.S. Geological Survey Circular 1366, 147 p.

RECLAMATION

Managing Water in the West

Technical Evaluation of the Gold King Mine Incident

San Juan County, Colorado



U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

October 2015

Executive Summary

On the morning of August 5, 2015, mine reclamation activities led by the U.S. Environmental Protection Agency (EPA) onsite project team triggered an uncontrolled rapid release of approximately 3 million gallons of acid mine water from the Gold King Mine located about 5 miles north of Silverton, Colorado. Commonly referred to as a "mine blowout," the outflow carried with it iron-oxyhydroxide sediments that had deposited inside the mine workings. The iron-oxyhydroxide absorbed heavy metals when it formed in the mine, and when released it changed the acid water to a vivid orange-brown color. The blowout eroded soil and rock debris from the mine portal, eroded pyritic rock and soil from the adjoining waste-rock dump, and eroded road-embankment fill from several downstream unpaved road stream crossings. Most of the eroded rock, gravel, and sand were deposited in Cement Creek. As the flow continued downstream, deposition of small amounts of soil particles mixed with orange-brown iron-oxyhydroxide precipitates containing heavy metals continued to occur along the Animas River and San Juan Rivers until the plume reached Lake Powell in Utah on August 14, 2015.

EPA requested an independent technical evaluation of the Gold King Mine incident. The evaluation provided in this report was performed by the Bureau of Reclamation (BOR) and peer reviewed by the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE).

In preparing this report, BOR found that the conditions and actions that led to the Gold King Mine incident are not isolated or unique, and in fact are surprisingly prevalent. The standards of practice for reopening and remediating flooded inactive and abandoned mines are inconsistent from one agency to another. There are various guidelines for this type of work but there is little in actual written requirements that government agencies are required to follow when reopening an abandoned mine.

The uncontrolled release at Gold King Mine was due to a series of events spanning several decades. Groundwater conditions in the upper reaches of Cement Creek have been significantly altered by the establishment of extensive underground mine workings, the extension of the American Tunnel to the Sunnyside Mine, and the subsequent plugging of the American Tunnel. The final events leading to the blowout and uncontrolled release of water occurred due to a combination of an inadequately designed closure of the mine portal in 2009 combined with a misinterpretation of the groundwater conditions when reopening the mine portal in 2014 and 2015.

In attempting to reopen the Gold King Mine, the EPA, in consultation with the Colorado Division of Reclamation, Mining and Safety (DRMS), concluded the adit was partially full of water based on excavations made in 2014 and 2015 into

the downstream side of backfill placed at the portal. Adit seepage was observed in the downstream excavations to be emerging at an elevation about 6 feet above the adit floor. It was incorrectly concluded that the water level inside the mine was at a similar elevation, a few feet below the top of the adit roof. This error resulted in development of a plan to open the mine in a manner that appeared to guard against blowout, but instead led directly to the failure.

The collapsed material in the adit and the backfill added in 2009 were derived from the collapsed rock and soil that contained a significant amount of clay. It was not a typical roof collapse comprised of mostly cohesionless broken rock. The clay content contributed to the significant attenuation (head loss) of flow in the collapsed debris and the placed backfill as the mine water flowed through it. Also, deposition of iron-oxyhydroxide sediments inside the mine likely contributed to additional reductions in the seepage flow as the sediment layer grew thicker with the passage of time. Changes in seepage were observed and documented in photographs in both 2014 and 2015, but its implications with respect to attenuation of the flow through the fill were not accounted for.

After the EPA project team concluded that the adit was not full to the top with water, they implemented a plan to open the mine in a manner similar to the one used successfully to reopen the adit at the nearby Red and Bonita Mine in 2011. The plan consisted of excavating the fill to expose the rock crown over the adit but leave the fill below the adit roof in place. Then a steel pipe ("stinger") would be inserted through the fill and into the mine pool, a pump would be attached, and the water in the mine would be pumped down.

A critical difference between the Gold King plan and that used at the Red and Bonita Mine in 2011 was the use in the latter case of a drill rig to bore into the mine from above and directly determine the level of the mine pool prior to excavating backfill at the portal. Although this was apparently considered at Gold King, it was not done. Had it been done, the plan to open the mine would have been revised, and the blowout would not have occurred.

The incident at Gold King Mine is somewhat emblematic of the current state of practice in abandoned mine remediation. The current state of practice appears to focus attention on the environmental issues. Abandoned mine guidelines and manuals provide detailed guidance on environmental sampling, waste characterization, and water treatment, with little appreciation for the engineering complexity of some abandoned mine projects that often require, but do not receive, a significant level of expertise. In the case of the Gold King incident, as in many others, there was an absence of the following:

1. An understanding that water impounded behind a blocked mine opening can create hydraulic forces similar to a dam.

2. Analysis of potential failure modes.

3. Analysis of downstream consequences if failure were to occur.

4. Engineering considerations that analyze the geologic and hydrologic conditions of the general area.

5. Monitoring to ensure that the structure constructed to close the mine portal continues to perform as intended.

6. An understanding of the groundwater system affecting all the mines in the area and the potential for work on one mine affecting conditions at another.

This evaluation report provides a detailed account of the basis for these findings and recommendations for prudent engineering considerations that EPA (and others) should consider to preclude the occurrence of similar incidents.

It is important to note that although the USACE peer reviewer agreed that the report properly describes the technical causes of the failure, he had serious reservations with the chronology of events internal to EPA from the day of the telephone call to BOR and up to the day of the mine failure. He pointed out that the actual cause of failure is some combination of issues related to EPA internal communications, administrative authorities, and/or a break in the decision path, and that the report was non-specific regarding the source of information concerning EPA documents and interviews with EPA employees and the onsite contractor. The USACE believes that the investigation and report should have described what happened internal within EPA that resulted in the path forward and eventually caused the failure. The report discusses field observations by EPA (and why they continued digging), but does not describe why a change in EPA field coordinators caused the urgency to start digging out the plug rather than wait for BOR technical input as prescribed by the EPA project leader.

The BOR Evaluation Team (evaluation team) believed that it was hired to perform a technical evaluation of the causes of the incident, and was not asked to look into the internal communications of the onsite personnel, or to determine why decisions were made. The evaluation team did not believe it was requested to perform an investigation into a "finding of fault," and that those separate investigative efforts would be performed by others more suitable to that undertaking.

"Playa Breaking" Ceremony
Red Hill Bay Restoration Project
Nov. 5, 2015

NEWS RELEASE

November 5, 2015

Contact: Christian Schoneman, 1-760-348-5278 ext. 227
Marion Champion, 1-760-604-4120

Federal, state and local partners kick off Salton Sea Red Hill Bay Restoration Project

The U.S. Fish and Wildlife Service and the Sonny Bono Salton Sea National Wildlife Refuge, in cooperation with the state Department of Water Resources, Imperial County and state and local agencies, commemorated the kickoff of a 420-acre wetlands restoration project at the Salton Sea that could prove pivotal, as restoration efforts move forward, in addressing California's largest and most troubled body of water.

Officials gathered at the Red Hill marina, the footprint of the shrinking sea, for a "Playa Breaking" ceremony.

The Red Hill Bay Restoration Project is designed to restore and improve the quality of wetland habitat in the Red Hill Bay marina to conditions similar to what the Salton Sea shoreline was like decades ago. The objective is to reestablish the marina as an important shallow-water habitat for migrating water birds while covering the newly exposed playa with saline water to decrease fugitive dust emissions, protecting public health.

"This project is an important contribution to the state, federal and local agency effort to return ecological values to the Salton Sea that benefit both wildlife and the people who value the Salton Sea," said Ren Lohoefener, Director of the U.S. Fish and Wildlife Service's Pacific Southwest Region.

Congressman Raul Ruiz (CA-36) spoke on the House floor to celebrate the groundbreaking. "The Red Hill Bay Project is the first step in realizing my vision to combat the health threats, environmental crisis, and adverse economic impacts of the receding Sea by transforming this threat into an opportunity to prevent dust exposure and spur renewable energy and tourism," said Dr. Ruiz. "This first large scale ground-breaking project shows that if we work together, we can achieve results towards a bigger vision."

On the scientific side, the restoration project will pump water from both the Alamo River and the Salton Sea, blending the waters in two 210-acre impoundments. This new practice of using agricultural drain water to create wildlife habitat, once considered not viable, has since been developed by the U.S. Geological Survey and the Bureau of Reclamation, concluding that the mixing of the water sources has the potential to provide much-needed water for habitat creation while meeting targeted salinity levels.

Added IID Board President Stephen Benson: "For all of us who call the Imperial or Coachella Valley our home, today's groundbreaking marks an important first step towards a realistic restoration program. Red Hill Bay is a significant project because it demonstrates what can be accomplished when we forge a partnership between federal, state and local agencies.

"IID has and will continue to advocate for a Salton Sea restoration program that includes short-term, medium-term and long-term solutions. We are encouraged by the recent actions announced by our governor and the Salton Sea Task Force and we look forward to continued collaboration between all parties."

Projects of similar design are currently being planned by state and local agencies.

###

COLORADO MESA
UNIVERSITY
RUTH POWELL HUTCHINS
WATER CENTER

5th Annual Upper Colorado River Basin Water Forum

October 28-29, 2015

PROGRAM, ABSTRACTS & BIOS

(Click on Speaker's name to go to their biography, abstract and presentation)

Wednesday, October 28, 2015

7:30am – Breakfast and Registration
8:00 - Welcome
8:10 – **Morning Keynote**

Extreme Conditions Across the West
Kevin V. Werner, NOAA Western Region Climate Services Director

8:45 – **Panel of State Climatologists: Extreme Weather in the Colorado River Basin**
Moderator: Jim Pokrandt, Colorado River District

- *Robert Davies, UT Climate Center, Utah State University*
- *Nolan Doesken, CO Climate Center, Colorado State University*
- *David Dubois, NM State Climatologist, New Mexico State University*
- *Nancy Selover, AZ State Climatologist, University of Arizona*

10:25 – **Strange weather: what does it mean for our future?**
Moderator: Gigi Richard, Colorado Mesa University

- Winter Weirding of 2014/2015
  Chris Landry, Center for Snow & Avalanche Studies
- What does El Niño mean for the Colorado River Basin in 2015/2016?
  Klaus Wolter, NOAA-Earth System Research Lab, University of Colorado at Boulder
- The dynamics of vulnerability: why adapting to climate variability will not always prepare us for climate change
  Lisa Dilling, Western Water Assessment, University of Colorado at Boulder

11:30 – **Lunch/ Poster Session**

1:00 – **Managing for Multiple Purposes under Challenging Conditions**
Moderator: David Graf, Colorado Parks & Wildlife

- The Clock is Ticking: An Occupancy-based Assessment of Regional Vulnerability for Desert Fishes of the SW USA
  Phaedra Budy, US Geological Survey and Utah State University
- Managing Flows for Multiple Purposes in Colorado: Effects to Riparian Plant Communities
  Barbara Galloway, ERO Resources Corporation
- A scalable ecological decision support framework for optimizing water resource use and management
  Seth Mason, Lotic Hydrological, LLC

2:05 – **Managing for Multiple Purposes: Case Studies**
Moderator: Jeff Sellen, Western State Colorado University

- An experimental habitat enhancement effort for desert rivers: San Rafael River restoration project
  Brian Laub, Utah State University
- Managing for multiple purpose reservoir releases and irrigation diversion under increasingly extreme hydrologic conditions: Little Snake River Case Study
  Dawn Arnell and Larry Hicks, Little Snake River Conservation District
- Farmers looking ahead & working with multiple stakeholders on efficiency: the No Chico Brush project
  Perry Cabot, Colorado Water Institute, Colorado State University; Cary Denison, Trout Unlimited; Tom Kay, No Chico Brush

Wednesday, October 28, 2015 (cont'd)

3:45 – **Communicating Water Challenges and Solutions**
Moderator: Corey Beaugh, Colorado Division of Water Resources

- Storytelling to address Water Conflicts
  Constance Holland, Storyteller
- Living Landscapes: Personal Accounts of Water Conservation in a Modern Day American Home
  Natalie Sullivan, Center for ReSource Conservation
- Water Fluency Course Impact
  Jayla Poppleton, Colorado Foundation for Water Education

4:45 – **Reception and Afternoon Keynote**

***Delta Dawn* short film by Peter McBride** **followed by remarks from Taylor Hawes of The Nature Conservancy**

6:00 – Adjourn for the day

Thursday, October 29, 2015

7:30 – Breakfast & Registration
8:00 – Welcome
8:10 – **Morning Keynote**

Colorado Climate Plan ***Taryn Finnessey, Colorado Water Conservation Board***

8:45 – **Alternative Water Allocation & Governance Strategies**
Moderator: Laurian Unnevehr, University of Illinois at Urbana-Champaign

- Who wins, who loses? Water markets under imperfectly competitive conditions
  Chris Goemans, Colorado State University
- Transitioning to a New Era in Western United States Water Governance: Examining Sustainable Water Policy in the Colorado River Basin
  John Berggren, University of Colorado Boulder

9:45 – **Adaptation Strategies in Storage and Urban Land Use**
Moderator: Jessie Pahler, Western Water and Land

- Shifting the water resource management paradigm by increasing adaptive capacity for water storage in the American Southwest
  Dagmar Llewellyn, Bureau of Reclamation
- Integrating multiple strategies to achieve a more sustainable water future
  Eric Hecox, South Metro Water Supply Authority
- The Colorado Water & Growth Dialogue: tools for integrating land-use strategies into water supply planning
  Marc Waage, Denver Water

10:50 – **Adaptation Strategies in Agriculture**
Moderator: Rusty Lloyd, Tamarisk Coalition

- Update on CO Water Bank Project: first year of results on agronomic impacts & measurements of water savings
  Perry Cabot, Colorado State University; Paul Kehmeier, Farmer; and Joe Bernal, Bernal Farms
- Young farmers at the helm: New findings on adaptation and stewardship
  Kate Greenberg, National Young Farmers Coalition
- Meeting Long-term Agricultural Demands – More than Water is Needed!
  Charles Howe, University of Colorado (for John Wiener, University of Colorado)

12:00 - Lunch

Thursday, October 29, 2015 (cont'd)

1:30 - **Renegotiating the Interim Guidelines for Managing Lakes Powell and Mead** *(panel)*
Moderator: Eric Kuhn, Colorado River District

- Angela Rashid, *Colorado River Board of California*
- *Chuck Cullom, Central Arizona Project*
- *Steve Wolff, Wyoming State Engineer's Office*
- *Ted Kowalski, Colorado Water Conservation Board*

3:05 – **Extremes, Averages, or Both: Where Do the Risks Lie?**
Doug Kenney, Chair, Colorado River Research Group

3:30 – Adjourn

4:00 – **Outing to Colorado River**
Visit Watson Island for a short walk and tour of riparian restoration project along the Colorado River, followed by an informal happy hour at the Edgewater Brewery. Transportation is not provided. Meet at the Western Colorado Botanical Gardens, 641 Struthers Ave, Grand Junction, CO.

Poster Presentations:

- **East River Health Headwaters Nonconsumptive Needs Assessment**
  Briant Wiles, Graduate Candidate for Master of Environmental Management, Western State Colorado University
- **Understanding hydro-meteorological variability and trends of streamflow droughts in the headwater basin of Colorado River**
  Maryam Pournasiri Poshtiri and Indrani Pal, College of Engineering and Applied Science, University of Colorado Denver*
- **Exploring Climate Change Driven Shifts to Water Rights and Policy Along the Colorado River**
  David Jacob Scarr, University of Colorado, Boulder Geography Department
- **River Studies and Leadership Certificate: An Inter-university partnership with the River Management Society**
  Gigi Richard, Colorado Mesa University, Joel Barnes, Prescott College, and Risa Shimoda, River Management Society
- **Measuring Water Table and Carbon Storage in Mountain Fens**
  Rod A. Chimner and John A. Hribljan, Michigan Technical University; Tim Cutter and Marcie Bidwell, Mountain Studies Institute
- **Quantifying Proximate Body Composition in Catostomids Using Bioelectrical Impedance Analysis**
  Kristine Crippen and Eriek S. Hansen, Department of Biological Sciences, Colorado Mesa University