



RECOMMENDATIONS OF THE BYPASS FLOWS WORKGROUP

April 2016

**Co-chaired by:
Arizona Department of Water Resources
and U.S. Bureau of Reclamation**

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ACRONYMS AND ABBREVIATIONS

2007 Guidelines	<i>Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead</i>
Basin Study	<i>Colorado River Basin Water Supply and Demand Study</i>
ADWR	Arizona Department of Water Resources
AF	acre-feet
CAWCD	Central Arizona Water Conservation District
Cienega	Cienega de Santa Clara wetland
GDP	Gross Domestic Product
IBWC	International Boundary and Water Commission
ICMA	Intentionally Created Mexican Allocation
MWD	Metropolitan Water District of Southern California
MOU	Memorandum of Understanding
NIB	Northerly International Boundary
Reclamation	Bureau of Reclamation
SIB	Southerly International Boundary
SNWA	Southern Nevada Water Authority
U.S.	United States
Workgroup	Bypass Flows Workgroup
WMIDD	Wellton-Mohawk Irrigation and Drainage District
YDP	Yuma Desalting Plant

1. BACKGROUND

The Colorado River System is in a drought that began 16 years ago, leading to substantially decreased water surface elevation levels in both Lakes Mead and Powell. Colorado River System modeling projections show an increasing near-term risk that water surface elevations in both Lakes Mead and Powell could decline to levels that would not only trigger shortage conditions in Lake Mead operations as set forth in the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead¹ (2007 Guidelines), but could also reach critical levels impacting the ability to draw or benefit from water in the lakes, including severely impacting hydropower resources.

In response to this situation, the Bureau of Reclamation (Reclamation), the States of Arizona, California, Nevada and municipal water agencies (Central Arizona Water Conservation District [CAWCD], Metropolitan Water District of Southern California [MWD] and Southern Nevada Water Authority [SNWA]) executed a Memorandum of Understanding² (MOU) in December 2014 for drought response action plans. The plan includes voluntary development of additional quantities of water stored in Colorado River reservoirs, in particular Lake Mead, to reduce the risk of Lake Mead reaching critical reservoir elevations. The MOU sets forth a shared goal of developing between 1.5 and 3.0 million acre-feet (maf) of additional water by 2019. The MOU also indicates that planning is needed to address long-term system sustainability, a component of which is to replace, recover and reduce system losses from the Colorado River System.

These losses include the “bypass flows” which are pumped agricultural drainage water that bypass the River and cannot be included in water deliveries to Mexico due to salinity management constraints. These flows have averaged over 100,000 acre-feet annually since 1974 when the United States (U.S.) initiated actions to comply with Minute 242³ of the 1944 Water Treaty⁴ with Mexico. To focus on the bypass flows, in early 2015 Reclamation partnered with the Arizona Department of Water Resources (ADWR) to co-chair and convene a Bypass Flows Workgroup (Workgroup) in order to identify approaches to reduce, replace or recover a like

¹ 2007 Guidelines are available at: <http://www.usbr.gov/lc/region/programs/strategies.html>

² MOU is available at: http://www.usbr.gov/lc/region/g4000/LB_DroughtResponseMOU.pdf

³ “Permanent and definitive solution to the international problem of the salinity of the Colorado River,” August 30, 1973.

⁴ Water Treaty for the "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande," February 3, 1944.

amount of the bypass flows that contribute to declining reservoir levels at Lake Mead (see Appendix A).

2. NATURE OF THE BYPASS FLOWS

There are six irrigation districts⁵ in Yuma County, Arizona that divert Colorado River water for commercial agriculture. According to Yuma County Agriculture Water Coalition, “agricultural and supporting services are the single largest private sector contributor to Yuma’s Gross Domestic Product (GDP). With a GDP of nearly \$5.4 billion, Yuma County’s economy would rank 151 out of 192 countries, globally.”⁶

The use of Colorado River water in the Yuma area raises the groundwater table and in many areas the table is so high that without wellfield operations to lower the water table, crop production would be harmed. Reclamation and the Wellton-Mohawk Irrigation and Drainage District (WMIDD) operate over 180 high capacity wells to pump water from the ground as agricultural drainage. This pumped agricultural drainage is too saline to return to the Colorado River and deliver to Mexico while continuing to meet the Minute 242 salinity differential.

Mexico and the U.S. adopted Minute 242 on August 30, 1973 after more than a decade of negotiations between the two countries to resolve Mexico’s protests about higher salinity water arriving at Morelos Dam. The primary source of the salinity is from pumped agricultural drainage that originated in the WMIDD beginning in the 1950’s after construction of the Wellton Canal and farm operations that came into production thereafter. The district was discharging its brackish drainage water into the Gila River, which joins the Colorado River near Yuma. To improve water quality to Mexico the U.S. agreed to adopt measures in Minute 242 to ensure that the water delivered to Mexico upstream of Morelos Dam has an annual average salinity of no more than 115 parts per million +/- 30 parts per million greater than the annual average salinity of Colorado River water at Imperial Dam.

⁵ North Gila Valley Irrigation District, Unit B Irrigation & Drainage District, Yuma (or South Gila) Irrigation District, Yuma County Water Users Association, Yuma Mesa Irrigation and Drainage District, Wellton-Mohawk Irrigation and Drainage District.

⁶ “A Case Study in Efficiency – Agriculture and Water Use in the Yuma, Arizona Area”, Yuma County Agriculture Water Coalition, February 2015.

To implement the necessary actions to comply with Minute 242, Congress enacted the Colorado River Basin Salinity Control Act⁷ (Salinity Control Act) in 1974. Title I of the Salinity Control Act authorized a program of works “for the enhancement and protection of the quality of water available in the Colorado River for use in the United States and the Republic of Mexico” and enables the United States to comply with the obligations of Minute 242. Title I of the Salinity Control Act authorized the Secretary of the Interior to undertake specific measures including: “Extension of the Bypass Drain, reduction of WMIDD irrigable acreage, development of well fields to furnish water for use in the United States and for delivery to Mexico, lining or construction of a new Coachella Canal in California, and construction and operation of a desalting plant and appurtenant works.” In 1978, the extension of the Bypass Drain was completed in Mexico and reached the northern end of the Santa Clara Slough (now known as the Cienega de Santa Clara wetland [Cienega]). Thereafter, WMIDD brackish drainage water was pumped and discharged into the Bypass Drain instead of the Colorado River. These brackish drainage flows that make up the bypass flows do not count toward the Mexican Water Treaty delivery allocation. In order to make-up for the volume of bypass flows not discharged into the Colorado River an equivalent volume of water must be released from Lake Mead, which contributes to declining reservoir levels.

Collected brackish drainage water from WMIDD is the primary source of flows in the Bypass Drain. Recently however, reduced flows in the Colorado River during the drought, lower salinity water arriving at Imperial Dam⁸ and efforts to operate as efficiently as possible (e.g., minimize excess flows to Mexico), have resulted in less water available to dilute the salinity of collected agricultural drainage being discharged into the River. Consequently, additional pumped drainage from wells in the Yuma area; specifically, wells located in the South Gila and Yuma Valleys have been added to the flow in the Bypass Drain to stay within the Minute 242 salinity differential. For the 20-year period 1995 through 2014, the bypass flows totaled approximately 2.25 maf.⁹ For the recent five-year period 2010 through 2014 the bypass flows totaled an average 125,958 acre-feet (AF) annually (see Figure 1). Prior to that, flows averaged 110,419 AF annually for the previous five-year period 2005 through 2009 (see Figure 1).

⁷ Colorado River Basin Salinity Control Act of June 24, 1974 (Public Law 93-320).

⁸ Since the creation of the Colorado River Salinity Control Forum in 1973 and passage of the Colorado River Basin Salinity Control Act in 1974 measures have been put in place that reduce the annual salt load of the Colorado River. The salinity of Colorado River water arriving at Imperial Dam has been reduced by about 90 parts per million.

⁹ Source: IBWC for 1995 through 2012; Reclamation for 2013 and 2014. 2013 and 2014 are provisional values.

Figure 1. Total Bypass Flows by year

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Acre- Feet	107,433	107,514	106,944	115,435	114,770	117,465	130,612	126,225	110,910	144,579

2013 and 2014 are provisional values based on Reclamation data; final values provided by the International Boundary and Water Commission are typically two years in arrears

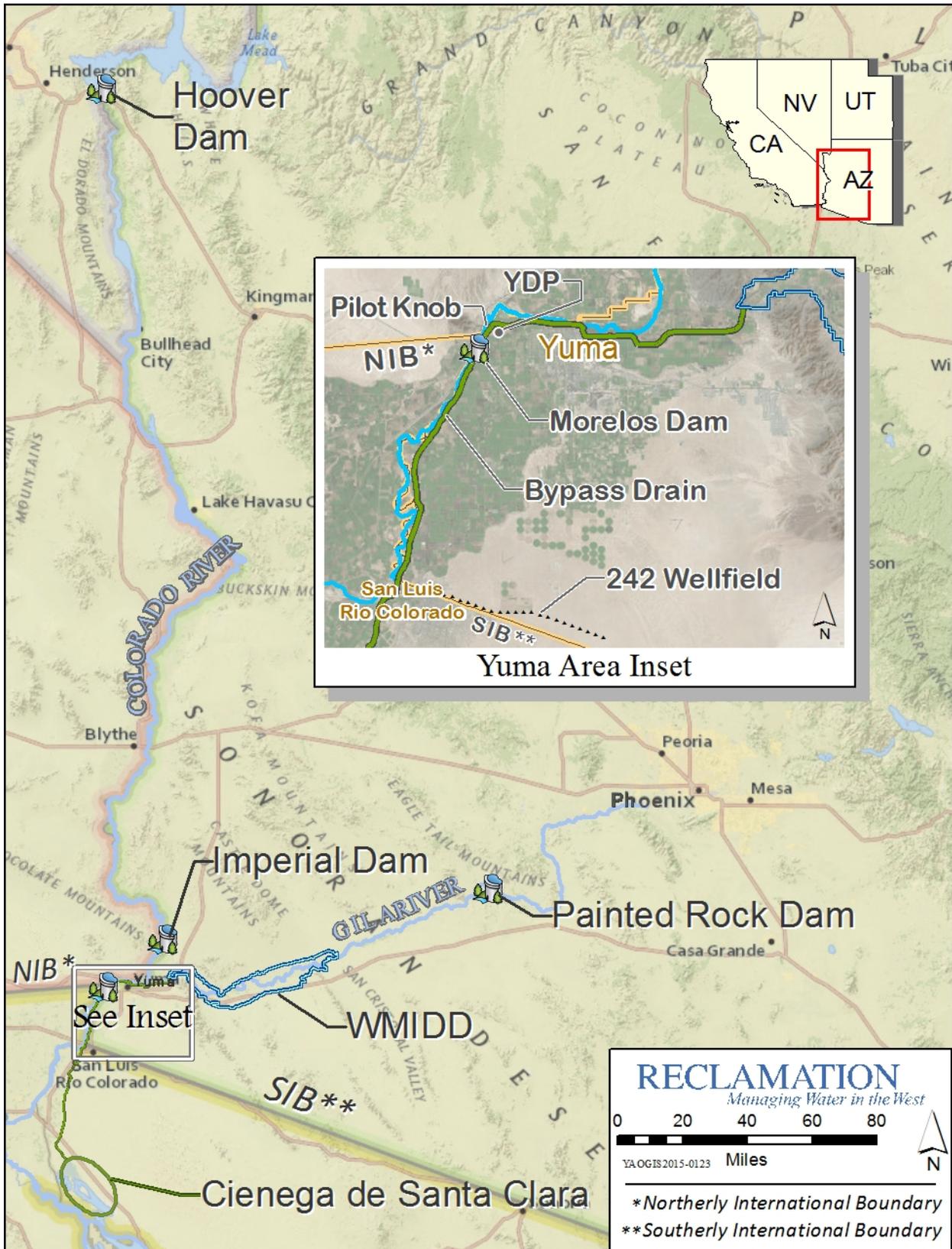
Since construction of the Bypass Drain was completed in 1978, except for brief periods of Yuma Desalting Plant¹⁰ (YDP) operation, bypass flows in their entirety have reached the Cienega and are the primary water source for the wetland. The 52,300-acre¹¹ Cienega is part of the 2.3 million acre¹¹ Upper Gulf of California and Colorado River Delta Biosphere Reserve, the highest category of protection that Mexico assigns to a wetland. This area provides wetland habitat for migratory birds of the Pacific Flyway and for various species, including threatened and endangered species.

Figure 2 provides an overview of the geographic area focused on by the Bypass Flows Workgroup.

¹⁰ Due to agency budget constraints as well as surplus and normal conditions on the lower Colorado River prior to the drought, the YDP has been maintained, but not operated except for periods in 1992 – 1993, 2007 and 2010 – 2011.

¹¹ Source: “Conservation Priorities in the Colorado River Delta, Mexico and the United States”, Sonoran Institute, Environmental Defense, et al., 2005.

Figure 2. Area focused on by the Bypass Flows Workgroup



3. BYPASS FLOWS WORKGROUP

As noted earlier, the Workgroup was co-chaired and convened by the ADWR and Reclamation (see Appendix B, Figure 8 for the list of Workgroup members). It was created to focus on the bypass flows “in a sustainable manner that conserves the limited water supplies of the Colorado River, recognizes the environmental values of the Cienega, and integrates local, regional and international concerns.”¹² The Workgroup was aware that “any water management actions contemplated by this Workgroup that are funded or implemented by Reclamation would, of course, need to be fully analyzed and vetted through public review processes including, for example, environmental reviews.”¹³ Consistent with this guidance and the MOU, the Workgroup began by defining its objective and sub-objectives.

The Workgroup’s objective, developed by its members was:

To aid in reducing further decline of Colorado River Reservoirs by identifying, analyzing and recommending a set of options that collectively conserve at least 100,000 AF of water annually in Lake Mead by reducing, replacing, or recovering a like amount of the bypass flows in a fiscally, legally, bi-nationally, and environmentally responsible manner.

In addition, the Workgroup members developed five sub-objectives to further assist their work:

- Avoid involuntary impact to any contract holder’s full use of its respective entitlement of Colorado River water;
- Obtain voluntary acceptance of impacts associated with options;
- Ensure consistency with the Law of the River;
- Implement solution(s) at a reasonable cost and as soon as possible but preferably within 5 years¹⁴ (by December 31, 2019); and
- Prioritize achieving bypass flows reduction/offset during low reservoir conditions (i.e. greater reduction/offset may not be as critical during high-normal/surplus conditions).

¹² Letter from ADWR to Reclamation dated December 9, 2014 (see Appendix A).

¹³ Letter from Reclamation to ADWR dated December 29, 2014 (see Appendix A).

¹⁴ Timing and date reflects the MOU of December 2014.

4. OPTIONS, ANALYSIS AND RATING PROCESS

The Workgroup evaluated all of the water flows and existing infrastructure in the Yuma area and identified possible options to reduce, replace, or recover the flows.

The Workgroup recognized at the outset of the analysis that many of the options would require consideration of potential impacts in Mexico including those to the flows to the Cienega and accordingly would involve discussions with Mexico to fully analyze those options. However, the focus of the Workgroup was to develop a preliminary consensus in the U.S. before beginning those discussions. As a result, the Workgroup only evaluated domestic considerations of each option. Matters related to water users and natural resources in Mexico are matters of foreign policy that are addressed through the International Boundary and Water Commission (IBWC), the international body responsible for addressing Colorado River matters between the U.S. and Mexico, pursuant to the 1944 Water Treaty.

The Workgroup also recognizes that additional joint cooperative actions with Mexico could be necessary to reduce impacts for many of the options and that such specific joint cooperative actions would be subject to consultations with Mexico through the IBWC. For example, options that reduce the volume or increase the salinity of the bypass flows to the Cienega could be combined with other options and/or joint cooperative actions to address those changes in volume and salinity.

The Workgroup proposed and considered 13 options that it believed could positively impact the bypass flows and aid in stabilization of the elevation of Lake Mead while meeting the Workgroup's objective and sub-objectives (see Figure 3). It is likely that a combination of options may be required in order to meet the Workgroup's objective and sub-objectives. Development and implementation of a combination of options, including constructive consultation with Mexico and efforts to manage potential impacts that could result from the options will be key to ensuring that these objectives and sub-objectives are fully accomplished.

Figure 3. Options developed and considered by the Workgroup

Option	Description
1. YDP 1/3 – As authorized	One-third capacity YDP operation as it is currently configured, desalinating the bypass flows
2. YDP 1/3 – Existing wells and conveyances	One-third capacity YDP operation desalinating other Yuma area groundwater, using existing wells and conveyances
3. YDP 1/3 – New wells and conveyances	One-third capacity YDP operation desalinating other Yuma area groundwater, using new wells and conveyances
4. YDP 1/3 – Industrial water use	One-third capacity YDP operation; ultra-low salinity product water provided to industrial water users
5. YDP 1/3 – Municipal water use	One-third capacity YDP operation; product water provided to U.S. and/or Mexico municipalities
6. YDP 2/3 – Shared with Mexico	Two-thirds capacity YDP operation; additional capacity in excess of Mexico’s annual Colorado River water entitlement
7. 242 Wellfield expansion project	Returning the Wellfield to recent historic pumping levels; lower salinity water to the Northerly International Boundary (NIB)
8. System Conservation in the U.S.	Voluntary, compensated reductions in Colorado River water use by U.S. water users
9. Bi-national responsibility for bypass flows	Certain flows to Cienega maintained by U.S.; in light of environmental benefits in Mexico, Mexico charges a portion of flows against its 1.5 MAF Treaty allocation
10. Leverage salinity differential	Modifications to salinity compliance by converting to real-time salinity measurement and a fixed or partially fixed monthly salinity limit
11. System Conservation in Mexico	Voluntary, compensated reductions in Colorado River water use by Mexican water users
12. SIB-NIB bypass flows exchange via 242 pumping	More low salinity 242 Wellfield water to the Southerly International Boundary (SIB) for reduced water delivery at NIB or more water to the Cienega
13. Maintain ICMA storage levels	Further enhance Intentionally Created Mexican Allocation (ICMA) provisions

Options 2, 7 and 10 create water that is intended to become system water to maintain and enhance elevations at Lake Mead and provide overall system benefit. Additional agreements and consultations with ADWR would be required for these options where water agencies receive return flow credits that reduce the irrigation districts consumptive use, or if new wells are anticipated.

After considering each option relative to the Workgroup's objective and sub-objectives, the Workgroup analyzed the 13 options by applying a wide range of evaluation criteria to each option. Evaluation criteria ranged from technical criteria such as quantity of yield and cost, to subjective criteria such as implementation risk and policy considerations.

For each criterion associated with each bypass flows option, a quantitative and/or qualitative description was developed. Recommendations were developed by the Workgroup based on the degree to which each option met the group's objective and sub-objectives as well as the outcome of the application of the evaluation criteria.

5. RECOMMENDATIONS OF THE WORKGROUP

The Workgroup recommends that some combination of the following eight options be used (see Figure 4). While the options require additional analysis, the Workgroup is confident that they collectively represent reasonable choices for methods to resolve the bypass flows in a fiscally, legally, bi-nationally, and environmentally responsible manner. All of these options, except “System Conservation in the U.S.” likely require consultations with Mexico through the IBWC and may result in a supporting binational agreement. Subject to additional analysis, those options may be considered for potential inclusion in discussions with Mexico for a successor agreement to Minute 319. All eight options may not be implemented; some options overlap in aspects of how the bypass flows might be reduced, replaced or recovered. Also, further analysis as well as consultations with U.S. parties and with Mexico will also result in some options proving more advantageous than others.

Figure 4. Options Recommended by the Bypass Flows Workgroup

Option	Estimated annual water yield (acre-feet)
1. YDP 1/3 – As authorized	33,000
2. 242 Wellfield expansion project	25,000
3. System Conservation in the U.S.	10,000
4. System Conservation in Mexico	10,000
5. Leverage salinity differential	40,000
6. Bi-national responsibility for bypass flows	50,000
7. SIB-NIB bypass flows exchange via 242 pumping	25,000
8. Maintain ICMA storage levels	20,000

The estimated yields for options 1 and 2 are based on the physical operating characteristics while yields for options 3 through 8 reflect the collective judgment of the Workgroup

A description of each of the recommended options follows. In addition, Section 6 of this report suggests and describes potential portfolios, combinations of options that are recommended.

Yuma Desalting Plant Operations as Authorized

The YDP is a brackish water reverse osmosis desalination plant located on the outskirts of Yuma, Arizona. The plant was designed and constructed for desalination of bypass flows. This option is operation of the YDP at one-third of full capacity as the plant is currently configured and using the bypass flows as feed water for the YDP.

Such plant operations would yield approximately 33,000 AF annually. Preparing the plant for long-term sustained operations would cost an estimated \$26.5 to \$28.5 million and would require 3 years from the date funding is received to implement. Operating costs are an estimated \$350 to \$380 per acre-foot, though could vary outside of that range based on the cost of chemicals and electricity.¹⁵ Plant operation results in decreased volume and increased salinity of the bypass flows reaching the Cienega; operation of the YDP would require consultations with Mexico. A new Minute to the 1944 Water Treaty was required for operation of the YDP in 2010 and 2011.

242 Wellfield Expansion Project

The 242 Wellfield (formally called the Protective and Regulatory Pumping Unit) lies within a strip of land called the “5-Mile Zone.” Minute 242 of the 1944 Water Treaty limits U.S. and Mexico pumping within the “5-Mile Zone” to no more than 160,000 AF of water annually by each country. During the past five years (2010-2014) the U.S. has pumped an average of 28,025 AF of water annually from the 242 Wellfield. During the previous five-year period (2005-2009) an average of 43,087 AF of water was pumped annually from the 242 Wellfield. This option is the pumping of lower salinity water from the 242 Wellfield and routing it north to the Colorado River for inclusion in water deliveries to Mexico at the NIB.

This project could yield approximately 25,000 AF annually.¹⁶ One-time capital costs are an estimated \$17 to \$19 million and the project could be completed within 2.5 years of receipt of full funding. On-going costs are an estimated \$9 per acre-foot (primarily electricity associated with groundwater pumping).¹⁵ Since the 242 Wellfield lies within the “5-mile Zone” consultations with Mexico would be required in order to facilitate this project.

¹⁵ Exclusive of amortization of one-time capital costs.

¹⁶ Bureau of Reclamation would work with Arizona parties to ensure water conservation can be achieved (return flow credits).

System Conservation in the U.S.

System conservation is the implementation of projects that result in voluntary, compensated reductions in water uses by agricultural, municipal or industrial water users. Participating entities would be compensated on a per acre-foot basis for measureable reductions in the use or loss of lower Colorado River water that help increase the water surface elevation of Lake Mead.¹⁷ Examples of such projects include, but are not limited to: land fallowing, increased system efficiency, and water re-use. Expanded system conservation efforts could be used as a mechanism to replace bypass flows and offset the impact to Lake Mead. Any water conserved through system conservation for purposes of bypass flows replacement would need to be specifically designated as such.

For purposes of this analysis, system conservation projects were assumed to yield approximately 10,000 AF annually, but could be larger. The lead-time associated with these projects varies between approximately 18 months and 2.5 years. Six to 12 months is typically required to solicit and evaluate proposals, make awards, and execute necessary contracts and ancillary agreements. Subsequently the implementation of projects or programs typically requires 12 to 24 months. \$100 to \$500 per acre-foot is a reasonable expectation for the cost of new system conservation projects.

System Conservation in Mexico

As noted earlier, system conservation is the implementation of projects that result in a voluntary, compensated reduction in water use by agricultural, municipal or industrial water users; compensation on a per acre-foot basis for water preserved in Lake Mead. In this case the participating entities would be in Mexico. Estimated costs were assumed to be similar to the anticipated range for system conservation activities in the U.S.

For purposes of this analysis, system conservation projects in Mexico were assumed to yield approximately 10,000 AF annually, though the actual yield (and implementation lead-time) would depend on the outcome of consultations with Mexico and the specific nature of the projects implemented.¹⁸ Any water conserved through system conservation

¹⁷ A System Conservation Pilot Program was initiated under a MOU between CAWCD, MWD, SNWA, Denver Water and Reclamation signed July 30, 2014. Experience gained from this Pilot could be used for a new program.

¹⁸ To date Mexico has not elected to participate in the System Conservation Pilot Program initiated in mid-2014.

for purposes of bypass flows replacement would need to be specifically designated as such.

Leverage salinity differential

This option proposes modifications to salinity compliance under Minute 242 of the 1944 Water Treaty by converting from the current approach (an annually calculated average salinity differential) to real-time salinity measurement and possibly a fixed or partially fixed monthly salinity limit. The modification would likely include:

- A modification to Mexico's monthly water order at the NIB to increase the amount of water delivered at the NIB during the lowest delivery months during which time salinity management is most challenging.
- The U.S. could agree to reduce pumping levels during these lowest delivery months.
- To offset this impact and also generate additional water¹⁹, the U.S. would increase pumping levels (possibly requiring additional infrastructure) during the highest water delivery months to Mexico when salinity is of less concern.
- Both countries would adopt real-time salinity measurement and management.

These modifications could result in mutual bi-national benefits:

- Additional use of Yuma drainage flows to meet Mexico's water order would result in additional water savings that would benefit the system and users in both countries.
- Mexico could better meet daily changes in water demands through more real-time coordination and operations with the U.S.

For purposes of this analysis, this option was assumed to yield approximately 40,000 AF annually, though the actual yield (and implementation lead-time) would depend on the outcome of consultations with Mexico.

¹⁹ Additional agreements and consultations with the ADWR would be required for any new wells and where water agencies receive return flow credits that reduce irrigation districts consumptive use.

Shared bi-national responsibility for bypass flows

In connection with a new Treaty Minute addressing cooperative approaches to Colorado River management, the U.S. and Mexico would agree to maintain some level of flows to the Cienega de Santa Clara wetland. The two countries would provide more certainty regarding the defined amount of water going to the Cienega. Given the environmental benefits and potential interest in ensuring a reliable water flow to the Cienega into the future, consideration would be given to account for a portion of the flows as part of Mexico's annual Treaty allocation. For purposes of this analysis, this option was assumed to yield approximately 50,000 AF annually, though the actual yield (and implementation lead-time) would depend on the outcome of consultations with Mexico.

SIB-NIB bypass flows exchange via 242 pumping

In association with the option for shared bi-national responsibility for the bypass flows Mexico would agree to accept a larger quantity of higher quality water from the 242 Wellfield at the SIB in exchange for one of the following:

- A reduced delivery of water at the NIB (e.g., accepting a reduced amount of water at the NIB with a modestly increased salinity in exchange for lower salinity water at the SIB); or
- Additional Yuma agriculture drainage directed into the Bypass Drain in connection with an agreement to count a portion of the bypass flow water as part of Mexico's annual Treaty allocation.

For purposes of this analysis, this option was assumed to yield approximately 25,000 AF annually, though the actual yield (and implementation lead-time) would depend on the outcome of consultations with Mexico.

Maintain ICMA storage levels

Minute 319 to the 1944 Water Treaty is a five-year agreement between the U.S. and Mexico expiring in 2017. Under one provision of this Minute, Mexico adjusts its Colorado River water delivery schedule during low Lake Mead elevations, while having access to additional Colorado River water during high reservoir conditions. Under Minute 319 Mexico may store a maximum 250,000 acre-feet of water annually in Lake

Mead through 2017 by creating Intentionally Created Mexican Allocation (ICMA).²⁰ Mexico may use its ICMA for any purpose, including offsetting shortage reductions, based on reservoir conditions. Water stored in Lake Mead through ICMA helps to maintain and enhance Lake Mead elevations and may partially offset the present risk of the bypass flows drawing down Lake Mead water surface elevations.

Under Minute 319 when Lake Mead elevations are at 1,145 feet or higher, but below flood control conditions, Mexico may take up to 80,000 acre-feet per year of additional water from the River. If Lake Mead elevation drops to 1,075 feet or below, Mexico must reduce its 1.5 MAF allocation by 50,000 to 125,000 acre-feet of water. Minute 319 also allows U.S. entities to invest in water infrastructure improvements in Mexico in return for a share of the water such projects would save.

This option proposes the continuation of ICMA beyond the timeframe associated with Minute 319 pursuant to a new Minute. Mexican ICMA could be used as a mechanism to replace bypass flows and offset the impact to Lake Mead.

For purposes of this analysis, this option was assumed to yield approximately 20,000 AF annually, though the actual yield (and implementation lead-time) would depend on the outcome of consultations with Mexico and the salinity management framework.

²⁰ Any water that Mexico defers (originating under Minute 318) pursuant to Section III.1 of Minute 319 counts towards Mexico's annual maximum storage of 250,000 AF.

6. POSSIBLE PORTFOLIOS OF OPTIONS

As indicated in Figure 4, the Workgroup has estimated water yields for each recommended option. The actual yield will depend on further analysis, the outcomes of consultations, options selected, and how an option actually performs. All eight options recommended by the Workgroup may not be implemented nor are all eight necessary to achieve the goal of conserving at least 100,000 AF of water annually in Lake Mead. Certain portfolios, combinations of options may be possible; descriptions of those portfolios follow.

The first such potential portfolio is a collection of options that would require one-time capital infrastructure investment (see Figure 5). That infrastructure investment would deliver a measure of performance certainty (i.e., water yield) because yield estimates are based on the physical operating characteristics of infrastructure. This portfolio is dependent on funding and bi-national consultations. There is a foundation for bi-national consultation for the YDP in Minute 316 that could be leveraged for such consultations.

Figure 5. Infrastructure Focused Portfolio

Option	Estimated annual water yield (acre-feet)
1. YDP 1/3 – As authorized	33,000
2. 242 Wellfield expansion project	25,000
3. System Conservation in the U.S.	10,000
4. System Conservation in Mexico	10,000
5. <i>To be determined</i>	22,000
Total AF	100,000

The second potential portfolio is a collection of options that would require bi-national negotiations (see Figure 6). The actual water yield of the options would be dependent on the outcome of those negotiations. This portfolio would require limited capital investment for infrastructure development and has lower on-going operations and maintenance expenses than the previous portfolio. This portfolio is highly dependent of bi-national consultations with Mexico.

Figure 6. Bi-national Focused Portfolio

Option	Estimated annual water yield (acre-feet)
5. System Conservation in Mexico	10,000
6. Leverage salinity differential	40,000
7. Bi-national responsibility for bypass flows	50,000
Total AF	100,000

The third potential portfolio is a collection of options that would require investments and bi-national negotiations (see Figure 7). The YDP was successfully operated for a nearly one-year Pilot Run completed in 2011, recovering a portion of the bypass flows while protecting the Cienega through Minute 316. Pumping of the 242 Wellfield to recent historic levels and negotiated changes to Mexico’s Colorado River water delivery schedule such that Mexico would accept delivery of the bypass flows as part of the annual Treaty delivery amount would allow for additional water to remain in Lake Mead while improving water quality in Mexico’s Mexicali Valley.

Figure 7. Combination Portfolio

Option	Estimated annual water yield (acre-feet)
1. YDP 1/3 – As authorized	33,000
7. Bi-national responsibility for bypass flows	50,000
8. SIB-NIB bypass flows exchange via 242 pumping	25,000
Total AF	108,000

The current drought has led to substantially decreased water surface elevations in both Lakes Mead and Powell. The bypass flows, over 100,000 acre-feet of pumped agricultural drainage water that bypass the river, are not included in water deliveries to Mexico due to salinity management constraints and therefore contribute to declining water surface elevations at Lake Mead. The Workgroup was created to identify, analyze and recommend options that collectively conserve at least 100,000 AF of water annually in Lake Mead by reducing, replacing or recovering a like amount of bypass flows in a fiscally, legally, bi-nationally and environmentally responsible manner. The Workgroup's recommended options can create at least 100,000 AF annually and constructively contribute to reducing the risk of reaching critical reservoir elevations.

APPENDIX A

Letters exchanged between the Arizona Department of Water Resources and Bureau of Reclamation establishing the Bypass Flows Workgroup

JANICE K. BREWER
Governor



Michael J. Lacey
Director

ARIZONA DEPARTMENT of WATER RESOURCES
3550 North Central Avenue, Second Floor
Phoenix, Arizona 85012-2105
602.771.8426
azwater.gov

December 9, 2014

Sent via e-mail to tfulp@usbr.gov and via U. S. Postal Service on December 9, 2014

Mr. Terry Fulp, Ph.D.
U.S. Bureau of Reclamation
P.O. Box 61470
Boulder City, NV 89006

Dear Dr. Fulp,

As you are well aware, drought conditions in the Colorado River Basin are the worst in over a century of record-keeping and are both unprecedented and unforeseen even when examining longer-term metrics. On behalf of the State of Arizona, the Arizona Department of Water Resources is dedicated to proactively addressing Colorado River supply and management challenges now to protect the viability and resiliency of the Colorado River system and sustain economic development in Arizona and the rest of the Basin for decades to come.

In addition to our work with Reclamation and our Lower Basin neighbors in California and Nevada, we are pursuing a number of proactive water management strategies, such as demand management, the increased use of reclaimed water and brackish groundwater, revised watershed management practices, weather modification, and other actions. As we face these unprecedented drought conditions, we recognize that the key to identifying and implementing creative solutions to our water challenges will come through robust partnerships with local, tribal, regional and federal entities.

One water management challenge that can no longer be unaddressed is the ongoing "bypass" of water from the Colorado River through the Modified Outlet Drainage Extension. We believe that the continued bypass of flows needs to be addressed in a sustainable manner that conserves the limited water supplies of the Colorado River, recognizes the environmental values of the Cienega de Santa Clara, and integrates local, regional and international concerns. Recognizing the broad range

Mr. Terry Fulp, Ph.D.
December 9, 2014
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of interested stakeholders, in early 2015, we will be launching a workgroup focused on identifying approaches to implement a sustainable program to reduce, reuse or replace approximately 100,000 acre feet of the Colorado River water currently considered "bypass flow." This letter requests your participation, as a partner with the State of Arizona through my office, on this multi-entity workgroup.

Past stakeholder-based efforts have led to improvements to Colorado River system management. Arizona has worked cooperatively to identify and implement a number of proactive water management actions, including work that was critical to the strategies recommended by the Seven Colorado River Basin States, and ultimately adopted in the 2007 Record of Decision: *Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead*. Arizona has also been fully engaged in the U.S.-Mexico cooperative efforts on the Colorado River, which have led to the adoption of Minutes 316, 317, 318 and 319 during the period from 2010-2012. Of note, inclusive stakeholder efforts led to a successful pilot run of the Yuma Desalination Plant, conserving thousands of acre-feet of Colorado River water while preserving flows to the Cienega.

We are fully cognizant that any successful effort to implement a sustainable program to reduce, reuse or replace approximately 100,000 acre feet of the Colorado River water "bypass flow" will ultimately have to include stakeholders from the Republic of Mexico and engagement by and with the International Boundary and Water Commission, among others. While we recognize their important interests and equities, we believe that as stewards of Arizona's water resources, we should first initiate a domestic conversation before expanding to international discussions.

We hope that we can partner with your office on this effort. I have asked Tom Buschatzke, ADWR's Assistant Director for Water Planning to chair this high-priority matter. Thank you for your attention to this matter and we look forward to working with you to successfully resolve this water management challenge.

Sincerely,



Michael J. Lacey, Director

Cc: Thomas Buschatzke, Assistant Director, Arizona Dept. of Water Resources



IN REPLY REFER TO:
LC-1000
PRJ-29.00

United States Department of the Interior

BUREAU OF RECLAMATION
Lower Colorado Regional Office
P.O. Box 61470
Boulder City, NV 89006-1470

DEC 29 2014

Mr. Michael J. Lacey
Director
Arizona Department of Water Resources
3550 North Central Avenue
Phoenix, AZ 85012

Subject: Response to Letter Dated December 9, 2014 Regarding "Bypass Flow" Workgroup

Dear Mr. Lacey:

Thank you for your letter dated December 9, 2014, regarding your request on behalf of the Arizona Department of Water Resources (ADWR) that the Bureau of Reclamation's Lower Colorado Regional Office participate in a workgroup focused on identifying approaches to implement a sustainable program to reduce, reuse, or replace approximately 100,000 acre-feet of the Colorado River water currently considered "bypass flow." Subject to and recognizing a number of important limitations and considerations as articulated below, we would appreciate the opportunity to work with you in this matter and would be pleased to partner with your office on this effort beginning early next year.

As background, and as you know, Reclamation is currently engaged in a number of planning efforts to identify and implement strategies to reduce or minimize the adverse effects of the ongoing historic drought in the Colorado River Basin. These efforts include our work to implement the proactive elements of the 2007 Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, the work we initiated in 2004 to investigate strategies to offset and replace bypass flows through voluntary reductions in water use in the Lower Basin, and our investigations of operational options for use of the Yuma Desalting Plant conducted in 2007 and 2010-2011.

We value the partnerships we have with a broad range of interests - both domestically and in Mexico - on the Colorado River, and believe that your plan to convene a workgroup to assess approaches and options to reduce, reuse, or replace approximately 100,000 acre-feet of the Colorado River water that is currently considered "bypass flow" is both a timely and appropriate initiative.

Before embarking on this effort, it is appropriate to expressly state some considerations that are unique to Reclamation's engagement in this effort. First and foremost, any water management actions contemplated by this workgroup that are funded or implemented by Reclamation will, of course, need to be fully analyzed and vetted through public review processes including, for

example, environmental reviews. Additionally, in light of the applicable requirements that apply to the United States (U.S.) Government and are contained in the International Boundary and Water Commission's (IBWC) Minute 242, adopted in 1973 ("*Permanent and Definitive Solution to the Problem of the Salinity of the Colorado River*"), all actions contemplated for implementation will ultimately need to be coordinated with the IBWC, through its U.S. Section.

In order to ensure proper coordination and appropriate transparency with the IBWC, we have consulted with the U.S. and Mexican Sections regarding your request in order to highlight the importance of your focus to prioritize the efforts of the workgroup, and the importance of Reclamation's engagement on this issue, along with our commitment to work cooperatively with the IBWC as ideas and concepts are developed by and through the workgroup. While we recognize the importance of beginning this dialogue with domestic stakeholders, we cannot overemphasize the importance of protecting and enhancing the cooperative partnerships we have developed with the Republic of Mexico on Colorado River matters in recent years.

We hope and are optimistic that our participation with ADWR on the workgroup will lead to further breakthroughs on Colorado River management in a manner that respects the broad range of viewpoints and needs on these and other related Colorado River management issues. I am pleased to give you our commitment to work with you to co-chair this matter in coming months and would ask that your designee, Mr. Tom Buschatzke, coordinate the work with Ms. Jennifer McCloskey, our Deputy Regional Director who I have asked to chair Reclamation's efforts on this very important matter. Jennifer, as you know, is extraordinarily familiar with the issues and challenges associated with bypass flows and operations in the border region.

We look forward to working with your staff and other affected stakeholders in this effort.

Sincerely,



Terrance J. Fulp, Ph.D.
Regional Director

APPENDIX B

Members of the Bypass Flows Workgroup

Figure 8. Members of the Bypass Flows Workgroup

Member	Affiliation
Chuck Cullom	Central Arizona Water Conservation District
Peter Culp	Squire Patton Boggs LLP
Tom Davis	Yuma County Water Users Association
Pat Graham	The Nature Conservancy
Elston Grubaugh	Wellton-Mohawk Irrigation and Drainage District
Vineetha Kartha	Arizona Department of Water Resources
Jennifer McCloskey (co-chair)	Bureau of Reclamation
Wade Noble	Wellton-Mohawk Irrigation and Drainage District, Yuma Irrigation District, Yuma Mesa Irrigation and Drainage District, Unit B Irrigation & Drainage District
Colby Pellegrino	Nevada (Southern Nevada Water Authority)
Jennifer Pitt	National Audubon Society
Maria Ramirez	Bureau of Reclamation
Tanya Trujillo	California (Colorado River Board of California)
Gerry Walker (co-chair)	Arizona Department of Water Resources

APPENDIX C

The following options were considered by the Workgroup, but not recommended for further consideration at this time. While these options have merit, the recommended options were preferred by the Workgroup based on the objective, sub-objectives and the evaluation criteria.

Yuma Desalting Plant Operations – Existing wells and conveyances

The YDP could potentially desalinate other groundwater in the Yuma area besides the bypass flows; feed water for the YDP could originate from existing Reclamation wells and conveyances outside of the WMIDD (e.g., in the South Gila or Yuma Valleys).

Yuma Desalting Plant Operations – New wells and conveyances

Feed water for desalination by the YDP could also originate from the development of new wells and construction of new pipelines outside of the WMIDD, but in the Yuma area.

Yuma Desalting Plant Operations – Industrial water use

Instead of discharging YDP product water to the Colorado River for inclusion in water deliveries to Mexico, the plant's product water would be piped from the YDP to an industrial water user that requires a high volume of water that is very low in total dissolved solids (e.g., petrochemical, beverage, pharmaceutical, microelectronics, and pulp/paper).

Yuma Desalting Plant Operations – Municipal water use

YDP product water could also be used to serve municipal potable needs in communities near the YDP instead of discharging product water into the Colorado River. Product water produced by the YDP would undergo additional processing to meet potable water standards and subsequently be piped to population centers such as San Luis and/or Algodones, Mexico or Yuma, Arizona.

Yuma Desalting Plant Operations – Two-thirds capacity shared with Mexico

This is operation of the YDP at two-thirds of full capacity instead of one-third; as the plant is currently configured and using the bypass flows as feed water for the plant.

Water from the YDP would be discharged into the Colorado River for inclusion in water deliveries to Mexico. One-half of YDP's production would be designated as replacement of the bypass flows; the remaining half would be considered a new water supply for Mexico, above and beyond its 1.5 maf annual entitlement.