RECLAMATION
Managing Water in the West

Supplemental Environmental Assessment

Implementation of Rio Grande Project Operating Procedures, New Mexico and Texas

June 21, 2013

Mission Statements

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The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Supplemental Environmental Assessment for the Implementation of Rio Grande Project Operating Procedures

Proposed agency action:	Implementation of Rio Grande Project Operating Procedures
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Date:	June 21, 2013

List of Acronyms and Abbreviations

AAO	Albuquerque Area Office	Flycatcher	Southwestern Willow Flycatcher
1902 Act	Reclamation Act of 1902	FONSI	Finding of No Significant Impact
1905 Project Act	Rio Grande Project Act of 1905	HCCRD	Hudspeth County Conservation and Reclamation District No. 1
AF/AFY	acre-foot (acre-feet)/acre-feet per year	IBWC	International Boundary and Water Commission, United States Section
CFR	Code of Federal Regulations	ITA	Indian Trust Assets
CFS	cubic feet per second	LRG	Lower Rio Grande in New Mexico
CIR	crop irrigation requirement	NEPA	National Environmental Policy Act
Compact	Rio Grande Compact	NMSP	New Mexico State Parks
1906 Convention	1906 Convention between the United States and Mexico for Equitable Distribution of the Waters of the Rio Grande	NPDES	National Pollution Discharge Elimination System
Corps	US Army Corps of Engineers	OA	Operating Agreement
CWA	Clean Water Act	Project	Rio Grande Project
EA	Environmental Assessment	Reclamation	Bureau of Reclamation
EBID	Elephant Butte Irrigation District	RM	River mile
EIS	Environmental Impact Statement	Service	U.S. Fish and Wildlife Service
EPCWID	El Paso County Water Improvement District No. 1	Silvery Minnow	Rio Grande silvery minnow
EPWU	El Paso Water Utility	TCEQ	Texas Commission on Environmental Quality
ESA	Endangered Species Act of 1973	TDS	total dissolved solids
FDR	farm delivery requirement	WWCRA	West-Wide Climate Risk Assessment

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1 Summary

The Bureau of Reclamation, Albuquerque Area Office (AAO) proposes to continue implementing operating procedures and an operating agreement (OA), signed in 2008, for the Rio Grande Project (Project) (Proposed Action).

Reclamation initially intended this supplemental Environmental Assessment (EA) to analyze the potential impacts of implementation of the OA on the human environment over the entire remaining period of the OA (through 2050). However, further analysis and review of the potential effects of implementation of the OA revealed two points: 1) for the period 2013-2015, differences in potential impacts between previous operations of the Project under the No Action alternative and the projected operations under the OA are projected to be minimal and insignificant, and 2) based on the available data and analytical tools, we can only reasonably predict potential impacts to the human environment over a limited time frame. In light of uncertainties regarding the persistence of drought conditions and the need to improve the analytical tools to detect impacts of the OA, it was determined that analysis of a longer period would be of limited utility at this time.

Consequently, Reclamation believes it should prioritize its review on the short-term, during which the known information will be of the greatest utility to the general public and decision-makers. Reclamation's period of analysis for this supplemental EA is therefore limited to a three year period. Upon completion of the current NEPA process and during this three year period, Reclamation will voluntarily commence and actively pursue the development and refinement of modeling tools to thoroughly analyze the implementation of the OA over its remaining life (through 2050) through an Environmental Impact Statement (EIS). Through this overall approach, Reclamation is providing analysis of short-term impacts in a timely manner while still performing detailed analyses of longer-term impacts in order to assist in the public's consideration of the Proposed Action.

Reclamation issued a draft of this supplemental EA for public review on May 8, 2013. The comment period ended on June 6, 2013. Comments received from the public were reviewed and incorporated into this final supplemental EA (see Appendix G). Consideration of comments resulted in minor editorial changes, clarification, and additions to this final supplemental EA, as noted in the responses to comments.

1.1 What is the Rio Grande Project?

The Project includes two dams and reservoirs, Elephant Butte and Caballo, a power generating plant, and five diversion dams (Percha, Leasburg, Mesilla, American, and International) (Figure 1.1).

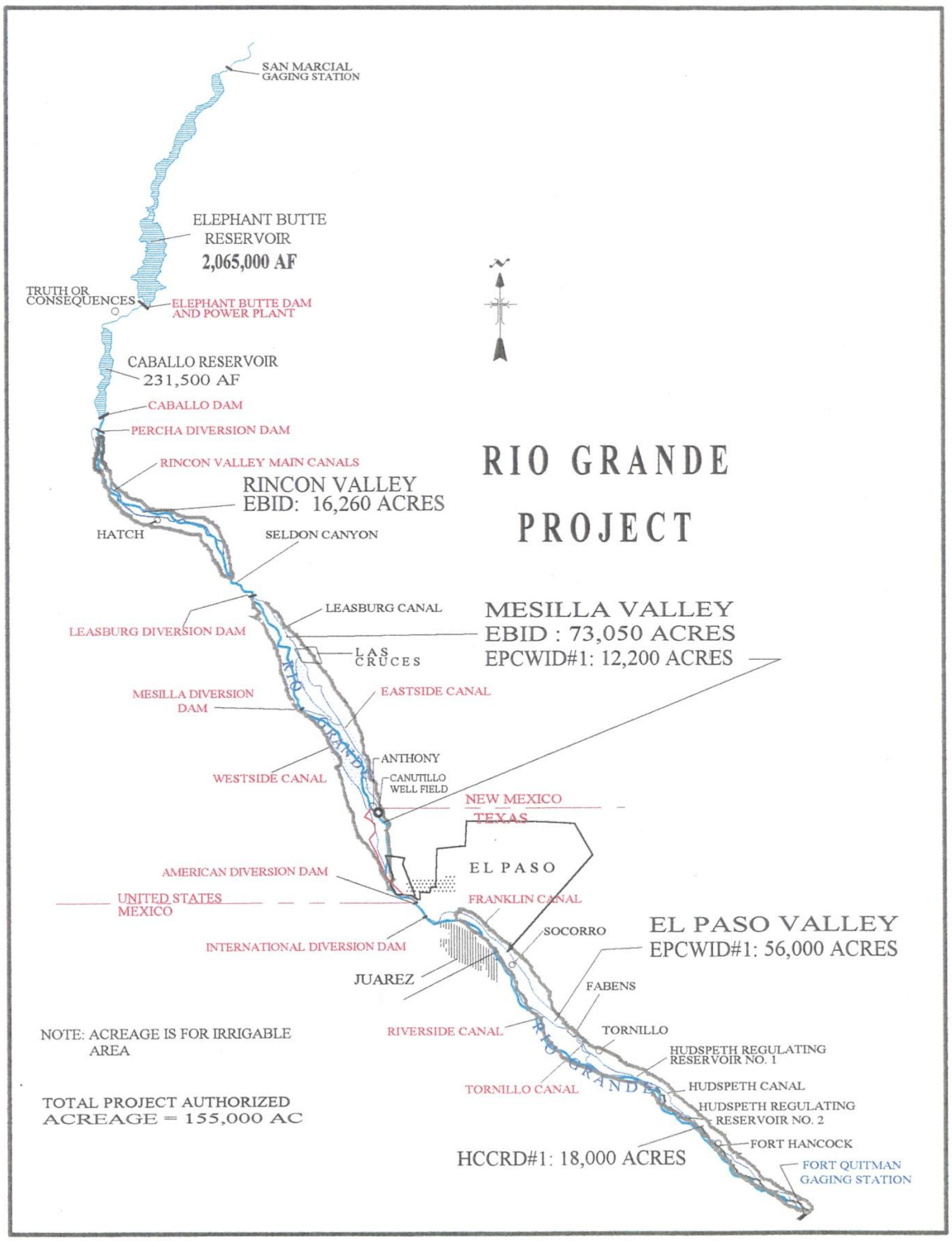

Figure 1.1. Map of Rio Grande Project.

The Project was authorized by Congress under the authority of the Reclamation Act of 1902, and the Rio Grande Project Act of February 25, 1905. The Project provides irrigation water to the Elephant Butte Irrigation District (EBID), which includes 90,640 acres authorized to receive Project water in the Rincon and Mesilla Valleys of New Mexico, and to the El Paso County Water Improvement District No. 1 (EPCWID), which includes 69,010 acres in the Mesilla and El Paso valleys of Texas. The Project serves a total irrigable land comprised of 159,650 acres, 57 percent of which are in New Mexico and 43 percent of which are in Texas. The two districts use Project water to irrigate a variety of crops, including lettuce, chiles, onions, cotton, sorghum, and pecans. The Project also provides water to Mexico under an international treaty which stipulates that 60,000 acre-feet per year (AFY) will be delivered to the head of the Mexican Canal as a full allocation. The City of El Paso also receives water from the Project under a series of 1920 Act contracts which allow the conversion of irrigation water to municipal and industrial uses. Drainage and tail water from Project lands at the terminus of the Project provides a supplemental water supply to 18,000 acres in Hudspeth County Conservation and Reclamation District No. 1 (HCCRD) in Texas.

The HCCRD is located down-gradient and to the south and east of EPCWID in Texas. The United States and the HCCRD entered into a Warren Act Contract, dated December 1, 1924, and amended in 1951, which provides for the use of Project Water by the HCCRD. The Warren Act Contract originally provided that "[t]he United States will deliver to [HCCRD] at the terminus of the Tornillo Main canal, during the irrigation season of 1925 and thereafter during each irrigation season as established on the Rio Grande project, such water from the project as may be available at said terminus without the use of storage from Elephant Butte reservoir." The 1951 amendments to the Warren Act Contract added language specifying that the United States could deliver seepage or drainage water from land irrigated within the EPCWID, via canal, to HCCRD. Because HCCRD only receives return flows and other runoff from EPCWID, they function essentially as one unit in that to the extent that deliveries to EPCWID remain approximately the same, the deliveries of return flows to HCCRD will remain approximately the same. Thus, as this document deals with effects of the OA upon EPCWID, those descriptions will also apply to HCCRD.

1.2 What is the Rio Grande Project Operating Agreement?

The OA is a written description of how Reclamation allocates Project water to EBID, EPCWID, and Mexico consistent with applicable water rights, state and federal laws, and international treaties. The OA is provided in Appendix A.

The Project and the OA have a long and litigious history as detailed in Appendix C. By way of summary, Reclamation operated the Project itself, until signing contracts with EBID and EPCWID for the transfer of operations and maintenance of particular items of the irrigation delivery and drainage system. In 1979 Reclamation contracted with EBID to assume responsibility for operation and maintenance of Percha, Leasburg, and Mesilla Diversion Dams. In 1980, Reclamation contracted with EPCWID to transfer operation and maintenance responsibilities for Riverside Diversion Dam, and the distribution and drainage system in Texas downstream to HCCRD. The Riverside Diversion Dam was removed in 2003 in an effort to improve flood control capability. Both contracts required Reclamation and the two districts to create a mutually agreeable "detailed operational plan…setting forth procedures for water delivery and accounting." As detailed in Appendix C, however, a mutually agreeable operating plan was not established until 2007 with the OA. In the absence of established operating procedures, Reclamation imposed ad hoc operating procedures to govern operations. These ad hoc operating procedures were modified by Reclamation as needed between 1980 and 2007. During that time, Reclamation calculated, allocated, and delivered each district's annual diversion allocation, but the methods, equations, and procedures were modified as needed and optimized, according to real-time water conditions. Finally in 2007, after years of litigation and negotiation, the three parties agreed upon operating procedures and in 2008 signed a 50-year OA. A corresponding Operations Manual was established in August 2008. The Operations Manual is reviewed annually and was last updated in May 2012 (Appendix B).

1.3 Principles Underlying the Operating Agreement

The provisions adopted in the OA reflect the parties' interest in the long term sustainability of the Project and related resources, which include Rio Grande surface waters and hydraulically connected ground water in both New Mexico and Texas.

The OA largely reflects historical operation of the Project, with two key changes. First, the OA provides carryover accounting for any unused portion of the annual diversion allocations to EBID and EPCWID. Under the No Action alternative, the unused portion of a district's annual allocation balance contributes to the total amount of usable water available for allocation during the following year; as a result, a portion of one district's unused allocation becomes part of the other district's annual allocation the following year (see Section 3.2.2). Under the OA, any unused portion of the annual diversion allocations to EBID and EPCWID is carried over to the district's allocation balance the following year. The carryover provision of the OA is designed to encourage water conservation within the Project by allowing each district to retain their unused allocation up to a specified limit.

Second, the OA provides for adjustment of the annual Project allocations to EBID and EPCWID to account for changes in Project performance, as characterized by the Project diversion ratio (calculated as the ratio of total Project allocation charges to total Project releases during a given period; see Appendix F, Section 2.4). The diversion ratio represents the amount of Project allocation that is utilized per unit release of Project water from Caballo Dam; the diversion ratio is thus a measure of Project performance with respect to the ability of the Project to meet delivery obligations to EBID, EPCWID, and Mexico. While numerous factors affect Project performance, recent changes in performance are predominately driven by the actions of individual landowners within EBID, including crop selection and related effects on crop irrigation requirement; irrigation practices and related effects on on-farm irrigation efficiency; and widespread use of groundwater for supplemental irrigation as permitted and regulated by the State of New Mexico (see Section 4.2.2.3). The diversion ratio provision of the OA ensures that annual Project allocations and Project deliveries to EPCWID are consistent with historical Project performance as characterized by the D-2 Curve (see Section 3.2.2.2), and that deviations in Project performance relative to historical conditions are accounted for through adjustment of the annual Project allocation to EBID.

The surface water acquisition program as instituted by El Paso Water Utilities (EPWU) was developed to encourage use of surface water during wet years and conservation of groundwater for use during dry years. The carryover provision of the OA would therefore facilitate the objective of the surface water acquisition program by encouraging conservation of Project surface water. In addition, the carryover provision would provide EPWU greater certainty in the amount of Project water available to EPWU.

The City of Las Cruces has acquired lands within EBID in order to obtain the corresponding allotment of Project water through contract with Reclamation under the 1920 Miscellaneous Purposes Act; the necessary contracts are currently being developed but have not been finalized. The OA is intended to provide more water to EBID and its customers during wet years and during periods of high Project performance relative to the historical D-2 baseline. The carryover provision of the OA would facilitate conservation of EBID's allocation during these periods for use by the district's customers, including the City of Las Cruces, during dry years. The carryover provision would also provide greater certainty in the amount of Project water available to the City of Las Cruces.

Figure 1.2 conceptually illustrates the interaction between groundwater and surface water in the Rincon and Mesilla Valleys. When groundwater elevations adjacent to the Rio Grande or a given drain segment are above the surface water elevation in the channel, the hydraulic gradient drives groundwater flows towards the channel (Figure 1.2(a)). In this situation, groundwater discharge to the channel increases the available surface water supply. When groundwater elevations adjacent to the Rio Grande or a given drain segment are below the water elevation in the channel, the hydraulic gradient drives groundwater flow away from the river (Figure 1.2(b)). In this situation, seepage from the channel into the underlying aquifer decreases the available surface water supply. In the event that groundwater elevations adjacent to a given channel segment fall substantially below the channel elevation, the channel may become hydraulically disconnected from the underlying aquifer (Figure 1.2(c)); in this situation, seepage from the channel reaches a maximum rate and is no longer affected by fluctuations in groundwater elevation.

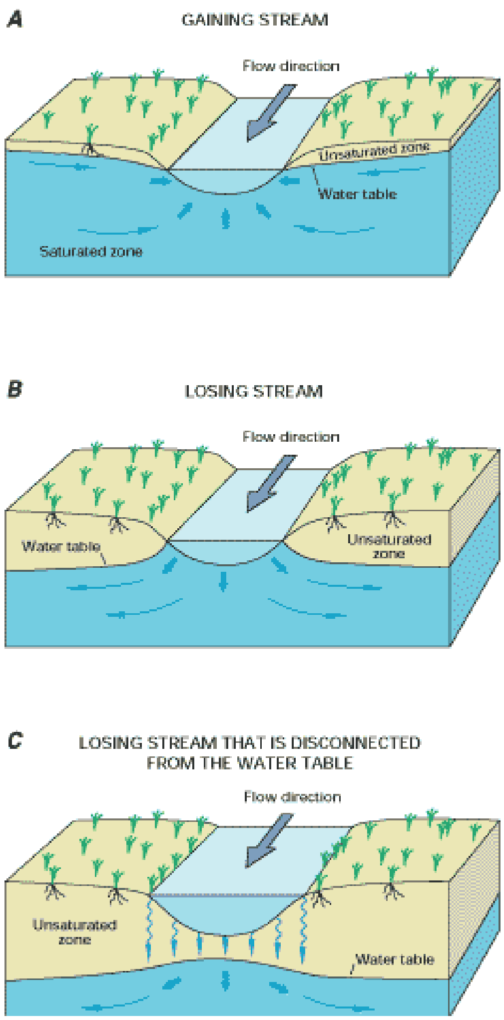

Figure 1.2: Groundwater movement associated with gaining streams, losing streams, and streams disconnected from the groundwater table by an unsaturated zone (USGS 1998). Concepts also apply to stream reaches.

Due to the strong interaction between groundwater and surface water in the Rincon and Mesilla Valleys, any decline in groundwater elevations increases seepage losses and reduces the Project surface water supply available for diversion by EBID, EPCWID, and Mexico. Conversely, any increase in groundwater elevations acts to decrease seepage losses and increase the Project surface water supply available for diversion.

While numerous factors affect groundwater resources within Rincon and Mesilla Valleys, groundwater pumping for supplemental irrigation is a primary driver of groundwater fluctuations within the Project. In addition to their allocation of surface water from the Project, many individual landowners within EBID and EPCWID rely on groundwater pumping for supplemental irrigation, as authorized by the states of New Mexico and Texas. Groundwater pumping within EBID and within the portion of EPCWID located in the Mesilla Valley draws water primarily from the Rio Grande Alluvial Aquifer and the Mesilla Bolson, both of which are shallow unconfined aquifers that are hydraulically connected to the Rio Grande and to the network of drains that collects and returns water from Project lands to the river channel. Groundwater pumping within Rincon and Mesilla Valleys thus depletes Project surface water supplies and Project deliveries to EBID, EPCWID, and Mexico by increasing seepage losses from the Rio Grande and decreasing groundwater discharge to the river channel and to Project drains. By contrast, groundwater pumping within the El Paso Valley portion of EPCWID does not affect Project deliveries as the effects of pumping occur downstream of Project diversion points. Groundwater pumping within EBID is an order of magnitude greater than groundwater pumping within the Mesilla Valley portion of EPCWID (see Section 4.2.2.3); effects of groundwater pumping within EBID on Project performance is therefore substantially greater than the effects of groundwater pumping within EPCWID.

The OA was crafted to explicitly acknowledge the dynamic interaction between groundwater and surface water supplies in the Rincon and Mesilla Valleys and to deal with the effects of changes in Project performance relative to historical conditions, which result predominately from the actions of individual landowners within EBID, on Project allocations and deliveries to EPCWID and Mexico. Under the diversion ratio provision, the annual Project allocation to EPCWID is equal to the district's historical diversion allocation based on the D-2 Curve (see Section 3.2.2); the annual allocation to EBID is adjusted to reflect current-year (actual) Project performance as reflected by the Project diversion ratio. When the diversion ratio is high relative to the historical baseline defined by the D-2 Curve, EBID generally receives an increase in annual allocation compared to the district's diversion allocation under prior operating practices; when the diversion ratio is low relative to the D-2 baseline, EBID generally receives a decrease in Project allocation compared to prior operating practices. The success of the OA in appropriately accounting for recent changes in Project performance is supported by the evaluation of Project allocations and deliveries detailed in Chapter 4.

1.4 Why supplement the 2007 Environmental Assessment?

In 2007, in compliance with the National Environmental Policy Act (NEPA) and its implementing regulations at 40 CFR 1500-1508, Reclamation prepared an EA to determine whether implementing the Project operating procedures defined in the OA would significantly affect the quality of the human environment. The EA and the operating procedures were anticipated to be in effect until June 2012. Based on the information, data, and analysis available in 2007, none of the environmental impacts were anticipated to reach a level of significance.[1] In the 2007 EA, Reclamation committed to gather data over the first five years of implementation to support future evaluation of effects on the environment. This supplemental EA fulfills that commitment.

[1] In defining "significantly" the Council on Environmental Quality's regulations require consideration of context and intensity of the environmental effects of an action. An EIS must be prepared when the effect of an action is considered significant.

1.5 Topics in this assessment

Based on internal review and external scoping and outreach, the following topics and issues are included for analysis in this EA.

• Water Resources
    ○ Surface Water
    ○ Groundwater
    ○ Water Quality
• Vegetation
• Wildlife
	• Listed Species
	• Cultural Resources
	• Farming and Land Use
	• Parks and Recreation
	• Environmental Justice
	• Indian Trust Assets

2 Purpose and Need to Implement Operating Procedures

The need for the operating procedures and OA remains as described in the 2007 EA. Since 1979 and 1980, Reclamation, EBID and EPCWID have had contractual obligations to agree upon a detailed operational plan setting forth procedures for allocation, delivery, and accounting of Project water. This need was finally satisfied in 2008 when the three parties entered into a Compromise and Settlement Agreement (2008 Settlement), which required implementation of the OA and Operations Manual, and resolved decades of litigation, as described in Appendix C.

The purpose of the Proposed Action is to meet contractual obligations to provide EBID and EPCWID with a written set of procedures defining the allocation of Project water to both districts consistent with their rights under applicable law, with which both districts agree, and which can be changed only with the unanimous consent of the districts and Reclamation.

Also, the Proposed Action allows each district to carryover the unused portion of its annual diversion allocation, up to a specified limit, rather than the unused portion contributing to the total usable water available for allocation the following year. The Proposed Action considers adjustments to annual diversion allocations in response to changes in the ability of the Rio Grande to convey Project water from Caballo Dam to points of diversion, as represented by the diversion ratio.

Outside of these operational elements, the operation of the Project would proceed unchanged.

3 Alternatives

3.1 Introduction

Two alternatives were evaluated in 2007 and remain the same for this supplemental EA:

- No Action; and
- Proposed Action: Continued implementation of OA.

3.2 No Action

The operation of the Project has consisted of four functions, all of which would remain unchanged under the No Action alternative:

- Storing Project water;
- Allocating the stored Project water to EBID and EPCWID and Mexico primarily by applying the D-2 and D-1 allocation relationships, respectively (with annual adjustments as agreed-upon to optimize operations);
- Releasing the Project water to satisfy orders from the two districts and the International Boundary and Water Commission, United States Section (IBWC) on behalf of Mexico to deliver the allocations; and
- Diverting Project water at the diversion dams and distributing that water through the irrigation and drainage system to individual farmers. (Since 1980, this has been a function of the districts.)

Implementation of the No Action alternative would not completely satisfy the stated purpose and need for action as requested by the parties to the contracts as these contracts require the development of operating procedures to govern the operations of the Project. Implementation of the No Action alternative would also result in the breach of a settlement agreement among the United States, EBID, and EPCWID (Settlement Agreement 2008). The No Action alternative would continue Project operations according to pre-OA conditions.

3.2.1 Storing Project Water

Under the No Action alternative, Reclamation stores Project water in Elephant Butte and Caballo Reservoirs. The total conservation storage capacity is 2,249,520 acre-feet (AF). The most recent sedimentation survey of Elephant Butte Reservoir (Ferrari 2008) determined that the reservoir capacity is currently 2,024,586 AF. Caballo Reservoir has a total capacity of 324,934 AF, comprising 224,934 AF of storage and 100,000 AF of flood control space. Presently under a 1996 court order, Reclamation is restricted to storing no more than 50,000 AF in Caballo Reservoir during the non-irrigation season[2].

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[2] According to Court Order No. CIV-90-95- HB/WWD of October 17, 1996, which resulted from a negotiated settlement with the U.S. irrigation districts, the Caballo Reservoir storage level is targeted not to exceed 50,000 AF (elevation 4,146.11 ft) from October 1 to January 31 of each year, unless flood control operations, storage of water for conservation purposes, regulation of releases from Elephant Butte Dam, safety of dams purposes, emergency operations, or any other purpose authorized by Federal law, except non-emergency power generation, dictate otherwise. Significant variation above 50,000 AF during the

At the beginning of the calendar year (water year) and prior to the onset of the irrigation season, Reclamation would calculate the existing total water in storage. Total storage would include annual Rio Grande Compact (Compact) deliveries, which are comprised of any accumulated inflows, less evaporative losses. From this total quantity of water, non-Project storage (San Juan – Chama Project Water[3] and Compact Credit Water) would be subtracted and the resultant amount would be the total usable Project storage.

In years when the irrigation season would begin with less water than what is needed for a full allocation, Reclamation would update the Project storage calculations each month during the irrigation season until a final allocation is made. Updates would be based on inflows and releases during the month, and include the amount of water from the previous end-of-month Project storage and usable water available for release.[4]

The usable available water supply is water which the Project has in storage, plus all inflow to the Rio Grande downstream of Caballo Dam to International Dam, that may be used to comply with the terms of the 1906 Convention between the United States and Mexico regarding equitable distribution of waters of the Rio Grande (1906 Convention), the Rio Grande Compact, irrigation delivery commitments with EBID and EPCWID, and contracts with San Juan Chama water owners. The usable water available for release is that which remains after accounting for Rio Grande Compact Credit accounts and San Juan Chama accounts. Project operations are consistent with the Rio Grande Compact as administered and agreed by unanimous consent of the Rio Grande Compact Commission.

3.2.2 Allocating Project Water

Procedures used to determine annual Project diversion allocations to EBID, EPCWID, and Mexico under the No Action alternative are summarized below. Complete details of all data and calculations used to determine annual diversion allocations under the No Action alternative are provided in Sections 2.4 and 3.1 of Appendix F.

Under the No Action alternative, annual diversion allocations are determined based on the usable water available for release from Project storage during a given year, including the usable water in storage at the start of the year plus any usable water that becomes available during the year as inflow to Project storage or as relinquishment of credit waters. Prior to the start of the year, Reclamation would determine initial Project

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winter months of October through January requires collaboration and consultation between the districts and Reclamation.

[3] The San Juan – Chama Project was authorized in 1962 (PL 87-483) to allow diversion of Colorado River basin water into the Rio Grande basin of New Mexico. Subsequent authorizations under PL 97-140 allowed for the Cities of Albuquerque and Santa Fe to enter into agreements with Reclamation to store 50,000 and 25,000 AF, respectively, in Elephant Butte Reservoir.

[4] Project water available for release is water that could be released to meet Rio Grande Project purposes and authorizations at any time during the year. The amount is calculated by adding the total storage in Elephant Butte and Caballo reservoirs, subtracting estimated evaporation for the remainder of the irrigation season, San Juan-Chama Project Water, and Compact Credit Water for New Mexico and Colorado.

allocations to EBID, EPWID, and Mexico based on usable water in Project storage according to the D-1 Curve and D-2 Curve as described below. Full Project supply was defined as usable water available for release equal to 763,842 AF, which corresponds to an estimated 931,897 AF available for diversion based on the D-2 Curve. In years when the usable water available for release at the start of the year was equal to or greater than 763,842 AF, a full allocation was issued at the start of the year. In years when the usable water available for release at the start of the year was less than 763,842 AF, allocations were updated on a monthly basis throughout the season to account for inflows and/or relinquishment of credit waters during the year until a final allocation was determined. In years when usable water was less than full supply, the final allocation did not always correspond to the amount of usable water in Project storage at any particular time during the year.

All water reaching the bed of the Rio Grande within the Project area contributes to Project supply and is captured and used for Project deliveries, including operational spills, bypass flows, other return flows from EBID and EPCWID, groundwater discharge to the Rio Grande and to Project drains, and any other tributary inflows that reach the bed of the Rio Grande within the Project. All losses of surface water from within the Project, including seepage and evaporation as well as decreased groundwater discharge, thus affects the total Project supply. The D-1 and D-2 Curves used by Reclamation to determine annual Project allocations under the No Action Alternative represent the effects of inflows and losses within the Project on historical Project performance. The D-1 and D-2 Curves were developed from Project operations data for the period 1951-1978. The D-1 Curve is a linear regression equation that represents the historical relationship between the total annual release from Project storage and the total Project delivery to lands within the United States plus delivery to the heading of the Acequia Madre. The D-2 Curve is a linear regression equation that represents the historical relationship between the total annual release from Project storage and the total Project delivery to canal headings on the Rio Grande, including delivery to all authorized points of diversion for EBID and EPCWID as well as the heading of the Acequia Madre for diversion to Mexico. The D-1 and D-2 Curves reflect historical Project performance during the period 1951-1978, including effects of losses and inflows on Project deliveries.

3.2.2.1 Allocation to Mexico

Under the No Action alternative, in accordance with the 1906 Convention, the annual Project allocation to Mexico is 60,000 AFY, except in years of "extraordinary drought or serious accident to the [United States] irrigation system". Under these conditions, Mexico's full allocation would be reduced in the same proportion as the Project delivery to lands within United States, such that the annual allocation to Mexico is equal to 11.3486% of the sum of the quantity of Project water delivered to lands in the United States plus the quantity of Project water delivered to the heading of the Acequia Madre for diversion by Mexico. The water is delivered to the bed of the Rio Grande, measured at the Acequia Madre heading, and the delivery carried out in cooperation with the IBWC. Under the No Action alternative, Reclamation would endeavor to coordinate the releases for each district and Mexico in order to minimize the conveyance losses incurred in making such deliveries.

Under the No Action alternative, during extraordinary drought conditions the total annual Project delivery to Project lands within the United States (i.e., delivery to individual farm gates within EBID and EPCWID) plus total deliveries to the heading of the Acequia Madre would be calculated based on the D-1 Curve. The D-1 Curve was developed by Reclamation and IBWC in 1980 to calculate the annual allocation to Mexico when less than a full supply is available; the D-2 Curve was developed in light of the change from Reclamation delivering water to United States Project lands to delivery of water to the district's diversion headings. The D-1 curve is a simple linear regression equation:

$Y = 0.8260932 * (X) – 102,305;$

where X is the total amount of usable water released from Project storage during a given year in AFY, and Y is the total delivery to lands in the United States plus the delivery to Mexico at the Acequia Madre heading in AF. As detailed above, Project deliveries calculated from the D-1 Curve reflect historical Project performance during the period 1951-1978, including losses and return flows within the Project.

3.2.2.2 Allocation to EBID and EPCWID

Under the No Action alternative, total annual diversion allocations to EBID and EPCWID would be calculated using the D-2 Curve. Similar to the D-1 curve, the D-2 Curve is a simple linear regression equation:

$$Y = X*1.3377994 – 89,970$$

where X is the total amount of usable water released from Project storage during a given year in AFY, and Y is the total amount of water available for diversion from the Rio Grande by EBID, EPCWID, and Mexico at their respective canal headings.

For a given annual release from Caballo Dam, the D-2 Curve represents the total (gross) amount of water available for diversion from the Rio Grande by EBID, EPCWID, and Mexico during that year under historical Project performance conditions. Under the No Action alternative, the amount of water available for diversion within the United States by EBID and EPCWID would be determined by subtracting the annual allocation to Mexico from the total amount of water available for diversion during the year as calculated by the D-2 Curve. EBID would then be allocated $88/155^{ths}$ (57%) of the amount of water available for diversion and EPCWID would be allocated $67/155^{ths}$ (43%).

During some years, actual Project performance was below the baseline historical condition represented by the D-2 Curve. In some of these years, the annual diversion allocations to EBID and EPCWID determined by Reclamation based on the D-2 Curve could not be satisfied from the usable water available for release from Project storage due to increased seepage losses and/or decreased groundwater discharge, return flows, and other inflows relative to historical conditions. In these years, Reclamation operated the Project so as to maximize deliveries to EBID and EPCWID while ensuring that EBID received 57% and EPCWID received 43% of the total Project diversion within the United States. Thus under the No Action alternative, Reclamation would adjust Project allocations to EBID and EPCWID on an *ad hoc* basis in years when Project performance was below the historical D-2 baseline such that it would not be possible to satisfy diversion allocations calculated from the D-2 Curve.

As discussed in Section 1.3, Project performance depend on a number of factors, including cropping patterns, irrigation practices and efficiency, operation and maintenance of canals, laterals, and drains, and groundwater pumping within the Project and surrounding areas. Diversion allocations based on the D-2 Curve reflect conditions within the Project during the period 1951-1978 and do not account for changes in conditions within the Project since 1978 that may affect Project performance.

Under the No Action alternative, the unused portion of both district's annual diversion allocation, if any, minus evaporative losses, would contribute to usable water in Project storage at the start of the following year, which is then allocated according to the D-2 Curve. As a result, 43% of any unused EBID allocation (minus evaporative losses) is effectively reallocated to EPCWID the following year and 57% of any unused portion of EPCWID allocation (minus evaporative losses) is effectively reallocated to EBID the following year.

During wet periods when conservation is typically less critical, the districts are likely to call for accumulated carryover waters for increased crop production incentives, to recharge groundwater aquifers, or to flush naturally occurring salts from the irrigated fields. During very dry periods, the districts are likely to call for accumulated carryover waters to make use of all available water. Historically, EPCWID has had considerably more uncalled for (and therefore carried over) allocated water than EBID, which under No Action operations would be effectively re-allocated to EBID the following year. Historically, EBID has usually called for all available water. EBID's degree of certainty of water for irrigation in times of drought lies in the practice of supplementing surface water supplies with groundwater pumping.

3.2.3 Releasing Project Water

As the districts and Mexico call for water, Reclamation would adjust releases based on the current system efficiency of delivering water from Caballo Dam to the respective diversion gates[5]. The volume of water in the river system would depend on the amount of water released from the reservoirs and hydrologic conditions throughout the Project, including bank storage and groundwater elevations adjacent to the Rio Grande and drain networks within the Project, soil moisture storage and deep percolation from farmlands, flow and water levels in canals and laterals, and municipal effluent reaching the Rio Grande between Caballo Dam and American Diversion Dam. All of these factors affect conveyance losses from and return flows to the Rio Grande between Caballo Dam and Project diversions. Under normal and wet conditions, water released from Caballo

[5] System delivery efficiency is defined as the ability of the river to transport water released from Project storage to the diversion dams, accounting for losses from evaporation and seepage.

Reservoir would be less than the amount of water delivered at the headgates due to the availability of return flows, groundwater discharge, and municipal effluent for downstream diversion.

3.2.3.1 Releases from Elephant Butte Dam

Under the No Action alternative, releases from Elephant Butte Dam would be provided to ensure capacity in Caballo Reservoir is available to meet delivery requirements. Releases would be scheduled on a monthly and hourly basis to ensure adequate water for Project deliveries, and may represent an increase from initially announced releases as more water becomes available. Releases from Elephant Butte Dam would be based on allocations to Mexico, EBID, and EPCWID and are restricted by other factors. These factors include the capacity of the hydropower turbines of the Elephant Butte power plant; the flood control flow capacity of the channel downstream, as maintained by Reclamation (under separate permit with Corps) at 5,000 CFS for protection of communities including Williamsburg and Truth or Consequences, New Mexico; and the limits of storage in Caballo Reservoir. When possible, releases would be made through the power plant. The three turbines of the powerplant are limited to approximately 600 to 700 CFS each, limiting releases to no more than 2,100 CFS at a given time. There would be no changes in releases from Elephant Butte Dam to satisfy power generation during the irrigation season, and no water would be released under normal (non-flood) circumstances during the non-irrigation season. Reclamation retains some discretion regarding the timing of releases from Elephant Butte into Caballo Reservoir, to maintain sufficient water in Caballo for irrigation demands.

3.2.3.2 Releases from Caballo Dam

Under the No Action alternative, releases from Caballo Dam would be made when the districts and Mexico call for water, and would be a function of meeting irrigation delivery requirements. During normal non-flood Project operation, there would be no other releases from Caballo Dam. Flood control is an authorized function of Caballo Dam. Adjustments to releases from Caballo Reservoir would be made throughout the irrigation season, sometimes on an hourly basis as needed.

3.2.4 Diverting Project Water and Delivering Water to Users

Pursuant to law and contract, the fourth stated function of the Project - diversion and distribution - was delegated to the two districts in 1979 and 1980. Under the No Action alternative, diversions would still be measured at the delivery gates, and deliveries to irrigated lands would still be a function of the districts.

3.3 Proposed Action (Continued Implementation of the OA)

The Proposed Action consists of continued implementation of the operating procedures defined in the Rio Grande Project Operating Agreement (OA) and the corresponding Rio Grande Project Operations Manual, developed in 2008 and most recently revised in 2012. Under the Proposed Action, Reclamation would continue to store, allocate, release, and deliver Project water for authorized uses within the United States and for delivery to Mexico as under the No Action Alternative. Annual Project allocations would continue to be determined by Reclamation based on the usable water in Project storage available for release during the current year, including usable water in storage at the start of the year plus any usable water that becomes available during the year as inflow to Project storage or as relinquishment of credit waters. Reclamation would continue to determine initial Project allocations to EBID, EPWID, and Mexico based on usable water in Project storage at the start of the year, and would update allocations monthly based on reservoir releases and changes in usable storage. Reclamation would continue to determine annual diversion allocations to Mexico and EPCWID based on the D-1 and D-2 Curves as under the No Action alternative, and Project releases would continue to be scheduled and managed to meet delivery orders submitted by EBID, EPCWID, and IBWC on behalf of Mexico. The OA is thus largely consistent with historical Project operating practices.

As summarized in Section 1.3, differences between the OA and the No Action alternative are limited to two key provisions: (1) the carryover provision, which provides carryover accounting for the unused allocation balance remaining on EBID's and EPCWID's respective project water accounts at the end of each year; and (2) the diversion ratio provision which provides for adjustment of annual allocations to EBID and EPCWID to account for deviations in Project performance relative to historical conditions as characterized by the Project diversion ratio. Changes in Project allocation to EBID and EPCWID under the carryover provision and diversion ratio provision are summarized below. Complete details of all data and calculations used to determine annual diversion allocations under the Proposed Action are provided in Appendix F, Sections 2.4 and 3.1.

While the term of the OA is January 1, 2008 to December 31, 2050, Reclamation determined that the duration of analysis for this supplemental EA should consider only the three year period encompassing the 2013-2015 irrigation seasons (see Section 1.0). The OA and Operations Manual are reviewed annually, and updated as needed with unanimous consent of all parties in order to optimize Project operations consistent with applicable water rights, state and federal laws, and international treaties. While the OA has not been modified since it was established in 2008, the Operations Manual has been updated several times to clarify calculations used in the allocation procedure and to optimize Project operations to better meet the needs of the Districts, particularly during severe and sustained drought conditions affecting the Project during the past decade. For the purposes of this EA, the Proposed Action is considered as specified in the OA and the most recent revision of the Operating Manual.

3.3.1 Carryover Provision

The carryover provision of the OA provides carryover accounting for the unused allocation balances remaining on EBID's and EPCWID's respective Project water accounts at the end of each year. Under the No Action alternative, the total diversion allocation available to each district during a given year was determined based on the usable water available for release from Project storage during that year, without consideration of the balance remaining on the district's Project water account at the end of the prior year. Under the Proposed Action, each district's unused allocation balance at the end of a given year is carried over and applied to the district's Project water account the following year and thus contributes to the total diversion allocation available to the district the following year.

In the event that either district does not utilize all of its total diversion allocation during a given year, the quantity of water that would have been released from Project storage to satisfy the unused portion of the district's allocation instead remains in Project storage at the end of the year. Under both the Proposed Action and the No Action alternative, this quantity of water, minus evaporative losses, contributes to the total quantity of usable water in Project storage available for release the following year. Under the No Action alternative, annual Project allocations were determined based on the total usable water available for release, without consideration of carryover water. By contrast, under the Proposed Action, each district's unused allocation balance remains on its Project water account and contributes to its total diversion allocation the following year. Annual Project allocations are then determined based on the amount of usable water in Project storage available for current-year allocation, which in turn is determined by deducting the quantity of water that must be released from Project storage in order to satisfy both districts' carryover balances from the total quantity of usable water available for release. The quantity of water that must be released to satisfy both districts' carryover balances is determined based on the current (actual) Project diversion ratio and thus reflects actual Project performance at the time of release.

The carryover provision of the OA allows each district to accrue and maintain carryover balance for any period of years and in any amount up to 60% of the district's respective full annual allocation under the OA. EBID therefore may accrue carryover balance up to a limit of 305,918 AF, and EPCWID may accrue carryover balance up to 232,915 AF. In the event that either district accrues carryover balance in excess of their respective limit, the excess balance would be transferred to the other district's Project water account. In the event that both districts carryover balances exceed their respective limits, excess carryover balance from both districts reverts to the Project.

The carryover provision of the OA does not affect the procedure used to determine the annual Project allocation to Mexico. As under the No Action alternative, pursuant to the 1906 Convention, the annual allocation to Mexico would be 60,000 AF except in years of "extraordinary drought or serious accident to the [United States] irrigation system". During extraordinary drought conditions, the annual allocation to Mexico would be determined as under the No Action alternative based on the total annual Project delivery to Project lands within the United States (i.e., delivery to individual farm gates within EBID and EPCWID) plus total deliveries to the heading of the Acequia Madre as calculated using the D-1 Curve.

3.3.2 Diversion Ratio Provision

Under the OA, as under the No Action alternative, Reclamation would determine the total amount of usable water in Project storage at the beginning of each water year and during each month thereafter. As under the No Action alternative, the annual allocation to Mexico is determined based on the total delivery of Project water to lands within the United States and to the heading of the Acequia Madre for diversion to Mexico, which in turn is calculated from the D-1 Curve based on the projected release of usable water from Project storage during the current year (see Section 3.3.1).

Reclamation then determines the total amount of usable water available for current-year allocation and the corresponding total available diversion under historical and current Project performance. The usable water available for current-year allocation is determined by subtracting the carryover obligation from the total usable water available for release, where the carryover obligation is the amount of usable water that must be released to satisfy EBID and EPCWID prior-year carryover balances. The total diversion available from current-year allocated water under historical Project performance conditions is determined based on the D-2 Curve (D-2 diversion allocation); the total diversion available under current Project performance is calculated based on the current Project diversion ratio (diversion ratio allocation).

The annual allocation to EPCWID from usable water available for current-year allocation is equal to $67/155^{ths}$ (43%) of the total diversion available to lands within the United States, which in turn is calculated as 43% of the difference between the D-2 diversion allocation minus the annual allocation to Mexico, as under the No Action alternative. The total diversion allocation to EPCWID is then calculated as the sum of the district's annual allocation and prior-year carryover balance, plus the district's American Canal Extension (ACE) conservation credit (see Appendix F, Sections 2.4 and 3.1.2).

The annual allocation to EBID from usable water available for current-year allocation is then calculated by subtracting the total diversion allocations to Mexico and EPCWID from the annual diversion ratio allocation. The total diversion allocation to EBID is then calculated as the sum of the district's annual allocation and prior year carryover balance.

Calculation of annual allocations to EBID and EPCWID under the OA involves additional adjustments under some conditions. A positive adjustment (increase) is applied to both districts' allocations when the usable water available for current-year allocation is greater than 600,000 AF and current (actual) Project performance exceeds the historical D-2 baseline. A negative adjustment (decrease) is applied to both districts' allocations during extreme drought conditions, defined as consecutive years with Project releases below 400,000 AFY. In addition, the OA implements a minor modification of the D-2 Curve. A minimization term was added to the original D-2 regression equation to explicitly limit the usable water available for current-year allocation to 763,842 AF; this limit is similarly imposed under the No Action alternative, but is made explicit in the OA. An additional term was then included in the equation to allow Project releases of up to 790,000 AF, equal to the normal annual release defined under the OA and the average annual release of usable water specified under the Rio Grande Compact. In addition, a maximization term was added to the equation to ensure that the annual D-2 diversion allocation cannot be negative. Allocation adjustments and the modified D-2 regression equation are detailed in Sections 2.4 and 3.1.3 of Appendix F.

The D-2 equation was based on a period with less pumping. When the actual diversion ratio is low, the D-2 equation overestimates the amount of water that can be delivered for diversion based on a given volume of release. The OA essentially fixes this problem in two ways. First, the total allocation under the OA procedure should never exceed the amount of water that can actually be delivered for diversion based on (a) the amount of water available for release during the current year and (b) the current diversion ratio. In many cases, this results in the total diversion allocation being less under the OA than prior operations. This reduces the chance that either district would have a diversion allocation that Reclamation would not be able to satisfy (i.e., reduces the risk of "paper water" exceeding "wet water").

Second, by determining annual Project allocations to Mexico based on the total usable water released during the year using the D-1 curve, the diversion ratio provision ensures that the annual diversion allocation to Mexico is consistent with historical Project operations and with the 1906 Convention. By determining annual Project allocation to EPCWID based on the D-2 Curve, the OA ensures that Project allocations and deliveries to EPCWID are not affected by changes in Project performance that result predominately from the actions of individual landowners within EBID and surrounding areas, including changes in cropping and irrigation practices and continued use of groundwater for supplemental irrigation within EBID as permitted and regulated by the State of New Mexico. Finally, by determining the carryover obligation and total annual diversion allocation (i.e., diversion ratio allocation) each year based on current (actual) Project performance, the OA ensures that the total diversion allocation can be satisfied from the usable water available for release, thereby avoiding instances of *ad hoc* operation similar to those under prior operating practices.

4 Environmental Consequences

This section discusses the potential or anticipated impacts of the Proposed Action and No Action alternative. Direct impacts are caused by the action, and occur at the same time and place as the action. Indirect impacts are caused by the action, and occur later in time or more geographically removed, but are still reasonable and foreseeable. Cumulative effects, or impacts, are the effects on the environment that may result from the incremental effects of the alternatives when added to other past, present, or reasonably foreseeable actions regardless of what agency or person undertakes such actions (40 CFR 1508.7; 43 CFR 46.115).

The following Natural, Cultural, Socioeconomic Resources, and Indian Trust Assets sections discuss the potential or anticipated direct and indirect impacts of the implementation of the Proposed Action on resources or elements of the environment.

4.1 Related Projects and Actions

This EA is tiered from several previous NEPA analyses and references other related analyses, including;

- IBWC's Flood Control Project Final EIS (USIBWC 2004a);
- Rio Grande Canalization Project Brief and Final EIS (USIBWC 2004b);
- El Paso-Las Cruces Regional Sustainable Water Project EIS (USIBWC 2001);
- Reclamation's Elephant Butte and Caballo Reservoirs Resource Management Plan and EIS (Reclamation 2003);
- Phreatophyte management at Elephant Butte/Caballo Reservoirs (Reclamation 2004);
- Elephant Butte Lake State Park Management Development and Management Plan (Reclamation 2006); and
- El Paso Water Utilities; Desalination process at the Umbenhauer Plant to treat and use water in the American Canal during the non-irrigation season (EPWU 2013)

4.2 Natural Resources

4.2.1 Basis of Significance

As stated, in part, in the 2007 assessment, a significant effect on natural resources would:

1. contribute to an environmental violation, or cause the Project to not conform to applicable federal, state, or local law, regulation, or standard, such as a federal water quality standard, or
2. result in the permanent degradation or loss of native vegetation communities, jurisdictional wetlands, or important wildlife habitat, or
3. jeopardize the continued existence of a listed species or adversely modify designated critical habitat under the Endangered Species Act (ESA) of 1973, or
4. result in a predicted substantial deviation from historic water quantities or qualities, as evidenced by marked changes in Project supplies, allocations, releases or quality of regulated water such as drinking water.

4.2.2 Water Resources

4.2.2.1 Introduction

Much of the discussion on the potential impacts of the Proposed Action on water resources coincides with numerous factors influencing surface and groundwater in the Project area, including improvements in irrigation efficiency within EBID; changes in cropping patterns within EBID and portions of EPCWID; changes in groundwater administration by the State of New Mexico, including the allocation of groundwater pumping rights as part of the State's adjudication of water rights; urbanization of Project lands; and ongoing effects of severe and sustained drought conditions since 2003 that continue to the present. It should be noted that analysis of recent trends cannot attribute observed trends to any particular driver.

4.2.2.2 Surface Water

Introduction

Through the 2007 EA, Reclamation committed to gather data over the first five years of operating under the OA in order to assess potential effects of the agreement on the environment. This supplemental EA therefore evaluates potential effects of the proposed action based on two separate analyses. First, effects are evaluated by comparing actual Project operations during the first five years of the OA (2008-2012) to estimated Project operations that would have occurred during this period under the No Action alternative, i.e., under prior operating practices that were in place during the period 1980-2007. A probabilistic analysis was conducted to evaluate potential effects of the OA over the three year period from the start of the 2013 irrigation season to the end of the 2015 irrigation season. This probabilistic analysis estimates the likely range of Project operations under the OA and under the No Action alternative for the period 2013-2015 based on the range of historical hydrologic conditions experienced over the period 1951-2012.

The analysis detailed in the section titled "What is the status of surface water?" assesses the results of the first five years of implementing the OA. The analysis detailed in the section titled "How does the Proposed Action affect surface water?" describes the potential future effect of the Proposed Action on surface water resources.

As discussed below, conditions since 2008 have been substantially affected by severe and sustained drought conditions. While the ongoing drought is comparable in magnitude and duration to the drought of the 1950s, conditions during 2008-2012 are not representative of the range of hydrologic conditions within the basin over the past several decades. Estimated effects of the OA during the period 2008-2012 and likely effects during the period 2013-2015 reflect the historically low Project storage and low carryover balances for EBID and EPCWID at the end of the 2012 irrigation season.

Methodology

Historical (actual) Project operations data and annual allocation models were used to evaluate the potential effects of the OA on Project operations during the first five years under the OA (2008-2012) and during the subsequent three irrigation seasons (2013-

2015). Project data and annual allocation models were used to estimate effects of the OA on annual Project allocations to EBID, EPCWID, and Mexico; total annual releases from Project storage; total annual diversions by EBID, EPCWID, and Mexico; and total Project storage at the start and end of irrigation season (March 1 and October 31 of each year, respectively). Project operations data used in this analysis include actual Project storage, usable water, allocations, releases, gross diversions, and Project allocation charges for the period 2008-2012; actual Project storage, releases, and gross diversions for the period 1951-2007 were also used to evaluate historical Project operations, to develop relationships between Project variables (e.g., district diversions and usable water), and to compare Project operations under the OA to the range of historical Project conditions. All data, calculations, and assumptions used in this analysis are detailed in Appendix F (see Section 3.1); in addition, definitions of Project allocation components used in the OA and in following analyses for both the OA and prior operating practices are provided in Appendices E and F, Section 3.1.4.

The Council on Environmental Quality (40 CFR 1502.22) states that NEPA analyses should consider reasonably foreseeable environmental impacts and not a worst case analysis with a low probability of occurrence. It is common for hydrologic analyses to use exceedance/non-exceedance curves to display projected future hydrologic scenarios for NEPA impact analysis. In this context, it is common to use the 20th and 80th percentiles to frame the reasonably foreseeable hydrologic conditions that may occur. In the analysis presented here, low non-exceedance probabilities are generally associated with drier conditions and high non-exceedance probabilities are generally associated with wetter conditions. The analyses in the following sections predominantly use the 20th (drier) and 80th (wetter) percentiles of non-exceedance curves to define the reasonably foreseeable future conditions. Considering the analysis of reservoir elevation for example, reservoir elevation is expected to be below the 80% non-exceedance value approximately 80% of the time and thus above this value approximately 20% of the time; the 80% non-exceedance value thus reflects generally wetter conditions compared to the overall distribution of reservoir elevations. The analyses also present the 50th percentile as the condition most likely to occur.

While there is considerable uncertainty in the projections of future hydrology, use of the same hydrologic data allows differences between the two alternatives to be isolated and compared. It must be noted that the hydrologic conditions used in this study for the period 2013-2015 are not predictions of future conditions; rather, they represent a probabilistic estimate of the range of likely hydrologic conditions that might occur during this period based on the probability distribution of historical hydrologic variability in the Project. The effects of climate change were not considered due to the limited time horizon of the analysis. Over the three-year period evaluated, any effects attributable to climate change will be negligible in comparison to the substantial range of climatic and hydrologic variability experienced over the history of the Project.

What is the status of surface water?

Water flows into Elephant Butte Reservoir from the Rio Grande, tributary inflow and the Low Flow Conveyance Channel (LFCC). The LFCC is a manmade channel located alongside the river, designed to convey water from San Acacia Diversion Dam to Elephant Butte Reservoir.

The natural inflow to Elephant Butte Reservoir is highly variable, as indicated in Figure 4.2, ranging from less than 20,000 to over 1,500,000 AFY over the period 1951-2012. Notably, inflows have been substantially below average much of the last ten years. New Mexico is currently experiencing severe to extreme drought conditions statewide (USGS 2013; http://droughtmonitor.unl.edu) following three years of below normal precipitation and runoff. Streamflow records for the Rio Grande at San Marcial (USGS gages 08358300 and 08358400) indicate that the average inflow of 383,550 AFY from this source over water years 2010, 2011, and 2012 was approximately 53% of the long-term average of 721,693 AFY. While inflow measured at San Marcial is an informative representation of overall system variability, flow measurements at San Marcial are highly uncertain due to the nature of the channel (wide and shallow with dynamic sandy bed). Because of this, San Marcial gage records are not used in this analysis. Instead, total net inflow to Elephant Butte Reservoir is used to quantify inflows to Project storage. Total net inflow is calculated as the change in reservoir storage plus reservoir releases over a given period. Measured and calculated annual inflows to Project storage over the period 1951-2012 are shown in Figure 4.2; note that for the purpose of this analysis, annual inflows were calculated over the period November 1 through October 31 to coincide with the end of irrigation season (i.e., annual inflow for 1951 reflects inflows over the period November 1, 1950 through October 31, 1951; see Appendix F, Section 3.1 for details)

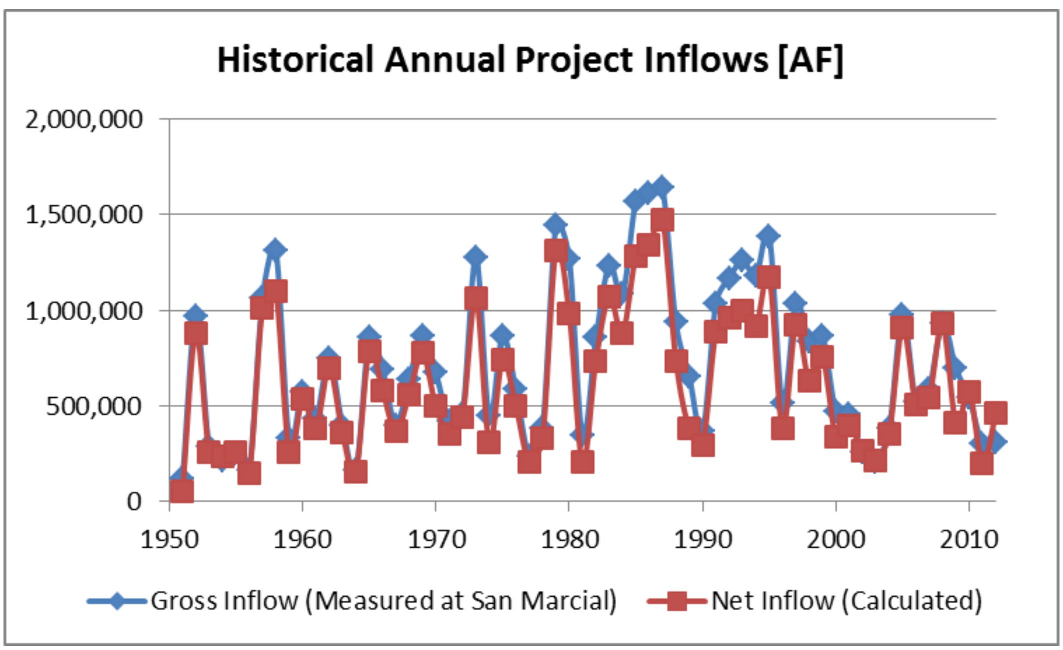


Figure 4.2. Historical annual Project inflows for the period, 1951-2012. Gross inflows consist of Rio Grande streamflow measured at San Marcial, NM (USGS gages 08358300 and 08358400); net inflows represent usable inflows calculated from the change in storage plus reservoir releases over each year.

Figure 4.3 depicts the historic non-exceedance curve of daily reservoir surface elevation in Elephant Butte Reservoir over the period 1916-2012. This figure shows that, during this time period, there was an 80% chance of the reservoir level exceeding elevation 4,323 feet relative to the USBR datum, which corresponds to a reservoir storage of 394,180 AF, and a 20% chance of the reservoir levels exceeding 4,398 feet, which corresponds to a reservoir storage of 1,722,190 AF. As noted above, reservoir values between the 20% and 80% non-exceedance probabilities are considered here to represent the range of reasonable conditions.

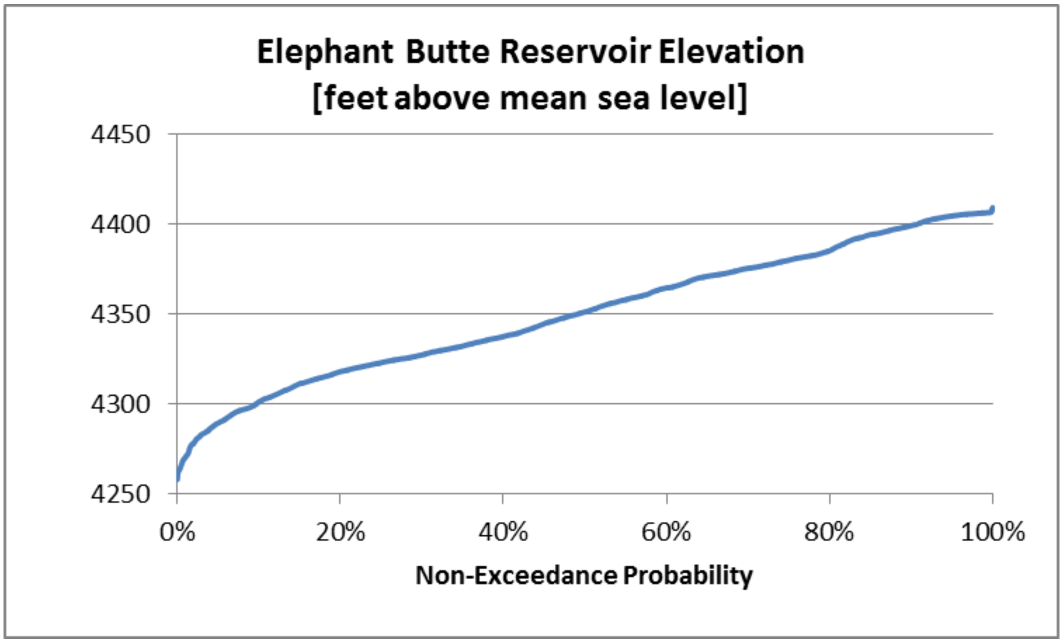


Figure 4.3. Non-Exceedance Curve of Daily Reservoir Elevation in Elephant Butte Reservoir, 1916 - 2012

Review of First Five Years of Operating Agreement: 2008-2012

The potential effects of the Proposed Action on surface water supplies and Project operations during the first five years of the OA (2008-2012) were evaluated by comparing historical (actual) Project operations during this period to estimated Project operations that would have occurred during this period under the No Action alternative, i.e., under prior operating practices that were in place during the period 1980-2007.

Analysis was limited to consideration of potential effects of the Proposed Action on management of the available surface water supply, including allocation of Project water to EBID, EPCWID, and Mexico; release of usable water from Project storage; diversion of Project water to EBID, EPCWID, and Mexico; and available usable water in Project storage at the start and end of each irrigation season (March 1 and October 31 of each year, respectively). This analysis assumes that the Proposed Action has no effect on upstream operations and usable inflows to Project storage, i.e., inflows that contribute to usable water in Project storage rather than Rio Grande Compact Credit Waters;

discussion of the potential effect of the Proposed Action on the Rio Grande Compact and related effects on Project supply are discussed below.

<u>Allocation of Project Water</u>

The Total Diversion Allocation available to each district for any given year is the total quantity of Project water that each district may call for and divert during that year, accounting for credits for flows bypassed by the district. Each district's Total Diversion Allocation consists of its Annual Allocated Water plus its Accrued Carryover Balance from prior years, as well as any Transfer of Allocation Balance that occurs between districts during that year. The Total Diversion Allocation available to each district during any given year is equal to the sum of its Annual Allocated Water, Accrued Carryover Balance, and Transfer of Allocation Balance. Annual Allocated Water consists of new allocation added to the district's Project water account during the current year based on current-year inflows to Project storage and inflows to Project storage that occurred in previous years but did not contribute to prior-year Project allocations (i.e., previously unallocated usable water in Project storage). Accrued Carryover Balance consists of the total unused balance remaining on each district's Project water account at the end of the prior year and contributes to the district's current-year account balance. Transfer of Allocation Balance refers to the transfer of allocation between districts, which occurs explicitly under the OA due to the limit imposed on Accrued Carryover Balance and implicitly under the No Action alternative due to the lack of explicit carryover accounting. Detailed descriptions of Project allocation components under the OA and under the No Action alternative are provided in Appendix E and in Section 3.1.4 of Appendix F.

The actual average Annual Allocated Water allocated to EPCWID during the period 2008-2012 was 55,059 AFY greater under the OA than the district's estimated average Annual Allocated Water during this period under the No Action alternative; the actual average Annual Allocated Water allocated to EBID under the OA was 55,760 AFY less under the OA than it is estimated it would have been under the No Action alternative. The actual average Total Diversion Allocation to EPCWID during this period was 179,573 AFY greater under the OA, while the average total allocation to EBID was 47,138 AFY less under the OA than it is estimated it would have been under the No Action alternative.

Results indicate that the change in Total Diversion Allocation to EPCWID is primarily driven by differences in the district's Accrued Carryover Balance. As a result, much of the estimated increase in Total Diversion Allocation to EPCWID arises from multi-year carryover of the district's unused allocation balance, as opposed to increase in the district's Annual Allocated Water (i.e., water that is newly allocated to the district each year). By contrast, the estimated change in Total Diversion Allocation to EBID is primarily attributable to differences in the district's Annual Allocated Water. Differences in Annual Allocated Water are partially offset by an increase in Transfer of Allocation Balance from EPCWID to EBID under the OA during this period.

In accordance with the 1906 Convention, Mexico receives a diversion allocation of 60,000 AFY under both the OA and prior operating practices, except during extraordinary drought conditions. During extraordinary drought conditions, Mexico receives a diversion allocation equal to 11.3486% of the sum of the total quantity of water delivered to lands within the United States plus delivery to the heading of the Acequia Madre. The procedure used to determine the annual diversion allocation to Mexico is identical under the OA and the No Action alternative. Allocations and deliveries to Mexico are therefore not discussed in this section.

The following tables (Tables 4.1 a, and b) summarize annual Project allocations to EBID and EPCWID over the period 2008-2012, including Annual Allocated Water, Accrued Carryover Balance, and Transfer of Allocation Balance allocated to each district. Table values for the OA are actual allocation values taken from the final Project allocation worksheet for each year; final Project allocation worksheets used in this analysis were obtained from Reclamation's El Paso Field Division and verified by representatives from EBID and EPCWID. Table values for the No Action Alternative are estimated using the annual allocation model of prior operating practices (see Appendix F, Section 3.1 for details)

Table 4.1. Annual Allocated Water, Carry-Over Water Accrued to Date, and Total Allocation Available each year to EBID, EPCWID, and Mexico, 2008-2012.

Table 4.1a: EBID Allocation Summary, 2008-2012

EBID	OA (Actual)				No Action (Estimated)				Difference			
	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation
2008	0	324,990	0	324,990	0	434,275	60,738	495,013	0	-109,284	-60,738	-170,022
2009	-4,304	255,598	80,879	332,173	0	269,542	42,342	311,884	-4,304	-13,944	38,537	20,289
2010	40,343	255,257	10,271	305,871	0	288,476	0	288,476	40,343	-33,219	10,271	17,395
2011	20,015	57,089	0	77,104	0	77,551	0	77,551	20,015	-20,461	0	-446
2012	17,333	118,300	0	135,633	0	220,193	18,346	238,539	17,333	-101,893	-18,346	-102,906
Average	**14,677**	**202,247**	**18,230**	**235,154**	**0**	**258,007**	**24,285**	**282,293**	**14,677**	**-55,760**	**-6,055**	**-47,138**

Table 4.1b: EPCWID Allocation Summary, 2008-2012

EPCWID	OA (Actual)				No Action (Estimated)				Difference			
	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation	Accrued Carryover Balance	Annual Allocated Water	Transfer of Allocation Balance	Total Diversion Allocation
2008	106,982	388,192	0	495,174	106,982	330,641	-60,738	376,885	0	57,551	60,738	118,289
2009	232,882	400,984	-80,879	552,987	74,580	205,220	-42,342	237,457	158,302	195,764	-38,537	315,529
2010	232,915	291,905	-10,271	514,549	0	219,635	0	219,635	232,915	72,270	-10,271	294,914
2011	224,348	43,466	0	267,814	0	59,044	0	59,044	224,348	-15,579	0	208,769
2012	9,042	132,935	0	141,977	32,314	167,647	-18,346	181,615	-23,272	-34,712	18,346	-39,638
Average	**161,234**	**251,496**	**-18,230**	**394,500**	**42,775**	**196,437**	**-24,285**	**214,927**	**118,459**	**55,059**	**6,055**	**179,573**

As noted above, the estimated decrease in average Total Diversion Allocation to EBID during the first five years of the OA primarily reflects the diversion ratio provision of the OA. As described above in Sections 1.3 and 3.2.2, the diversion ratio provision of the OA deals with potential negative effects of changes in Project performance, which result predominately from the actions of individual landowners within EBID, by ensuring that Project allocations and deliveries to EPCWID remain consistent with historical Project performance. The allotment of Annual Allocated Water to EPCWID each year under the OA remains equal to the district's historical diversion allocation based on the D-2 Curve and is therefore consistent with historical Project performance and deliveries. The annual allocation to EBID is adjusted to reflect deviations in current-year (actual) Project performance relative to the D-2 baseline. When Project performance, as characterized by the Project diversion ratio, is high relative to the historical baseline, EBID receives an increase in Annual Allocated Water; when Project performance is low relative to historical conditions, EBID generally receives a decrease in Annual Allocated Water in order to deal with the effects of deviations in Project performance on allocations and deliveries to EPCWID.

Decreases in Annual Allocated Water to EBID during the period 2008-2012 reflect the low Project performance throughout this period. Low values of the Project diversion ratio during the period 2008-2012 are indicative of high losses within the Project during this period, including increased seepage losses from the Rio Grande and decreased discharge of groundwater to the Rio Grande and Project drains. Examination of Project releases and gross diversions over recent decades strongly indicates that declining Project performance coincided with the onset of severe drought conditions in the early 2000s, prior to implementation of the OA. Numerous factors affect Project performance, including crop selection and related effects on crop irrigation requirement; irrigation practices and related effects on on-farm irrigation efficiency; and widespread use of groundwater for supplemental irrigation by individual landowners as permitted and regulated by the State of New Mexico. As detailed in Sections 4.2 and 4.4 of Appendix F, previous studies indicate that changes in Project performance since the early 2000s is likely to result primarily from widespread use of groundwater for supplemental irrigation within EBID.

<u>EBID Surface Water Allocations, 2008-2012</u>

Project allocations to EBID during the first five years of the OA (2008-2012) are shown in Figure 4.4, along with estimated annual Project allocations to EBID during the same period under the No Action alternative; Figure 4.4 illustrates the district's Total Diversion Allocation, as well as the contributions of Annual Allocated Water, Accrued Carryover Balance, and Transfer of Allocation Balance that make up the Total Diversion Allocation. As noted above, the average annual Total Diversion Allocation to EBID under the OA during this period is approximately 47,138 AFY less than the estimated average annual allocation to EBID under the No Action alternative. The estimated difference in allocation to EBID is due to two differences in allocation procedures between the OA and the No Action alternative:

1. Carryover provision of the OA (See Section 1.3): During the period 2008-2012, carryover of unused allocation balance by EPCWID was greater than carryover by

EBID. Deduction of the water required to satisfy EPCWID's unused allocation balance (i.e., carryover obligation) from the total quantity of usable water in Project storage reduced the usable water available for allocation each year, therefore reducing the Annual Allocated Water to EBID in all years and most notably in 2008 and 2009. However, explicit carryover accounting and transfer of allocation balance between districts under the OA resulted in a decrease in the transfer of allocation balance from EPCWID to EBID compared to the implicit transfer that occurred under the OA due to lack of explicit carryover accounting.

2. Diversion ratio provision of the OA (see Section 1.3): Project performance, as characterized by the Project diversion ratio, was substantially less than the baseline historical performance defined by the D-2 Curve. As a result, Annual Allocated Water to EBID is decreased relative to the district's allocation under the No Action alternative, in order to deal with the effects of decreased Project performance on Project allocations and deliveries to EPCWID.

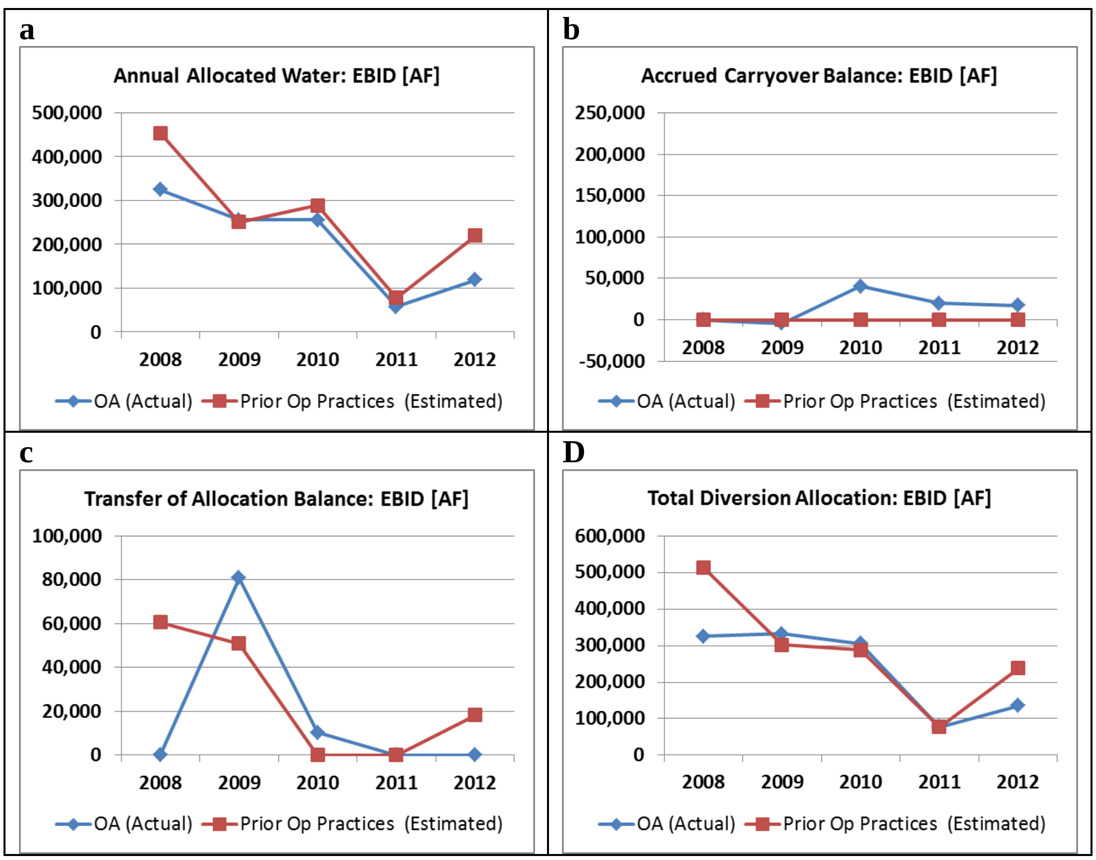


Figure 4.4: Historical (actual) Project allocations to EBID under the OA and estimated annual allocations to EBID under prior operating practices for the period 2008-2012. (a) Annual Allocated Water; (b) Accrued Carryover Balance; (c) Transfer of Allocation Balance; (d) Total Diversion Allocation.

EPCWID Surface Water Allocations, 2008-2012

Project allocations to EPCWID during the first five years of the OA (2008-2012) are shown in Figure 4.5 along with estimated annual Project allocations to EPCWID during the same period under the No Action alternative. Similar to Figure 4.4, Figure 4.5 illustrates the district's Total Diversion Allocation, as well as the contributions of Annual Allocated Water, Accrued Carryover Balance, and Transfer of Allocation Balance that make up the Total Diversion Allocation. The average Total Diversion Allocation to EPCWID under the OA during this period is approximately 179,573 AFY greater than the district's estimated average allocation under the No Action alternative. The estimated increase in allocation to EPCWID is primarily due to the inclusion of unused prior year allocation balance (i.e., carryover) in the following year's Total Diversion Allocation under the carryover provision of the OA. In addition, inclusion of American Canal Extension (ACE) Conservation Credits contributed to increased allocations to EPCWID in 2008 and 2009 and the adjusted difference between the EBID Diversion Ratio Allocation and D-2 Diversion Allocation (Row 30 of Table 4 of the OA; see Appendix F, Section 3.1.3) contributed to the EPCWID Diversion Allocation in 2011. It should also be noted that in 2009 and 2010, EPCWID carryover exceeded the maximum carryover allowed under Section 1.10 of the OA; in each of these years, excess carryover balance was transferred to EBID's diversion allocation as per Section 1.11 of the OA.

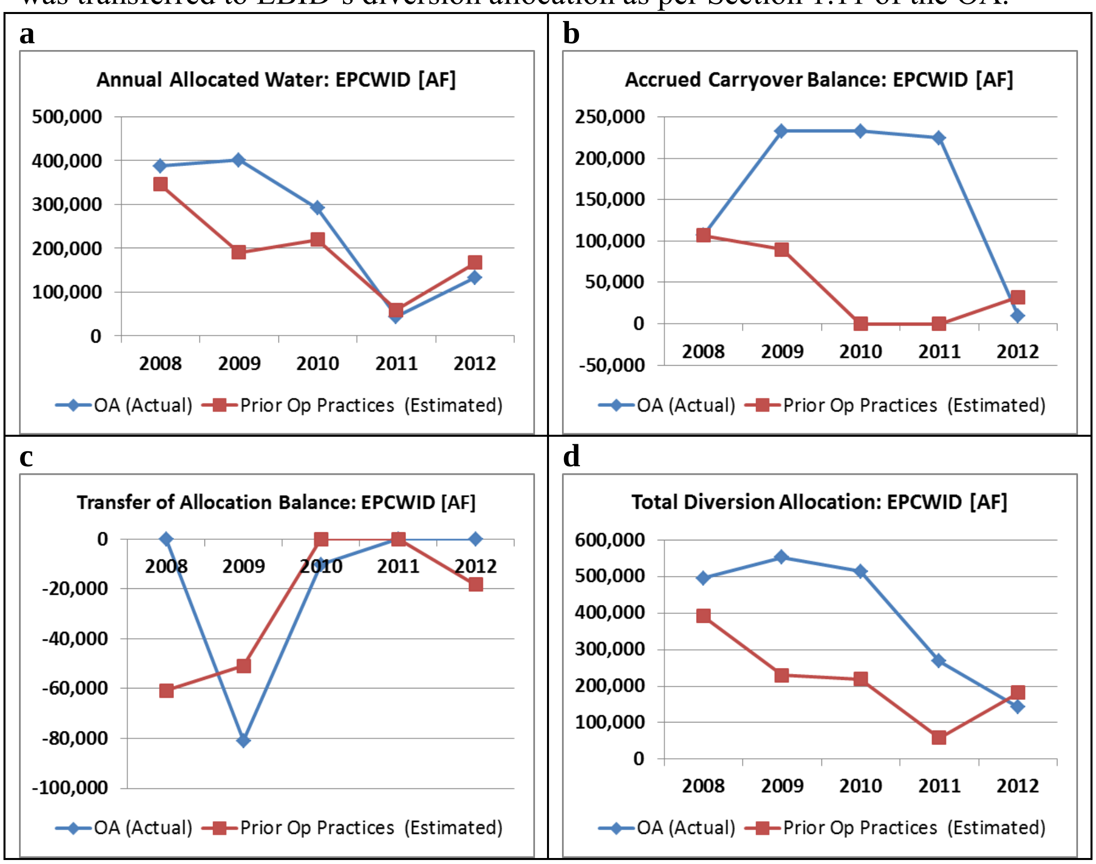


Figure 4.5: Historical (actual) Project allocations to EPCWID under the OA and estimated annual allocations to EPCWID under prior operating practices for the period 2008-2012. (a) Annual Allocated Water; (b) Accrued Carryover Balance; (c) Transfer of Allocation Balance; (d) Total Diversion Allocation.

Annual Release from Project Storage

Actual total annual releases from Project storage under the OA and estimated releases under No Action are illustrated in Figure 4.7 and annual release values are provided in Table 4.2. The average annual release under the OA (actual) for the period 2008-2012 is 559,740 AFY; the average release under prior operating practices (estimated) is 559,401 AFY. The OA thus results in an estimated increase of just 339 AFY in the average annual release from Project storage. Given that this analysis assumes the OA has no effect on inflows to Project storage and that total usable Project water is effectively depleted at the end of the 2012 irrigation season under both operations, the difference in total Project release over the period 2008-2012 is expected to be zero. The estimated average difference of 339 AFY therefore reflects uncertainties that are not directly accounted for in this analysis, including uncertainties in the Project data used in this analysis as well as the lack of explicit consideration of reservoir evaporation and reservoir seepage losses.

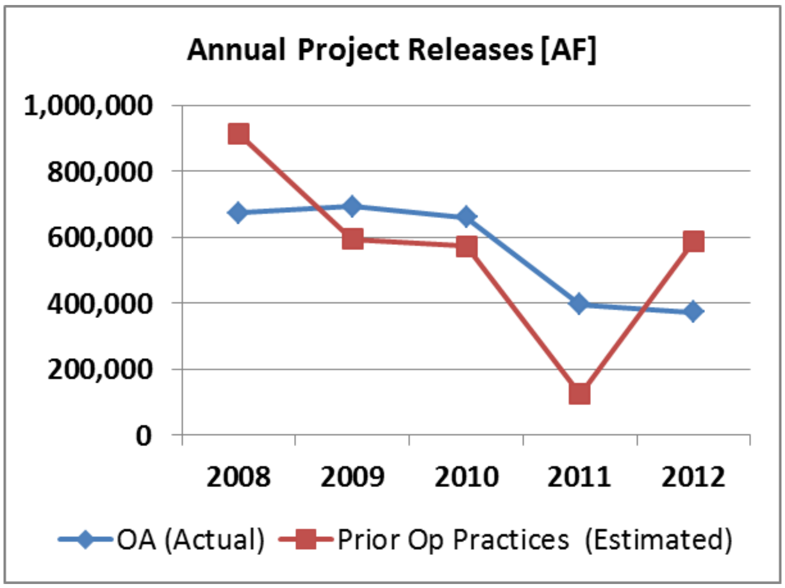


Figure 4.7: Historical (actual) total annual releases from Caballo Dam ($R_{Caballo}$) under the OA and calculated annual releases under prior operating practices for the period 2008-2012.

Table 4.2: Total Annual Releases from Caballo Dam (2008-2012).

	Annual Release OA (Actual)	Annual Release Prior Operations (Estimated)
2008	674,724	893,178
2009	694,199	616,494
2010	660,300	574,114
2011	396,876	125,533
2012	372,600	587,686
Average	**559,740**	**559,401**

Total Project Storage

Figures 4.8 and 4.9 show the historical (actual) total Project storage at the start and end of irrigation season for the period 2008-2012 and the corresponding estimated storage under the No Action alternative. For the purposes of this analysis, the start of irrigation season is taken as March 1 of each year, the end of irrigation season is taken as October 31, and releases from Project storage between November 1 and February 28 of each year are considered negligible. Total usable water available for release is calculated by deducting non-Project water (i.e., Rio Grande Compact Credit Waters and San Juan-Chama Waters) from the total volume of water in Project storage.

Total Project storage and usable water in Project storage are generally greater under the OA compared to the No Action alternative due to the carryover provision of the OA, which encourages conservation by allowing each district to maintain the unused portion of its allocation balance from one year to the next. Under both operating procedures, however all usable water is nearly depleted at the end of the 2011 and 2012 irrigation seasons due to the extremely low supply caused by ongoing drought conditions.

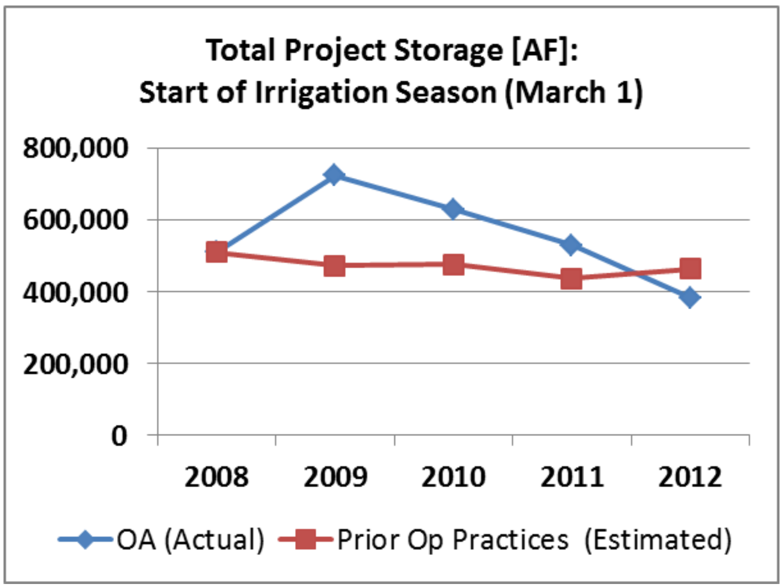


Figure 4.8: Historical (actual) total Project storage at the start of irrigation season under the OA (blue) and the corresponding estimated total Project storage under prior operating practices (red) for the period 2008-2012.

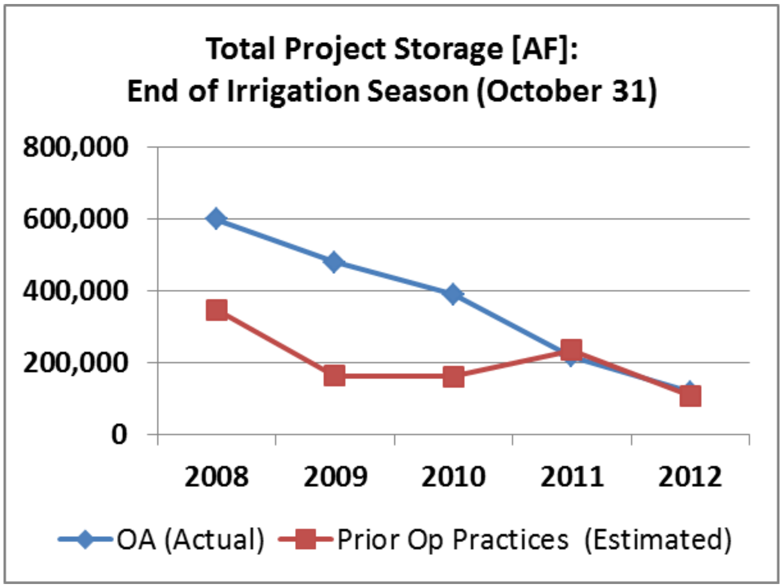


Figure 4.9: Historical (actual) total Project storage at the end of irrigation season under the OA (blue) and the corresponding estimated total Project storage under prior operating practices (red) for the period 2008-2012.

<u>Elephant Butte Reservoir Elevation</u>

Figure 4.10 shows the historical (actual) estimated maximum reservoir surface elevation in Elephant Butte Reservoir and the estimated reservoir surface elevation under prior operating practices for the period 2008-2012. The maximum reservoir surface elevation is taken as the reservoir elevation corresponding to the estimated storage in Elephant Butte Reservoir at the start of irrigation season, prior to release of water to meet Project deliveries. Similar to total Project storage and usable water in Project storage, the carryover provision of the OA results in a minor increase in reservoir elevations compared to the No Action alternative in most years.

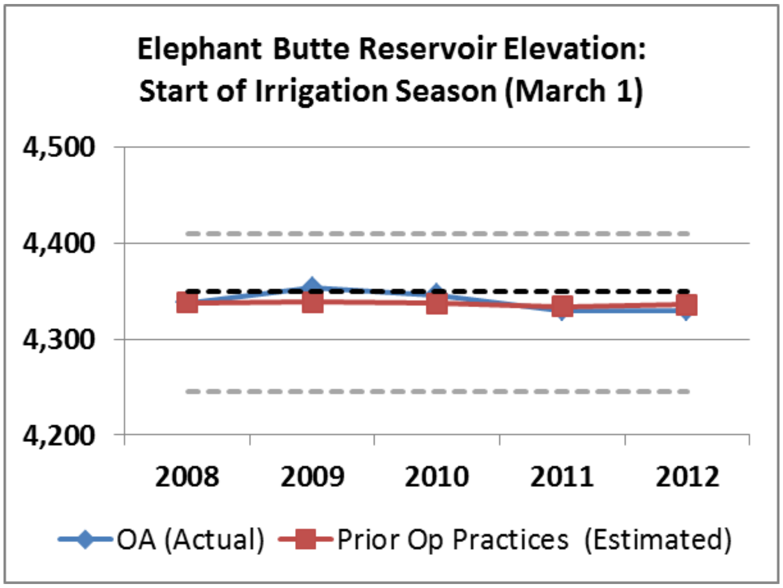


Figure 4.10: Historical (actual) Elephant Butte Reservoir elevation relative to USBR datum at the start of irrigation season under the OA and calculated reservoir surface elevation under prior operating practices for the period 2008-2012. Gray dashed lines indicate maximum and minimum reservoir elevations at full pool and zero storage, respectively; the black dashed line indicates the elevation at which flycatcher territories have been identified.

<u>How would the Proposed Action affect surface water (2013-2015)?</u>

This section describes the potential future effect of the Proposed Action on surface water resources during the period of analysis, which extends through the end of the 2015 irrigation season. Potential future effects are evaluated by comparing projected Project operations under the No Action and Proposed Action alternatives as described below.

Methodology

An annual allocation model was developed to evaluate Project operations under the anticipated range of water supply and demand conditions within the Project during the 2013-2015 irrigation seasons. The model calculates annual Project operations, including annual allocations, releases, diversions, and storage, based on Project storage at the end of the prior year and annual inflows to Project storage during the current year. The effects of groundwater-surface water interaction on Project operations are accounted for based on the estimated diversion ratio. The model calculates total Project storage on March 1 and October 31 of each year, which under normal conditions correspond to the start and end of irrigation season, respectively. Initial conditions in the model are based on actual Project conditions at the end of the 2012 irrigation season. From that point forward, the model simulated Project operations through the end of the 2015 irrigation season. Thus, conditions in the model for the beginning of year 2013 are representative of but not the same as actual conditions. Reservoir surface elevation in Elephant Butte Reservoir is subsequently estimated based on the most recent Elephant Butte Area-Capacity table.

The annual allocation model used in this study incorporates two sets of operations, one that is fully consistent with Project operations under the No Action alternative and one that is fully consistent with Project operations under the Proposed Action (i.e., the OA). Details of all calculations and assumptions used by the model to represent the Proposed Action and the No Action alternative are provide in Appendix F (Sections 3.1.2 and 3.1.3, respectively). Potential effects of the Proposed Action are evaluated by comparing projected Project operations for the period 2013-2015 under the Proposed Action to those under the No Action alternative.

Effects of the OA on Project operations during the 2013-2015 irrigation seasons will depend on inflows to Project storage and the annual Project diversion ratio during this period, as well Project delivery orders made by EBID, EPCWID, and Mexico. However, it is not possible to accurately predict inflows, Project diversion ratios, or Project diversions in advance. The potential effects of the OA during the period 2013-2015 were therefore considered using a probabilistic approach. Actual annual inflows for the period 1951-2012 were re-sampled to develop probability distributions of Project operations over this period. This was done by calculating and comparing Project operations under the OA and under the No Action alternative for each historical three-year inflow trace. For example, the annual allocation models developed for this study were used to calculate Project operations based on historical inflows over the periods 1951-1953, 1952-1954, and so on, for a total of 62 three-year periods. For each three-year inflow traces, allocation models were initialized based on actual Project storage and district carryover balances at the end of the 2012 irrigation season (October 31, 2012), and Project operations were calculated over a three-year period. Results from these 62 scenarios were then used to develop probability distributions of annual Project allocations, diversions, releases, and storage over the future period 2013-2015. Figure 4.11 shows the non-exceedance curve of annual inflows to Project storage based on historical inflows for the period 1951-2012. This approach assumes that the probability distribution of historical Project inflows is representative of likely inflows over the period 2013-2015. This approach also assumes that the portion of inflows that contribute to usable water, as opposed to Rio Grande Compact, is not affected by Project operations.

In addition to Project inflows, the annual Project diversion ratio for future years is highly uncertain. Extensive analysis was carried out to identify a reliable predictor of the diversion ratio based on information available at the start of a given irrigation season. The most reliable predictor of the annual diversion ratio identified as applicable to this study is the prior year diversion ratio—i.e., the serial correlation of the diversion ratio from one year to the next. For the purposes of this analysis, annual Project diversion ratios during the period 2013-2015 were estimated using a serial regression relationship derived from historical Project operations data for the period 1951-2012 (see Appendix F, Section 3.1.2). This approach provides the best available estimate of the annual diversion ratio in future years for the purpose of this analysis.

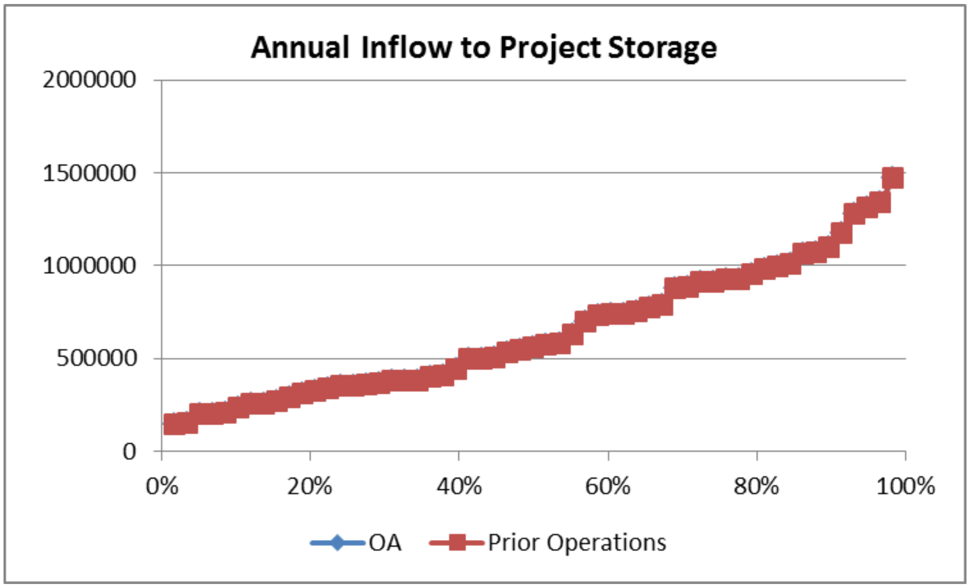


Figure 4.11. Non-exceedance curve of annual inflow to Project storage based on historical inflows for the period 1951-2012.

Surface Water Allocations

Summary

Results shown in Figure 4.12 indicates that for non-exceedance probabilities less than 60%, projected Annual Allocated Water and Total Diversion Allocation to EBID for the 2015 irrigation season are generally similar under the OA and under prior operating practices. However, for non-exceedance probabilities greater than 60%, the Total Diversion Allocation to EBID for the 2015 season is up to 123,000 AF greater under the No Action alternative compared to the OA.

For EPCWID, results shown in Figures 4.13 indicate that the district's Total Diversion Allocation for 2015 is generally greater under the OA compared to prior operating practices, except under wetter conditions (non-exceedance probabilities greater than 75%). Under wetter conditions, the Total Diversion Allocation to EPCWID under the OA approaches the district's maximum allocation under the No Action allocation.

As detailed above, under both the OA and prior operating practices, the annual allocation model developed for this study determines annual allocations to Mexico are calculated in accordance with the 1906 Convention. Under both operating procedures, Mexico receives a diversion allocation of 60,000 AFY under both the OA and prior operating practices, except during extraordinary drought conditions. During extraordinary drought conditions, Mexico receives a diversion allocation equal to 11.3486% of the sum of the total quantity of water delivered to lands within the United States plus delivery to the heading of the Acequia Madre. The procedure used to determine the annual diversion allocation to Mexico is identical under the OA and the No Action alternative. Allocations and deliveries to Mexico are therefore not discussed in this section.

As clearly shown in Figures 4.15 and 4.16, differences in Annual Allocated Water and Total Diversion Allocation to EBID and EPWCID between the OA and prior operating practices are highly sensitive to Project performance during the period of analysis, as characterized by sensitivity to the estimated Project diversion ratio used in this analysis. Sensitivity of the estimated difference in allocation to EBID is greatest under wet conditions. High values of the diversion ratio during wet conditions result in a large increase in allocation to EBID under the OA, whereas low values of the diversion ratio during wet conditions result in a large decrease in allocation to EBID under the OA. Sensitivity of the estimated difference in allocation to EPCWID is greatest under normal conditions (non-exceedance probabilities between 33% and 66%). Under these conditions, high values of the diversion ratio result in a decrease in allocation to EPCWID, while low values of the diversion ration result in an increase in allocation to the district. Sensitivity analysis indicates that the effects of the OA on Project operations during the 2013-2015 irrigation seasons will strongly depend on Project performance during this period as reflected by the diversion ratio.

Analysis

Non-exceedance curves of annual Project allocations to EBID and EPCWID for 2015 are shown in Figures 4.12 and 4.13, respectively. Figures 4.12-4.13 illustrate the likely range of each district's Total Diversion Allocation for 2015, as well as the contributions of Annual Allocated Water, Accrued Carryover Balance, and Transfer of Allocation Balance that make up the Total Diversion Allocation. It should be noted that non-exceedance curves of Project allocations are different for each year due to the effects of prior-year operations on current year storage, carryover obligations, and allocations; however, the general characteristics of non-exceedance curves for 2013 and 2014 are similar to those for 2015. Values of the 20%, 50%, and 80% non-exceedance allocation are provided in Table 4.3 and 4.4 for years 2013-2015.

Figures 4.14-4.17 show the differences in annual allocation to EBID and EPCWID, respectively, for the 2015 irrigation season as a function of non-exceedance probability. In each of these figures, the thick black line corresponds to differences calculated from the results shown in Figures 4.12 and 4.13 (i.e., the difference between the red and blue lines in each figure). The gray lines correspond to differences based on Project operations calculated using different values of the Project diversion ratio. For each of the gray lines, Project operations were calculated using the annual allocation models developed for this study; however, fixed (constant) values of the Project diversion ratio were used in place of values estimated based on the serial regression equation described above. . Thin gray lines with hollow symbols correspond to annual Project diversion ratios ranging from 0.8 to 1.3. The thick gray line with filled gray symbols corresponds to an annual Project diversion ratio of 1.17, which is equal to the long-term average gross diversion ratio.

Table 4.3. Surface water allocations (AF) for EBID for the 20th, 50th, and 80th non-exceedance percentiles.

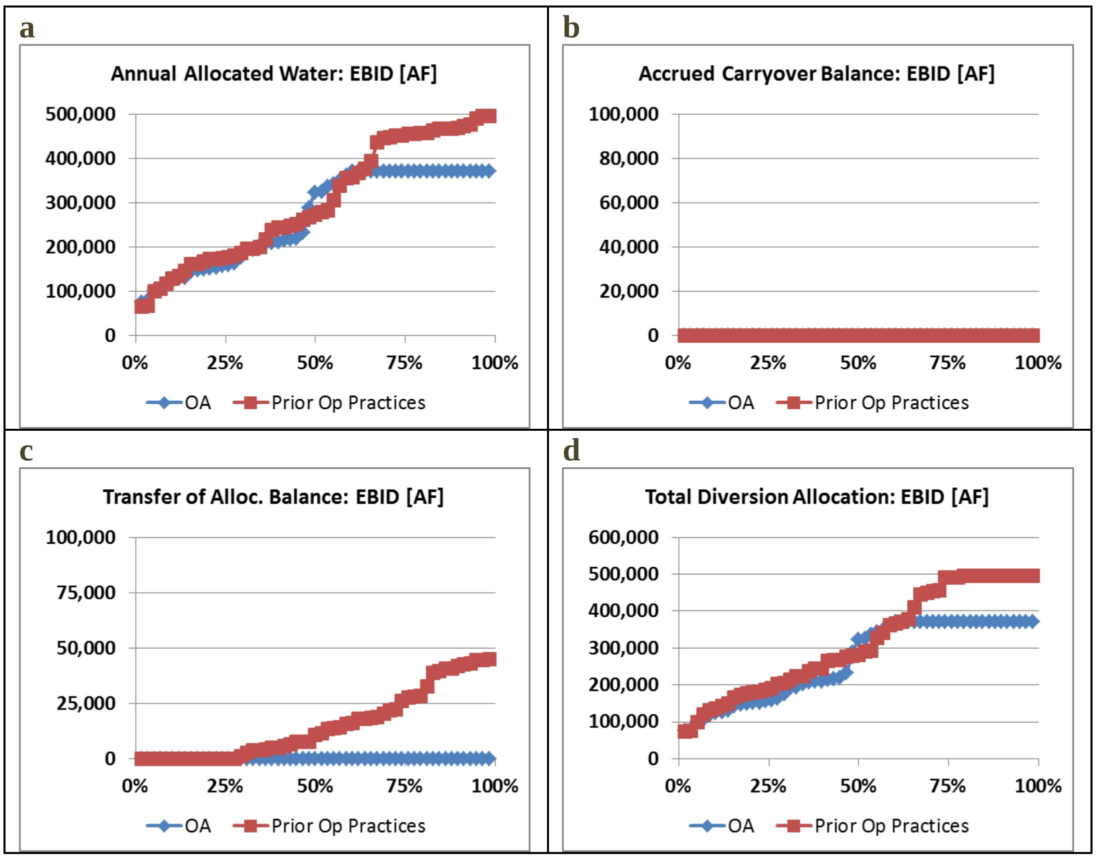
Annual Allocated Water: EBID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	123,918	230,029	419,612	123,918	160,424	301,356
2014	145,183	253,522	455,473	138,430	195,246	339,285
2015	172,168	272,368	456,995	151,143	322,643	371,141
Accrued Carryover Balance: EBID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	2,573	2,573	2,573	2,573	2,573	2,573
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
Transfer of Allocation Balance: EBID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	2,065	2,065	2,065	0	0	0
2014	0	4,486	18,548	0	0	0
2015	0	10,863	32,807	0	0	0
Total Diversion Allocation: EBID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	128,556	234,668	424,250	126,491	162,997	303,929
2014	158,857	261,598	495,013	138,430	195,246	339,285
2015	180,058	280,099	495,013	151,143	322,643	371,141

Table 4.4. Surface water allocations (AF) in for EPCWID for the 20th, 50th, and 80th non-exceedance percentiles.

Annual Allocated Water: EPCWID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	94,347	175,136	319,477	94,347	249,028	304,241
2014	110,537	193,022	346,780	146,834	278,940	304,241
2015	131,083	207,371	347,939	157,311	304,241	304,241
Accrued Carryover Balance: EPCWID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	5,597	5,597	5,597	5,597	5,597	5,597
2014	0	7,901	32,669	8,819	20,211	43,031
2015	0	19,134	57,785	20,082	46,735	57,813

Transfer of Allocation Balance: EPCWID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	-2,065	-2,065	-2,065	0	0	0
2014	-18,539	-4,486	0	0	0	0
2015	-28,351	-10,863	0	0	0	0

Total Diversion Allocation: EPCWID						
	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	97,878	178,667	323,009	99,944	254,625	309,838
2014	120,948	199,171	376,885	173,620	304,241	323,787
2015	137,089	213,257	376,885	209,900	319,485	342,422



4.12: Non-exceedance curves of estimated Project allocations [AF] to EBID under the OA and under prior operating practices for the 2015 irrigation season. (a) Annual Allocated Water; (b) Accrued Carryover Balance; (c) Transfer of Allocation Balance; (d) Total Diversion Allocation.

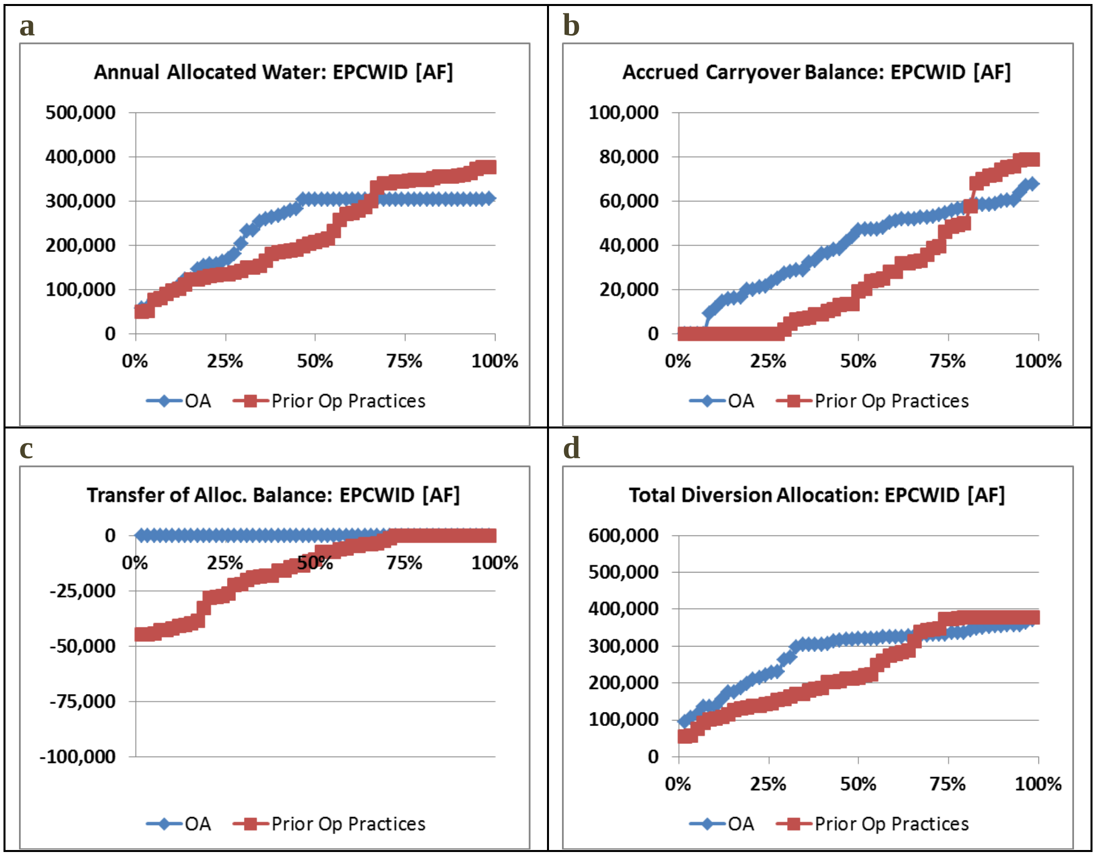


Figure 4.13: Non-exceedance curves of estimated Project allocations [AF] to EPCWID under the OA and under prior operating practices for the 2015 irrigation season. (a) Annual Allocated Water; (b) Accrued Carryover Balance; (c) Transfer of Allocation Balance; (d) Total Diversion Allocation.

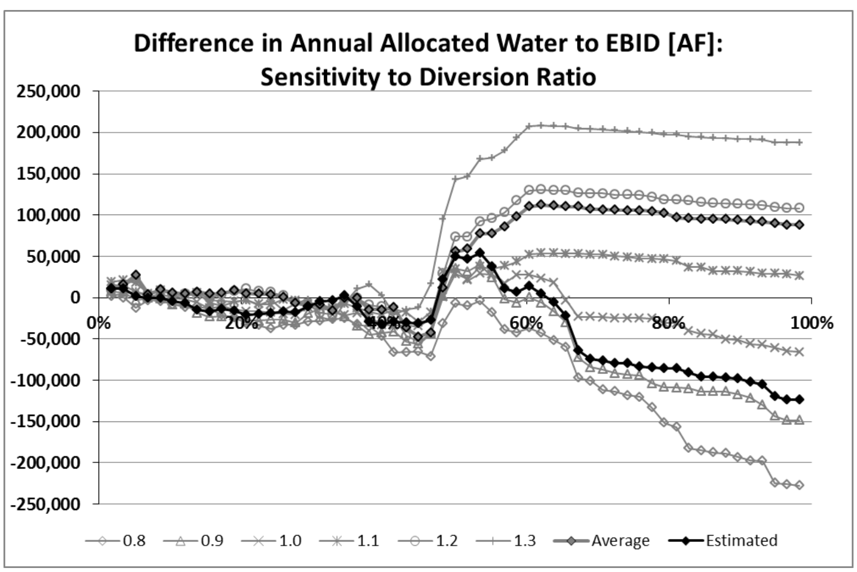


Figure 4.14: Difference between estimated non-exceedance curves of Annual Allocated Water to EBID for water year 2015 under the OA and prior operating practices for various values of annual Project diversion ratio; see text for complete description.

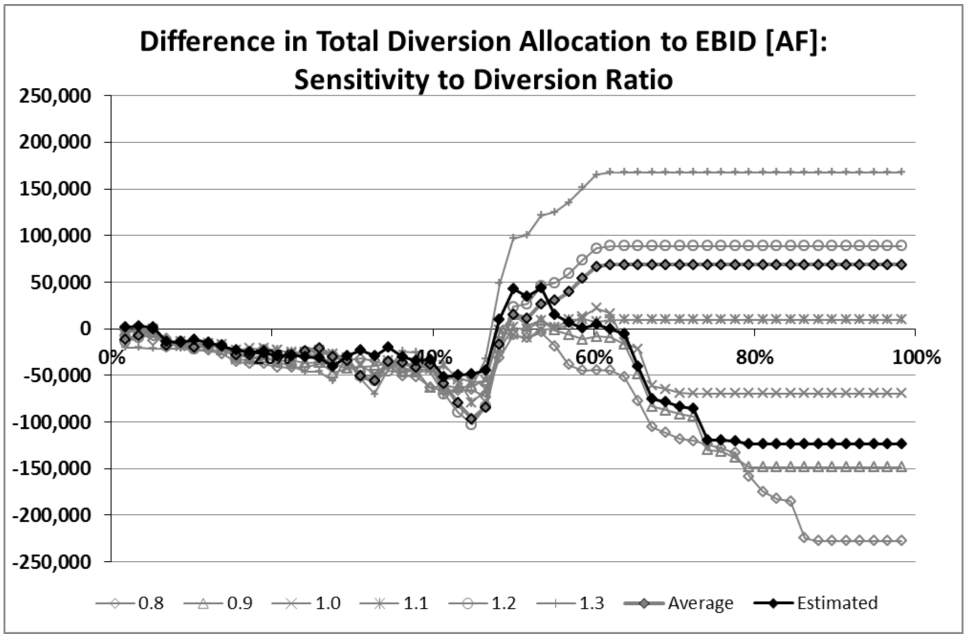


Figure 4.15: Difference between estimated non-exceedance curves of Total Diversion Allocation to EBID for water year 2015 under the OA and prior operating practices for various values of annual Project diversion ratio; see text for complete description.

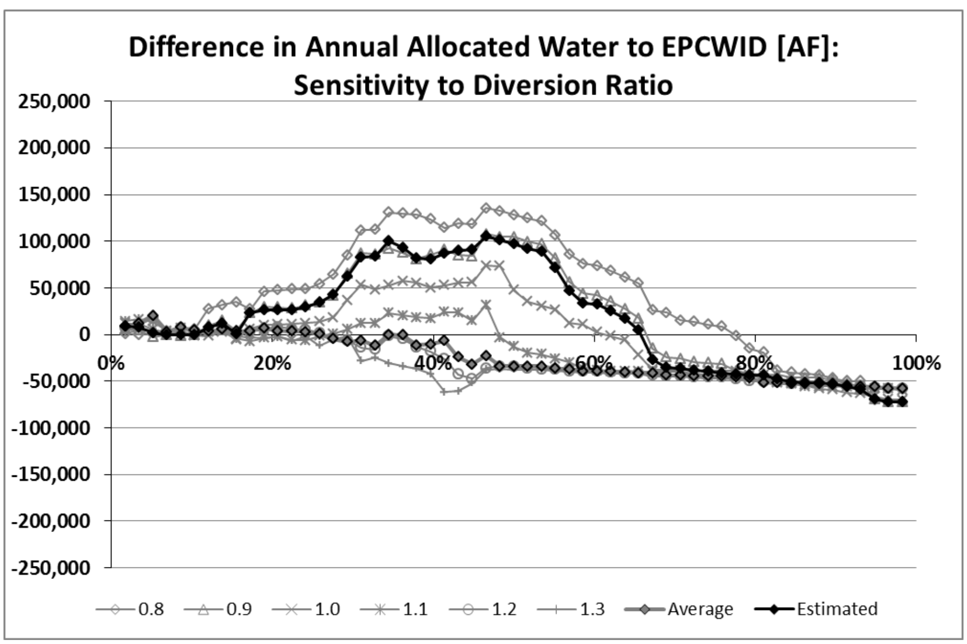


Figure 4.16: Difference between estimated non-exceedance curves of Annual Allocated Water to EPCWID for water year 2015 under the OA and prior operating practices for various values of annual Project diversion ratio; see text for complete description.

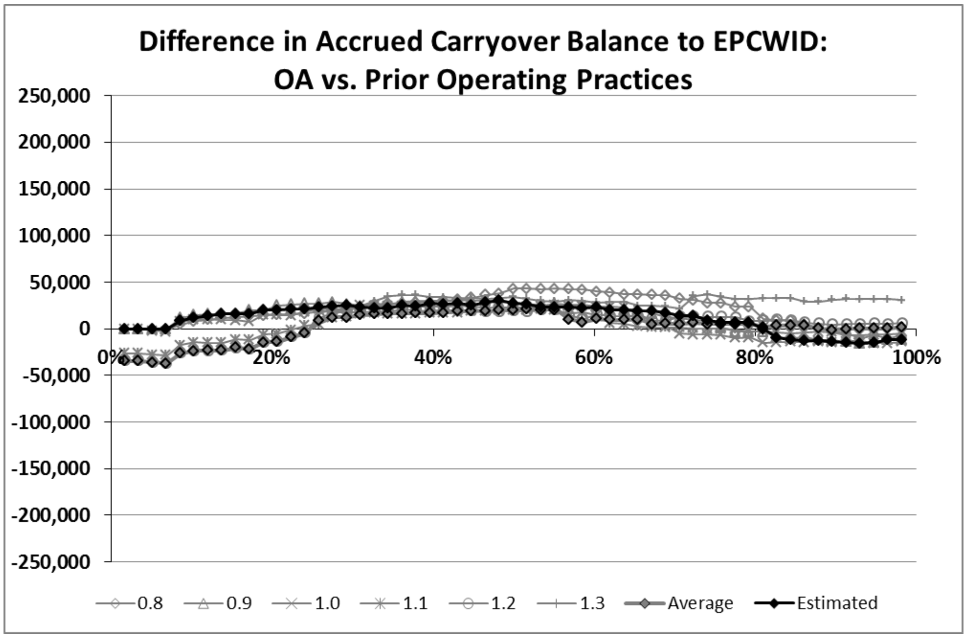


Figure 4.17: Difference between estimated non-exceedance curves of Accrued Carryover Balance to EPCWID for water year 2015 under the OA and prior operating practices for various values of annual Project diversion ratio; see text for complete description.

Annual Release from Project Storage

Summary

Under drier and normal (20% and 50% non-exceedance probabilities, respectively), there is no substantial difference between annual Project releases from Caballo Dam under the Proposed Action and No Action alternative. A decrease in Project releases occurs under wetter conditions (80% non-exceedance probability) for all years due to a concomitant increase in carryover storage due to conservation efforts by each district. Under all inflow scenarios, 2013-2015 projected releases are within the range of historic operations.

Analysis

Figure 4.18 shows the non-exceedance curve of projected annual releases from Project storage for 2015 for both the Proposed Action and the No Action alternative. Non-exceedance curves of Project releases are different for each year due to the effects of prior-year operations on releases; however, the general characteristics of non-exceedance curves for 2013 and 2014 are similar to 2015. Table 4.6 summarizes the releases for the 20th, 50th, and 80th non-exceedance percentiles for 2013 - 2015.

Table 4.6. Releases (AF) from Caballo Reservoir from 2013 – 2015.

	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	269,430	536,507	923,175	266,978	479,494	780,365
2014	321,754	563,711	957,874	337,683	543,908	785,379
2015	348,535	575,484	916,074	341,051	718,869	789,261

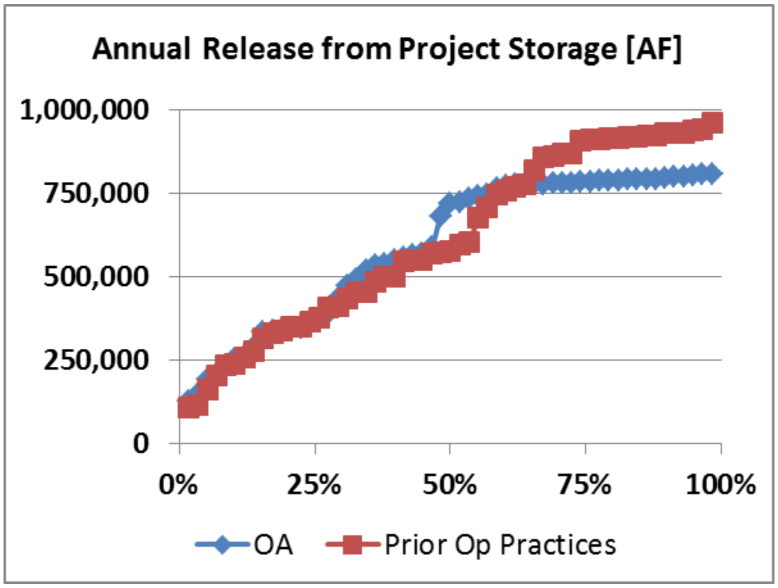


Figure 4.18. 2015 Caballo Reservoir release (AF) non-exceedance curve.

Total Project Storage

Summary

Project storage will fluctuate under any set of operating rules. Total Project storage is generally higher under the Proposed Action when compared to the No Action alternative. The difference is small under the drier 20th and average 50th percentiles. The increased total Project storage under the wetter 80th percentile non-exceedance is more pronounced due to increased carry-over storage during wetter conditions.

Under the Proposed Action, future elevations and water surface area of Elephant Butte Reservoir are expected to be within the range of historic water surface elevations. Since 1951, when Project allocations were first determined, total storage in the reservoirs has ranged from 77,130 AF in 1957 to 2,383,900 AF in 1988, when the reservoirs last spilled. Based on recent Project data, on average 4.5% of storage is in Caballo Reservoir and 95.5% is in Elephant Butte Reservoir.

Analysis

The following non-exceedance curves, Figures 4.19 and 4.20, show the probability distributions of projected annual total Project storage at the start and end of irrigation season for 2015, respectively. Non-exceedance curves of total Project storage are different for each year due to the effects of prior-year operations on current year storage; however, the general characteristics of non-exceedance curves for 2013 and 2014 are similar to 2015. Values of the 20%, 50%, and 80% non-exceedance allocation are provided in Table 4.7 and Table 4.8 for years 2013-2015. Project storage at the start of year 2013 is projected based on actual Project storage and inflows at the end-of-irrigation season 2012, and is identical under the Proposed Action and No Action alternative.

Table 4.7. Projected March 1st storage of water (AF) in Elephant Butte Reservoir from 2013 – 2015.

	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	224,280	286,550	335,500	252,950	286,550	335,500
2014	271,772	339,754	393,630	289,076	376,325	487,674
2015	278,907	351,370	444,802	307,768	406,972	683,214

Table 4.8. Projected October 31st storage of water (AF) in Elephant Butte Reservoir from 2013 – 2015.

	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	143,330	152,708	189,143	194,652	194,652	321,103
2014	143,330	164,816	251,335	192,556	208,699	474,904
2015	143,330	163,830	286,285	207,340	221,681	553,813

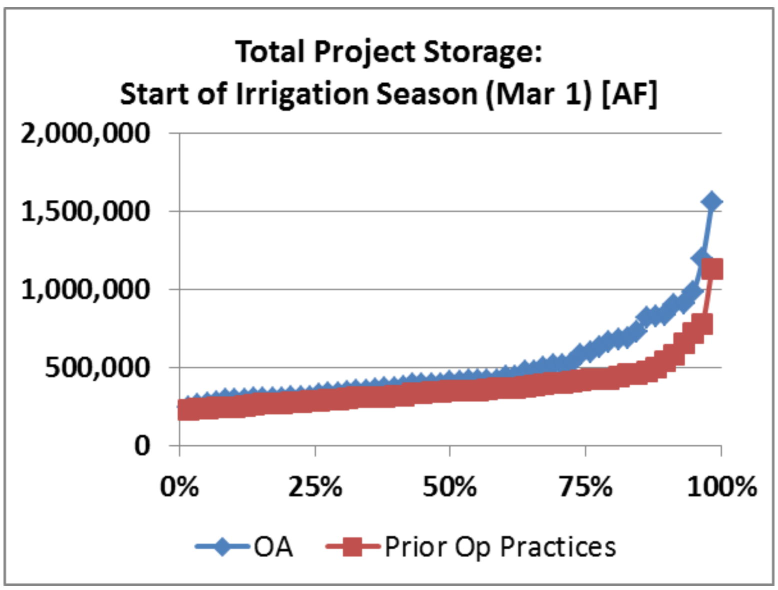


Figure 4.19. 2015 Total Project March 1st storage (AF) non-exceedance curve.

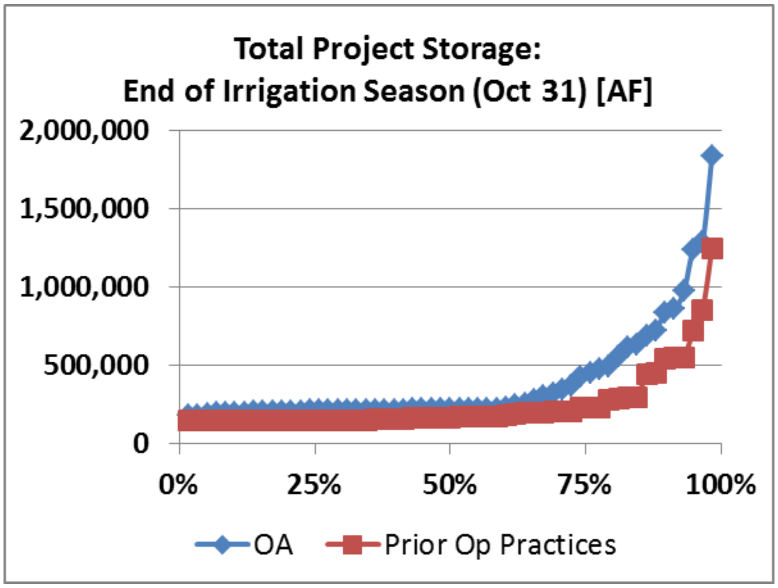


Figure 4.20. 2015 Total Project October 31st storage (AF) non-exceedance curve.

Conclusion

Surface Water Allocations

As described above, the analysis presented here indicates that Project allocations to EPWID were greater under the OA than under No Action alternative during the period 2008-2012 and are likely to be greater under the OA during the period 2013-2015, particularly under drier and normal water supply conditions. By contrast, this analysis indicates that Project allocations to EBID were generally lower under the OA during the period 2008-2012 and are likely to remain lower under the OA during the period 2013-2015. The increase in Project allocation to EPCWID results from a combination of the carryover provision of the OA, and hence the large increase in carryover balance accrued by EPCWID under the OA compared to the No Action alternative, as well as the diversion ratio provision, which results in a moderate increase in annual allocation to EPCWID under the OA. By contrast, the decrease in Project allocation to EBID under the OA results primarily from the diversion ratio provision.

As detailed in Sections 1.3 and 3.3, one of the key principles underlying the OA is the need to account for effects of groundwater pumping and other factors within the Project and surrounding areas on Project performance, with respect to the delivery of Project water from storage to authorized points of diversion. The diversion ratio provision of the OA adjusts Project allocations to EBID and EPCWID to account for changes in Project delivery performance, as reflected by changes in the Project diversion ratio. Groundwater pumping within the Project and surrounding areas began in the 1950s, and has increased steadily during subsequent decades. Groundwater pumping is under the jurisdiction of the states of New Mexico and Texas, not the Federal project. However, it is widely recognized that groundwater pumping within the Project and surrounding areas depletes surface waters within the basin by inducing flow from surface water into the groundwater system to replenish the pumped water, thereby decreasing the amount of water that the Federal project can deliver to its constituents.

Previous studies suggest that changes in Project performance as represented by the diversion ratio are largely driven by groundwater pumping within the Rincon and Mesilla Valleys. Groundwater pumping for irrigation is the largest component of groundwater demand in the region, particularly during dry years. In 2005, NMOSE estimated that groundwater pumping for irrigation in the Rincon and Mesilla Valleys in New Mexico, the majority of which occurs within EBID to supplement Project surface water supplies, is between 200,000 and 300,000 AFY in dry years. Similar estimates of pumping for irrigation in the Texas portion of the Mesilla Valley range from 18,000 and 22,000 AFY under dry conditions. Since groundwater pumping for supplemental irrigation in the New Mexico portion of the region is approximately an order of magnitude greater than in the Texas portion of the region, it is reasonable to conclude that the majority of the effects of groundwater pumping on Project performance result from pumping within New Mexico, the majority of which occurs by individual landowners within EBID as permitted and regulated by the State of New Mexico. In addition, as described below in Section 4.2.2.3, recent changes in cropping and irrigation practices and other factors by individual landowners within EBID have likely contributed to changes in recharge and groundwater use that further impact Project performance. The diversion ratio provision of the OA therefore deals with the effects of changes in Project performance with respect to the D-2 baseline, which result predominately from the actions of individual landowners within EBID, on Project allocations and deliveries to EPCWID and Mexico.

The shortfall in Project deliveries due to recent deviations from the D-2 baseline can be estimated by comparing the annual gross Project diversion for a given year to the corresponding baseline annual diversion calculated using the D-2 Curve (see Appendix F, Sections 2.4 and 3.1.2). As detailed above, the D-2 Curve is a linear regression equation that represents the historical relationship between annual Project releases and annual gross diversions at river headings. For a given annual release, the D-2 Curve estimates the annual gross diversion that can be delivered to Project headings under historical baseline performance conditions representative of the period 1951-1978. The D-2 Curve reflects the effects of groundwater pumping on Project operations during the period 1951-1978; shortfalls estimated with respect to a D-2 baseline therefore reflect the change in shortfall of Project deliveries compared to the period 1951-1978, rather than the total shortfall caused by groundwater pumping. However, analysis of historical gross diversions indicates that Project deliveries were near the D-2 baseline throughout the period 1980-2002. In addition, analysis of groundwater trends within the Project and surrounding areas indicate that groundwater pumping did not result in sustained decreases in groundwater levels until 2003, at which point widespread and substantial declines in groundwater elevations are evident throughout much of the region. These results suggest that the D-2 curve is a reasonable depiction of baseline conditions that prevailed throughout more than 40 years of Project operation.

Historical (actual) annual releases and gross diversions for the period 2008-2012 are shown in Figure 4.21 and Table 4-9, along with corresponding baseline diversions calculated using the D-2 Curve. Actual diversions were substantially below the D-2 baseline in all years, with an average annual shortfall of 148,357 AFY below the D-2 level. Under prior operating practices, shortfalls would have been apportioned between EBID and EPCWID according to the authorized acreage within each district (i.e. 57% to EBID and 43% to EPCWID). For 2008-2012, the average annual delivery shortfall under prior operating practices would thus be -84,228 AFY to EBID and -64,128 AFY to EPCWID.

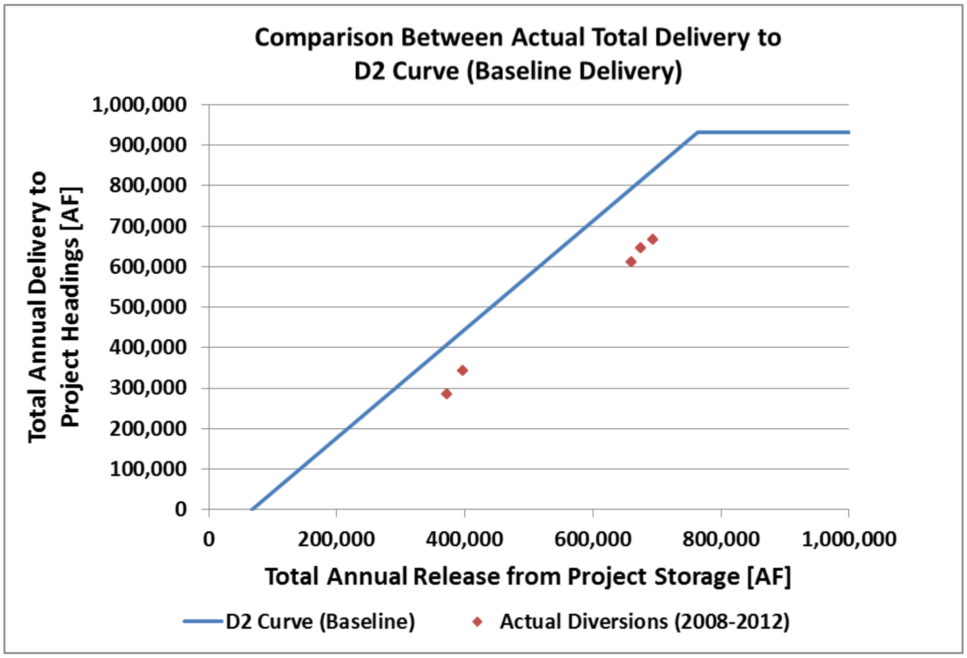


Figure 4.21: Historical (actual) total gross Project diversions plotted as a function of historical (actual) total Project release for the period 2008-2012. The D-2 Curve is plotted for comparison.

Table 4.9: Annual Project Releases, Diversions, and Estimated Depletions (2008-2012)

Year	Annual Release	Annual Gross Diversion (Actual)	Annual Gross Diversion (D-2 Curve)	Estimated Shortfall
2008	674,724	645,870	812,675	-166,805
2009	694,199	667,554	838,729	-171,175
2010	660,300	612,357	793,378	-181,021
2011	396,876	342,795	440,971	-98,176
2012	372,600	283,886	408,494	-124,608
Average	**559,740**	**510,492**	**658,850**	**-148,357**

Under the OA, effects of groundwater pumping on Project diversions are accounted for by adjusting allocations to EBID and EPCWID according to the diversion ratio provision. The diversion ratio provision adjusts the annual Project allocation to EPCWID to maintain the district's D-2 baseline diversion. The annual Project allocation to EBID is then adjusted to reflect current-year Project performance as reflected by the diversion ratio. When the diversion ratio is high, EBID generally receives an increase in allocation compared to the D-2 baseline; when the diversion ratio is low, EBID generally receives a decrease in Project allocation compared to the D-2 baseline.

The average annual allocation to EPCWID during the period 2008-2012, excluding carryover balance, was 62,675 AFY greater under the OA than the estimated allocation under prior operating practices, whereas the average annual allocation to EBID during this period, excluding carryover balance, was 63,739 AFY less under the OA under prior operating practices. The estimated increase in allocation to EPCWID is therefore approximately equal to the district's estimated shortfall during this period with respect to the D-2 baseline. The estimated increase in allocation to EPCWID is accounted for by a corresponding decrease in allocation to EBID. In the years covered by this supplemental EA, 2013-2015, the same principles apply, and the diversion ratio is likely to be similar to the diversion ratio experienced in recent years. Therefore, EPCWID is likely to continue to experience increases in annual allocation, and EBID is likely to continue to experience decreases in annual allocation, in magnitudes that reflect the shortfalls in EPCWID deliveries relative to the D-2 baseline.

Annual Release from Project Storage

As described above, total Project releases from Caballo Dam are expected to be within the range of historic operations under the Proposed Action.

Total Project Storage

As described above, future elevations and water surface areas of Elephant Butte Reservoir are expected to be within the range of historic water surface elevations under the Proposed Action.

<u>How would No Action affect surface water (2013-2015)?</u>

This section describes the potential future effect on surface water resources that would be expected to occur over the next three years as a result of the No Action alternative.

Purpose and Need for the OA

The No Action alternative could impede Reclamation's ability to meets its full contractual obligation to deliver Project water to EPCWID. In addition, the No Action alternative would fail to comply with requirements of transfer contracts with each district to develop an operating agreement for the Project. Additionally, the No Action alternative would not meet the purpose and need for the OA, which was designed in response to EPCWID's legal complaint regarding negative effects of groundwater pumping and other actions within EBID and surrounding areas of New Mexico on Project performance and Project allocations and deliveries to EPCWID, and in response to EBID's complaint that historical Project operations were biased due to the lack of consistent and written operating procedures.

Surface Water Allocations

Under drier conditions represented by the 20th percentile non-exceedance, there is no substantial difference between the allocations for EBID, EPCWID, and Mexico for the three-year period of analysis between the No Action and the Proposed Action alternative. Under the No Action alternative and wetter 80th percentile non-exceedance, the Annual Allocated Water and Total Diversion Allocation to EBID by 2015 would be 123,872 AF higher and 85,854 AF higher, respectively, than the Proposed Action, while the Annual Allocated Water and Total Diversion Allocation to EPCWID would be 43,698 AF higher and 34,463 AF higher, respectively, than the Proposed Action by 2015. However, it should be noted that projected differences in surface water allocations are highly sensitive to Project performance during this period.

Total Project Storage

Total Project storage is generally lower under the No Action alternative when compared to the Proposed Action. The difference is small under the drier 20th and average 50th percentiles. The decreased total Project storage under the wetter 80th percentile non-exceedance is more pronounced due to a reduction in carryover storage under the No Action alternative compared to the Proposed Action.

Caballo Reservoir Releases

Under drier conditions represented by the 20th percentile and average conditions represented by the 50th percentile nonexceedance, there is no substantial difference between Caballo Reservoir releases under the No Action alternative in any year when compared with the Proposed Action. An increase in Caballo Reservoir releases is observed under the wetter 80th percentile nonexceedance for all years under the No Action alternative due to a concomitant decrease in carryover storage.

4.2.2.3 Groundwater

Groundwater Conditions within the Project and Analysis Approach

The groundwater in the unconfined alluvial aquifers in the Rincon, Mesilla and Hueco Basins of New Mexico and Texas is hydraulically connected to the surface water in the reach of the Rio Grande that flows through the Project. Operation of the reservoirs and surface water system has the ability to impact groundwater resources, and pumping of groundwater has the ability to impact surface flows. Because of this strong hydraulic interconnection, surface water and groundwater can be used conjunctively within the Project service area, with shortages in surface water supplies to individual farms being made up for by groundwater pumping and the surface water, in turn, providing recharge to the groundwater system. This physical connection between the surface water and the shallow groundwater in the Project, as described in Section 1.3, was understood prior to the first Project water deliveries, particularly within the EBID service area. A 1917 supplemental Congressional authorization for the Project recognized this relationship when it specified excavation of drains that would collect shallow groundwater and deliver it to the river, and thereby transport water downstream. Water managers have long known that pumping of shallow groundwater for supplemental use by irrigators did not represent an additional supply in, or new source of water to, the basin, but rather, simply represented a change in the method, time, and place of diversion of available Project water supplies (Conover 1954, 121).

In many basins, the significance of the impact of groundwater pumping is evaluated with respect to the aquifer's firm yield – the aquifer yield that is balanced by groundwater recharge, and therefore does not result in mining of the aquifer. However, due to the strong interdependence between groundwater and surface water systems within the Project, the firm-yield approach is circular in this case. The river and the irrigation canals of the Project have long served as the primary source of recharge to the aquifers in the Project. Pumping of groundwater lowers the water table and increases the loss of river and canal flows to the aquifer, as river flows recharge the aquifers to replenish the water that has been removed (Maddock 2012). Lowering of the water table due to groundwater pumping can also diminish flows in Project drains, which results in decreases in Project surface water supply. Therefore, proposed actions, such as the OA, affect both surface water and groundwater, and the interaction between the two. Further, these impacts occur in concert with a complex variety of factors, including sustained drought, increased irrigation demand due to changes in cropping patterns, increases in on-farm efficiencies, and increased municipal and industrial groundwater use associated with a growing population in the area.

The general state of groundwater resources within the basin can, however, be characterized by evaluating longer-term trends in groundwater levels. In the analysis of the potential impact of the Proposed Action on groundwater supply and use that was performed for this EA, a trend analysis was performed. In this trend analysis, the Mesilla Basin in New Mexico was emphasized, since this is the section of the Project with the largest amount of supplemental pumping, and is the section with the most direct hydraulic connection with the Rio Grande. As of July 2012, EPCWID has been charged for groundwater pumped by wells in the Mesilla Valley directly out of its diversion allocation; therefore, this pumping should have no net effect on the surface water supply.

The OA does not directly affect groundwater pumping. However, changes in the distribution of water under the OA may result in incentives to pump groundwater by farmers who do not receive as much surface water under the OA as their crops require. Farmers with sufficient State-allocated rights may pump groundwater to make up for the full amount of any shortfall in surface water supply. These changes in incentives must be considered in the context of existing groundwater pumping and surface water operations, the general state of groundwater and surface water resources in the basin, and the interaction of groundwater and surface water resources within the basin. Existing groundwater pumping includes municipal pumping, irrigation pumping for lands irrigated with groundwater only, and supplemental irrigation pumping for lands that receive Project water.

Due to the short timeline of the supplemental EA, the evaluation of potential effects on groundwater resources presented here is mainly qualitative. Quantitative evaluation of effects on groundwater resources will require the use of sophisticated numerical groundwater models that are capable of simulating the many complex and interrelated factors that affect groundwater resources within the Rincon and Mesilla Valleys. The use of such a sophisticated modeling approach, however, will require a substantial amount of time to develop, verify, apply, and analyze and is therefore beyond the scope of the current study due to time constraints. Reclamation is committed to conduct further analysis of the potential effects of the OA and other factors on groundwater resources and groundwater/surface water interaction within the Rincon and Mesilla Valleys in the future using the most appropriate data and methods, including use of numerical groundwater models to quantify changes in groundwater head distribution, aquifer mass balance, and groundwater/surface water interaction. The qualitative evaluation presented here is sufficient to draw conclusions regarding the potential effects of the OA on of groundwater resources within the Project and surrounding areas.

History of Groundwater Allocation and Use

The Project, under full supply, historically allocated to each irrigated acre a farm delivery requirement (FDR) of 3.024 AFY. Surface water from the Project was the only water source for irrigated agriculture until the drought of the 1950's, when many wells were drilled to provide a supplemental water source, and groundwater pumping increased. The availability of this unregulated groundwater allowed irrigators to shift beneficial use of their water to high-water-use crops, such as pecans. Unrestricted groundwater development continued in the Rincon and Mesilla Basins in New Mexico, resulting in significant increases in groundwater demand until 1980 when the New Mexico Office of the State Engineer declared the LRG Underground Basin, within which permits would be required for any further groundwater development. Groundwater use that was initiated prior to the declaration of the underground basin was allowed to continue. The amount of water that can be pumped using pre-basin groundwater rights is currently being determined through a basin adjudication process by the State of New Mexico.

In a settlement agreement associated with this ongoing water-rights adjudication, New Mexico allocated a FDR of 5.5 AFY and a consumptive irrigation requirement (CIR) of 4.0 AFY for pecan crops irrigated from a groundwater source established prior to the declaration of the groundwater basin. This amount was authorized for diversion from groundwater, in its full amount at times when there is no Federal surface water supply, with no requirements for offset of the impact of this groundwater pumping on surface water supplies. Surface water allocations under full supply of the Project continue through block allocations to the Districts at rates equivalent to FDR of 3.024 AFY and a CIR of 2.6 AFY. Therefore, even under full surface water supply from the Project, this settlement authorizes 2.476 AFY FDR and 1.4 AFY CIR of groundwater use, with no requirement to offset the impacts of groundwater pumping on surface water supplies.

Groundwater pumping for irrigation use within the Mesilla Basin of New Mexico can be 50,000 to 100,000 AFY in years of full Project surface water supply, and can range between 200,000 and 300,000 AFY in years of low Project surface water supply, depending on crop distributions, available surface water supplies, and weather conditions (Barroll 2005). Additionally, domestic well use has increased, as a result of rural development, and municipalities are using a larger portion of their groundwater pumping rights, in response to municipal and industrial growth. Municipal groundwater pumping in the Mesilla Basin is currently estimated at approximately 30,000 AFY (Erek Fuchs, EBID Groundwater Resources Manager, personal communication, March 25, 2013).

Shortages in surface water supplies, along with greater control over the distribution of water and the timing of application that is available to irrigators using groundwater supplies, have led irrigators in both districts to increase their on-farm efficiencies (i.e., proportion of the water supply used productively for crop uptake). The trends towards greater on-farm efficiency have also contributed to gradual reductions in drain flows and return flows, which further contribute to decreases in the river's delivery efficiency. These trends, exacerbated by drought, have decreased Project deliveries. Under normal Project operations, a portion of the Project water that is applied to lands within EBID is recaptured in drains and is continuously re-diverted and applied to beneficial uses (Maddock 2012). Historically, after several years of full allocation from the Project, drain flows returned water to the river, and Project gross delivery efficiency could approach 120 percent, which represents an augmentation of surface flows by drains and return flows of up to 20%. As shown below in Figure 4-21, Project drain flows have diminished substantially, beginning in the 1950's (Barroll 2005). When the drains are dry, the overall Project supply is reduced, Project delivery losses are high, and Project gross delivery efficiencies (i.e., head gate diversions over Project releases) can be as low as 80-90%.

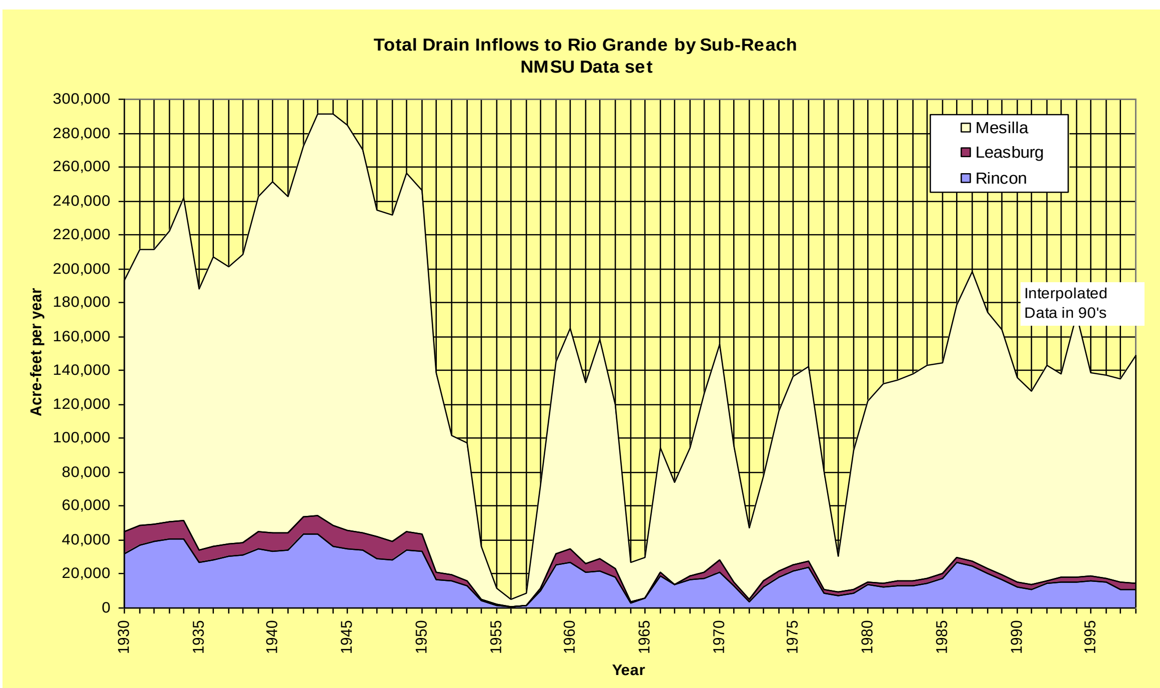


Figure 4.21. Total Drain Inflows to Rio Grande (NM) (Barroll 2005)

Just as the New Mexico Office of the State Engineer acknowledged in the 2000's that groundwater pumping was straining the aquifer and took steps to more tightly administer pumping, EPCWID acknowledged that the effects of decades of groundwater pumping impacted its portion of Project supply, both in quantity and quality (EPCWID 2007). One objective of the OA was to address apportionment of carry-over water and to reconcile the hydrologic change caused by increased groundwater pumping and the two districts' contractual rights to a portion of the Project supply.

Historical Trends Leading to the Operating Agreement

At the time that the OA was being negotiated and signed, groundwater elevations in the Project were experiencing a marked decline. In 2003, Project supplies in Elephant Butte and Caballo Reservoirs became insufficient for full Project supply; supplies have remained insufficient for full Project supply for most years since that time. Surface water supply to Project irrigators at levels less than full supply, along with the availability of supplemental groundwater, had led to a significant increase in groundwater use, along with a decrease in surface flows available to recharge the groundwater system. Groundwater pumping has increased to meet the expanded water requirements of high-water-use crops, which resulted in increases in the already-large riverbed losses to groundwater through the Rincon Valley and the New Mexico portion of the Mesilla Valley, as well as a net reduction of the Project's surface return flow, which further decreased available surface water supply. The reduction in surface flows impacted the Project's ability to transport water through the EBID service area to make deliveries to EPCWID.

In response, EPCWID filed a legal complaint claiming groundwater pumping in New Mexico was adversely impacting EPCWID's Project deliveries. EBID complained of not having consistent and written operating procedures. The OA was negotiated to resolve these complaints (Appendix C). Under the OA, EBID agreed to use a portion of its surface water allocation to deal with the reduction in surface flows and return flows via drains caused by groundwater pumping and other actions in New Mexico in order to assure deliveries to EPCWID and Mexico consistent with prior operations. EPCWID accepted direct charges against its diversion allocation for groundwater pumping by the district in the Texas portion of the Mesilla Valley to account for the effects of pumping on Project surface supplies . In addition, a mechanism for carry-over of each district's allocation was implemented by the OA in order to increase each district's operational flexibility and to promote water conservation.

Current Trends

In the 2007 EA, a commitment was made to monitor wells and gather groundwater data in order to better understand and quantify the interactions between surface and groundwater. For this supplemental EA, Reclamation has performed an analysis, based on available well data, of trends in groundwater levels within the Rincon and Mesilla Basins in New Mexico. This analysis indicates that widespread declining groundwater levels since Project inception are confined to the past decade, beginning in 2003. Visual inspection of selected well records confirms this. This period of declining groundwater levels includes the period of operation under the OA (2008-2012). However, as previously stated, the OA has no direct effects on groundwater pumping. Changes in groundwater levels during the period covered by the OA are caused by a variety of factors, including ongoing shortage of surface water supply, changes in cropping patterns and irrigation efficiency, urbanization of Project lands, drilling of new groundwater supply wells, and the allocation of increased groundwater pumping rights and amounts as part of New Mexico adjudication of water rights. The simple analysis presented cannot attribute observed trends to any particular driver.

Correlation analysis indicates widespread and statistically significant positive correlation between groundwater elevation and annual river flow below Caballo Dam, as well as between groundwater elevation and total annual Project diversions. Correlations are consistent over periods 1960-1989, 1970-1999, and 1980-present, suggesting that these correlations are robust under both wet and dry conditions. These results are intuitively consistent with conjunctive use of surface water and groundwater within the Project, and reaffirm the strong relationship between the two. During periods of high surface water availability, streambed recharge from the Rio Grande to the underlying aquifer increases and groundwater pumping decreases, resulting in higher groundwater elevations; conversely, during periods of low surface water availability, streambed recharge decreases and pumping increases, resulting in declining groundwater levels.

The diversion ratio integrates the hydrologic effects of multiple contributing factors. The greatest direct effect on the diversion ratio is not groundwater levels, but drain flows. Initial analysis made when the D-1 and D-2 equations were developed using Project data from 1951 to 1978 showed a strong correlation between drain flow and Project releases when a nine-month lag was applied. Drain flows are a consequence of shallow groundwater conditions, which in turn correlate to allocations and volumes of water applied to the lands. Correlation of groundwater elevations with diversion ratio is more complicated than for annual flow and diversions. Trend analysis indicates widespread positive correlation between groundwater elevations and diversion ratio over the period 1980-present; however, correlations over the periods 1960-1989 are negative and correlations over 1970-1999 are an approximately even mix of positive and negative. As detailed in Section 4.2, the relationship between groundwater elevation and diversion ratio is affected by prior-year conditions, which results in a complicated relationship between the two variables that is not well represented by simple correlation analysis. These results suggest that the diversion ratio cannot be estimated directly from contemporaneous changes in groundwater elevation (e.g., through regression).

How would the Proposed Action affect groundwater?

Project operations directly impact surface flows, and only indirectly impact groundwater, primarily through their effects on incentives to pump groundwater. The Proposed Action impacts surface water allocations within the Project, which in turn creates incentives for some individual farmers with State groundwater rights, to supplement a diminished surface water supply with groundwater.

Changes in demand are reasonably likely to occur in portions of the Project where groundwater is commonly used to supplement surface water supplies obtained from the

Project; these areas occur predominately within EBID. An increase in allocation to EBID under the Proposed Action is therefore reasonably likely to result in decreased groundwater pumping by farmers within EBID, whereas a decrease in allocation to EBID is reasonably likely to result in increased groundwater pumping by farmers within EBID. Increased groundwater pumping within EBID is likely to lower groundwater levels, which in turn reduces baseflows (groundwater inflows to the river), drain flows, and other return flows to the Rio Grande, and increases seepage losses from the Rio Grande to the underlying groundwater system. However, as these conveyance losses increase, the proportion of Project releases that recharge the hydraulically-connected groundwater aquifer also increases. This additional recharge is subsequently available for use by pumpers using the Rincon and Mesilla Aquifers in New Mexico, including farmers that are members of EBID, and the City of Las Cruces.

This same relationship holds for groundwater pumping within the Mesilla Basin portion of EPCWID. However, the irrigated acreage within the Texas portion of the Mesilla valley is approximately an order of magnitude smaller than the irrigated acreage in the New Mexico portion of the Mesilla valley. Also, the portion of the groundwater pumping that is performed by EBPWID, rather than by individual irrigators, is now directly deducted from the Project's allocation to EPCWID.

As shown schematically in Figure 4.22, the OA would have relatively small effect on EBID’s surface water allocation during times when the usable Project water available for allocation is low. When usable Project water is low and the diversion ratio is low, the OA results in a decrease in allocation to EBID that is generally less than 10% of EBID’s historical full allocation; when usable water is low and diversion ratio is high, the OA results in an increase in allocation to EBID that is also generally less than 10% of EBID’s historical full allocation.

During times when the usable water available for allocation is high (at or near full Project supply), however, annual allocation to EBID under the OA is strongly dependent on the Project diversion ratio. When both usable Project water and the Project diversion ratio are high, the Proposed Action results in a substantial increase in allocation of Project water to EBID compared to the No Action alternative, which would tend to reduce the incentives for groundwater pumping within the Project. It is only when the usable water available for allocation is high, but the Project diversion Ratio is low, that EBID is likely to experience a substantial decrease in allocation. In general, the Project diversion ratio is positively correlated with Project releases; it is therefore unlikely that the Project diversion ratio would be low when usable Project water is high, except in the case that excessive groundwater pumping from the Rincon-Mesilla aquifer in antecedent years with low usable water results in a substantial increase in system losses. Under these conditions, the diversion ratio provision of the OA results in a substantial decrease in annual Project allocation to EBID in order to deal with the impacts of groundwater pumping and other actions by individual landowners within EBID on Project deliveries to downstream points of diversion. Changes in Project allocation to EBID would result in corresponding changes in groundwater pumping for supplemental irrigation.

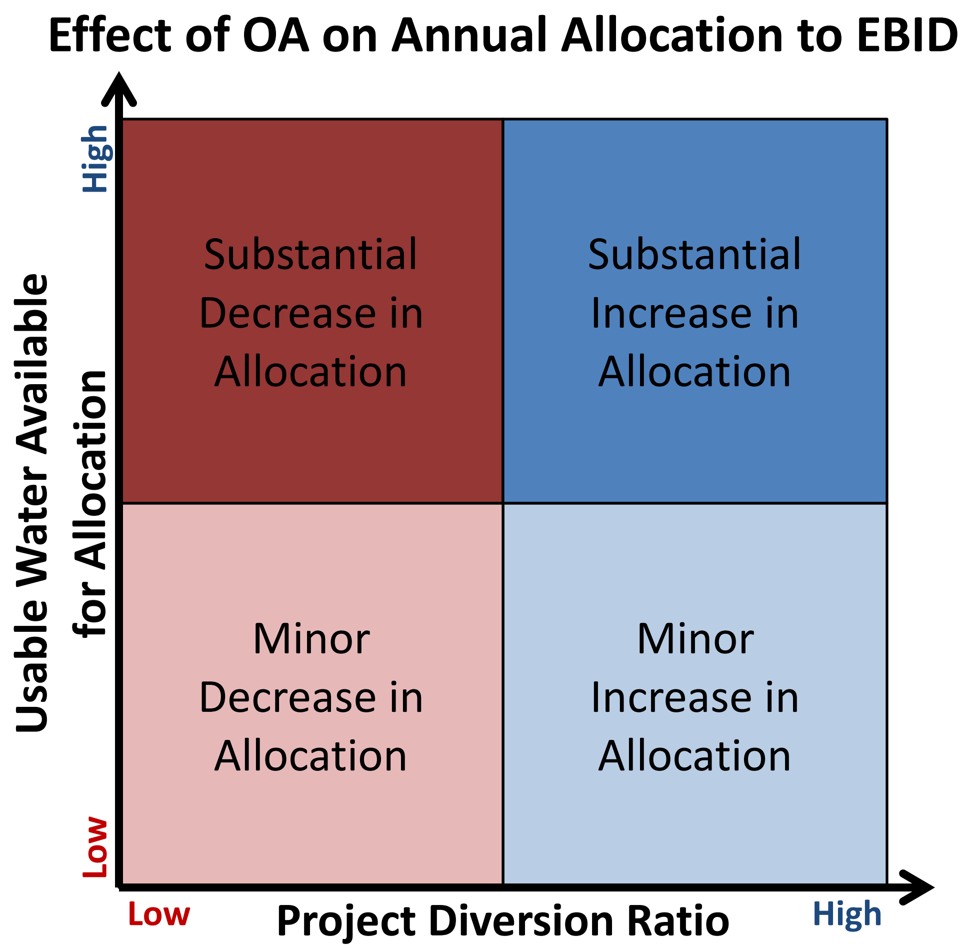


Figure 4.22: Effect of OA on the Annual Project Allocation to EBID.

For the five years in which the OA has been in effect, our analyses indicate an average decrease in EBID's Project allocation of 47,138 AFY. Of the allocated amount, approximately 50% arrives at the farm headgates (James Phillip King, pers. comm. April 2013: note - Reclamation Project allocations prior to 1979 also assume a 50% loss). Therefore, this change in allocation results in a decrease in EBID's supply of about 23,600 AFY. Groundwater pumping from the Rincon-Mesilla Aquifer in New Mexico, as described above, totaled somewhere between 300,000 and 330,000 AFY, including supplemental irrigation pumping and municipal pumping (but not including unmetered domestic well pumping). Therefore, during this period, the incentive to pump groundwater that is due to changes in surface-water allocations under the OA is estimated to be equal to about 10% of the total pumping from the Rincon-Mesilla Aquifer in New Mexico.

Evaluation of the impact of Reclamation's actions on incentives to pump groundwater is complicated by the fact that a complex web of hydrologic interactions impact the groundwater resource, most of which are beyond Reclamation's jurisdiction or control. For example, within the Project area, irrigators with rights to extract groundwater exercise their rights pursuant to state law. Reclamation has no discretion over the district's members' exercise of their groundwater rights, nor over the administration of groundwater rights in New Mexico or Texas.

In general terms, the impact of the Proposed Action on groundwater use is indirect, since the Proposed Action does not include any pumping. The Proposed Action affects incentives to pump by irrigators with State groundwater rights, but the effect of that pumping is minimal relative to other factors affecting groundwater use. Over the past five years, this indirect impact has been estimated to average about 23,600 AFY, which is less than 10% of the estimated total groundwater pumping from the Rincon-Mesilla Aquifer in New Mexico. During potential future years in which the diversion ratio is higher, this indirect impact would be even lower. This is because when surface-water allocations and water deliveries are reduced as a result of allocations made under the OA, the effect is to increase users' incentives to pump groundwater from the Rincon-Mesilla Aquifer in New Mexico. The increased groundwater pumping that may result if farmers have State-authorized water rights, in turn lowers groundwater levels, which reduces return flows to the river via drains, and increases losses from the riverbed into the groundwater system. As these conveyance losses associated with river deliveries increase, the proportion of Project surface water releases recharging the hydraulically-connected aquifer increases, and this additional groundwater is available for use by all of the groundwater pumpers relying on the Rincon-Mesilla Aquifer in New Mexico, including water-rights holders within EBID, groundwater-only irrigators relying on pre-basin groundwater rights, mutual-domestics, municipalities, and private domestic wells. While groundwater levels in the Project rise or fall in response to a variety of variables beyond the control of the Project, described above, as well as by a number of users both within and outside of EBID, the effect of the Proposed Action itself will be for EBID to partially deal with declines in groundwater levels associated with all groundwater pumping from the Rincon-Mesilla Aquifer in New Mexico, while also assuring that downstream surface-water users are not impacted by the groundwater pumping. The analysis described in Section 4.2.2.2 verifies that the OA has assured this downstream delivery over the last five years of Project operations.

As demonstrated above, the estimated impact of the Proposed Action on incentives to pump groundwater within the Project and surrounding areas is minimal relative to the total amount of groundwater pumping from the Rincon-Mesilla Aquifer. It is also estimated to be minimal relative to other factors affecting groundwater use in these areas, which are beyond Reclamation's discretion, including;

1. Persistent drought (shortage in usable water available for project allocation);
2. Changes in the administration of groundwater rights by the State of New Mexico;
3. Changes in cropping patterns from low-water-use crops to high-water-use crops;
4. On-farm efficiency improvements that affect drain flows and return flows and therefore influence the diversion ratio;
5. Population growth, increases in domestic well use and municipal pumping, and urbanization of Project farming acreage.

The analysis is not sufficiently detailed to accurately differentiate the incentives to pump groundwater by farmers within the Project, which is indirectly associated with the Proposed Action from those caused by other factors.

How would No Action affect groundwater?

The No Action alternative, as a return to prior operating procedures, would have a negative effect on Project water resources, since pumping of groundwater to supplement Project irrigation supplies in the Mesilla Basin would continue to negatively impact Reclamation's ability to transport water downstream to the Project diversion locations for EPCWID and Mexico. The prior operating practices do not provide a mechanism to deal with the effects of groundwater pumping on Project water supply, which would likely result in shortages to the downstream Project users. Groundwater pumping from the Rincon-Mesilla Aquifer in New Mexico, by a variety of users both within and outside of EBID, would likely continue under the prior operating practices at a rate greater than 90% of the rate projected under the Proposed Action.

The No Action alternative could impede Reclamation's ability to meets its contractual obligation to deliver full allocations of Project water to EPCWID and would not comply with the requirements in the transfer contracts with each district to develop an OA. Additionally, the No Action alternative would not meet the purpose and need for the OA, which was designed in response to EPCWID's legal complaint that groundwater pumping in New Mexico was adversely impacting EPCWID's Project deliveries and EBID's complaint of not having consistent and written operating procedures.

4.2.2.4 Water Quality

What is the status of water quality?

This section discusses the effects of the Proposed Action on water quality in comparison with the No Action alternative, and focuses on two parameters of concern, total dissolved solids (TDS) and E. coli bacteria.

Under section 303(d) of the Clean Water Act (CWA), individual states set water quality standards and maintain lists of impaired waters. The Rio Grande below Caballo Dam has been identified as a 303d impaired water. See Appendix H for a map identifying areas of impairment within the Project area.

In New Mexico, the Water Quality Control Commission is the issuing agency of water-quality standards. In Texas, the Texas Commission on Environmental Quality (TCEQ) is the issuing agency of water-quality standards. The main stem of the Rio Grande from the international boundary with Mexico upstream to one mile below Percha Diversion Dam is currently not meeting New Mexico water quality standards. Standards for E. coli bacteria and total maximum daily loads were approved by the New Mexico Water Quality Control Commission and US Environmental Protection Agency in 2007.

During scoping, compliance with the water quality standards of the CWA was raised as a concern and is summarized as follows. Changes to the critical low-flow period, when reservoir releases are not occurring, should be evaluated to determine if there is a potential for the OA to cause a violation of the State's surface water quality standards. During this past winter, the New Mexico Environment Department has been conducting a water quality survey of the LRG basin and has noted that significant stretches of the Rio Grande within the Project area are dry during the non-irrigation period. A preliminary analysis of data collected this winter from the Rio Grande at the New Mexico-Texas boundary indicated that it typically exceeds the 126 cfu/100mL *E. Coli* standard for Primary Contact Use. Smith (2011) reported bacterial source tracking results from the lower Rio Grande for 2010 and 2011.

The Paso del Norte Watershed Council received a watershed restoration grant to develop a Watershed Based Plan to protect and improve water quality in the lower Rio Grande from Percha Dam downstream to the American Dam. The two-year grant will fund a water quality sampling program, a bacterial source tracking study, subsequent data analyses, and a community outreach and education program. Water quality data will be collected from the river, drains and arroyos. Data analyses will identify the cause of elevated *E. coli* levels and indicate the bacterial source. This plan, expected later in 2013, will contain recommendations for best management practices that when implemented, would reduce pathogenic-based pollution in the river.

Michelsen et al (2009) describe spatial and temporal variation of TDS concentrations in river water at various gaging stations in the Project. TDS concentrations increase in a downstream direction and vary widely depending on flow rate and other conditions. TDS is lower during the irrigation season and higher during non-irrigation season, influenced by poor-quality return flows, wastewater effluents and groundwater inflows. During dry periods, levels of TDS in the Rio Grande system below Caballo Reservoir are, on average, more than 50 percent higher than during wet periods (IBWC 2002).

How would the Proposed Action affect water quality?

It is highly likely that any changes occurring in the Rio Grande as the result of the OA will fall within the range of variation measured between the irrigation and non-irrigation seasons.

The levels of TDS measured from 1995-2011 are shown in Figure 4.23,. Measured TDS levels during the dry period in which the OA has been in effect are higher than in the wet years of the late 1990s. This is a response to the dry conditions, as well as numerous confounding factors (cropping patterns, use of groundwater to supplement supplies…), rather than to the OA itself. The OA itself could be expected to decrease TDS concentrations in Texas relative to what they would have been under prior operating practices, since Texas receives a greater portion of its supply as surface water. December concentrations in 2003 (prior to the OA) and 2009 (during OA implementation) are above El Paso’s threshold for drinking water purposes. However, El Paso Water Utilities treats water to a level of safety exceeding that required by EPA regulation, and as a result the quality of drinking water provided to their customers is not adversely affected. Similarly, drinking water provided to the community of Las Cruces, New Mexico, by Las Cruces Utilities is treated to comply with Safe Drinking Act requirements.

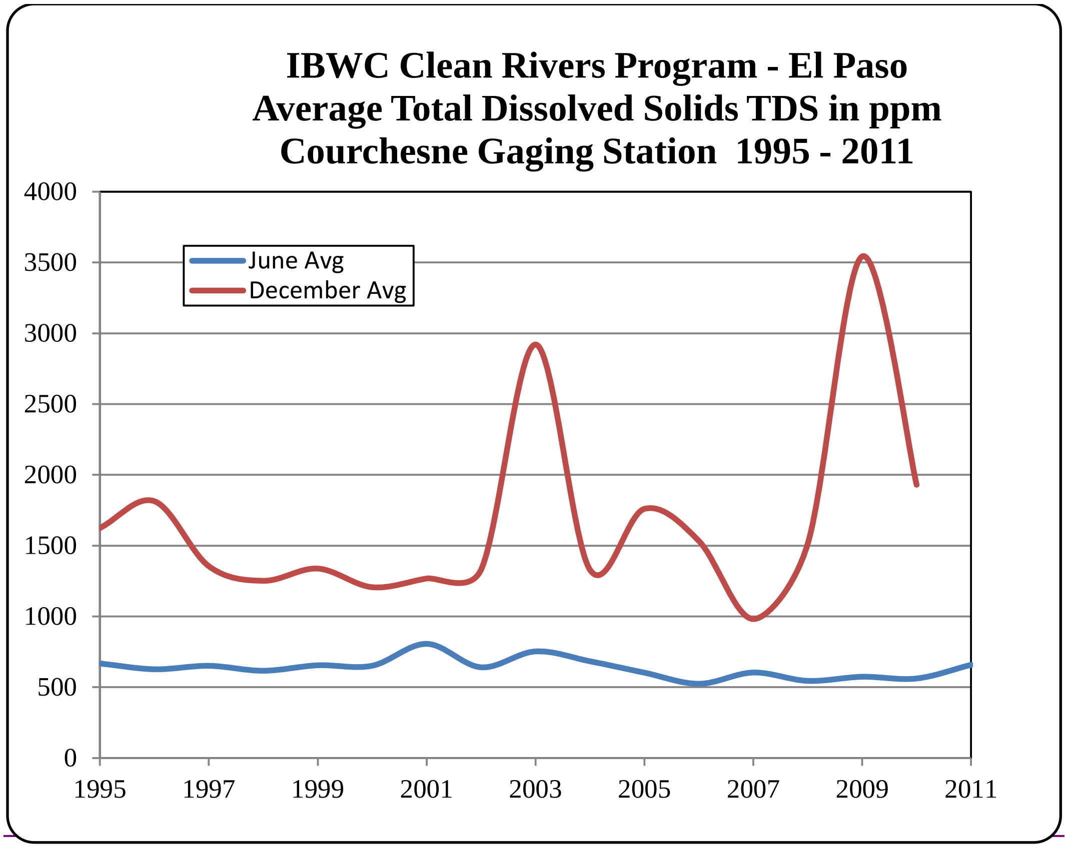


Figure 4.23. Average total dissolved solids (TDS) at the Courchesne Bridge gage, El Paso, Texas, TDS in ppm, from 1995 to 2011 (IBWC 2011).

While the TDS levels in the Rio Grande spiked during the non-irrigation season of 2009-2010, the water held in carry-over allowed for a wetter irrigation season than would have been possible under No Action. 2011 was wetter compared to 2010 and the additional water released produced an irrigation season in which the TDS levels in June were close to average (658 vs. 637 ppm). In comparison, the 2010 non-irrigation season saw salinity levels rise above 3500 ppm. On the basis of these data, it therefore appears that the proposed action does not contribute to any additional adverse effect to water quality, as compared to the No Action alternative.

<u>How would No Action affect water quality?</u>

Under the No Action alternative, Rio Grande water TDS at El Paso during the irrigation season has varied between 394 and 3,199 mg/L with an average of 834 mg/l and a median of 819 mg/L. During the non-irrigation season, the TDS ranged from 370 to 3,832 mg/L with an average TDS of 1,516 mg/L or 681 mg/L higher than its average TDS during the irrigation season (Michelsen et al. 2009:17). Historically, there is a 10 percent exceedance of TDS over 1,000 mg/L, usually occurring at the beginning or end of the irrigation season. During the non-irrigation season, TDS exceeds the 1,000 mg/L (800 ppm) drinking water secondary limit much of the time. The magnitude and frequency of elevated TDS concentrations would be expected to continue under either the Proposed Action or No Action alternative.

4.2.2.5 Implications for the Rio Grande Compact

The Proposed Action could have implications for the distribution of waters between the States of Colorado, New Mexico, and Texas under the Rio Grande Compact. These implications could include:

- Potential changes in timing of Article VII restrictions within New Mexico, which prohibit storage in upstream reservoirs constructed after 1929 at times when the Usable Project Storage for the Rio Grande Project in Elephant Butte and Caballo Reservoirs is below 400,000 acre feet, and

- Potential changes in the evaporative losses applied to Colorado's and New Mexico's Rio Grande Compact Credit Water stored in Elephant Butte as a result of changes in the amount of water stored in Elephant Butte.

Article VII Restrictions

Based on the estimated amount of usable water in Project storage that would have occurred during the period 2008-2012 had the Project been operated under the No Action alternative (see Section 4.2.2.2), the OA resulted in a change to the timing of Article VII restrictions on New Mexico under the Rio Grande Compact.

Tables 4.22 and 4.23 show the historical (actual) usable water in Project storage at the start and end of the irrigation season during the period 2008-2012 and the corresponding estimated usable water in storage had the Project operated under the No Action alternative, assuming no change in Rio Grande Compact Credit Waters. This simple comparison indicates that at the start of the irrigation season (March 1), the OA causes New Mexico to be out of Article VII status in 2009 and 2010, when it would have been under Article VII restrictions at these times under prior operating practices. Comparison indicates that at the end of the irrigation season (October 31), the OA causes New Mexico to be out of Article VII status in 2008, when it would have been under restrictions at this time under the No Action alternative.

These results suggest a benefit to New Mexico under the OA since when Article VII restrictions are lifted, New Mexico is able to store water upstream that, under the restrictions, would have moved downstream to Elephant Butte. Conversely, the OA may result in a decrease in Project supply due to lifting of Article VII restrictions. It should be noted, however, that if New Mexico is not in Article VII restrictions and stores water upstream, less water reaches to Elephant Butte, creating a feedback that could result in Article VII restrictions.

START OF IRRIGATION SEASON (March 1)									
	OA				Prior Ops				
	Total Project Storage	Rio Grande Compact Credits	San Juan Chama Credits	Usable Water	Total Project Storage	Rio Grande Compact Credits	San Juan Chama Credits	Usable Water	
2008	510,339	-61,240	-24,949	424,150	510,339	-61,240	-24,949	424,150	
2009	**724,149**	**-122,648**	**-34,585**	**566,916**	**473,263**	**-122,648**	**-34,585**	**316,030**	Change
2010	**630,160**	**-177,399**	**-45,406**	**407,355**	**476,076**	**-177,399**	**-45,406**	**253,271**	Change
2011	529,699	-159,429	-61,860	308,410	437,632	-159,429	-61,860	216,343	
2012	384,278	-74,880	-47,650	261,748	463,553	-74,880	-47,650	341,023	

END OF IRRIGATION SEASON (October 31)									
	OA				Prior Ops				
	Total Project Storage	Rio Grande Compact Credits	San Juan Chama Credits	Usable Water	Total Project Storage	Rio Grande Compact Credits	San Juan Chama Credits	Usable Water	
2008	**599,581**	**-54,887**	**-27,399**	**517,295**	**348,937**	**-54,887**	**-27,399**	**266,651**	Change
2009	480,634	-107,574	-36,538	336,522	163,898	-107,574	-36,538	19,786	
2010	390,843	-82,289	-58,579	249,975	162,096	-82,289	-58,579	21,228	
2011	218,196	-124,897	-50,280	43,019	235,072	-124,897	-50,280	59,895	
2012	119,987	-56,423	-41,707	21,857	109,609	-56,423	-41,707	11,479	

Evaporative Losses applied to Compact Credit Waters:

The water delivery point from New Mexico to Texas under the Rio Grande Project is Elephant Butte Dam. Therefore, evaporative losses from Elephant Butte reservoir are deducted from Colorado and New Mexico's Compact deliveries. Normally, the evaporative losses are deducted from the unallocated portion of the usable water in Project storage or from New Mexico's inflow. At times when there is no water in storage beyond the amount that will be allocated in a given year (i.e. in years for which there is insufficient usable water in storage for a full supply to the Project), New Mexico and Colorado's credit pools (water delivered above the requirements of the Compact), if they exist, and San Juan-Chama water stored by the Albuquerque Water Authority and the City of Santa Fe are the only water to which evaporative losses can be applied. Therefore, although the credit pools are not normally subject to evaporative losses, they are in this case.

The OA, primarily through its carryover provision, affects the amount of water in Elephant Butte Reservoir, which affects the surface area of the reservoir, and therefore affects the amount of evaporative loss that occurs from the reservoir. That evaporative loss, however, is applied to the native Rio Grande pool, which consists of New Mexico and Colorado accounts under the Rio Grande Compact, rather than to the pool of Project water that is allocated to the districts. Water allocated to the districts as carryover balance therefore is not subject to evaporation, even if the increase in physical water in storage associated with these carryover balances does evaporate.

The table below shows the estimated difference in annual evaporation from Elephant Butte Reservoir between the OA and the No Action alternative for each year during the period 2008-2012, along with corresponding difference in evaporative losses applied to the native Rio Grande water (including Compact credit waters) and imported San Juan-Chama water. Increased reservoir storage under the OA, which results largely from the carryover provision, results in an estimated increase in evaporation loss charged to the native Rio Grande water of up to 20% compared to the No Action alternative. This amount totals approximately 70,000 AF over the five-year period. The maximum change in any one year (2009) is 49%, 32,703 AF.

	Absolute Change (OA vs. Prior Operations)			Percent Change (OA vs. Prior Operations)		
	Evap Volume (Total Content) (AF)	Evap Volume (Rio Grande Content)	Evap Volume (San Juan Chama Content)	Evap Volume (Total Content) (AF)	Evap Volume (Rio Grande Content)	Evap Volume (San Juan Chama Content)
	15,039	16,011	-972	18%	20%	-26%
	31,691	32,703	-1,012	44%	49%	-22%
	21,392	22,809	-1,417	31%	38%	-18%
	4,722	5,542	-820	5%	7%	-10%
	-6,289	-7,637	1,349	-8%	-11%	15%
Change in Cumulative Evap:	66,556	69,428	-2,872	17%	20%	-9%

Summary:

The Proposed Action changes the amount of storage at Elephant Butte Reservoir in comparison to the historical operations as a result of water conserved under the OA as carryover only in the amount that would not have been carried over historically. This may affect the Rio Grande Compact in two ways; the OA generally decreases the amount of time under Article VII restrictions under the Compact, and increased storage under the OA also increases evaporation from the reservoir that may have impacts on the delivery computation for New Mexico. It is understood that increases in usable Project storage, which includes water needed to meet carryover obligations, is assessed evaporation which would result in a decrease in the percentage of the total evaporation assessed against non-usable Project pools.

Reclamation has performed a preliminary analysis of potential changes to Compact administration described above for the 2008-2012 period but has not fully quantified the effects. However, under the OA during the period 2013-2015, reservoir levels are likely to stay low, keeping Article VII in effect during this period. Severe drought conditions are a reality for 2013, therefore any carryover in allocation will be as a consequence of the timing of release and not from an intention to accumulate any carryover. Little, if any, carryover is expected in 2014 and 2015 unless unusual hydrologic events occur. Therefore, the potential for impacts to Compact calculations as a result of the OA are unlikely and the long-term effects will be analyzed under the EIS.

4.2.3 Vegetation

What is the status of vegetation?

The Project area is located in the Chihuahuan Desert with primary vegetation communities that include: Cultivated Cropland, Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub; Chihuahuan Mixed Salt Desert Scrub, and Apacherian-Chihuahuan

Mesquite Upland Scrub. The location of species depends on factors such as the soil, elevation, degree of slope and proximity to water. Wetlands and riparian areas are generally limited to the river edges, sand bars, low areas adjacent to the river within the floodplain, and at Elephant Butte and Caballo Reservoirs. Common native wetland or riparian vegetation may include cottonwood, willows, seepwillow, sedges, rushes, cattail, and salt grass. Saltcedar and Russian olive, two salt-tolerant invasive species, are also common and spreading in riparian areas along the river and at the two reservoirs.

Dominant species in the drier terraces and upland areas may include creosote bush, tarbush, apache plume, fourwing saltbush, alkali sacaton, blue grama, sand dropseed, and tobosa. Russian thistle, also known as tumbleweed, is an invasive species that often occupies disturbed areas and may occur within the Project area.

Vegetation at Elephant Butte Reservoir has been described by Reclamation (Ahlers, Reed and Siegle 2003) in the New Mexico State Parks' (NMSP) management plan (NMSP 2006) and in bird surveys (Sogge, et al. 1997). Reclamation has conducted both intensive and reconnaissance-level surveys of the vegetation in these areas as a means of documenting actual or potential habitat for the listed southwestern willow flycatcher (Moore and Ahlers 2012). Vegetation resources in the reach below Caballo Reservoir to El Paso within the Project area are extensively addressed by IBWC (IBWC 2003).

Below Caballo, the river to El Paso is narrow and deep. Most of the farms have allowed a narrow vegetated buffer zone to exist between agricultural areas and the river's bank. There are some areas where the river is adjacent to upland slopes and those areas have no farming and the riparian vegetation is a little wider. The other vegetated areas occur on sand bars in the river channel. Flows in this section of the river rarely allow for overbanking to occur and through the years IBWC has implemented a mowing program along the bank and a dredging program of the river channel.

Methodology

The vegetation within the Project area was considered in terms of composition or plant communities, including both native and non-native riparian vegetation and infestation of invasive weeds; as well as potential for use as wildlife habitat. Hydrologic modeling of inflows and Project releases were used to predict changes in biota. Upland, desert shrub communities further from the river would be unaffected by the Project operations, only the narrow ribbon of riparian vegetation along the river banks and the vegetation that has grown within the reservoir pools could potentially be affected by projected reservoir elevations and releases or groundwater levels.

How would the Proposed Action affect vegetation?

Riverine Area Vegetation under Proposed Action

The river channel between Elephant Butte and Caballo Reservoirs is deep, narrow, with an overall stable channel morphology, and little to no overbank flooding; thus the vegetation on the banks depends on consistent flows from the reservoir and groundwater springs. The Proposed Action would have neither positive nor negative impacts on riparian vegetation between Elephant Butte and Caballo when compared to the No Action alternative.

In the river below Caballo, the river channel is also relatively deep and narrow. For many years IBWC has mowed the buffer zone and dredged the river channel for more efficient delivery of water, and farming has only left a minimal vegetative buffer zone between fields and the river channel. With little to no flows in the river during the non-irrigation season the vegetation along the river's bank is dependent on reservoir releases during the irrigation season, irrigation return flows and local monsoon storm flow during the summer. In addition, as a result of extensive farming occurring adjacent to the river's vegetated bank, these root systems are also likely obtaining water from seepage from the irrigated fields during the irrigation season. Under both alternatives, as long as these flows are present, it is expected that native and non-native vegetation will continue to exist similarly to current conditions.

<u>How would No Action affect vegetation?</u>

Riverine Area Vegetation under No Action

Future low flows in the two river reaches have the greatest likelihood of negatively impacting riparian and marsh vegetation, including riverine wetlands. Under the No Action alternative, any impacts would be minor as predicted low releases remain within the range of annual fluctuation, with the dams not releasing water during the non-irrigation season. Such low flows stress phreatophytes, but would not be expected to cause substantial plant die-off. Impacts of low flows and the operations for irrigation purposes would continue to affect obligate phreatophytes such as willow more than facultative phreatophytes such as saltcedar. Thus the long-term trend is to favor continued saltcedar expansion.

From Percha Diversion Dam downstream under the No Action alternative, the long-term trends described by IBWC's various management programs (IBWC 2003) for riverine and wetland vegetation will continue. This includes dredging of the river channel, selective mowing to retain native vegetation and manage salt cedar. The long-term degradation of the channel from Caballo to just north of El Paso will mean that even with high flows (over 2,000 CFS) there is little to no chance of overbanking, and this will mean that vegetation will remain as it is currently. However, the Corps (2007:7.6) has noted that there is about two feet of aggradation that has occurred through El Paso, and higher flows may increase the frequency of over banking. This could create a more dynamic vegetation association in this area, but given the urban nature of this segment, such overbanking through El Paso would likely result in more weeds and disturbance-adapted vegetation.

<u>How would Both Alternatives affect vegetation?</u>

Reservoir Vegetation under Both Alternatives

Vegetation in and adjacent to both Elephant and Caballo Reservoirs is dependent on reservoir fluctuations. Caballo Reservoir's pool level is relatively stable, so vegetation is relatively constant; being dense near the water's edge and gradually reducing in density away from the water line. The vegetation along Caballo's shoreline will not be affected under both alternatives. At Elephant Butte, the vegetation seems to have reached its southern extent at about river mile (RM) 38-39. What currently exists of the reservoir is a deep narrow pool without much vegetation around it. The majority of vegetation at Elephant Butte only occurs at the upper end (delta) where the Rio Grande enters.

Temporary establishment and loss of vegetation and wildlife habitat below the full-pool elevations would occur under both alternatives. When there are higher reservoir elevations, exposed shoreline available for plant colonization would decrease and there would be less opportunity for plant growth. Lower elevations would increase the distance between permanent shoreline vegetation and aquatic habitats, which would increase shoreline available for plant colonization.

Invasive, Non-native Vegetation under Both Alternatives

The potential for invasive weeds to be introduced and spread by future flows or management actions would exist under both alternatives. To avoid or minimize the risk of noxious weed introduction or spread, Reclamation and IBWC have integrated pest management plans and policies that require high pressure washing systems and other methods to ensure that construction equipment, such as that used by IBWC to dredge the channel, would not transmit weeds.

It is predicted that with month-long periods of low to no flow, saltcedar and Russian olive expansion would be favored under both alternatives. Active management by IBWC, the districts, or the City of El Paso would be expected keep saltcedar under control.

4.2.4 Wildlife

<u>What is the status of wildlife?</u>

The Rio Grande, the two reservoirs and the associated riparian vegetation provides habitat for various species of sport fish and wildlife (IBWC, 2003; Bureau of Reclamation 2002 and 2003). The two reservoirs provide lacustrine aquatic habitats and influences of fluvial habitat, where the river enters at the deltas. Common wildlife at both Elephant Butte and Caballo Reservoirs include: deer, coyotes, rabbits, squirrels, chipmunks, raccoons, woodpeckers, egrets, killdeers, quails, great blue herons, and numerous species of waterfowl and shorebirds. Migratory bird species and waterfowl are also present. Previous studies by NMSP (New Mexico State Parks 2000) have documented over 250 species of birds within the region many of which are associated with riparian-wetland habitats.

Riparian areas constitute less than 1% of the land area in the arid southwest, yet provide habitat to a greater number of wildlife species than any other ecological community in the region. These riparian areas are also critical corridors for migratory species, especially birds that are moving from their southern winter grounds to their northern summer areas. When analyzing the river portion of the action area from Caballo to El Paso, IBWC assessed the wildlife habitat in the area to be below average to poor quality (IBWC 2003). There are some riverine wetlands within the river channel that offer high quality habitat, but these are small and far apart. Overall wildlife habitat from Elephant Butte Dam and along the river all the way to El Paso has been impacted through the years from agricultural and urban development. In general, the only remaining high value wildlife habitat occurs at Elephant Butte and Caballo Reservoirs and as a riparian strip adjacent to the river. The dynamic nature of flooding and drying at the upper portions of Elephant Butte have allowed for the establishment of large areas of riparian vegetation to establish which provides important habitat for wildlife.

Methodology

The method of analysis for wildlife assessment involved considering the potential effects of the alternatives to vegetation and water resources to determine whether these would cause changes affecting aquatic and terrestrial wildlife or their the habitats. Predictions of inflows and releases under both alternatives were used to predict changes in biota. Upland, desert shrub communities further from the river would be unaffected by Project operations under either alternative. Only the narrow ribbon of riparian vegetation along the river and the vegetation that has grown within the reservoir pools could potentially be affected by projected reservoir elevations and releases or groundwater levels.

<u>How would the Proposed Action affect wildlife?</u>

At Elephant Butte, modeling indicates that the Proposed Action could allow for slightly higher reservoir levels (from 6 – 25 feet higher beginning in year 2) than the No Action. A growing flood pool would be beneficial to aquatic species. In general, lake fish species would be expected to benefit from an increasing reservoir shoreline and flooded vegetation, while riverine fish would have slightly less riverine habitat in the reservoir pool. Modeling is not sensitive enough to predict the actual depth or duration of flooding that will occur. If flooding is of short duration, most native plants are able to handle such events and may in fact benefit from seasonal flooding, in comparison to a flooding event that lasts all summer long and/or beyond. Overall, wildlife are expected to shift to available habitat similarly as with changing reservoir levels in the No Action. In fact, a dynamic rising and lowering of the reservoir over time results in plant community succession, creating a diversity of habitat types and often is beneficial to wildlife and their habitats.

The aquatic habitat in the two river sections (between the reservoirs and downstream from Caballo to El Paso) is not expected to change under either alternative. The river below Caballo will have releases within the range of historical operations. Below Caballo, the entire river channel to El Paso is more directly influenced by the lack of releases during the non-irrigation season and by monsoon rains. During the non – irrigation season the further south on the river, groundwater or secondary arroyos may provide enough water into the river for short sections to keep the river wet.

<u>How would No Action affect wildlife?</u>

At Elephant Butte, modeling indicates that the No Action alternative could allow for slightly lower reservoir levels (from 6 – 25 feet lower beginning in year 2) than the proposed action. A smaller flood pool would result in less habitat for aquatic species. In general, riverine fish species would be expected to benefit from a lower reservoir and a longer river channel into the reservoir. While lake fish would have slightly less lacustrine habitat in the reservoir pool. Modeling is not sensitive to predict the actual depth or duration of flooding that will occur. If flooding is of short duration, most native plants are able to handle such events and may in fact benefit from seasonal flooding, in comparison to a flooding event that lasts all summer long and/or beyond. Overall, wildlife are expected to shift to available habitat similarly as with changing reservoir levels under the No Action alternative.

The aquatic habitat in the two river sections (between the reservoirs and downstream from Caballo to El Paso) is not expected to change under either alternative. The river below Caballo will have releases within the range of historical operations. Below Caballo, the entire river channel to El Paso is more directly influenced by the lack of releases during the non-irrigation season and by monsoon rains. During the non – irrigation season the further south on the river, groundwater or secondary arroyos may provide enough water into the river for short sections to keep the river wet.

<u>How would Both Alternatives affect wildlife?</u>

Wildlife under Both Alternatives

Under both alternatives, wildlife that use the reservoirs and their vegetated shorelines are already affected by and likely accustomed to the fluctuations of these habitats. At Elephant Butte, fluctuations in reservoir levels and releases would occur under both alternatives and result in temporary establishment and loss of vegetation and related wildlife habitat below the full pool elevations. The differences in modeled releases under the 20^{th} and 80^{th} percentiles are well within the monthly and annual release variations of the historical period and the modeled future conditions. When there are lower reservoir elevations, the distance between permanent shoreline vegetation and aquatic habitats would increase, and this would increase the distance wildlife would need to travel between permanent cover and the reservoir edge. Fluctuations would continue into the future, and habitats would continue to be dynamic and change along the shorelines and below the full reservoir pools, as has occurred in the past. At Caballo, since fluctuations are less pronounced, no changes to wildlife are expected under either alternative.

With the signing of the 2009 Record of Decision, the IBWC agreed to enhance 30 sites with native riparian habitat along the portion of the river downstream of Percha Diversion Dam to American Dam. Other agencies like Reclamation and NMSP and ISC, Cities of Las Cruces and El Paso, and non-governmental organizations like The Audubon Society will assist with restoring riparian habitat in this reach.

Aquatic Invasive Species under Both Alternatives

The potential for spread and/or continued presence of invasive mussels will be the same under both alternatives. Invasive zebra and/or quagga mussel DNA has been detected in upstream reservoirs. Under both alternatives, the potential remains for these mussels to become established in Elephant Butte and Caballo Reservoirs; however the slight alternations in reservoir operations or flows in the river reaches does not affect the potential for colonization or infestation of the reservoirs by mussels. Preventative measures to clean boats entering and leaving reservoirs will continue under both alternatives.

4.2.5 Listed Species

<u>What is the status of species listed under the Endangered Species Act?</u>
Based on literature review and field surveys, four threatened or endangered species occur or have been observed within the action area of the supplemental EA: the Interior Least Tern (tern), Piping Plover, Southwestern Willow Flycatcher (flycatcher), and Rio Grande silvery minnow (silvery minnow) (Table 4.9). See Appendix D for additional technical information on listed species.

Table 4.9. Four threatened or endangered species in the Project.

Scientific Name	Common Name	ESA Status
Sterna antillarum	Interior Least Tern	Endangered
Charadruis melodus	Piping Plover	Threatened
Empidonax traillii extimus	Southwestern Willow Flycatcher	Endangered
Hybognathus amarus	Rio Grande silvery minnow	Endangered

Critical Habitat

Flycatcher

Critical habitat for the flycatcher was redesignated by the U.S. Fish and Wildlife Service (Service) in January 2013 (78 FR 343-534). The southern boundary of critical habitat along the Rio Grande in New Mexico was extended to about RM 54, or about eight miles into the upper end of the Elephant Butte Reservoir pool. No critical habitat was designated south of this point, including areas within the proposed Project area south of Elephant Butte and Caballo Reservoirs in New Mexico or Texas.

Silvery Minnow

Critical habitat for the silvery minnow was designated in February 2003 and extends from Cochiti Dam downstream to the power lines at RM 62 at the upper-end of Elephant Butte Reservoir. No critical habitat for the silvery minnow occurs within the action area of the Proposed Action.

Methodology

The method of analysis for federally listed species first involved determining the potential for occurrence of these species within the action area utilizing information from field surveys conducted by Reclamation or others and literature review. If the presence of a listed species or its habitat were documented or suspected, then consideration was given to the potential effects of the alternatives to determine whether these would cause changes affecting listed species or their the habitats. Predictions of inflows and releases under both alternatives were used to assess changes in biota.

Upland, desert shrub communities further from the river or reservoirs would be unaffected by the Project operations under either alternative, so therefore these areas were not given further consideration. Only the narrow ribbon of riparian vegetation along the river, in-channel riverine habitats (sandbars, islands, banks, etc.), and the vegetation that has grown within the reservoir pools could potentially be affected by projected reservoir elevations and releases or groundwater levels.

How would the Proposed Action affect listed species or critical habitat?

Interior Least Tern

The tern is an unlikely migrant in the proposed Project area and is therefore not expected to occur. According to the Service, the tern can be considered a vagrant on the Middle Rio Grande and no tern nesting has been recently documented (Service 1995). According to the recovery plan from the Service in 1990, the only documented breeding along the Rio Grande takes place in South Texas, and the only documented breeding within the State of New Mexico can be found on the Pecos River (Service 1990), similar conclusions are drawn in the complete rangewide survey collected in 2005 (Lott 2006). Due to the highly unlikely presence of the species in the Project area, the proposed action would have no effect on the tern.

Piping Plover

The Piping Plover is a rare migrant to New Mexico and west Texas, but it has never been documented in the action area. It was sighted at Fort Bliss in Texas once in August (U.S. Geological Survey 2013), and it is possible, although unlikely, that it would be present in the action area as it migrates south. No Piping Plovers have been incidentally recorded during flycatcher surveys within the action area since the mid-1990s, however, it should be noted that these surveys are not generally conducted in habitat suitable for plovers and surveyors are not asked to record other bird observations specifically (Wilber, pers. comm.). Due to the highly unlikely presence of the species in the Project area, the proposed action would have no effect on the Piping Plover.

Southwestern Willow Flycatcher

Within the Project area, flycatchers are only known to breed in Elephant Butte Reservoir above elevation 4345 feet (Reclamation 2013) and along the Rio Grande in the Seldon Canyon area upstream of Percha Diversion Dam (IBWC 2004). These Seldon Canyon birds occur beyond the 100-year floodplain of the Project. The IBWC found that suitable dense vegetation for the flycatcher does not occur south of Percha Diversion Dam.

Elephant Butte Reservoir

Surveys for the flycatchers have been conducted by Reclamation at Elephant Butte Reservoir since the mid-1990s. The following figure (Table 4.10) provides a summary of surveys for flycatchers from 2003-2012.

Table 4.10. Territories occupied by Southwestern willow flycatchers in Elephant Butte Reservoir in 2003-2012 from full pool elevation down to 4345 feet in five foot intervals.

Elevation	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
>=4407	28	26	21	30	34	46	50	41	38	37
4400-4407	54	79	73	83	111	107	130	130	140	112
4395-4400	0	3	5	5	12	12	17	26	27	17
4390-4395	0	0	5	9	19	29	46	44	36	18
4385-4390	0	5	3	6	10	16	35	25	9	6
4380-4385	0	0	0	0	0	5	6	8	14	9
4375-4380	0	0	0	0	0	0	0	0	1	2
4370-4375	0	0	0	0	0	0	0	0	0	2
4365-4370	0	0	0	0	0	0	0	1	2	3
4360-4365	0	0	0	0	0	3	2	0	11	6
4355-4360	0	0	0	1	1	3	4	4	20	18
4350-4355	0	0	0	0	2	7	18	9	6	4
4345-4350	0	0	0	0	0	1	1	3	2	2
Total	**82**	**113**	**107**	**134**	**189**	**229**	**309**	**291**	**306**	**236**

Projected reservoir levels at Elephant Butte Reservoir were modeled for the No Action and Proposed Action using a March 1st forecast. Modeled Project reservoir elevations at the start of start of year 2013 are based on actual Project conditions at the end of the 2012 irrigation season. From that point forward, conditions are simulated for year 2013 through year 2015. Thus, conditions in the model for the beginning of year 2013 are representative of but not the same as actual conditions and are identical under the Proposed Action and No Action alternative. Non-exceedance curves of Elephant Butte Reservoir elevation are different for each year due to the effects of prior-year operations on current year elevation; however, the general characteristics of non-exceedance curves for 2013 and 2014 are similar to those for 2015. For the duration of the proposed action, reservoir elevations are projected to be between 4309 -4322 ft. at the 20^{th} percentile and from 4309-4355 ft. at the 80^{th} percentile (Table 4.11) (Figures 4.24).

Table 4.11. Elevation (ft) of water in Elephant Butte Reservoir from 2013 - 2015.

	No Action			Proposed Action (OA)		
	20 %	50 %	80 %	20 %	50 %	80 %
2013	4309	4309	4309	4309	4309	4309
2014	4315	4318	4324	4321	4324	4341
2015	4314	4320	4330	4322	4326	4355

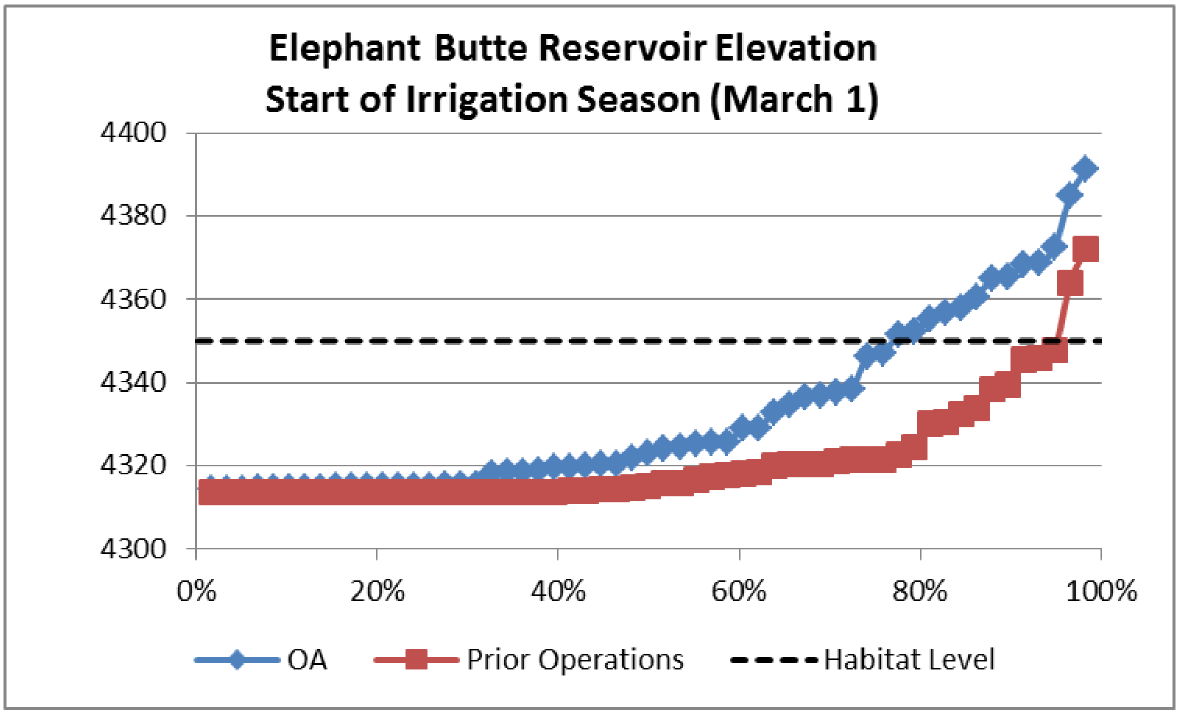


Figure 4.24. 2015 Elephant Butte Reservoir elevation non-exceedance curve.

Conclusion for Elephant Butte Reservoir

The 2007 EA and FONSI resulted in a determination that the proposed OA would have no effect to any proposed or federally listed species or critical habitat during the five years covered in the EA (through 2012). As shown in figure 4.10 (which was updated from the draft EA), reservoir elevations in 2008, 2009, and 2010 were slightly higher than an elevation of 4,345 ft, which is the lowest elevation where flycatchers occurred (previous draft EA indicated 4,355 ft). This resulted in inundations of several flycatcher territories in each of those years (1 in 2008, 1 in 2009 [maybe a few more as the water reached 4,352.86 ft. elevation on June 10, 2009, since there were 18 territories between 4,350-4,355 ft. elevation in the river mile 41 to 43 section of the Narrows, and the reservoir was down to 4,349.88 by July 2, 2009], and 3 in 2010) (Table

4.10). Water levels are estimated to have been from 2.56 - 5.18 (average 2.43) feet high underneath nesting trees during the period flycatchers are present (May 1-September 1). No flycatcher nests were flooded, in fact nests are typically in the mid- and upper canopy of the nest tree well above any surface water underneath. The number of territories at elevations between 4,345 – 4,355 increased in 2011 and 2012; in retrospect, suggesting that the extent and timing of the inundation in previous years could have indirectly benefited the habitat needed by the flycatcher (Appendix D). As noted below, elevations below 4,375 ft at RM 54 are outside of designated critical habitat.

This EA evaluates the potential effects for the next three years (2013-2015). To evaluate the potential impact of the Proposed Action on flycatcher nest habitats, projected reservoir elevations were compared to elevations of flycatcher territories identified in 2012 flycatcher surveys at Elephant Butte Reservoir. Based on this comparison, no flycatcher territories are anticipated to be inundated in 2013 or 2014. In 2015, the highest water levels that might occur under the wettest scenario evaluated (80% non-exceedance probability) could reach 4,355 feet in elevation. Under this unlikely scenario (particularly in light of the extremely dry forecast for 2013), up to six territories from the 2012 survey could be inundated; two territories between elevations 4,345 and 4,350 feet and four territories between elevations 4,350 and 4,355 feet. These inundations are most likely to occur prior to the start of flycatcher nesting season. Also, as noted above, the presence of surface water in flycatcher territories during the breeding season is considered important to successful nesting. Eighteen flycatcher territories, located above 4,355 ft. (between elevations 4,355-4,360 ft.), are not expected to be affected.

Rio Grande from Caballo Reservoir to El Paso

Reclamation surveyed for flycatchers from Caballo Reservoir to El Paso in areas of suitable flycatcher habitat during the summer of 2012. Twenty-eight total flycatcher territories were observed, which exceeds the recovery goals for this Rio Grande Management Unit of 25 total territories (Reclamation 2013). The riparian and aquatic habitat in the river downstream from Caballo to El Paso is not expected to change under either alternative. The river below Caballo Reservoir is projected to have releases within the range of historical operations over the next three years under the Proposed Action. These releases will support existing and proposed habitat restoration projects, such as the 30 riparian habitat sites IBWC agreed to enhance with the signing of the 2009 Record of Decision. Below Caballo, the entire river channel to El Paso is more directly influenced by the lack of releases during the non-irrigation season and by monsoon rains. During the non – irrigation season the further south on the river, groundwater or secondary arroyos may provide enough water into the river for short sections to keep the river wet.

Conclusion for Rio Grande below Caballo

Based on projected operations of the Proposed Action in the reach below Caballo Reservoir, there would be no effect to the flycatcher. No critical habitat for this species occurs in this reach and therefore there will be no effect to designated critical habitat.

Critical Habitat

The elevation of designated critical habitat within Elephant Butte Reservoir, based on the final designation at RM 54, is about 4,375 ft., and water levels are not expected to be higher than 4,355 ft. during the period of time evaluated in this EA. Therefore, there will be no effect to designated flycatcher critical habitat.

In summary, we have determined that the proposed action will have no effect to the flycatcher or designated critical habitat under this supplemental EA. Reclamation will be monitoring the location of flycatcher territories and actual reservoir levels during the 2013 – 2015 breeding seasons. If information indicates that there could be potential for adverse impacts to flycatchers, we would coordinate and consult with the Service pursuant to the requirements of Section 7 of the ESA. We will also update the Service regularly with current hydrological and biological data.

Rio Grande Silvery Minnow

In 2010 and 2011, silvery minnow were collected within the temporary channel in Elephant Butte Reservoir between RM 45.8 and 54.5. In general, silvery minnow were more abundant at sites above RM 50. No sampling occurred downstream of RM 45.8 due to accessibility issues. In 2012, no silvery minnow were found (Table 4.12). The fish has been extirpated from the rest of the action area below Elephant Butte Reservoir.

Table 4.12. Fish species collected during September sampling in the temporary channel within Elephant Butte Reservoir pool from 2010 – 2012.

	2010		2011		2012	
	#	#/100 m²	#	#/100 m²	#	#/100 m²
Rio Grande silvery minnow	233	24.07	65	2.83	0	0
Red Shiner	78	6.68	219	9.53	1044	29.74
Western Mosquitofish	41	3.70	26	1.13	1287	36.66
Channel Catfish	24	1.93	55	2.39	11	0.31
Flathead Chub	2	0.30	3	0.13	2	0.06
Threadfin Shad	1	0.09	0	0	0	0
Yellow Bullhead	1	0.08	0	0	0	0
River Carpsucker	0	0	7	0.30	0	0
Common Carp	0	0	0	0	2	0.06
Logperch	0	0	0	0	2	0.06
Fathead Minnow	0	0	0	0	1	0.03

Adult silvery minnow are strong swimmers capable of moving upstream substantial distances (25km) (Bestgen et al. 2010). As the reservoir fills, silvery minnow can move upstream into suitable habitat. The Rio Grande Silvery Minnow Recovery Plan (Service 2010) states that adults, eggs and larvae are transported downstream to Elephant Butte

Reservoir but it is believed that none of these fish survive because of poor habitat and predation from reservoir fishes. As mentioned above, no critical habitat for the silvery minnow occurs within the action area of the proposed action.

The silvery minnow does not have critical habitat within the Project area. The full pool of Elephant Butte Reservoir is influenced by Project operations, but provides poor quality habitat. There is a relatively low abundance of silvery minnow within the associated temporary channel, and fish within this reach have the ability to move upstream. Therefore, it is concluded that the Proposed Action would have no effect on the silvery minnow.

<u>How would No Action affect listed species?</u>

Interior Least Tern

Due to the highly unlikely presence of the species in the Project area, we have determined the No Action alternative would have no effect on the tern.

Piping Plover

Due to the highly unlikely presence of the species in the Project area, we have determined the No Action alternative would have no effect on the Piping Plover.

Southwestern Willow Flycatcher

Elephant Butte Reservoir

Under the No Action alternative, during the next 3 years, reservoir elevations at Elephant Butte are projected to be between 4309 - 4314 ft. at the 20th percentile and from 4,309-4,330 ft. at the 80th percentile (Figure 4.24). Based on the elevations of flycatcher territories identified in 2012 at Elephant Butte Reservoir (the lowest territories are between elevations 4,345-4,350 ft.), modeling of the no action indicates that no flycatcher territories would be impacted by water levels during the next 3 years. As indicated previously, critical habitat is estimated to be above elevation 4,375 ft. Therefore, the No Action alternative would have no effect to flycatchers or its designated critical habitat.

Rio Grande from Caballo to El Paso

In the reach of the Rio Grande between Caballo Reservoir and El Paso, operations under the No Action have not shown to adversely affect the flycatchers near Seldon Canyon. The riparian and aquatic habitat in the river downstream from Caballo to El Paso is not expected to change under either alternative. The river below Caballo will have releases within the range of historical operations. Below Caballo, the entire river channel to El Paso is more directly influenced by the lack of releases during the non-irrigation season and by monsoon rains. During the non – irrigation season the further south on the river, groundwater or secondary arroyos may provide enough water into the river for short sections to keep the river wet. Therefore, the No Action alternative would have no effect on flycatchers or its designated critical habitat.

Rio Grande Silvery Minnow

The silvery minnow does not have critical habitat within the Project area. The full pool of Elephant Butte Reservoir is influenced by Project operations, but provides poor quality habitat. There is a relatively low abundance of silvery minnow within the associated temporary channel, and fish within this reach have the ability to move upstream. Therefore, it is concluded that the No Action alternative would have no effect on the silvery minnow.

4.3 Cultural Resources

4.3.1 Basis of Significance

As stated in the 2007 assessment, a significant impact to a cultural resource would be an adverse effect that would alter the characteristics of an historic property that would qualify it for the National Register of Historic Places. A significant effect to an Indian sacred site would prohibit access or result in physical damage or destruction. While consulting for this supplemental EA, an additional tribal resource of concern was identified, i.e., native plants growing along the irrigation canals. A significant effect to such a resource would have to be identified by the concerned tribe during the consultation process.

4.3.2 What is the status of cultural resources?

Historic properties listed on the National Register of Historic Places are present within the area of potential effects of this undertaking. Elephant Butte Dam and the diversion dams and the Franklin Canal are listed on the National Register of Historic Places as an historic district. Other historic properties include the Garfield Lateral (LA-111726), Pittsburg Placer Mine (LA-13557), a Mogollon pithouse site (LA-2806), and an Apache battle site (LA-132559). In a follow up conversation in response to a Reclamation scoping letter, the Mescalero Apache Tribe had concerns with native plants growing along the irrigation canals in the service areas of the EBID and EPCWID. The Mescalero Tribe collects plant material for cultural purposes.

4.3.3 How would Both Alternatives affect cultural resources?

The method for assessing adverse effects to historic properties is whether changes would occur to alter the character-defining characteristics, and if so, whether a contemporary from the period of significance would recognize the property today. Neither the Proposed Action nor the No Action alternative would visually impact Elephant Butte Dam or contributing elements to the historic district, so there would be no adverse effects to these listed properties. No Indian sacred sites have been identified within the Project area, so there would be no effects to this type of cultural resource. The culturally important plant resources growing along Project canals would not be affected by either alternative because Project water will continue to flow in these canals and allow the growth (and harvesting) of plants valued by the Mescalero Apache Tribe.

Elephant Butte Reservoir has been receding to a size that only the southern pool remains inundated. The current lake boundaries are well within the high water mark, and what is above water is a steep highly eroded slope of the reservoir from high water to current conditions. Under both alternatives the fluctuation, and any wave action, of the reservoir will not affect undisturbed land around the perimeter of the reservoir. Under the No Action, the Elephant Butte Reservoir is projected to fluctuate 21 feet and under the Proposed Action the model assesses that the reservoir will fluctuate 56 feet in year 3, all within the existing normal high water mark level. Caballo Reservoir fluctuation will not change. The alternatives do not modify the high pool elevation at either reservoir. A Class III archeological survey of Elephant Butte and Caballo Reservoirs was conducted in 1998 and 1999. Since then several site assessments have been conducted. In sum, the proposed alternatives will not modify the fluctuation of the reservoirs and there will be no new impacts to cultural resources.

The two sections of the Rio Grande that are covered by the alternatives will maintain historic flows. Aside from the diversion dams, which will have no operational or physical changes, there is no Reclamation-owned land along the river. The two districts farm the entire floodplain and farm as close to the bankline as possible. Flows in the river channel are not projected to be higher than historic flows as a result of the alternatives, nor is overbanking projected to occur. There will be no impacts to cultural resources from either alternative at the river sections between Elephant Butte and Caballo Reservoirs and from Caballo Reservoir to El Paso.

4.4 Socioeconomic Resources

The analysis of social and economic conditions addresses the relationships between the Proposed Action and communities it may affect. The study area for socioeconomic analysis is based mostly on county-level data from Sierra, Dona Ana, El Paso and Hudspeth counties. While the northern end of Elephant Butte Reservoir is in Socorro County, it is excluded because there is no acreage in the county irrigated by the Project.

4.4.1 Basis of Significance

As stated in the 2007 EA, a significant socioeconomic effect would negatively affect public health, alter regional economics or recreational opportunities, or result in a disproportionately high and adverse human health or environmental effect on low-income or minority populations.

4.4.2 Farming and Land Use

<u>What is the status of farming and land use?</u>

Limiting factors for agricultural producers in EBID and EPCWID include surface and groundwater, land, labor and capital, technological constraints such as crop varieties, and weather conditions that influence crop yields (Ward et al. 2001:111). There are 90,640 acres of land within EBID that have authorized water rights, with an estimated 7,900 water users (DeMouche 2004). There are 69,010 acres within EPCWID. According to Ward et al. (2001:106), under a full-supply of both surface and groundwater, there are generally 82,680 planted acres within EBID and for EPCWID. There are generally 53,300 acres planted under a full supply of surface water. There is no substantial groundwater development by EPCWID. Table 4.13 shows the acres planted in EBID during the full allocation year of 2002 and the less-than-full-allocation year of 2003.

For both districts, three types of crops are grown: vegetable crops, row crops, and pecans. Vegetable crops include lettuce, chilies, and onions, which are generally grown under contract with a constant amount of land devoted to these crops from one year to the next. Profitability is high for these crops, but can vary widely. Row crops such as cotton or grain sorghum are generally less profitable, but have more stable returns than vegetables.

Acreage grown varies as national prices for row crops vary (Ward et al. 2001:112). Pecans are a major and highly profitable crop for EBID and EPCWID, but with a high initial investment cost (Ward et al. 2001:112). Producers will go to great lengths to protect their investment in pecan orchards. Several EBID growers have drilled wells 500 feet deep or more to help insure dependable supplies of water for this valuable crop.

Table 4.13. Acreage by Crop Type, EBID, 2002 to 2003. (Ward, et al. (2005)

	Year	
Acres/Crop	2002	2003
Vegetable	19,347	18,373
Row	16,710	15,253
Pecans	3,287	2,961
Total Acres	39,344	36,587

The economic value per AF to the districts is highly variable, ranging from $30 to $155. The marginal value of an AF under a drought can rise to $213 per AF for surface water (Ward et al. 2001). For this analysis, the value of an AF is set at $100 (cf. Ward, et al. 2006).

How would Both Alternatives affect farming and land use?

The effect to both districts of the Proposed Action is that it reduces water use in wet years, when its economic value at the margin is small, leaving some water in storage. In dry years, the accumulated water would be available for beneficial use, when its economic value at the margin is higher due to its greater scarcity (Hooper and Ward 2006). Land may be fallowed or type of crops shifted to try and maximize farm income, but this would occur under either alternative. To approximate the effects of the Proposed Action, releases from Caballo Reservoir associated with the 50th percentile nonexceedance probability were multiplied by the value of $100 per AF. As shown in Table 4.14, for these years, income under the Proposed Action is projected to be higher than that under the No Action alternative in 2015, about the same in 2014, and lower in 2013. As mentioned in Section 4.2.2.3, changes in surface water supply must be considered in the context of existing groundwater pumping and surface water operations, the general state of groundwater and surface water resources in the basin, and the interaction of groundwater and surface water resources within the basin. This simple analysis does not fully consider the groundwater available to EBID farmers for supplemental irrigation

Table 4.14. Hypothetical Farm Income under Alternatives.

Year	OA AF	No Action AF	Income under OA	Income under No Action
2013	458,071	536,507	$45,807,100	$53,650,700
2014	574,240	582,205	$57,424,000	$58,220,500
2015	659,445	612,826	$65,944,500	$61,282,600

4.4.3 Parks and Recreation

What is the status of parks and recreation?
Elephant Butte Reservoir is the largest, most heavily visited reservoir in the region (Booker et al. 2005). It is managed for its reservoir-based recreational values by NMSP under contract with Reclamation, along with Caballo Lake State Park, Percha State Park, and Leasburg Park. From 2000 to 2011, Elephant Butte averaged 1,205,279 visitors a year and Caballo Reservoir averaged 216,219 visitors per year (NMSP data). Boating is the primary recreational use at the parks with sport fishing secondary.

How would Both Alternatives affect parks and recreation?
A regional travel cost model developed by Booker et al. (2005) and Ward et al. (2001) is applied to estimate differences in economic value between the alternatives. The model is based on telephone surveys of water-based visitor use patterns from 1988 to 1989, updated by total visitor use counts in 2000. This was a wet period, but annual reservoir fluctuations resulted in the following equations which can be applied to projected Elephant Butte Reservoir storage water:

$$\text{Annual Economic Benefits} = \lambda_0 \,(\text{Reservoir volume})^{\lambda 1}$$

Where $\lambda_0 = 172.43$ is in thousand dollars per year and $\lambda 1 = 0.51$, and reservoir volume is in thousand AF. The equation applied to the 50th percentile estimated volume of Elephant Butte Reservoir for future years is shown in Table 4.15 by year and alternative.

Table 4.15. Travel Cost Model Applied to Elephant Butte Recreation.

Year	OA AF	No Action AF	OA AF	No Action AF
2013	191	191	2,511.54	2,511.54
2014	319	269	3,262.47	2,990.79
2015	348	282	3,410.50	3,063.66

For example, if average annual volume at Elephant Butte is 348 (thousand) AF in 2015 under the Proposed Action, annual visits are predicted to be (172.43 x (348) raised to the 0.51 power = 3410 (thousand) dollars in benefits per year or $3,410,500. This same projected year under No Action would result in $3,063,660. On average, the first three years under the Proposed Action would result in a mean benefit of $3,061,500 under action and $2,855,330 under no action.

4.4.4 Environmental Justice

What is the status of environmental justice communities?

Federal agencies are directed by Executive Order 12898 to identify and address disproportionally high and adverse effects of their projects on the health or environment of minority or low-income populations. A minority population is defined as African American, Hispanic, Asian American, American Indian, and Native Hawaiian. Low-income is defined by the Office of Management and Budget's Directive 14 as varying by family size. If the affected area has a minority or low-income population more than 20 percent higher than the reference area, further analysis is necessary to determine if these populations would receive a disproportionally higher share of adverse Project impacts.

Table 4.16 shows that 78 percent of the four counties that receive Project water is Hispanic, compared to 46 percent of New Mexico and 37 percent of Texas. Thus, for purposes of environmental justice, the four Project counties have minority populations higher than that of New Mexico and Texas so the counties qualify as environmental justice minority communities.

Table 4.16. Minority Population of the Four Rio Grande Project Counties, 2011 (U.S. Department of Commerce. 2012)

	Dona Ana, NM	Sierra, NM	El Paso, TX	Hudspeth, TX	New Mexico	Texas
Total Population	205,637	11,925	787,410	3,433	2,037,136	24,774,187
Hispanic or Latino	134,659	3,231	644,844	2,754	934,301	9,216,240
White alone	62,379	8,234	105,697	551	832,435	11,349,192
African American alone	2,982	25	20,854	87	35,602	2,856,383
American Indian alone	1,699	139	1,754	0	175,904	69,329
Asian alone	2,255	0	7,790	41	25,595	927,023
Native Hawaiian alone	22	0	596	0	941	17,758
Some other race	267	0	1,033	0	3,907	40,018
Two or more races	1,374	296	4,842	0	28,451	298,244
Percent of Total						
Hispanic or Latino	65.5	27.1	81.9	80.2	45.9	37.2
White alone	30.3	69.0	13.4	16.1	40.9	48.8
African American alone	1.5	0.2	2.6	2.5	1.7	11.5
American Indian alone	0.8	1.2	0.2	0.0	8.6	0.3
Asian alone	1.1	0.0	1.0	1.2	1.3	3.7
Native Hawaiian alone	0.0	0.0	0.1	0.0	0.0	0.1
Some other race	0.1	0.0	0.1	0.0	0.2	0.2
Two or more races	0.7	2.5	0.6	0.0	1.4	1.2

Figure 4.25 shows that Hudspeth County qualifies as a low-income community for environmental justice analysis having 44.7 percent of individuals living in poverty compared to 14.3 percent for the United States or 17.0 percent for Texas.

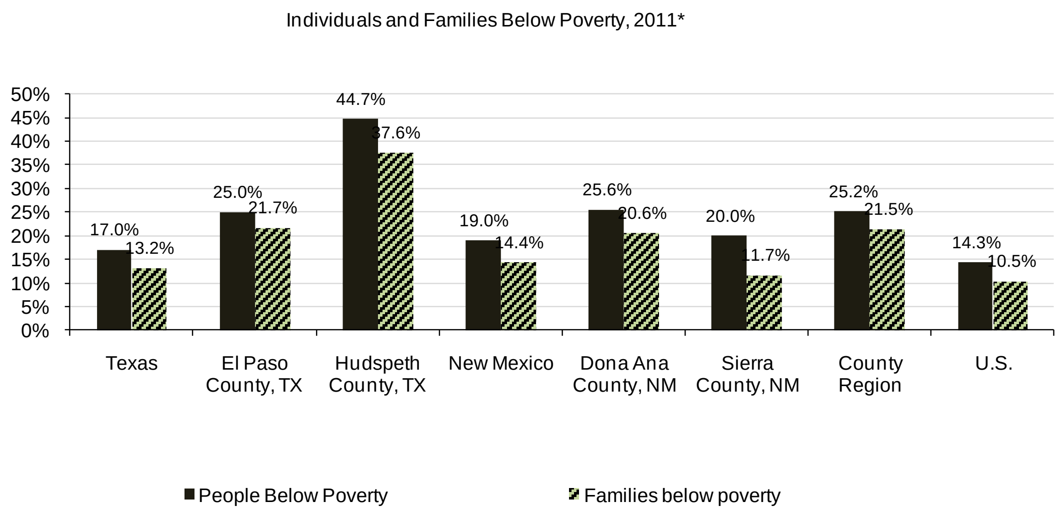


Figure 4.25 Distribution of low-income people and families in Project counties, 2011.

<u>How would Both Alternatives affect environmental justice communities?</u>
A disproportionately high and adverse effect on an environmental justice community means the adverse effect would be predominately borne by that community or would be appreciable more severe or greater in magnitude on the environment justice community than the effect on the overall population within the Project area. For the Project, the counties are predominately Hispanic compared to the rest of New Mexico and Texas, but the greatest concern lies with the two Texas counties of El Paso (82 percent Hispanic) and Hudspeth (81 percent Hispanic). As mentioned above, Hudspeth County is also a low-income county for environmental justice.

Looking at the water quality results, the two Texas counties have worse water quality than the upstream counties; however, El Paso has mitigated for this effect through its water treatment facilities. Further, neither of the alternatives would result in a significant impact. For socioeconomic purposes, the travel cost model and the extrapolation to farming incomes was not divided by counties, and so an estimate of disproportionate effects cannot be made. However, as in the 2007 EA and FONSI, Reclamation is committed to monitoring the effects of its selected alternative and committed to obtaining data about biophysical processes and their effects on the human environment. As a result, the Proposed Action will not have a disproportionately high or adverse effect on an environmental justice community.

4.5 Indian Trust Assets

What is the status of Indian trust assets?

Indian trust assets (ITA) are legal interests in property held in trust by the United States for Indian tribes or individuals. Reclamation consulted with the Mescalero Apache, the Indian tribe whose aboriginal territory is located within the current Project area, but they did not identify any ITAs that could be affected by either alternative.

5 Consultation and Coordination

5.1 Lead and Cooperating Agencies

Reclamation is the lead agency in preparing this supplemental EA and was assisted in the process by five cooperating agencies: IBWC, Corps, EPCWID, EBID, and the Texas Rio Grande Compact Commission. Reclamation consulted with and obtained the comments of these agencies due to their jurisdiction by law or special expertise with respect to potential environmental effects of the proposed action.

5.2 Public Involvement and the Scoping Process

Scoping is the phase in the NEPA process whereby the initial scope of issues to be analyzed is determined. This phase occurs early in the process and is intended to obtain the views of the public, agencies, Indian tribes, and other interested parties regarding the scope of the analysis.

Reclamation mailed scoping letters to potentially interested parties in January and April, 2012 and hosted two public scoping meetings in El Paso, Texas and Las Cruces, New Mexico. These meetings were held on April 25, and 26, 2012, respectively. The purpose of these meetings was to solicit input from the public regarding the format, content and analysis to be considered during the NEPA process. Meetings were announced in local newspapers and in a “Drought Watch on the Rio Grande.” The outcome of this public input process was a decision by the AAO Area Manager to supplement the 2007 EA.

One of the concerns raised during scoping was the duration of the analysis. The 2007 EA projected effects over a five-year period; i.e., through December of 2012. In 2008, the OA was signed with a 50-year duration. Some commenters wanted an analysis covering the full period of the agreement. As discussed in Section 1.0, the period of analysis for this supplemental EA is an initial three year period. During this three year period, Reclamation will voluntarily commence and actively pursue, upon completion of the current NEPA process, the development and refinement of the existing modeling tools to thoroughly analyze the implementation of the OA over its remaining life (i.e., for the period through 2050) through an EIS.   Through this overall approach, Reclamation is prioritizing resources for both the immediate future and the extended future to ensure that such information is completed in a timely manner to assist in the public's consideration of the Proposed Action.

Reclamation issued a draft of this supplemental EA for public review on May 8, 2013. The comment period ended on June 6, 2013. Comments received from the public were reviewed and incorporated into this final supplemental EA (see Appendix G). Consideration of comments resulted in minor editorial changes, clarification, and additions to this final supplemental EA, as noted in the responses to comments.

5.3 Tribal Consultation

In January 2012 and again in April 2012, Reclamation mailed potentially interested and affected Indian tribes a letter notifying them of the Proposed Action and inquiring whether they wanted government-to-government consultation. The letters were followed up with emails or phone calls. The Mescalero Apache Tribe was the only tribe offering comments. The following tribes were sent the mailing, but had no comments or concerns or did not respond: Apache Tribe of Oklahoma, Comanche Nation, Kiowa Tribe of Oklahoma, Hopi Tribe, Navajo Nation, Pueblo of Isleta, Pueblo of Acoma, White Mountain Apache Tribe, and Ysleta del Sur Pueblo.

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The following organizations or persons provided information that assisted in the preparation of this document (it does not include those who commented during scoping).

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