DOLORES PROJECT DROUGHT CONTINGENCY PLAN

A plan to reduce the impacts of drought for users of the Dolores Project by implementing mitigation and response actions to decreases theses impacts

~~*November*~~ *January* ~~*2017*~~*2018*

DOLORES WATER CONSERVANCY DISTRICT

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ABBREVIATIONS AND DEFINITIONS

1998 Report – 1998 Reconnaissance Report
AF – acre-feet
CCL&W – Consolidated Land and Water Company
CCU – Crop Consumptive Use
CDOT – Colorado Department of Transportation
CEDS – Economic Development Strategy
cfs – cubic feet per second
CRBFC – Colorado Basin River Forecast Center
CRSP – Colorado River Storage Project Act of 1956
CWCB – Colorado Water Conservation Board
DCC – Dove Creek Canal
DPR – Definite Plan Report
DWCD – Dolores Water Conversancy District
DWR – Division of Water Resources
EDS – Energy Dissipating Structure
ENR – Engineering News Record
ENSO – El Niño/Southern Oscillation
EQIP – Environmental Quality Incentives Program
FEIS – Final Environmental Impact Statement
FRE – Ute Mountain Ute Tribe's Farm and Ranch Enterprise
FSA – Full Service Allocation Irrigators
HDCD – High Desert Conservation District
HDPE – High-density polyethylene
KAF – one hundred thousand acre-feet
M&I – Municipal and industrial
M&R Team – Dolores River Native Fish Monitoring and Recommendation Team
McPhee – McPhee Reservoir
MVIC – Montezuma Valley Irrigation Company
MVID – Montezuma Valley Irrigation District
NASA – National Aeronautics and Space Administration
NIDIS – National Integrated Drought Information System
NOAA – National Oceanic and Atmospheric Administration
NRCS – Natural Resources Conservation Services
OM&R – Operation, Maintenance, and Replacement
Plan – Dolores Project Drought Contingency Plan or Drought Contingency Plan
Plateau – Upper Plateau Creek Reservoir
Project – Dolores Project
Reclamation – United States Bureau of Reclamation
SCADA – Supervisory control and data acquisition
SLO – Selective Level Outlet
SPI – Standard Precipitation Index
SNOTEL – Snow Telemetry
SWCD – Southwestern Water Conservation District
SWE – Snow water equivalent
THC – Towaoc/Highline Canal
USGS – United States Geological Survey
Western – Western Area Power Administration
WMCP – Water Management and Conservation Plan
WY – Water Year

EXECUTIVE SUMMARY

The Dolores Project (Project) is a Bureau of Reclamation (Reclamation) multi-purpose project located in Montezuma and Dolores Counties in southwest Colorado. The Project is operated by the Dolores Water Conservancy District (DWCD). The primary facility is the 381,000 acre-foot (AF) McPhee Dam and Reservoir (McPhee), with 229,000 AF of active capacity, located just downstream from the Town of Dolores on the Dolores River. The primary facility was completed in 1986. New delivery canals and irrigation laterals associated with the Project were completed in 1999; permitting all current Project waters users to receive their full allocations of water, if available. In 1993, the DWCD and Reclamation initiated the process for transferring responsibility responsibilities for the operation, maintenance and replacement (OM&R) of Project facilities. The transfer was, which was completed by 1998; DWCD provides OM&R for the Project.

The Dolores River, originating northeast of the District DWCD service area in the San Juan and La Plata Mountains, is the main source of water for the Project and storage in McPhee. Flows in the river vary considerably within and between years. Peak flows result from spring snowmelt in the headwaters of the San Juan Mountains, usually occurring in May and averaging 3,000 cubic feet per second (cfs);, reaching upwards of 5,000 cfs in some years. The volume of spring runoff is similarly variable, ranging from about 60,000 to over 500,000 AF per year. Tributaries to the Dolores River also collected in McPhee include Lost Canyon Creek, West Dolores River, Beaver Creek, House Creek, and Plateau Creek.

McPhee's active pool of approximately 229,000 AF has been fully allocated to specific water users through contracts with Reclamation. These specific Project water users include: to:

1) Individual farmers with approximately 28,900 allocated acres of full-service irrigation land northwest of McPhee delivered by the Dove Creek Canal;
2) 7,500 acres on the Ute Mountain Ute Reservation operated by the Ute Mountain Ute Tribe Farm and Ranch Enterprise (FRE) delivered through the Towaoc-Highline Canal;
3) Montezuma Valley Irrigation Company (MVIC) which receives a supplemental irrigation supply from the Project to supplement its Non-Project Colorado water rights;
4) The City of Cortez, the Town of Dove Creek, and the Tribal tribal community of Towaoc that receive M&Imunicipal and industrial (M&I) water; and
5) Water to be released from McPhee for downstream fish and wildlife purposes.

During drought conditions, all allocations except M&I water share *pro rata* in the shortage. At the end of a water year on October 31, any water remaining in McPhee is carried over to the next year for re-allocation to all users. No user can carryover water from one year to the next.

DWCD prepared this Dolores Project Drought Contingency Plan (Plan) to evaluate potential mitigation and response actions that may be implemented to reduce the water shortages and provide greater drought resiliency for the Project water user's; primarily the irrigators and fishery downstream of the Project. A Planning Task Force was formed consisting of the funding stakeholders—: DWCD, MVIC, FRE, and Reclamation representatives. They met regularly to discuss and develop actions while providing oversight of data analysis, reviewing work productionsproducts and participated in public stakeholder outreach efforts. The Plan serves as a source of information about the Project including the six required elements of a drought contingency plan.

The current drought monitoring process by DWCD and Reclamation utilize the runoff projections made by NOAA's Colorado Basin River Forecast Center (CBRFC), and other agencies. DWCD monitors data using a daily inflow/outflow spreadsheet which tabulates Project water supply and usage on a daily basis. Low elevation snowpack, between about 7,500 and 9,000 feet, is manually monitored to be used in conjunction with daily NRCS SNOTEL data for higher elevation sites. Drought monitoring by other agencies is also utilized. The CBRFC provides information on weather, climate, streamflow data, and water supply forecasts. Since nearly 80% of the runoff in the ~~Basin~~ Dolores River Basin comes from snowmelt~~, the Colorado River Basin is unique and forecasting this snowmelt, and~~ subsequent runoff projections ~~is~~ are an ever-moving target. Thus, CBRFC issues seasonal forecasts for water supply and snowmelt peak flows both monthly and bi-monthly during the runoff period.

The Project water users have experienced three major shortages since 2000. In the shortage years of 2002 and 2013, the Project water users received approximately 25% to 30% supply of water in 2002 and in ~~the shortage year 2003~~ 2013 a 50% supply of water was received. A water supply shortage may be caused by hydrology (i.e. the drought of 2002) or operational obligations (i.e. a user's contractually allocated water supply). The vulnerability assessment, to the extent possible, quantitatively evaluates the impact of the shortages on each of the Project water users.

The FRE is vulnerable to actual hydrologic shortages and projected shortages whether there is an actual shortage or not. This vulnerability is partially due to the FRE needing to determine the crop rotation in early ~~April~~ March based on ~~April~~ March 1 runoff projections which have been shown to be inaccurate in some years. In general, runoff projections become more accurate as time goes by. The Full-Service Area (FSA) irrigators are vulnerable to hydrologic drought and to some lesser extent projected shortages because FSA irrigated lands are located at higher elevations allowing for utilization of May 1 runoff projections. Therefore, FSA irrigators are vulnerable to actual droughts and less dependent upon projections. MVIC has very senior direct flow water rights, allowing users to be less vulnerable to hydrologic droughts unless conditions are extreme, such as in 2002. MVIC is vulnerable in runoff years when McPhee spills because its water stored in McPhee in April, May, and June also spills. The native fish downstream of McPhee are most vulnerable to long-term, year after year, shortages and less so to one-year shortages. Due to the limited stored water being dedicated to Project users to provide for contractual allocations and carryover storage, there are, obviously, no spills and no boating during drought years. The boaters are vulnerable to below average runoff which occurs in approximately half of the years based on historic hydrology.

Numerous potential mitigation and response actions were identified and evaluated. A mitigation action aims to mitigate the risks posed by drought and build long-term resiliency. Mitigation actions are categorized by structural and non-structural actions and may be implemented prior to a drought. A response action is a non-structural response that can be implemented during a drought year and, or during stages of drought to better manage the limited supply and decrease the severity of immediate drought related impacts.

Throughout the Plan's development, the Planning Task Force discussed and evaluated potential ~~mitigation~~ actions. The Plan is not a decisional document but, instead, lists potential actions for entities to consider in the future. ~~No~~ Some priorities were established, however because there are so many variables and entities involved in deciding which actions might be pursued not all actions were prioritized. Also, NEPA compliance is not required as part of the Plan but will be necessary on some of the actions that have a "Federal nexus".

The potential mitigation structural actions are described in the body of the Plan and listed in ~~Table 14~~Section 5.3. These structural actions range from piping of unlined ditches, valving of pipelines to improve operations, on-farm improvements, additional reservoir storage, and hydropower development to provide ~~funds~~a recurring revenue stream. Additional improvement opportunities exist for infrastructure upgrades. These upgrades improve water delivery, water management, and provide irrigators with pressurized water ~~existing~~ within the MVIC system. System wide improvements lead to more on-farm improvement opportunities. For the FSA irrigators, the biggest potential exists for on-farm efficiency improvements ~~and~~. DWCD is partnering with High Desert Conservation District (HDCD) in an effort to investigate and improve eligibility requirements for FSA irrigators to utilize available funding sources.

The need for joint operations of facilities and coordination of Project users also exists. Examples of coordination include better management of releases down a specific canal to eliminate waste, moving stored water from one reservoir to another for Project wide benefits, or joint communications and messaging to the general public.

Potential non-structural response actions were identified that could be implemented during a drought year. These actions may be implemented during specific stages of drought to better manage the limited supply and decrease the severity of immediate drought related impacts. Non-structural response actions generally include the following types of potential actions by Project participants:

- During a drought, an active communication structure among all Project users to provide information surrounding the timing and volume of available water. Monitoring of water supply projections would be increased to better inform forecasts used by Project users.
- Leasing of available water from one Project user to another when specific types of shortages are experienced.
- Re-operations of reservoirs during specific types of shortages.

DWCD shall take the lead in monitoring drought conditions and notify Project users of the severity of potential shortages. To the extent that they are willing, Project users are responsible for implementing actions specific to their structural and non-structural water management needs. Procedures needed to implement actions may vary by action or by Project user responsible for implementation. When an action involves policy agreement between multiple parties, staff will facilitate coordination to seek common alignments among the parties.

The Plan should not be considered a commitment to complete the identified ~~response~~ mitigation and ~~mitigation~~ response actions, nor should it be considered the last word on the present and future mitigation and response actions for the ~~Dolores~~ Project and its users. The Plan will be reviewed and updated periodically to assure that it is effectively addressing current hydrologic conditions and the changing needs of ~~either~~ those entitled to receive water from the Project or those water users entitled to divert and deliver their water rights using Project facilities.

Decreed water rights and existing contracts will need to be analyzed and reviewed in correlation with the implementation of any mitigation actions proposed by this Plan or any mitigation actions proposed at a later date.

Stakeholder involvement included the funding stakeholders and ~~the~~ public stakeholders. The funding stakeholders oversaw the development of the Plan and the public stakeholders reviewed the draft ~~report~~ Plan and provided numerous comments that have been included in the final Plan. The public stakeholder comments ~~included~~ ranged from comments not requiring a response, suggested improvements to the Plan ~~and~~ or specific questions. There were nearly 50 sets of comments with the majority ~~relating~~ from ~~to~~ McElmo Creek water users. The comments are paraphrased and identified in the Plan and, in many instances, the Plan was modified to address the comments or to include the suggested improvement. All comments in their entireties are provided in Appendix C.

DISTRICT BOARD RESOLUTION TO ADOPT PLAN

To be included later once Plan has been reviewed by Reclamation and Boards

ACKNOWLEDGEMENTS

The Dolores Water Conservancy District Board of Directors would like to thank all who participated in the 2017 Dolores Project Drought Contingency Plan development process. This Plan was funded by the United States Bureau of Reclamation, Dolores Water Conservancy District, Montezuma Valley Irrigation Company and the Ute Mountain Ute Tribe's Farm and Ranch Enterprise. Along with the funding partners and their staff, the Plan was prepared with the cooperation of the Colorado Division of Water Resources, Dolores Water Conservancy District Full Service Area Irrigators, Montezuma Valley Irrigation Company shareholders, and other interested stakeholders. Harris Water Engineering, Inc. would like to especially thank the members of the Planning Task Force for their regular participation in meetings, cooperation, patience, and assistance in the preparation of the Plan.

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The Dolores Water Conservancy District welcomes any comments that may improve the utility of this Plan. Please forward comments to the following address:

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1 Introduction

1.1 Purpose of the Drought Contingency Plan

The Dolores Project (Project) experienced severe shortages in 2013 (40% supply), and as of May 1, 2014, and 2015 were projecting shortage conditions until unusual late spring rains provided sufficient water to achieve a full supply. The Dolores Water Conservancy District (DWCD), the Montezuma Valley Irrigation Company (MVIC) and the Ute Mountain Ute Tribe's Farm and Ranch Enterprise (FRE) are the three funding entities and represent the Project contracted water users that are most vulnerable to shortages due to drought. The Drought Contingency Plan (Plan) allowed a comprehensive formal evaluation of potential mitigation and response actions to reduce the water shortages and provide greater drought resiliency for the Project irrigators and the fishery downstream of the McPhee Reservoir (McPhee). Municipal Project water users are not subject to shortages and are not considered in the Plan. Water users that are not Project water users are not part of the Plan, but the potential impacts of the Plan on these users are described.

The primary purpose of this Plan is to describe ways to increase carryover storage in McPhee, through a variety of actions that could be utilized for that purpose, while acknowledging the sometimes controversial and significant processes that will be necessary for some of these actions to move to implementation, should the relevant Project water users determine to do so. All Project water users will benefit from having increased storage in McPhee during drought periods. However, it is not required that the water saved from efficiencies be stored. Furthermore, any water saved may be used, as allowed, under the water right's holder decree(s) and contract(s).

Any changes to present uses or operations described as Plan actions are expected to go through all appropriate discussion, process, and necessary negotiation and approval before implementation. These may include a discussion with and between boards, federal partners, as well as future public outreach, MVIC shareholder involvement and approval, contractual negotiations, feasibility studies, NEPA compliance, Endangered Species Act compliance, etc.

In addition, DWCD and MVIC hold decreed water rights and are parties, along with Reclamation and the Ute Mountain Ute Tribe, to contracts that establish rights and obligations. These rights and obligations have legal effect on the actions that may be contemplated.

Rights and obligations were mentioned in this Plan for historical perspective and were not reviewed to ensure that the proposed mitigation actions discussed comply with existing legal water rights and Colorado law. This additional legal investigation and analysis will need to be engaged in before implementing the Plan's mitigation actions.

1.2 Planning Area

Figure 1 shows the Project area and facilities within the Dolores River basin, the Mancos River basin, and the McElmo Creek basin. The Project service area is Project water users in Montezuma and Dolores counties. The area considered in this Plan are primarily areas where the water users receiving water from the Project are located. In some instances, areas that are not Project water users and not part of the Plan, but are impacted by Project water use, are also described (e.g. McElmo Creek).

The Project provides water to the Dove Creek Canal (DCC) which travels northwest from McPhee. Lands are also served adjacent to the canal and southwest of the DCC. The Project provides water to Montezuma Valley by way of the Great Cute Dike and Dolores Tunnel. The Project also provides water by way of the Towaoc Highline Canal (THC) serving lands along the way from south of Cortez to Towaoc and the FRE. The Project provides water to approximately 75,000 acres of irrigated land.

The Dolores River, originating northeast of the Project in the San Juan and La Plata Mountains, is the main source of water for the Project and storage in McPhee. The Dolores River and tributaries feeding McPhee have an average annual runoff of about 351,000 acre-feet (as listed in the Definite Plan Report (DPR)). Tributaries to the Dolores River that also flow into McPhee include Lost Canyon Creek, West Dolores River, Beaver Creek, House Creek and Plateau Creek. The Project, including McPhee, was authorized in order to store water for supplemental and full service irrigation, municipal and industrial (M&I) use, as well as reservoir recreation and fish and wildlife enhancement.

McPhee is located in the center of the Project's service area, midway between the northern and southern boundaries, and sits at the southern edge of the San Juan Mountains at an elevation of approximately 6,924 feet at full. McPhee has a maximum surface area of 4,470 acres, with a storage capacity of 381,000 acre-feet (AF) and an active capacity of 229,000 AF. The Great Cut Dike, 64 feet high and 1,900 feet long, and McPhee Dam, 270 feet high and 1,370 feet long, store the waters of the Dolores River to create McPhee.

McPhee's active pool of approximately 229,000 AF has been fully allocated to specific water users through contracts with United States Bureau of Reclamation (Reclamation) to:

1) Individual farmers with approximately 28,900 allocated acres of full service irrigation land northwest of McPhee delivered by the DCC;
2) 7,500 acres on the Ute Mountain Ute Reservation operated by the FRE delivered through the THC;
3) MVIC which receives an irrigation supply from the Project to supplement its Non-Project Colorado water rights;
4) The City of Cortez, the Town of Dove Creek, and the Tribal community of Towaoc that receive M&I water; and
5) Water to release from McPhee for downstream fish and wildlife purposes.

During drought conditions, all Project allocations except M&I water share *pro rata* in the shortage. No user can carryover water from one water year to the next.

1.2.1 Geography

The Dolores River Basin watershed encompasses approximately 4,620 square miles in southwestern Colorado and southeastern Utah. Its headwaters in the San Juan Mountains include peaks exceeding 14,000 feet in elevation, while the elevation at McPhee Dam is 6,924 feet and at the River's confluence with the Colorado River in Utah is 4,400 feet. The Lower Dolores River generally flows from south to north in a deep canyon, interrupted only where the River crosses the

Gypsum and Paradox Valleys. The River courses through a range of plant communities, from alpine grasslands to montane forest areas and semi-arid shrublands.

The area draining into McPhee is approximately 800 square miles. It includes almost no urban development, including only the towns of Rico and Dolores, with populations of about 260 and 940, respectively. The San Miguel River, which joins the Dolores River at an elevation of about 5,535 feet, is the only significant tributary to the Dolores River downstream of McPhee Dam. At the confluence, the watershed area of the Dolores River has grown to approximately 1,341 square miles, yet water yield increases only slightly below McPhee because most of the Lower Dolores River tributaries have only intermittent or ephemeral flow.

The United States owns most of the lands within the Dolores River watershed and these lands are managed by either the Bureau of Land Management or the U.S. Forest Service. Most of the land use has low intensity development, such as for timber harvesting or grazing. Rico was a historically an important mining district, and private ranches are present along the Upper Dolores River corridor and its major tributaries. Private lands within the Lower Dolores River corridor are limited to sites where settlers in Slick Rock, Disappointment Valley, and Paradox Valley could gain access to the River. Development in the River and tributary corridors is limited to ranching and small commercial developments because the valleys are all quite narrow.

The Project serves lands in both Dolores and Montezuma counties. Lands served by the Project are as far north as Dove Creek and as far south as Towaoc. While the Project directly provides water to these irrigated lands, many surrounding lands benefit indirectly from the Project. The transbasin diversions of the Dolores River return to the Colorado River basin through McElmo Creek and subsequently the San Juan River. Major tributaries to McElmo Creek include Hartman Draw, Alkali Canyon, Trail Canyon, Goodman Canyon, Sand Canyon, Rock Creek, and Yellow Jacket Canyon which enters McElmo Creek in Utah. These tributaries collect return flows from lands irrigated by the Project. See Figure 1 for a map of the Project area.

1.2.2 Hydrology

Flows in the Dolores River, both naturally and as regulated by McPhee Dam, vary considerably within and between years. The yield, as measured at McPhee, has varied from 80,000 AF to over 600,000 AF annually over the past 50 years. Peak flows result from spring snowmelt in the headwaters of the San Juan Mountains, usually occurring in May and averaging 3,000 cfs, but reaching 5,000 cfs in some years at the Town of Dolores. (See Figure 2, 1897 through 2016 for past hydrology). The volume of inflows to McPhee during the runoff months (April, May, and June) is similarly variable, ranging from about 60,000 to over 500,000 AF per year in the past 50 years. Even with McPhee capturing and regulating spring flows, McPhee spring spills are still highly variable. High intensity thunderstorms cause localized peak flows intermittently during July, August, September, and October.

1.2.3 Precipitation

The Dolores River Basin above McPhee is largely forested and produces most of its runoff from snowmelt. The Lower Dolores River basin is largely semi-arid, characterized by low precipitation and humidity, abundant sunshine, a fairly large daily temperature range, and moderate westerly winds. Because of topographic changes, the local climate exhibits large variations within short distances, with increases in precipitation and decreases in temperature generally found from southwest to northeast. Average annual precipitation in the area above McPhee averages 30 inches while the entire Dolores River watershed's annual average precipitation is 20 inches.

The DWCD operation office is located at Great Cut on the west edge of McPhee where a weather station is maintained. The precipitation data from that weather station is shown in Figure 3; the annual precipitation from 1986 through 2016 summarized by water year. Since 2000, precipitation was above average for only five of the 16 years.

The combined inches of water for the four SNOTEL gages, with the longest period of record, on May 1 in the Dolores River basin is shown in Figure 4. These four sites are shown in Figure 1: Lone Cone SNOTEL, El Diente Peak SNOTEL, Lizard Head Pass SNOTEL, and Scotch Creek SNOTEL. It is generally accepted that the May 1 average SWE between these sites suitably indicates the amount of runoff that will occur. As in the other graphs, since 2000, on average, the snow remaining as of May 1 is less than average most years with four years having no snow left by this time which is well below the longer-term average.

Figure 1. Location Map

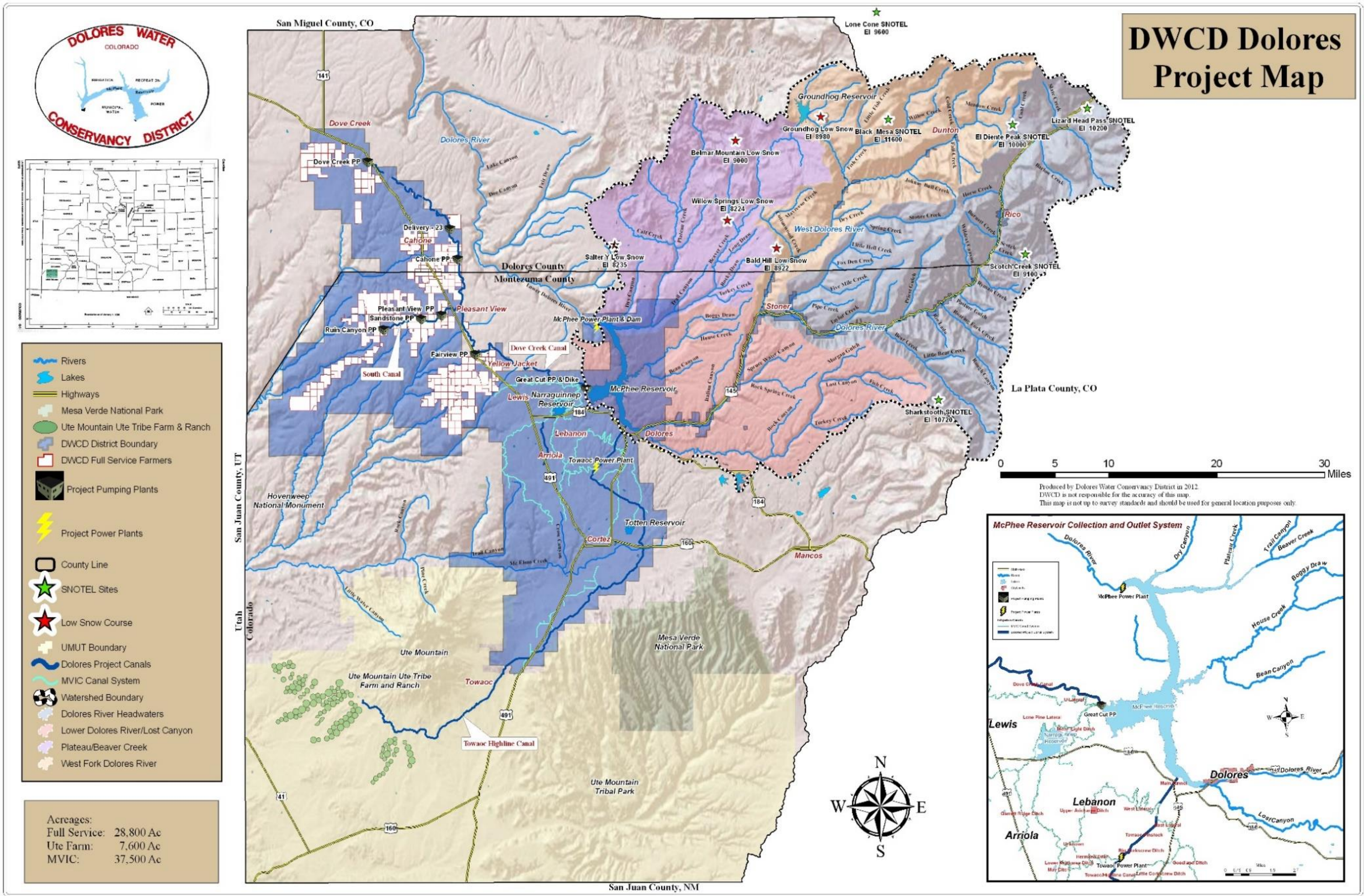


Figure 2. Yearly Streamflow of the Dolores River at the Town of Dolores (1896-2016)

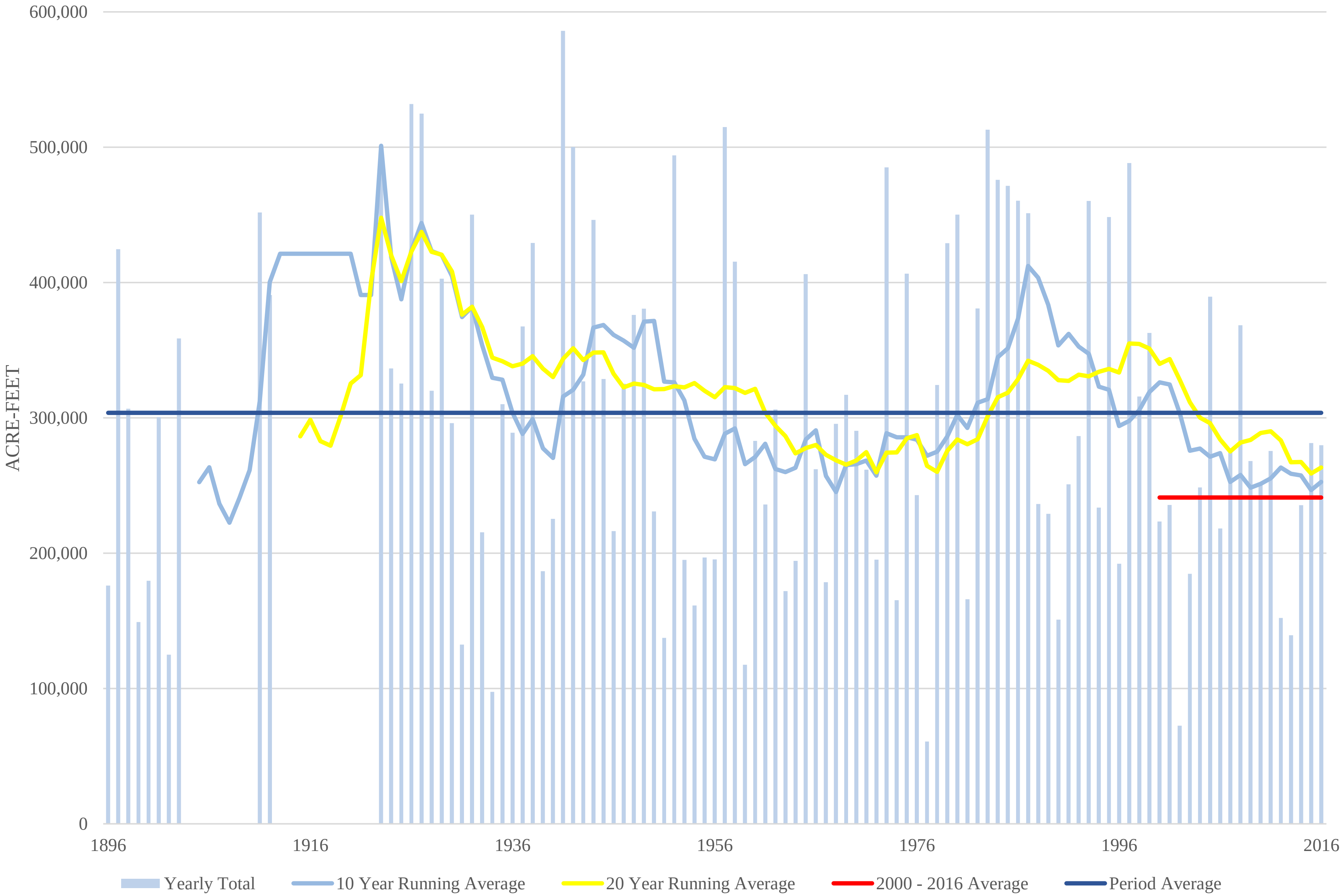


Figure 3. Precipitation at Great Cut (Water Year 1986-2016)

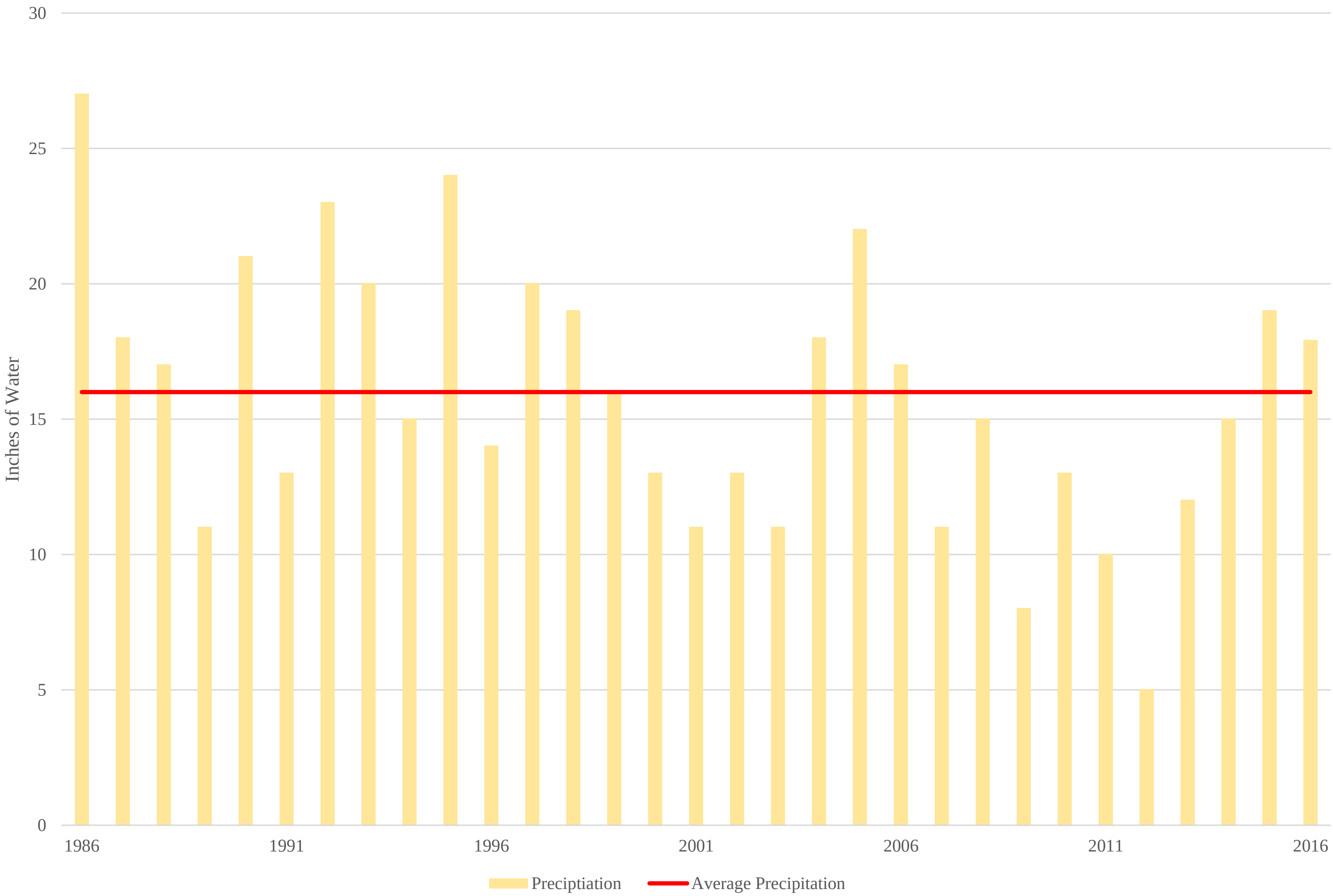
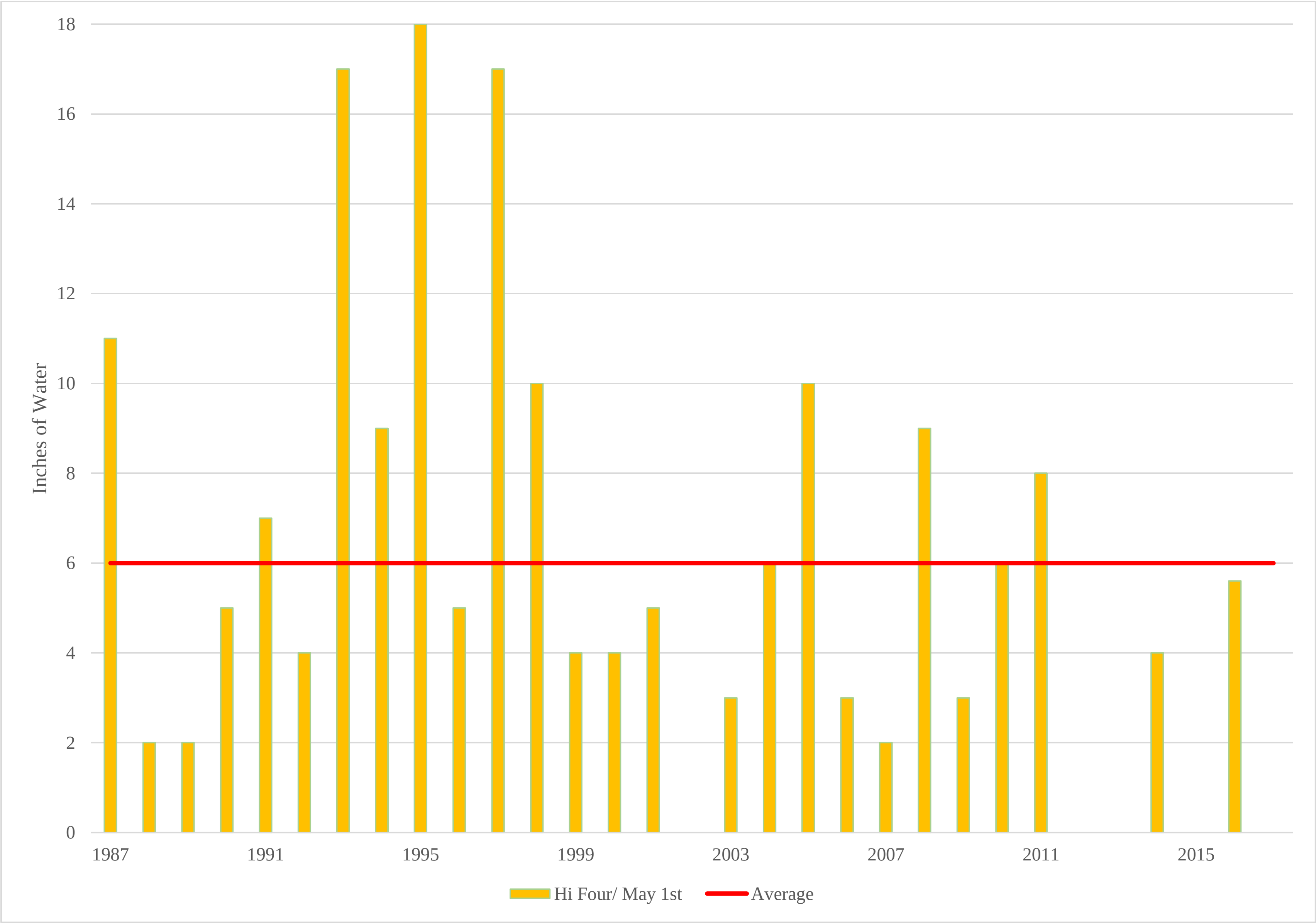


Figure 4. Average Cumulative Snow Pack on May 1 for Lone Cone, El Diente Peak, Lizard Head Pass, and Scotch Creek SNOTEL sites



1.3 History of Dolores Project

On an expedition to find a route from New Mexico to California in August of 1776, the Spanish Fathers Dominguez and Escalante camped near what is now McPhee. Found in their journals is a conception of what became the Project over two centuries later:

> *[T]here is everything that a good settlement needs for its establishment and maintenance as regards irrigable lands [and] pasturage…if the water supply could be brought to the vast expanse of land to south and west it would sustain a civilization.*

1.3.1 Irrigation of the Montezuma Valley

The first permanent non-native settlers arrived in the Dolores Valley (Valley) around 1877 to ranch and farm, capitalizing on the needs of the miners in Rico. Even though the Valley was isolated from the rest of Colorado, including the nearby city of Durango, there was a lucrative market for vegetables, meat, and hay. Although early ranchers and farmers settled in the Dolores River Valley close to the available water, the Valley's limited land area constrained the amount and vitality of agriculture in Montezuma and Dolores Counties. Most of the arable land in the area lies outside of the Valley in the Montezuma Valley which is part of the San Juan River basin.

Arable land conditions and the desire to sell land to settlers led to projects to divert Dolores River water outside of the Dolores River basin and into Montezuma Valley. An ambitious irrigation project was proposed as early as 1878, but low settlement numbers, restricted transportation, and limited financial resources inhibited support for the project. Cortez, established in the neighboring, drier Montezuma Valley in 1886, needed a dependable water supply. In February 1886, the Montezuma Valley Water Supply Company commenced work on a canal and a tunnel through the narrow ridge that separates the Dolores River from Montezuma Valley. The tunnel allowed much needed domestic and irrigation water to reach Cortez and the Montezuma Valley. Completed in November 1889, it was dubbed by *The Durango Herald as* "one of the greatest irrigation enterprises, not only in the state but in the West.".

As this 5,400-foot tunnel was nearing completion, another diversion, 4,000 feet long by 40 feet deep, the "Great Cut," was being constructed to serve the same market through a low divide northwest of the tunnel. In April 1887, the Dolores Number Two Land and Canal Company started constructing a six-mile canal, the Morton Flume and Great Cut, to serve lands west and north of those served by the tunnel. Together the two diversions had a combined 1,300 cfs capacity. When both companies faced bankruptcy, they consolidated into the Colorado Consolidated Land and Water Company ("CCL&W") in 1889. By 1890, when diversion dams channeled the flow of water from the Dolores River into the tunnel and Great Cut, over 100 miles of canals had been built throughout the Montezuma Valley to distribute water, and an early Narraguinnep Reservoir of approximately 6,000 AF had been partially constructed. Water reached the Town of Cortez in July of 1890 via a three-mile long Cortez Flume. By 1892, the CCL&W had obtained a surface water rights decree for 1,300 cfs. Predicting Cortez to grow to 50,000 people, the CCL&W planned to serve Cortez as well as irrigate much of the Montezuma Valley.

Years of financial difficulty, looming bankruptcy, and farmers facing water shortages led to changing company ownership. Efforts to provide the farmers with storage capacity and a reliable water supply spurred the formation of the Montezuma Valley Irrigation District (MVID). The MVID developed an irrigation system under the Irrigation District Law of 1901, allowing it to levy taxes, issue bonds, and to purchase, construct, and maintain canals. The first meeting of MVID's Board of Directors was held on January 7, 1902. MVID did not buy the water company from the company's debt holders until April 30, 1907. MVID floated a bond for $795,000 to buy the water rights and rebuild the irrigation system, including an enlargement of Narraguinnep Reservoir to 9,000 AF and a new, small Groundhog Reservoir (Groundhog) which was later breached by MVID in 1920. The High Line Canal, also known as the Mesa Verde Lateral, was leased to the U.S. Government to supply water to the Ute Mountain Ute Tribe. When MVID later failed in 1920, the MVIC was incorporated to operate the irrigation system.

In an effort to improve water supply to MVIC's irrigators, MVIC initiated plans in 1938 to replace the breached Groundhog and to construct 21,700 AF of storage with funding from the Works Progress Administration. During the 1950s and 1960s, MVIC enlarged Narraguinnep by increasing its capacity to 19,000 AF. Other system improvements included repairing or replacing flumes, canals and delivery turnouts and construction of the 3,000 AF Totten Reservoir in 1965. These improvements still did not provide MVIC's irrigators with a late season supply.

MVIC's diversion of water for transbasin use during the irrigation season left the Dolores River nearly dry immediately downstream of MVIC's points of diversion once spring runoff subsided. Dolores River flows started dropping in June and, by July, were less than MVIC's demand. Providing a reliable supply of water for late-season irrigation and year-round M&I use would require a larger storage reservoir.

1.3.2 Trans-Basin Diversions and Montezuma Valley

MVIC's direct flow water rights have an appropriation date of 1885 with an adjudication date of 1892. Based on water right appropriation dates, the first McElmo Creek water right filings were made in 1888 (based on water right appropriation dates), before the water was diverted to the San Juan Basin in 1890. There was little significant water available to appropriate in the McElmo Creek basin until the Dolores River water was diverted into the San Juan River basin by MVIC. The history of use of transbasin water in this previously dry valley has been driven by its unique geography. MVIC's surface water delivery and application by its shareholders has resulted in tailwater, surface accretions, and groundwater accretions attributed to MVIC's transbasin diversion accruing to numerous tributaries to McElmo Creek. The transbasin diversion resulted in both riparian environments and water for diversion for additional irrigation uses, to the extent such uses were permitted at the sufferance of MVIC. This imported water has been available for diversion, for reuse, and successive on additional lands, some of which are within MVIC's decrees, but are not owned by MVIC shareholders and, therefore, do not have a right to water attributable to MVIC's water rights. Those users include most McElmo Creek adjudicated water rights (some McElmo water users may hold shares in MVIC and are entitled to their pro rata portion of water available to MVIC's water rights). The McElmo Creek basin adjudicated water rights are on tributaries as well as the McElmo Creek. To the extent they are not MVIC shareholders, these water users have benefited from, but have not borne any of the costs associated with MVIC's century long efforts associated with the importation of water from the Dolores River basin.

Normally, in Colorado any water diverted from a stream "belongs" to that stream except to the extent that it is lawfully appropriated: a diverter takes water from the river, makes the decreed beneficial use, and returns any excess to the river of origin. Any water diverted, but not consumed by beneficial use, is owed back to the river. These return flows may seep slowly through the ground or run back to the river but will be available for other appropriators (i.e., one person's return flow is another's supply). However, the rights that attach to water attributable to transbasin diversions is different in Colorado compared to other states. Under Colorado law, water that is imported into a completely different river basin does not belong to the receiving basin. The importer of water, diverted from the stream of origin in priority, has the right to use and reuse to extinction the imported water, regardless of priorities in the receiving stream, as long as the importer maintains dominion and control over the imported water. Although water rights can be obtained for return flows of imported water when available, such appropriations have no right to the continued importation or to the water use practices that initially made that water available. This law applies to MVIC's diversions of water from the Dolores River to the McElmo Creek basin, and MVIC cannot be compelled to continue release or certain water management practices of transbasin water based on the McElmo Creek water users' history of diversion and use.

MVIC and DWCD have a long history of working together for the improvement of the transbasin area able to be served by Dolores River water. The history began when MVIC's conditional water rights needed additional infrastructure, including storage, to become perfected. Work on what resulted in the Project was part of the diligence used to maintain those conditional rights. The negotiation of the 1977 Repayment Contract between the United States of America and the DWCD and the 1977 Contract between DWCD and MVIC for the Adjustment of Water Rights and Sale of the Use of Irrigation Water was the foundation that allowed the development of the Project. During the construction and the initial operation of the Project from the early 1980's to the early 2000's, DWCD's policies were based on finding ways to ensure that existing water uses of the Dolores River would continue. The water supply described by Reclamation in the definite plan report that shaped the 1977 Repayment Contract was based on the expectation of those uses continuing. Even if strict administration of water rights had potential to reduce those uses, DWCD worked to find innovative ways to keep existing uses from being negatively impacted while it brought the Project into full use. Those efforts have resulted in such things as:

1) The MVIC/DWCD agreement to allow junior upstream irrigators to continue operating as they had historically. These irrigators fall under Decree 96CW49.
2) The 95CW104 decree including Groundhog exchange agreement that allowed for new M&I (well) development of water in the upper Dolores including the Town of Rico.
3) The inclusion in the Towaoc Highline Contract of the right for MVIC to use any water saved "for any use, including, but not limited to, fish and wildlife enhancement and maintenance of cottonwood habitat."
4) The design and implementation of a "water bank" for delivery of full service water allocations.

5) The sale of Class B stock by MVIC to DWCD to supply an expansion of full service acres. This sale included DWCD utilizing Totten Reservoir to meet future community needs.

MVIC and DWCD are continuing to work together to maximize the benefits associated with the existing transbasin water rights.

1.3.3 Formation of the Dolores Water Conservancy District

Realizing the need for a reliable late growing-season water supply, a volunteer economic development committee, "Cortez Bootstraps," was formed in the late 1950s to promote a large reservoir project on the Dolores River. Reclamation had been investigating the Dolores River/McPhee site for a large water storage facility, and the Project was authorized by the Colorado River Storage Project Act of 1956 (CRSP). When Representative Wayne Aspinall, Chairman of the House Interior Committee, visited the area he suggested that Cortez Bootstraps form a water conservancy district under Colorado law to be entitled to obtain Federal funding for the Project.

On November 20, 1961, the DWCD was created by decree of the Colorado District Court, Montezuma County, to support, organize, and manage the nascent Project, and to contract with the Reclamation as a public entity under the Colorado Water Conservancy District Act. With the DWCD's support and a finding of Project feasibility by the Reclamation, the Project's DPR and Final Environmental Impact Statement (FEIS) were completed in 1977. On February 8, 1977, with 3,926 votes in favor to 329 votes opposed, registered voters within the DWCD approved the DWCD's Project repayment contract with the United States, to be supported by an ad valorem tax (1977 Repayment Contract). The repayment contract governs the terms for repaying the Federal government for reimbursable Project costs, DWCD's operation, maintenance and replacement (OM&R) obligations, and various Project water allotments. Project construction began in the spring of 1978. When President Carter created a reclamation project "hit list," construction was suspended on all Reclamation projects in the western United States. In part because of the Project's role in resolving the Ute Mountain Ute Tribe's reserved water rights claim in the Mancos River, the Project was the first Reclamation project to be removed from that list and construction proceeded in 1979.

1.3.4 A Cooperative Venture with MVIC

MVIC, incorporated as a Colorado mutual ditch and reservoir company, holds some of the most senior water rights on the Dolores River. The Southwestern Water Conservation District (SWCD) applied for the original water rights for the Project in 1947. Since MVIC's water rights were senior, the Project could not have been constructed without MVIC's participation.

The original DWCD Decree established seven (7) specific Divisions represented by the Directors. Three of the Divisions were the City of Cortez, Town of Dove Creek, and Town of Dolores. The other four (4) geographical areas covered outside the municipalities form the south DWCD boundary through the Montezuma Valley and up, including that portion of the DWCD in Dolores County. A subsequent Court action made all the Directors at large, and the Board representation varied from the original geographic areas. The DWCD Board worked with the MVIC Board and Reclamation to shape the Project and to provide the significant additional Project water benefits that residents of the Montezuma Valley had been working to achieve since the early years of settlement.

Negotiations were held to determine how MVIC would participate in the Project in a way that provided MVIC shareholders with a late-season irrigation supply while MVIC retained control of its irrigation water delivery system and ownership of its senior water rights. Those negotiations culminated in a 1977 contract between DWCD and MVIC under which MVIC retained most of its senior water rights while obtaining an allocation of supplemental irrigation water from the Project (1977 DWCD/MVIC Contract).

FSA (or Non-MVIC) irrigators would receive their entire water supply from the Project, pursuant to individual petitions (contracts) with DWCD. Certain limitations on MVIC's use of its Non-Project water rights were required to ensure that the assumptions upon which the Project's yield was calculated in the DPR would remain valid. Additional issues addressed in the 1977 DWCD/MVIC Contract and the DWCD/Reclamation 1977 Repayment Contract included how water would be delivered to MVIC using Project facilities, how much storage and direct flow Project water would be delivered to MVIC each year (pursuant to MVIC's senior water rights), how MVIC's Project repayment and OM&R payment obligations would be determined, and how much of MVIC's Non-Project water MVIC could be used for other than irrigation purposes (i.e., 3,000 AF annually for stock and domestic purposes).

The Towaoc Highline Canal (THC) Contract of 1989 was negotiated in the same spirit of partnership to build on the foundation of the 1977 DWCD/MVIC Contract. The THC Contract of 1989 allowed MVIC to retain the use of any saved water generated by the new salinity features that had become part of the Dolores Project infrastructure. Exhibit A to the Stipulated Settlement that ended the Federal lawsuit of 2009 clarified the procedure for determining the amount of Project water that is available to MVIC for its shareholders' use on an annual basis under the 1977 DWCD/MVIC Contract as modified by the THC 1989 Contract.

1.3.5 Colorado Ute Indian Water Rights Settlement Act

The Colorado Ute Indian Water Rights Settlement Act passed by Congress in 1988 (Settlement) was primarily based on utilizing water allocations in the Project to offset the Tribe's Winters Doctrine claims in the Mancos River basin. The Project helped to achieve one of the earliest Indian reserved water rights settlements, which helped to preserve the status quo for non-Indian water users on the Mancos River in eastern Montezuma County. The reserved rights settlement provided, for the first time, a safe domestic water supply to Towaoc, the Tribe's principal town, late in the 20th century. A total of 1,000 AF is allocated for M&I purposes for the Ute Mountain Ute Tribe. Water is treated by the City of Cortez and then a long pipeline conveys water to the Tribe's Town of Towaoc. Delivery of a safe drinking water supply substantially improved life on the Tribe's Reservation and eliminated the need for the hauling of water for over 1,500 people.

The FRE was allocated approximately 23,300 AF (DPR average annual 22,900 AF, with shortages). The FRE operates a 7,500 acre irrigated farm using 108 center pivot sprinklers on the west side of the Tribe's reservation. FRE is a major enterprise of the Tribe employing many Tribal members and providing income to the Tribe. As a part of the Settlement, the Federal Government, through Reclamation, paid for a gravity pressurized irrigation delivery system to sprinkler irrigate the 7,500 acres with maximum efficiency. This system is similar in efficiency to the irrigators along the Dove Creek Canal except for the non-Indian FSA irrigators have their water pumped.

1.3.6 Construction of the Dolores Project

McPhee Dam was completed by 1986 and Project water was made available to Cortez and MVIC that year. The first Project FSA irrigators received Project water in June 1987, but the majority of the Project was not fully online until the completion of facilities to serve the Ute Mountain Ute Tribe's lands in the mid-1990s. By 1999, all current Project facilities were completed. Project construction thus covered a span of 20 years, from September 20, 1979, through October 10, 1999. DWCD crews started in 1985 on preliminary DWCD operations. In 1993, the DWCD and Reclamation initiated the process for transferring responsibility for the OM&R of Project facilities to DWCD, which was completed by 1998.

The cost of the Project, including interest during construction, totaled $752.4 million. Reimbursable costs of the Project, totaling $426.5 million, are paid by a combination of CRSP power revenues, Project water users yearly assessments over 50 years, and taxes from landowners within the DWCD. Non-reimbursable costs of the Project, which do not have to be repaid by the local community, include archeological mitigation, fish and wildlife mitigation, recreation, salinity features, and facility relocations.

The Project was one of the last Federal projects constructed as part of the CSRP. The Project is unique in that it incorporates two purposes that are not historically part of a Reclamation project. First, it assisted in satisfying the Ute Mountain Ute Tribe's reserved water rights claims. Second, it provided for a fishery release to the lower Dolores River and is the second largest allocation of Project water stored in McPhee.

1.3.7 DWCD Activities since Project Construction

The DWCD operates the DCC to provide pressurized irrigation water to approximately 29,000 acres using pumps to lift and pressurize delivery pipelines.

- Great Cut pumping plant lifts the water into the earth lined DCC at rates of up to 350 cfs.
- Water then travels via gravity down the canal.
- Water is controlled by check structures in the canal.
- Water is delivered to local pumping plants.
- Local pumping plants deliver the water through over 100 miles of piped laterals under pressure to the Project's Full Service farmers.

This technology provides efficient deliveries with conveyance losses limited to about 5% versus estimates of 25% or more for older traditional flood irrigation systems. Additionally, Project farmers have maximum flexibility in how and when to take their Project water, which allows greater on-farm efficiencies than under historic irrigation practices. These design decisions allowed for the use of pivot and side roll irrigation on the 100% pressurized Project system. The improvements involve significant technical complexity including fiber communications, computerized control systems, and high voltage electrical power systems. This infrastructure design requires staffing with highly trained technicians and craftsmen to carry out round-the-clock irrigation season water deliveries.

DWCD purchased up to 6,000 AF of water per year from MVIC as Class B shares under the Purchase Agreement dated August 27, 2002. Under that Purchase Agreement, DWCD also purchased Totten Reservoir and its water rights, which DWCD has utilized for the last three years to provide water to various McElmo Creek irrigators. DWCD's Class B share water is available to irrigate 3,000 acres of land originally designated to be irrigated by MVIC, but for which MVIC had not completed the infrastructure necessary to deliver water to those lands. This source of supply to DWCD, referred to as Class B water, was to be priced at an up-front cost of $250.00 per allotted acre and payment of the same annual costs as those paid by DWCD full service irrigators. Pricing includes an account charge, a DWCD construction charge, and a proportionate share of DWCD's OM&R costs. In allotting available water, the DWCD Board gave priority to "Affordable Blocks" of land which could be economically served by pressurized water. Those areas included: (1) land which could be served by the Sandstone, Ruin Canyon, and Fairview Pump Stations; and (2) land near the DCC. Fifty-four individuals, owning 13,186 acres, petitioned for water. A DWCD Engineering team evaluated the lands to determine how each parcel could best be served, with capacity and feasibility criteria the primary considerations. To make this water available, the DWCD also negotiated a contract with Reclamation to transport the Class B water through Project facilities (pump plants and canals). Beginning in 2002, the DWCD Board has been allocating Class B water to eligible landowners, as necessary to supply their irrigation needs.

In 2008, DWCD completed its Dove Creek Lawn and Garden Irrigation System. 200 contracts were originally sold, and by 2013 177 lawn and garden irrigators in Dove Creek had metered taps installed. This program provides Project water for lawn and garden irrigation. Those irrigators pay an annual fee to lease water and for O&M of the system. DWCD took out a loan from CWCB to establish the system, which has since been repaid. DWCD also purchased thirteen taps for re-sale to Dove Creek residents, some of which have been resold.

The DWCD has installed and upgraded electronic equipment to allow for remote monitoring and operation of Project facilities. An original SCADA system came partially online in 1991 for Reach 1 of the DCC. Further sections of DCC came online through 1993 until completely automated. The THC followed from 1993 to 1995. Those early systems included two mainframe computers and all copper wiring. The computers have been replaced several times and are now off-the-shelf desktop models with Microsoft operating systems and a Rockwell software package. The copper wiring was replaced in phases between 2004 and 2007. Terminal hardware has migrated during these years from Remote Terminal Units to Programmable Logic Controllers in conjunction with the new fiber lines and software upgrades. Finally, an early multi-mode fiber cable to McPhee Dam was replaced in 2013 to current single mode fiber standard hardware to control the power plant and dam gates.

DWCD reached an agreement with Reclamation and the CWCB to provide an annual set amount of 700 AF Project water to replace water injected by Reclamation's Paradox Valley Unit to control salinity loads in the Dolores River. The original augmentation Plan for the salinity works had allowed a variable amount of augmentation water annually (i.e., 71 to 924 AF) depending on the filling of McPhee.

In settlement of a lawsuit brought by MVIC against DWCD and Reclamation in 2009, DWCD, Reclamation, and MVIC, together with the Ute Mountain Ute Tribe, agreed to a procedure for calculating MVIC's annual allocation of Project water. Exhibit "A" to the Stipulated Settlement, a calculation sheet, provides an agreed-upon methodology for determining the amount of Project water MVIC is entitled to annually.

DWCD maintains what is known as the "inflow/outflow" spreadsheet which keeps track of the water availability and water usage for each Project user versus their allocation on a daily basis during the irrigation season (April through October) and weekly during the non-irrigation season. The inflow/outflow spreadsheets are available from the mid-1990's to present. These spreadsheets provide detailed data on historic water availability and usage which will be used extensively in the evaluation of actions in the Plan. The inflow/outflow spreadsheet is distributed by email to Project water users and other interested persons four times a week.

With all water users fully drawing their allocations of water beginning in 2000, the Project has 16 years of good operational data of which three years have seen significant shortages beyond the DPR estimates due to the continual drought in the upper Colorado River basin. Also in 2014 and 2015 shortages were forecasted based on the April 1 runoff forecast and shortage conditions were initiated, but April and/or May precipitation was adequate to provide a full supply. Therefore, in the three recent years, there was either an actual shortage (2013) or projected shortage as late as May 1 (2014 and 2015).

1.4 Dolores Project Drought Background

The Project has had three years of actual water shortage, beginning with 2002, and two more years of projected shortages that were saved by unusually late spring precipitation. There appears to be a long-lasting weather pattern that has resulted in sustained drought in the Colorado River basin and specifically the Dolores River basin. The Project has implemented drought actions "on the fly" since 2002 but has not developed a contingency plan to address drought that appears to be continuing. The development of this Plan allowed for primary Project water users (Reclamation, DWCD, FRE, and MVIC), who represents all of the water users susceptible to drought caused water shortages, to cooperatively evaluate actions that might be implemented to mitigate and respond to future droughts. Given the weather pattern over the past 16 years, the next drought and shortage year could be next year. The M&I water users are provided a full supply even if other water users are in shortage, so these users are not susceptible to drought as are the irrigators and fishery.

As shown on figures and tables throughout the Plan, including several at the end of this section, the Project has suffered water shortages in 2002, 2003 and 2013 and projected May 1 shortages in both 2014 and 2015. MVIC sued DWCD and Reclamation in Federal Court in June of 2009 over breach of contract for water deliveries. The Ute Mountain Ute Tribe also became a party to the action. The suit was eventually settled through negotiations and a water allocation formula referred to as "Exhibit A," which provides an agreed-upon methodology for calculation of the amount of water MVIC is to receive under the Project contracts. In order to not have tensions increase to the point of a lawsuit again, all of the parties have taken steps to cooperate more effectively. The lack of conflict during the shortages in 2013 showed that the parties are willing to work cooperatively. Also, the Plan's development process shows the improved cooperation with the Funding Stakeholders jointly developing the Plan.

The projected shortages in 2014 and 2015 were saved by unusually late spring precipitation. On May 1, 2015, the Project was anticipating a 40% supply based on runoff projections at that time and DWCD announced that shortage conditions would exist for water users. Luckily, there was exceptional precipitation in May and June of 2015 which resulted in a full supply, but the increased supply came too late for some irrigators, especially the FRE, to adjust their cropping plans to utilize the available water, resulting in reduced crop production and loss of income.

Overall, the most significant risk to the irrigators is the reduced crop production and associated secondary income throughout the community. The risk is exacerbated on the Ute Mountain Ute Reservation where reduced income to the FRE equates to less Tribal employment. The risk to the fishery is significant to the native sensitive species (bluehead sucker, flannelmouth sucker, and roundtail chub) downstream in the Dolores River canyon and the non-native trout population immediately downstream of McPhee. The Project includes two hydropower plants that produce power for use in the Western Area Power Administration system. By producing less renewable power, the Western Area Power Administration system may need to supplement power production with non-renewable sources. McPhee itself is a source of recreation as well as the Dolores River downstream of the dam. These recreational options are diminished during a drought and discourage tourists from visiting a drought impacted area.

The shortages and droughts also impact local economies. The decline in income for irrigators reverberates throughout the community. This decline, in turn, affects other members of the community who rely on the irrigators spending for their own income (i.e. local equipment supplies and supplier of agriculture products). Public health concerns are less significant due to M&I water not sharing in shortages but could arise from lower, warmer flows.

The data in the figures provided below, demonstrate that the Project has been in a drought since 2000 with especially dry periods in 2002 to 2004, and 2013. The WaterSMART grant funding provided an opportunity for the Project water users to take a broader look at how they might mitigate and respond to persistent drought and associated shortage conditions. Included in this section are the following figures displaying data of persistent drought conditions for 16 years, from 2000 through 2016.

- <u>Figure 5. McPhee Maximum Active Capacities 2000 – 2016</u>
  This figure shows that McPhee has only been full seven of the last 16 years and will fill in 2017.

- <u>Figure 6. Total McPhee Reservoir Inflow</u>
  This figure shows the total inflow to McPhee from the first-year McPhee was operational in 1986 to 2016. Since 2000, there are only two years where the inflow was greater than

the average. The average for the last 16 years is over 125,000 acre feet less than the average for the first 14 years of the Project's operation.

- Figure 7. McPhee Ending Active Capacity and Spill
  The capacity of McPhee at the end of the water year on October 31 and the amount of spill, if any, from 1986 to 2016 is shown. Active storage in McPhee is near empty in six of the 16 years creating below average carryover for 10 of the last 16 years. Only two years with significant spills and five years with minimal spills.

- Figure 8. Percentage of Full Allocation Available
  The previous figures show data on the water supply and storage available since 2000. Figure 8 shows the resulting supply to the non-Indian FSA irrigators, the FRE, and the fishery release as a percentage of full supply. The figure shows that there were actual shortages in three of the 16 years. The table doesn't show years that shortages were predicted on, but late wet springs provided just enough water to provide a full supply (2004, 2014, and 2015).

When irrigation allocations were made from the Project water supply by Reclamation, the defining criteria was described as a shortage "for any one season is limited to 50%, the total for two consecutive seasons is limited to 75%, and the total shortage for ten consecutive seasons is limited to 100%." These criteria have been exceeded several times in recent years. The Plan has elements designed to partially mitigate not meeting the criteria primarily through increased carryover storage. The Plan includes finding ways for users to efficiently use their allocations or rights as a tool to reach the goal of increasing their on-farm resiliency to drought and carryover storage in McPhee. The total use patterns for both the FSA irrigators and MVIC shareholders in recent years reflect individual users incorporating efficiencies to adapt to drought related shortages. These efficiencies have utilized, from the different tools available to them, ways to maintain a viable agricultural business that leaves some of the water supply unused in years of a full supply. The unused water has helped build carryover storage. The understanding of these different tools will help shape this Plan.

There is no intention to require a reduction in rights or allocations when water is more efficiently used in order to build carryover storage that will benefit all users of McPhee water supplies. For instance, any water savings by MVIC and its shareholders can be used as it decides, whether it be to increase carryover storage or provide water to lands allowed by its decree.

Figure 5. McPhee Maximum Active Capacities

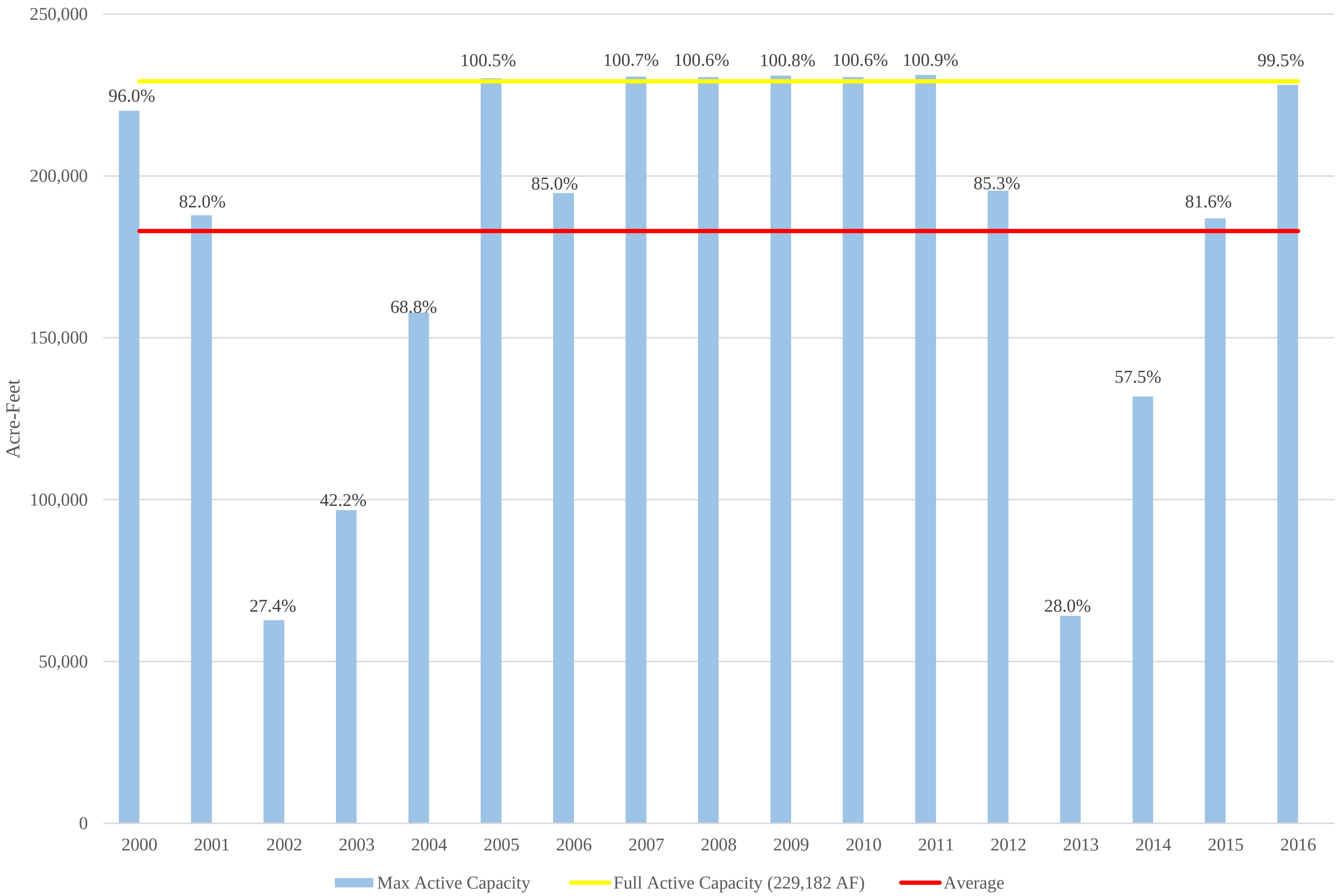


Figure 6. Total McPhee Reservoir Inflow

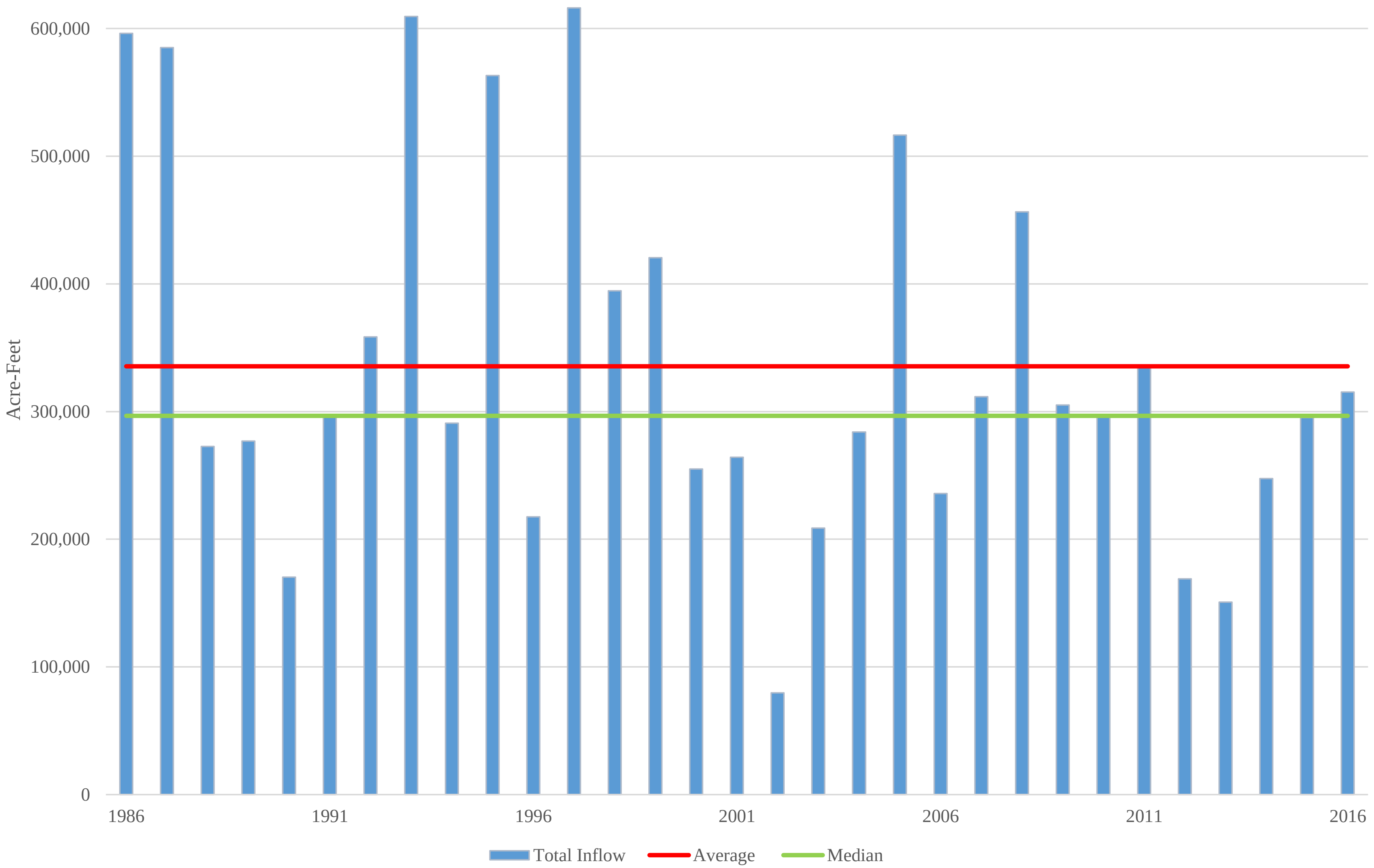


Figure 7. McPhee Ending Active Capacity and Yearly Spill

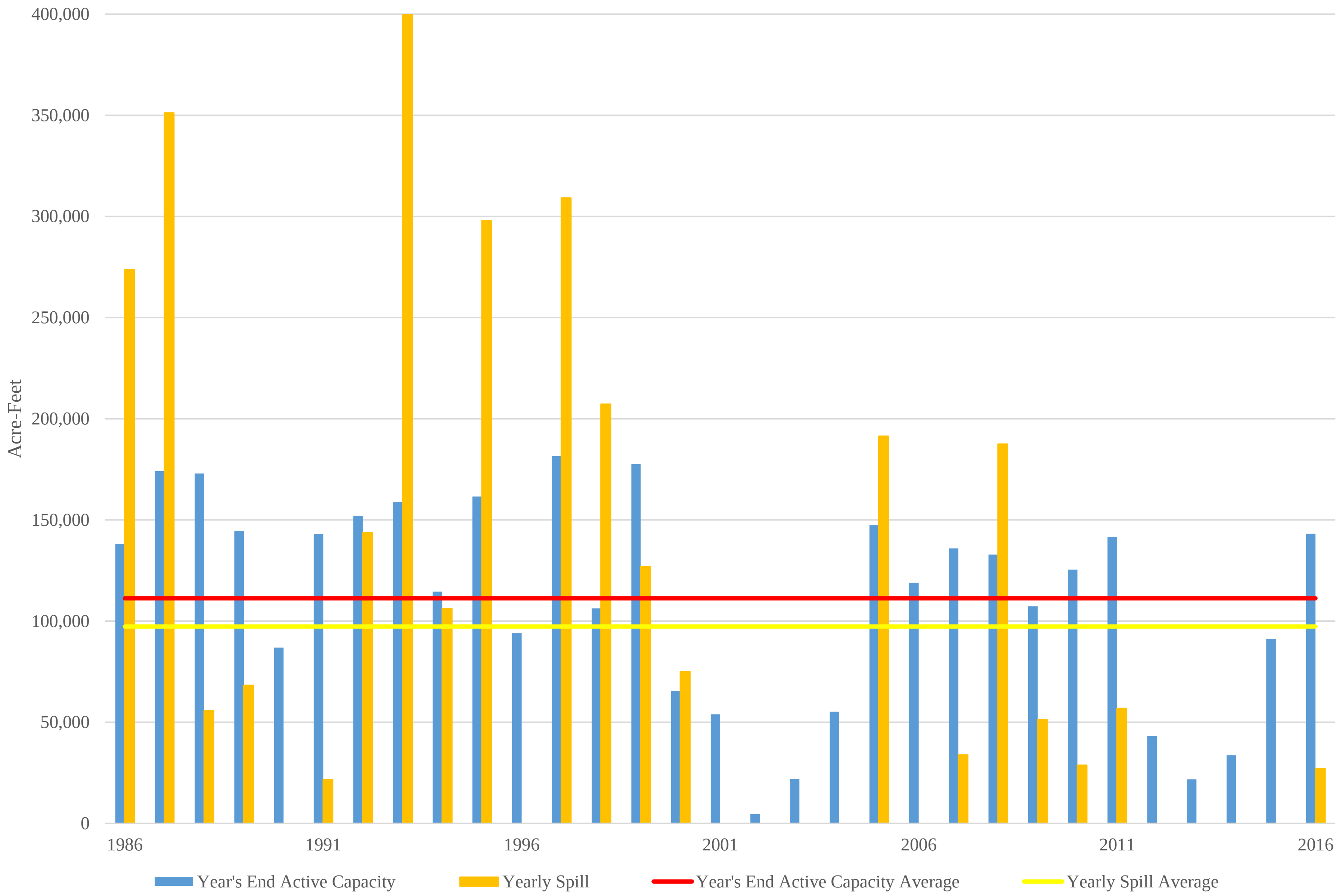
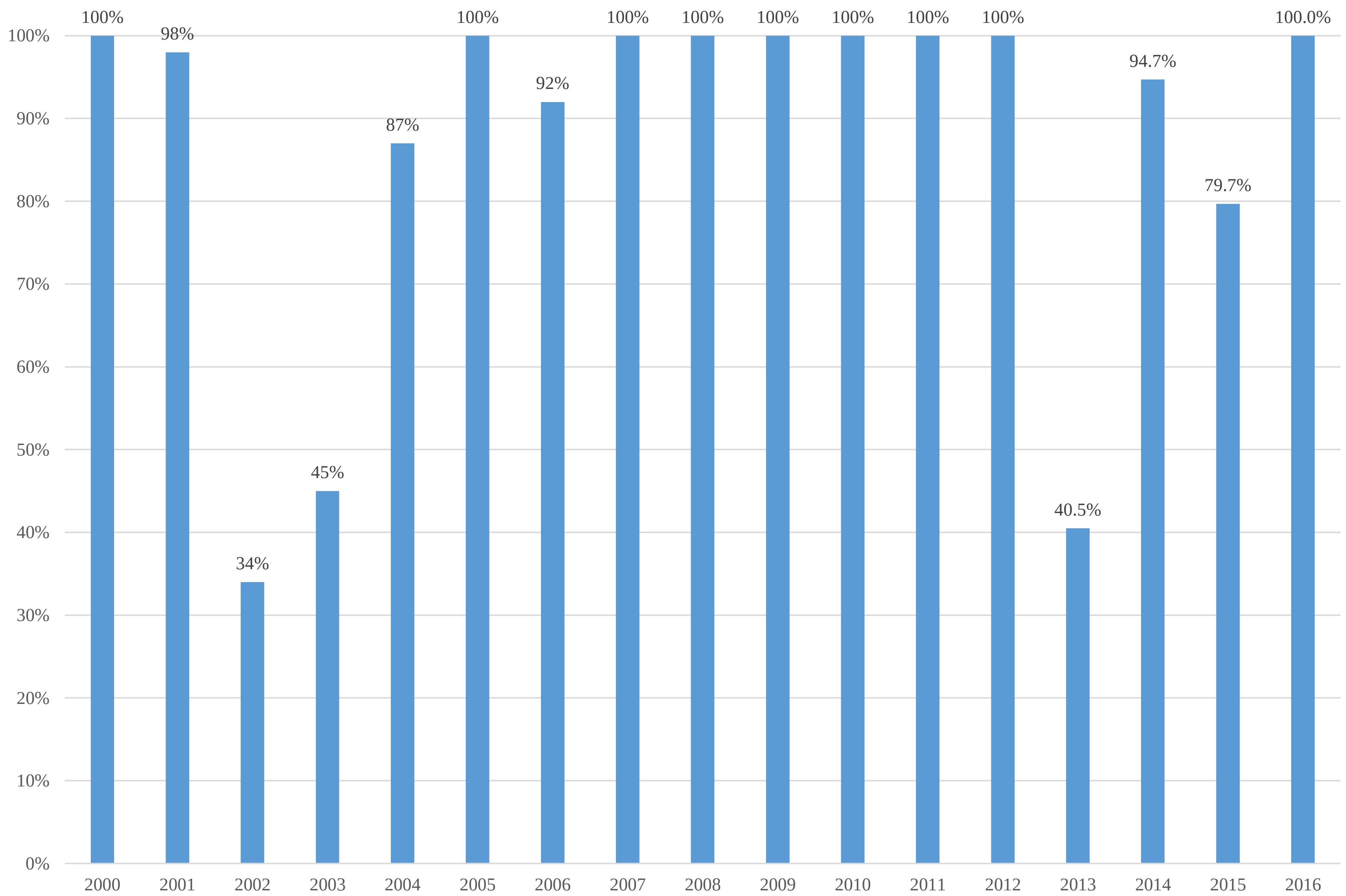


Figure 8. Percentage of Full Allocation Available



2 Funding and Public Stakeholder Involvement

2.1 Planning Task Force

DWCD, MVIC, and FRE, (three non-federal entities) and Reclamation funded the Plan. The non-federal entities provided matching cash and in-kind contributions for the grant. The Planning Task Force (Task Force) was made up of the funding stakeholders and consisted of the DWCD, MVIC, FRE, and Reclamation. One or more of the Task Force members had institutional responsibility and represented all aspects of the Project including fishery releases, boating, irrigation, power production, and municipal use. The Task Force considered the involvement of public stakeholders in the day-to-day development of the Plan but concluded that the four entities adequately represented the water users entitled to receive water from the Project.

The Task Force provided oversight for the bulk of the baseline data analysis, reviewed work products, and participated in public outreach efforts. Under the leadership of the grant recipient DWCD, the Task Force supervised and provided guidance in the development of the Plan and organized the involvement of the public stakeholders. Though not members of the Task Force, representatives of the Colorado Division of Water Resources and High Desert Conservation District attended some of the meetings when the Task Force sought additional input on water rights issues and on-farm irrigation improvements.

2.2 Task Force Involvement

The Task Force met regularly throughout the development process of the Plan. The group met monthly, at a minimum, or multiple times per month. The agendas consisted of brainstorming drought mitigation and response actions, reviewing mitigation and response actions, receiving drought updates from task force members, discussing scheduling of tasks, and incorporation of comments received during review periods.

2.3 Public Stakeholders

The Task Force identified key public stakeholders to be involved in the Plan's development process during the grant application process. The Task Force also identified members of the public who had expressed interest in the Plan's development. Throughout the Plan, comments concerning the Plan from public stakeholders are addressed, regardless of whether the comments are from Project water users or users affected indirectly from the Project. Appendix B to the Plan contains a list of all public stakeholders who provided comments to the Plan, list of participants in public meetings, and a public meeting summary. Each specific comment may be found in Appendix C.

2.4 Public Stakeholder Involvement and Comments

A draft of the Plan was sent to members of the Dolores River Dialogue as well as made available for the public at large on DWCD's website in May 2017. The comment period was from May 15 through July 21, 2017. All public meetings were held at the DWCD office (60 South Cactus, Cortez, Colorado).

The initial timeline proposed for the comment period was to begin on May 15 and allowed a 30-day review and comment period, with a public meeting held within this timeframe as well. The public meeting was held on June 6, 2017. This public meeting was attended by a variety of public stakeholders: DWCD Board members, MVIC Board members, members of the Dolores River Dialogue, MVIC shareholders, and water users from McElmo Creek. A discussion was held surrounding concerns and comments on the draft Plan. Due to concerns raised by people attending the meeting regarding the 30-day timeline for comments, the Task Force requested an extension to the grant agreement to allow for a 60-day period; more than doubling the time allowed for comments. In addition to the longer comment period, an additional public meeting was held on July 17, 2017. The July meeting was attended by more than 60 people. A meeting summary was prepared and is included in Appendix B.

A total of 47 individual emails and letters providing concerns and/or comments were received during the comment period. These comments range from overarching concerns to specific suggestions for inclusion or exclusion into the draft Plan. While some comments were directed at specific actions and/or sections, many were general statements offering different historical perspectives or repeating past concerns. The comments were recorded and made available to the Boards in their entireties. The Boards, along with recommendations from the Task Force, determine how each comment or concern will be incorporated into the draft Plan.

Public stakeholder comments are included in the sections that had comments specific to that section. Most comments expressed concerns with structural and non-structural actions.

Public stakeholder comments on the process are listed below:

- The Task Force should have included recreation and fishery interests. (Addressed in Section 2.1)
- The Task Force should have included a representative from McElmo Creek. (Addressed in Section 1.2)
- Input should have been sought prior to the first draft of the Plan being distributed publicly. (Addressed in Section 2.1)

3 Drought Monitoring

3.1 Summary of Monitoring

The Dolores Project is primarily concerned with drought caused water shortages to agricultural supplies since the municipal users face no shortages per contractual agreement which is backed up by a supply buffer in McPhee.

The Project accounts for approximately 135 KAF of historic water rights, primarily direct flow, diverted from the Dolores River annually. After these senior rights are met, McPhee collects the excess inflow, spring runoff primarily, to create the Project water supplies as shown below.

Table 1. Dolores Project Allocations

Individual Allocations	DP Allocation Quantities (KAF)	Historic Irrigation & Municipal Needs (KAF)	Totals (KAF)
MVIC	13.7	130.0	143.7
DWCD FSA	56.3		56.3
UF&R	24.5		24.5
Downstream Fishery	30.5		30.5
M&I Supplies	8.7	5.0	13.7
Minor & Misc.	0.8	1.0	1.0
Totals (KAF)	134.5	136.0	270.5

There are no alternative irrigation water supplies available to Project irrigators. Natural precipitation may help, but is unreliable averaging approximately 16 inches, not all delivered when needed by crops. Therefore, the Project allocations supply up to 90% of the local agricultural needs that are used from April 1 through October 31 each year. When the projected water supply, based on the November 1 carryover and CBRFC forecasted snowmelt inflow, are not expected to meet the 270 KAF Project allocations then a drought caused shortage is triggered.

Historically, after an irrigation season, McPhee ends up near the elevation of 6,900 on November 1 with 111 KAF of active storage (229 KAF when full at elevation 6,924). McPhee gets about 80% of annual inflow from the snowmelt runoff sourced from accumulating snow beginning in November. The snow quantity drives the CBRFC forecast produced bi-monthly starting on January 1 of each year. Therefore, combined storage and projected runoff drive the McPhee supplies and determine when a Project agricultural water supply drought is triggered pursuant to contracts. Shortage is triggered when McPhee cannot supply the allocations, then a drought is declared. The shortage severity can be minor, 10% or less, or extreme with less than 50% of the Project allocated supplies provided. As agricultural production is directly proportional to required crop water needs the production and financial impacts increase almost linearly with drought severity.

See Section 6.2 for more explanation of the following dates for scheduled assessments that may trigger drought warnings and ultimately shortage declarations to Project users for the upcoming irrigation season.

- November 1 – 60,000 AF or less of active storage indicates more than average runoff is needed to meet full Project agricultural allocations for the next irrigation season.

- January 1 – First monthly CBRFC forecast is produced based on most recent 35-year hydrologic record and shows exceedance levels in KAF for 90%, 70%, 50% (Most Probable), 30% and 10% runoff probabilities. Based on carryover storage and Project allocations, DWCD determines what probability is needed to meet the 270 KAF allocation requirement ~~need~~. If the runoff quantity required to supply all Project agricultural allocations is more than the 70% probability of exceedance, then increased monitoring and communication with Project users about potential impending drought begins.

- January to March 1 – Continually monitor changes in snowpack and resulting forecasted inflows. Update Boards. Publicize to Project users as new information is recognized.

- March 1 – Meet and discuss current projected water supplies specifically with FRE to help them make ~~their~~ farm cropping plans based on potential water supplies. Publish current forecasted supplies and potential drought shortages for all Project users.

- April 1 – If full Project supply is not certain, then trigger drought shortage declaration for irrigators. Early irrigators cannot wait longer to make decisions on seed purchases, fertilizer applications and planting any longer.

- May 1 to July 1 – Continue to update Project supplies based on actual runoff as the severity, precise percentage of allocation shortage, may change.

~~The DWCD has an established process for monitoring near and long term water availability. A significant amount of water supply and drought related data is available to DWCD. This data ranges from their own monitoring of McPhee inflows and outflows, monitoring of SNOTEL sites, forecast provided by multiple other agencies, to reviewing historical baseline data.~~

~~Public stakeholder comments general to this section:~~

- ~~Recommend that drought forecasting methods be examined to include best scientific methods.~~

~~3.4~~3.2 Methodology for Monitoring, Accounting, and Determining Drought

The current drought monitoring process, including methodologies and determination of a drought, by DWCD is described in the following sections. Monitoring is conducted at annual and monthly intervals. Long term monitoring of the data is included to potentially recognize drought cycles, drought recovery cycles, and development of potential future improvements to monitoring efforts.

Over the last decade, drought has become a national issue, and the negative impacts are very specific to each local area. This concern led to more coordinated federal action and resulted in the National Integrated Drought Information System (NIDIS) website that maintains the U.S. Drought Monitor (developed by the National Drought Mitigation Center), that provides a current status for drought in all 50 states. Because of the diversity within the United States, regional information is more valuable, and we follow the Intermountain West NIDIS monitor with the Colorado Climate Center.

As a starting point, the National Drought Mitigation Center outlines the following operational definitions of drought as:

1. *Meteorological drought* is usually an expression of precipitation's departure from normal over some period of time. Meteorological measurements are the first indicators of drought.

2. *Agricultural drought* occurs when there is not enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.

3. *Hydrological drought* refers to deficiencies in surface and subsurface water supplies. It is measured by streamflow and by lake, reservoir and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels.

4. *Socioeconomic drought* occurs when physical water shortage starts to affect people, individually and collectively. Or, in more abstract terms, most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

Several frequently asked questions from the CWCB help illuminate conditions here in our Colorado:

- Is Colorado currently in a drought? This question is an all too common in Colorado and there is no straightforward answer. Drought is a prevalent natural phenomenon in Colorado. Single season droughts over some portion of the State are common. Prolonged periods of drought develop slowly over several years and are cyclical in nature. With Colorado's semiarid and variable climate, there will always be a concern for water availability within the State.

- What is a drought declaration? Drought declarations are traditionally made by public officials and may be made at the local, state and federal level. In Colorado, the Water Availability Task Force is responsible for assessing drought conditions and recommends to the governor when an official drought declaration should be made. Water providers can also officially declare a drought. Water restrictions and other drought response measures may be enforced following local drought declarations.

- How often does drought occur? Historical analysis of precipitation and other drought indices show that drought is a frequent occurrence in Colorado. Short duration drought as defined by the three-month Standardized Precipitation Index (SPI) occur somewhere in Colorado in nearly nine out of every ten years. However, severe, widespread multiyear droughts are much less common. Since 1893, Colorado has experienced six droughts that are widely considered “severe.” These droughts affected most of the state, involved record-breaking dry spells, and/or lasted for multiple years.

Beyond the historic 120 years of record, we may consider longer term data from Colorado River Basin Paleo Climate studies based on long term tree ring studies reaching back to approximately 750 AD showing droughts of multi-decadal length. This data includes the 12^{th}-century drought that likely drove the Ancestral Pueblo people from our area. Finally, the CWCB Colorado River Water Availability Study and Reclamation’s Colorado River Basin Water Supply and Demand Study attempted to integrate potential climate change scenarios into future planning.

The Colorado Climate Center clarifies a Colorado specific problem with the above drought definitions. The government officially defines drought as "a period of insufficient rainfall for normal plant growth, which begins when soil moisture is so diminished that vegetation roots cannot absorb enough water to replace that lost by transpiration." While this is a good definition for areas that depend on rainfall for their moisture, 80% of surface water supplies in Colorado come from melting snowpack. A better definition of drought for Colorado might read:

"A period of insufficient snowpack and reservoir storage to provide adequate water to urban and rural areas."

The Project can be affected by all of the definitions listed above. As an irrigation project, the Project relates the interactions to how they ultimately result in delivery of water to crops and resulting production numbers from Project producers. The various definitions above do lead to a natural system of monitoring that is relative to different seasons of the year.

Monitoring is an annual cyclical process where each year rolls into the next with variable carryover effects. The water year in Colorado, and established by contract for the Project, is November 1 through October 31. The water year has historic roots in the state laws that reflect the climatic and hydrologic realities of Colorado snowfall to runoff to irrigation cycles.

Starting November 1, the Project measures the current water storage levels in both McPhee and the MVIC reservoirs. MVIC immediately starts filling their reservoirs with senior water rights on November 1. Carryover storage has averaged about 100,000 to 120,000 AF in McPhee which can supply approximately 40% or more of the annual project diversions. Groundhog is a high elevation reservoir with a small collecting basin and, similar to McPhee, is not usually drained since it may take multiple years to re-fill. Narraguinnep, on the other hand, is often drained and has historically filled up in all but three of the 105-year record. The status of all three reservoirs determines the starting point for the next hydrologic cycle. Carryover storage can vary from very low reservoir elevations, raising the risk of future shortage, to very full, limiting the risk of a shortage on the following year. The reservoir data and the river flow to fill them is monitored via reservoir elevations and from state and USGS streamflow gages.

November begins the snow accumulation season that will determine the water supply for the next year. Fall's monsoon rains, specifically falling in the higher elevation terrain from July through October, determine the starting soil moisture for the natural mountain water storage above the man-made structures. While this information is not precise, it is related to observed fall precipitation, then modeled and checked against base flows. Soil moisture has a measurable 10% to 20% effect on subsequent runoff.

Snow should accumulate in the mountains from November through May. The snow accumulation is tracked by snow water equivalent, SWE, and is the more reliable measure of the anticipated water supply for the upcoming irrigation season. This accumulation comes down in the April through July runoff period and generally yields 80% of the Colorado River and Project water supply.

To understand and track this natural reservoir progress through the season, DWCD tracks several sources including NRCS SNOTEL sites, a low snow course monitored by the DWCD, river gages (as available), lake elevations, and other regional data such as the Dust on Snow reports from the Silverton based Center for Snow and Avalanche Studies. The snowpack leads to a runoff forecast courtesy of the NRCS and the NOAA Colorado River Basin Forecast Center (CBRFC) based on years of records, statistical analysis, modeling and some satellite data as available. These forecasts combined with carryover storage yield most of the season's supply for McPhee and the Project. This target moves throughout the winter snow accumulation season and becomes more accurate as we approach April, May, and June. Depending on when decisions must be made, this can drive the accuracy of the available water supply forecast. Demonstrated most recently in 2015 with rapidly changing May and June forecasts.

~~3.5~~3.3 Description of Past Dolores Project Droughts

The USGS Dolores River Gage provides the longest available record specific to this basin with over 100 years of usable records and data. Since 82% of the Project supply comes over this gage, it effectively can be a proxy for the total Project supply historically. More recently the driest 14 years (2000 through 2014) in Colorado River basin history has been used for short term potential ranges of possible future weather.

Analysis of these records shows that two specific drought years, 1977 and 2002, would cause water shortages regardless of Project carryover. Carryover would have to have been higher than physically possible after normal use from a full reservoir the year prior. In both cases, the natural water supply was less than 25% of the long-term average.

The DPR studied 1928 to 1973, a 48-year record, and modeled only two significant shortages and two minor shortages, but obviously missed the more recent record dry years of 1977 and 2002. These DPR shortages came from several years of low flows and normal diversions that depleted carryover that, combined with a lower than average snowpack, did not deliver sufficient inflow. The historic studies, particularly the DPR, saw dry decades during the 1930's dust bowl and 1950's

Colorado drought. These long-term droughts demonstrate how multi-year dry spells often lead to Project shortage.

Since the Project came fully online in 2000, recent project experience shows several shortages over a brief period. After 2002, 2003 remained in shortage due to low carryover from 2002 combined with approximately 50% of normal inflow. Likewise, 2012 saw full Project deliveries but left the McPhee so low at 37,000 AF that, combined with only 140,000 AF total annual inflow, was not enough to meet the Project needs. This shortage lingered into 2014 which also lacked a full supply, ending at about 90% of the total by the end of the runoff season. As stated before on May 1, 2015, DWCD had announced shortages that were only alleviated by record setting May precipitation. The Project appears to continue in a decade-plus-long drought starting in 2000. 2017 is above average, but it is still unknown if the drought has been left behind or not.

Early spring Project supply shortages also had very specific impacts on the FRE planning and subsequent operations. By the time a full supply became apparent, the FRE had already committed to and prepared for a dry year farming plan. Although some adjustments were made, they could not fully satisfy on FRE production needs. Some Project irrigators could adjust to the full supply while others could not due to already implemented dry year farming plans

These historical records give some milestones on precursor snow pack levels that may indicate upcoming drought in the immediate season. Specifically, managers look at various CBRFC forecasts (the 90%, 70%, and 50%) starting March 1, in combination with current carryover to project the upcoming year's potential water supply. These early forecasts largely relate to the current snow pack, fall modeled soil moisture, and some forward looking short term forecasts.

~~3.6~~3.4Current Drought Monitoring and Potential Future Improvements

Empirical studies predicting drought conducted over the past century have shown that meteorological drought is never the result of a single cause. Instead, drought is the result of many causes which are often synergistic in nature. A great deal of research has been conducted in recent years on the role of interacting systems in explaining regional and even global patterns of climatic variability. One such phenomenon is the El Niño/Southern Oscillation (ENSO) that seems useful in the tropics.

The immediate cause of drought is the predominant sinking motion of air (subsidence) that results in compressional warming (high pressure), which inhibits cloud formation and results in lower relative humidity and less precipitation. Prolonged droughts occur when large-scale anomalies in atmospheric circulation patterns persist for months, seasons or longer periods of time. The extreme drought that affected the United States and Canada during 1988 resulted from the persistence of a large-scale atmospheric circulation anomaly.

Scientists do not know how to predict precipitation or the potential for a drought a month or more in advance for most locations. Predicting drought depends on the ability to forecast two fundamental meteorological surface parameters, precipitation and temperature. From the historical record, we know that climate is inherently variable. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depend on air-sea interactions, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of dynamically unstable synoptic weather systems at the global scale. The potential for improved drought projections in the near future differs by region, season, and climatic regime.

The Project area, latitude 37+ degrees above the tropics, faces current long-range forecasts that are of very limited reliability. The reliability that does exist is primarily the result of empirical and statistical relationships. In the tropics, empirical relationships have been demonstrated to exist between precipitation and ENSO events, but few such relationships have been confirmed above 30 north latitude. Meteorologists do not believe that reliable forecasts are attainable for all regions a season or more in advance.

So, where do we go from here? Today, more than ever before, information regarding drought conditions is available over the internet. While loaded with information the national drought websites don't provide equal utility to the Project users. The national and state sites are trying to use uniform definitions and data platforms. The more focused regional information is, the more helpful it is to specific Project operation planning. These sites provide some guidance, but, as listed above, can give no long term specific guidance.

Therefore, at any given stage of the continuous water year cycle, we can assess current status and potential future scenarios. This data would, of course, include current reservoir storage and mountain SWE. The fall soil moisture, modeled and observed, will affect future CBRFC forecasts. The CBRFC specifically uses the actual 1980 through 2015 weather as future potential inputs to formulate probabilistic forecasts for subsequent runoff starting from the current conditions. Some local data, like the DWCD Low Snow Course, can add some local precision to the modeled forecasts. Other demand-side local information may also affect future irrigator demands that are not directly available beyond the Project area.

DWCD can also support the continuously evolving tools used by the CRBFC, including the incorporation of more satellite observations and more sophisticated snow models. Likewise, DWCD can support the use of new or additional observational tools by national agencies, primarily the NRCS on the SNOTEL data, but could also include USGS tools. One potential is for remote SWE sensing from satellite technology currently under preliminary development by NASA and other science based agencies. This technology offers the potential to have more accurate data that leads to forecasts improving their precision in the future.

With the above information, DWCD runs the Dolores Project Allocation sheet & MVIC Project water calculations that ultimately determine the available Project supplies to the irrigators. With a variety of possible future scenarios, the various governing bodies can plan accordingly for the future.

Public stakeholder comments specific to this section:

- Criteria and indices are important to know when a drought is occurring and the extent of the drought. Multi-year criteria were suggested to attempt to determine when a drought shortage may occur prior to the actual shortage. "Actions and thresholds should also be part of staged drought response to enable earlier, but gradual, response to an event." (Addressed as best as possible in this section.)
-

- Recommend that drought forecasting methods be examined to include best scientific methods. (Addressed as best as possible in this section.)

4 Vulnerability Assessment

The Project water users have experienced three major shortages since 2000. In the years 2002 and 2013 the Project water users received approximately a 25% to 30% supply and in 2003 a 50% supply of water. This section qualitatively, and to the extent possible, quantitatively evaluates the impact of the shortages on each of the Project water users.

4.1 Impact of Past Dolores Project Droughts on Water Users

4.1.1 Ute Mountain Ute Tribe Farm and Ranch Enterprise

The FRE operates a 7,500 acre irrigated farm using 108 center pivot sprinklers on the west side of the Ute Mountain Ute Tribe's reservation. The land is irrigated by the 43 mile long THC that conveys up to 135 cfs of water to the FRE from McPhee. The THC begins near the south end of McPhee at the outlet of the Dolores Tunnel and the Towaoc Power Plant. The THC then goes south and southwest to the FRE.

The 7,500 acres of land is split into six irrigated land blocks with delivery pipelines beginning from the THC. Blocks 5 and 6 have separate headgates from the THC. Blocks 1, 2, 3, and 4 are served by one headgate at the end of the THC. The THC is high enough in elevation that all the sprinkler systems are pressurized by gravity and no pumping is required. In fact, the entire delivery system to the FRE is gravity flow beginning at McPhee to each sprinkler field.

In the Reclamation DPR, the crop consumptive use of the FRE was estimated using an assumed crop mix of 50% alfalfa, 20% grain, 10% pinto beans, 15% pasture, and 5% corn. The net delivery requirement at McPhee was estimated to be 3.11 acre-feet per acre to provide an average of 2.34 acre-feet per acre of crop consumptive use. The allocated total annual irrigation supply was 23,300 acre-feet based on 3.11 acre-feet per acre and 7,500 acres (not including the Ute Mountain Ute Tribe's M&I allocation). The 23,300 AF is included in the Colorado Ute Settlement Act of 1988 as a "Project Reserved Water Right."

The estimated water requirement of 23,300 AF per year has proven to be insufficient to adequately irrigate the 7,500 acres. The reason is more alfalfa is grown than estimated in the DPR because of favorable market conditions. The result is the FRE needs an additional 2,000 to 4,000 AF per year. In essence, FRE is water short nearly every year.

In the drought year of 2002, the FRE received only 6,300 AF, 27% of the allocated 23,300 AF. In 2003, the FRE received 12,600 AF, 54%. The 2013 supply was 9,100 AF, 39%. The shortages in these three drought years caused a major reduction in the crop production and income to FRE.

Due to the late season precipitation, 2015 was an unusual year which demonstrates the problem with spring runoff projections. The projected water supply in both April and May indicated there would only be a 40% to 50% Project water supply. Based on this information, FRE determined it was best not to plant all the fields due to the projected shortage of water. Beginning in the middle of May, there were significant rains that changed the actual water supply to 100%. These rains covered the entire Upper Colorado River Basin and were called "miracle May" because the water supply went from drought to average conditions within a few weeks from mid-May to mid-June.

Even though the FRE water supply shows a full supply the crop production and income were reduced because planting could not be recovered to use the supply.

The FRE records are not formatted to directly provide the total reduction in crop production and associated income but were adequate to provide the relative reduction in income. Table 1 shows for each of the drought years the supply, percent supply, and the percent of income. The percent of income is based on an indicator crop, alfalfa, which is assumed to reflect the income from all the FRE crops.

Table 2. FRE Drought Water Supply and Income

Year	AF Supply	% of Average Supply	% of Average Income
Normal	23,300	100%	n/a
2002	6,300	27%	16%
2003	12,600	54%	28%
2013	9,100	39%	17%
2015	21,400	92%	71%

In a 12-year period from 2002 to 2013, the FRE had three years where production and income were only 16% to 28% of the average income when compared to income with a full water supply. Note again that 2015 had nearly a full water supply, but the income was reduced because the availability of a full water supply was not known until late May.

Though the data doesn't readily show how many years it takes to recover from drought conditions, statements from FRE indicate that drought impacted lands were not back into full production until two to three years after the drought due to a loss of markets and the reality that two years is required to re-establish alfalfa stands.

The growing season for FRE starts in mid-April; therefore, the water supply projection in early ~~April~~March- is the basis that FRE uses to decide what crops to plant in the coming irrigation season. When there is a full water supply FRE has approximately 60% of the irrigated land in alfalfa because that has proven to be the best income. However, alfalfa crops use the most water of any crop and, because it takes a couple of years to develop a mature stand, it is the least flexible from year to year. Annual grains (e.g. wheat and corn) are more flexible each year and take less water, but the income is less. In early April FRE must decide what crops can be irrigated in the coming season, such as: whether to rotate some alfalfa fields to grain; fallow fields; and how much wheat and corn to plant.

In a full water supply year, the entire 7,500 acres can be irrigated with a proper mix of high water use alfalfa and lower water use grains. In projected shortage years, the decision is much harder to balance the available water with the amount of alfalfa and grains. Also, annual grains cannot be decided last minute because the seed may not be readily available. 2015 emphasizes the problem of using the April forecast, as explained above. It was not possible to change the cropping plan from a significant shortage projection in early April to a full supply year at the end of May.

The FRE bases its summer planting plans on the ~~April~~ March 1 runoff projection of whether there will be a shortage of irrigation water. FRE is vulnerable to actual hydrologic shortages and projected shortages whether there is an actual shortage or not.

While the impacts of drought, both projected and actual, are more obvious for crop production other impacts also occur. Overall impacts to the FRE bottom line include income, and scrutiny from the Tribal ~~c~~Council if insufficient funds that may require financial support from the Tribal general fund in a given year to "break even".

For example, based on the severity of the drought, FRE may purchase too much seed and/or fertilizer which is then not fully utilized resulting in a loss of money spent on unusable products. In turn, many of these products are not useable the next year and will need to be purchased again next year. Based on the severity of the drought, FRE may need to lay off staff for a season due to the lack of workable fields in a given season. Many of the staff are Tribal members and the loss of income ripples through the entire Tribal community. This may also affect future staff availability or lack of willingness to work for FRE when long-term job stability is unknown.

4.1.2 Non-Indian Full Service Irrigators

The non-Indian full service irrigators, also known as FSA irrigators, utilize the 40 mile long DCC that diverts from the Great Cut Dike on the west side of McPhee. The DCC goes northwest from McPhee and ends near the Town of Dove Creek. Approximately 28,985 acres are irrigated by individual landowners. The land is all sprinkler irrigated using pumping plants along the DCC to pressurize the water to each parcel of land.

The Reclamation DPR allocated an average of 1.96 AF per acre for most of the Project and 2.15 AF per acre for the Hovenweep area, with a maximum diversion to the land of 55,282 AF. Each parcel of irrigated land has a specific volume of allocated water that is provided through a delivery box with a meter to monitor the allocation. The DPR crop consumptive use was estimated assuming a crop mix of 55% alfalfa, 20% grain, 15% pinto beans, 3% pasture, and 7% corn. As with FRE, the FSA irrigators have planted more than 55% alfalfa because of the strong market which has resulted in some farmers having less water than they need.

Table 2 is similar to Table 1 in the above section for FRE and shows the percent supply in the drought years compared to a normal year and the percent of average income. The percent of average income is based on the data in Table 3 and is collected by the DWCD each year for the FSA irrigators and provides a good indication of the fluctuation in farm income.

Table 3. Full Service Irrigation Drought Water Supply and Income*

Year	AF Supply	% of Average Supply	% of Average Income
Normal	56,600	100%	n/a
2002	17,000	30%	37%
2003	28,000	49%	60%
2013	16,700	30%	43%

When FSA irrigators have significantly reduced income during a shortage, the DWCD's income is also reduced. DWCD sells water to full service farmers using a base charge and so much an acre-foot. When there is only a 30% supply the DWCD income is reduced nearly 70%. For instance, in 2013 DWCD had nearly $1 million in lost revenue that reduced reserves significantly. DWCD irrigators have agreed to replenish the "Water Supply" reserves through an annual surcharge to full service users. This surcharge provides rate relief during drought periods, without diminishing DWCD's long term capacity to perform O&M on what is a complex, relatively high-tech water storage and delivery system. The cost of drought has an immediate and long term impact on the FSA irrigators and DWCD.

Table 4. Full Service Irrigation Crop Census Summary

	2000	2001	2002	2003	2004	2005	2006	2007	2008
HAY									
Total Acres	22,633	22,730	19,598	19,948	18,357	20,133	21,964	21,409	21,359
Percent of Total	90%	92%	87%	81%	73%	79%	85%	82%	82%
Total Value*	$7,917,480	$8,593,715	$3,403,357	$5,547,266	$6,529,809	$7,842,977	$9,416,350	$10,572,391	$10,552,651
SMALL GRAIN									
Total Acres	1,254	1,200	1,392	1,627	1,868	978	1,070	2,664	2,135
Percent of Total	5%	5%	6%	7%	7%	4%	4%	10%	8%
Total Value*	$577,412	$868,238	$538,286	$738,252	$787,241	$332,840	$637,690	$1,362,967	$844,492
BEANS									
Total Acres	345	475	1,130	2,670	4,387	3,880	1,868	1,004	1,004
Percent of Total	1%	2%	5%	11%	17%	15%	7%	4%	4%
Total Value*	$65,243	$118,108	$251,715	$670,969	$1,953,167	$1,137,897	$683,130	$704,976	$704,976
PASTURE & OTHER									
Total Acres	884	390	345	426	599	626	847	911	1,440
Percent of Total	4%	2%	2%	2%	2%	2%	3%	4%	6%
Total Value*	$169,303	$136,513	$191,611	$219,953	$673,338	$959,426	$955,563	$1,212,061	$1,629,983
TOTAL ACRES	*25,116*	*24,795*	*22,465*	*24,700*	*25,211*	*25,617*	*25,749*	*25,989*	*25,938*
TOTAL VALUE*	*$8,729,438*	*$9,716,574*	*$4,384,969*	*$7,176,440*	*$9,943,555*	*$10,273,142*	*$11,692,734*	*$13,852,395*	*$13,732,102*

	2009	2010	2011	2012	2013	2014	2015	Average (2000-2015)
HAY								
Total Acres	20,749	20,797	20,213	20,294	17,866	20,764	19,754	20,536
Percent of Total	79%	79%	75%	75%	81%	95%	90%	83%
Total Value*	$8,258,777	$8,994,764	$14,794,144	$14,898,157	$4,226,782	$10,476,059	$12,116,650	$9,008,833
SMALL GRAIN								
Total Acres	2,425	1,938	3,306	1,370	1,442	1,579	1,964	1,763
Percent of Total	9%	7%	12%	5%	7%	7%	9%	7%
Total Value*	$816,782	$552,257	$1,516,700	$366,732	$367,365	$640,223	$601,750	$721,827
BEANS								
Total Acres	1,683	2,379	1,462	2,335	1,536	2,030	1,550	1,859
Percent of Total	6%	9%	5%	9%	7%	9%	7%	7%
Total Value*	$839,651	$1,044,536	$1,552,580	$2,979,294	$520,792	$2,025,540	$3,841,712	$1,193,393
PASTURE & OTHER								
Total Acres	1,363	2,379	1,462	2,335	1,536	1,683	2,015	1,202
Percent of Total	5%	9%	5%	9%	7%	8%	9%	5%
Total Value*	$1,790,601	$1,044,536	$1,552,580	$2,979,294	$520,792	$1,097,012	$120,092	$953,291
TOTAL ACRES	*26,219*	*26,326*	*26,973*	*26,996*	*21,967*	*26,056*	*25,283*	*25,337*
TOTAL VALUE*	*$11,705,811*	*$12,492,459*	*$21,247,455*	*$19,267,638*	*$5,858,932*	*$14,238,834*	*$16,680,204*	*$11,877,344*

Note: total values were not adjusted to account for inflation

Similar to the data in Tables 2 and 3, the "Colorado Agricultural Statistics" for 2010 to 2015 were also reviewed for Dolores and Montezuma Counties to assess whether per acre yields would provide information regarding the reduced crop production as a result of the 2013 drought. Tables 4 and 5 summarize the per acre yield which definitively indicates that the 2013 drought reduced the hay production to approximately one-third average production in both counties. The hay production is an indicator for the other crops.

Table 5. Dolores County Drought Crop Yield Per Acre

Year	Water Supply	Yield Tons/Acre	% of Average Production
2010	Average	3.6	100%
2011	Average	3.35	100%
2012	Average	4.75	120%
2013	30% Average	1.35	35%
2014	Average	3.8	100%

Table 6. Montezuma County Drought Crop Yield Per Acre

Year	Water Supply	Yield Tons/Acre	% of Average Production
2010	Average	3.9	100%
2011	Average	3.55	100%
2012	Average	4.4	110%
2013	30% Average	1.8	46%
2014	Average	3.8	100%

The data in Tables 2, 4, and 5 indicate the significant reduction in crop production resulting from the droughts of 2002, 2003, and 2013 which shows the vulnerability of irrigation to hydrologic drought in those years.

The FSA irrigators can use the May 1 runoff projections to determine their planting for the summer because their growing season begins in mid-May. The projection is much more accurate than the ~~April~~ March 1 projections that FRE uses. The FSA irrigators have an extra month to modify their cropping plans if there will be a shortage. Therefore, the FSA irrigators are vulnerable to actual droughts but less so to projections. The lost income to the FSA irrigators and the reduction in revenue to DWCD from the reduced sale of water is both a short and long term burden. The FSA irrigators are vulnerable to the shortage from drought both immediately in lost income in the drought year, but also long term in a surcharge to DWCD to make up for lost revenue during a drought. A certain amount of funds is needed every year to maintain and operate the irrigation portion of the Project and, if income is short in a drought year, it must be replaced in later years.

4.1.3 Montezuma Valley Irrigation Company

MVIC water supply is primarily provided through its senior direct flow and storage water rights from the Dolores River (the "Non-Project water rights") and supplemented by stored Project water from McPhee. The amount of Project water is determined based on the amount provided by the Non-Project water rights to the classified arable acres within the MVIC system. The more the Non-Project water rights provide, or are anticipated to provide, the less Project water is required. On the other hand, the less water available to MVIC from Non-Project water rights the more Project water. Also, MVIC is allocated water stored in McPhee prior to July 1 pursuant to the terms of the THC ~~Contact~~ Contract of 1989 (the Call Water), which is calculated in accordance with Exhibit A to the Stipulated Settlement and informed by the Inflow/Outflow worksheet. However, in spill years the Call Water stored water is spilled in accordance with the terms of the THC Contract of 1989. The result is that MVIC tends to have less water in years the Call Water is spilled. As seen in Table 6 the MVIC water supply is fairly constant (e.g. 90% of average or better) unless there is an exceptional drought such as in 2002.

The MVIC system has been in operation since the 1880's and is a combination of century old ditches and irrigation practices in half of the area of the system while the other half is served by the THC and sprinkler irrigation systems. The crops under MVIC are nearly all grass hay and alfalfa used for pasture and harvest. There is nearly no grain. Grass hay generally has lesser economic export value compared to alfalfa. The economic losses due to water shortages for MVIC were not as severe as they were for the FRE and FSA irrigators.

Table 7. Total MVIC Project and Non-Project Water Supply*

Year	Average AF Supply	% of Average Supply
Normal	135,000	100%
2002	80,300	60%
2003	118,400	88%
2013	118,700	88%
2015	122,700	91%

**Note: MVIC does not have a specific volume Project water allocation but the volume varies based on the amount of water provided by their Non-Project direct flow water rights.*

MVIC is less vulnerable to hydrologic drought than FRE or FSA irrigators, due to the seniority of the Non-Project water rights. Only extreme drought years such as 2002 (see Table 6), cause a deep shortage, but other years that Project water supply is very short MVIC suffers shortages that are not nearly as severe (e.g. 2013). However, because of the provisions of the THC Contract of 1989, MVIC is vulnerable to shortages in years that McPhee spills all of the Call Water first and therefore lost to MVIC shareholder use later in the irrigation season. Therefore, MVIC has more water after July 1 and the Project has a full supply when there is not a spill than in years that McPhee spills. Due to the operation of the Project contracts, to the extent Call Water spills, it is replaced in part by Project water, so that MVIC receives an amount Project water equal to approximately 70% of the Call Water spilled, subject to other limitations on total deliveries to MVIC under the Project contracts. MVIC is vulnerable to drought in extreme hydrologic drought years and years when McPhee spills.

4.1.4 Fishery Downstream of McPhee Reservoir

The fishery below McPhee Dam consists of both native and non-native fish populations. Trout, the non-native population, is located within approximately the first 12 miles below McPhee to the Bradfield Bridge. The native fish of concern, or "three-species," are roundtail chub (*Gila robusta*), flannelmouth sucker (*Catostomus latipinnis*), and bluehead sucker (*Catostomus discobolus*). Concerns about declines in these three species within the Colorado River Basin prompted resource agencies to draft and adopt a multi-state, multi-agency conservation agreement, the Three Species Agreement, to address the range wide declines of these species and to develop and implement voluntary actions that pre-empt the need for federal listing under the Endangered Species Act of any of these species. In the Dolores River, the flannelmouth and bluehead sucker population is particularly valued for its genetic purity. Across much of the range of the flannelmouth, the native fish has been diminished through hybridizing with the non-native white sucker.

There may be suitable habitat for these three native species along the entire length of the Dolores River below McPhee, although coldwater habitat along with predation by brown trout above Bradfield Bridge limits native fish populations in that reach. All three native species were caught during the 2017 electrofishing survey through Slickrock Canyon. During this survey, 94% of the 591 fish caught were natives, which is a very high percentage of natives compared to most rivers in the Colorado River Basin. Three species abundances (measured in fish caught per minute of electrofishing) doubled since the 2007 survey from 0.22 fish/min to 0.43 fish/min. Although, the 2017 results still indicate low fish abundance compared to the San Miguel River just above the Dolores confluence, where a 2008 survey of these species returned 3.1 fish/min.

Studies and collaborative planning efforts on the Dolores River, including the A Way Forward report and the Lower Dolores River Implementation, Monitoring, and Evaluation Plan for Native Fish (June 2014) (Fish Plan) have assisted Dolores River stakeholders in better understanding the native fishery in the Dolores River and to identify tools that could potentially help improve the status of each native fish species. Those study and planning efforts identify three impacts on the native fishery that display the fishery's vulnerability to drought.

Under the Fish Plan, management of peak flow events is identified as a significant opportunity to improve the Dolores River native fishery and the downstream environment. However, drought conditions that reduce the magnitude, duration, and frequency of peak flow events will limit the ability to maintain important river channel characteristics. Without peak flow events to provide channel maintenance, numerous changes take place on the river that degrades native fish habitat, including:

- Important fish habitat for foraging and reproduction is lost, e.g. without "flushing flows," cobble beds that serve as spawning grounds become clogged with fine sediment.
- Refuge habitat for different life stages of fish is reduced, e.g. deep pools that allow fish to survive extreme low flows for short periods of time become filled with sediment and are eliminated.

- The channel becomes narrower, leading to reduced total habitat.
- Backchannel and side channel habitat required by newly emerged young fish has been lost or has become inaccessible.

The total fishery allocation is 31,798 AF in a full supply year. Including a base allocation of 29,300 AF plus 1,274 AF in senior downstream water rights, 524 AF from reallocation downstream water rights and 700 AF of Paradox water. The base allocation and reallocation of the downstream water rights are treated as Project water, while the senior water rights and Paradox water are not. Project water for the fishery is subject to the pro-rata shortage based on same available water supply as the other Project users, and in 2013 only 12,704 AF (40%) of the Project water supply was available for the fishery.

Table 8. Downstream Fishery Project Water Supply*

Year	AF Supply	% of Full Supply
Normal	31,932	100%
2002	11,678	37%
2003	16,320	51%
2013	12,704	40%
2015	31,532	99%

*The water year for the fishery is from April 1 through March 31; this is different the irrigation season.

The native fishery on the Dolores River is vulnerable to extended low base flow conditions and is especially vulnerable to acute low-flow conditions caused by project water shortages. For example, the low abundance of riffle-dwelling bluehead sucker may reflect low availability of that habitat, because riffles dry or may become uninhabitable when base flows are low. Native fishes have the capacity to endure drought conditions and persist in dewatered environments, but flow limited systems that consist mainly of disconnected pools do not represent viable habitat for native fishes over the long-term, especially in the presence of predatory non-native fishes.

Low base flow conditions can also have impacts on the trout, which are adapted to cold water. During low flows, the lower volume of water may be heated by the air to temperatures above the thermal tolerance of trout (about 20 degrees C), and as a result trout biomass may potentially drop during low flows. An example of the acute impact drought can have on trout occurred between 2012 and 2013, when the density of trout (fish per mile) dropped by 65%, and the biomass (pounds of trout per surface acre of river) dropped by 79% (24 pounds per AF in 2012 to 5 pounds per AF in 2013) after the 2013 low water year. (This data was collected from three historic sites spanning from just below McPhee to about 3 miles above Bradfield Bridge). Both the 2012 and 2013 numbers are well below the 60 pounds per acre required for Gold Medal status.

4.1.4.1 Non-Native Vulnerabilities

One of the biggest concerns for native fish with respect to drought is the potential for extended warm, still conditions, resulting from low base flow to favor reproduction of non-native species that prey on the young of native fishes, particularly when there is no peak flow to cool the water and disrupt spawning non-natives. This dynamic was documented on the Dolores River in the early

2000s and has more recently been documented for highly predacious smallmouth bass on the Yampa River.

Releases made to the fishery downstream of McPhee occur by means of a Selective Level Outlet (SLO) tower as the inlet to the hydropower plant. The SLO has three different grates that could provide releases of water that is of varying temperatures. Water temperature may affect downstream nutrients and dissolved oxygen levels. The SLO different grates have never been used due to concerns with escapement of smallmouth bass from the McPhee. CPW has directed Reclamation to only use the lowest inlet for releases as to minimize the risk of escapement of non-native fish.

4.1.4.2 The Native Fish Monitoring & Recommendation Team and Biology Committee

The Dolores River Native Fish Monitoring & Recommendation Team (M&R Team) is currently working to assist the Bureau of Reclamation and DWCD to identify and monitor opportunities for improvement in the management of native fish. The M&R Team and the Biology Committee are well-positioned to identify further vulnerabilities in the Dolores River fisheries and opportunities to implement drought mitigation and response actions that will help make the fisheries more resilient to drought.

The need for a Biology Committee was established in~~during~~ the *1996 Environmental Assessment and Finding of No Significant Impact* for implementation of proposed actions to modify the operation of McPhee and acquire additional water for releases downstream to the Dolores River. The primary function of the committee is to manage the fish pool ~~f~~to best~~or~~ support~~ing~~ the trout fishery downstream of the McPhee dam to the Bradfield Bridge. The committee includes participants from the following entities: Bureau of Reclamation, Colorado Parks and Wildlife, U~~ntied~~ S~~tates~~ Forest Service, Trout Unlimited, US~~ntied~~ States Fish and Wildlife Service, and Bureau of Land Management.

In addition to the Biology Committee, ~~T~~the M&R Team plays a coordinating and advisory role in the stewardship of the Dolores River from McPhee to the Bedrock gage. The M&R Team make up includes participants from the following entities: American Whitewater, Bureau of Land Management, Bureau of Reclamation, Colorado Parks and Wildlife, Dolores Water Conservancy District, Montezuma Valley Irrigation Company, San Juan Citizens Alliance, The Nature Conservancy, Trout Unlimited – Local Chapter, United States Forest Service, Ute Mountain Tribe, Dolores County, Montezuma County, Montrose County, and San Miguel County.

The advice and recommendations of the M&R Team are guided by:

- ~~1.~~ Dolores River Native Fish Implementation, Monitoring, Evaluation and Plan (Implementation Plan), developed by the M&R Team and accepted by DWCD in June of 2014.
- ~~2.~~ The "Implementation Plan" was developed based on an evaluation of three experts on the three-warm water native fish of concern, in accordance with the "Range-wide Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker", commonly referred to as "The Three Species Agreement" which involves multiple states, tribes, and resource management agencies.

1.

2. The M&R Team is guided by the Mission Statement of the Dolores River Dialogue:

"To explore management opportunities, build support for and take action to improve the ecological conditions downstream of McPhee Reservoir while honoring water rights, protecting agricultural and municipal supplies, and the continued enjoyment of boating and fishing."

No entity participating in the M&R Team is yielding any of their individual authorities or responsibilities to participate on the M&R Team. The ~~purpose of the~~ M&R Team ~~is to~~ scoordinates and aligns stewardship and monitoring plans and strategies to allow each institution to carry out their appropriate role in actions that have the consensus support of the M&R Team.

4.1.4.3 Opportunities to Address the Dolores River Fisheries' Allocation Drought Vulnerability

Prior studies and collaborative planning efforts on the Dolores River have helped to identify key opportunities to address drought vulnerability of the Dolores River fisheries allocation and other project interests and stakeholders.

Opportunities to implement drought mitigation and response actions that result in increased carry-over storage in McPhee, while benefiting many project interests and stakeholders, will also provide significant drought resiliency benefits to the Dolores River fisheries allocation. Specifically, increased carryover storage will:

- Make it more likely that managed releases and fish habitat improvement downstream will occur (and will occur more frequently and at higher magnitudes).
- Make it more likely that the thermal regime can be managed to avoid adverse impacts to native fish embryos and larvae.
- Reduce the likelihood of shortages to the base flow pool, which will allow the base flow pool to maintain critical summer base flows to support the resiliency of the Dolores River fisheries.
- Help suppress unwanted non-native fish populations by providing more peak flows that tilt the survival advantage to native fish, and by avoiding extreme low-flow conditions that given an advantage to unwanted non-native fish like smallmouth bass.

Opportunities to develop and implement non-structural drought mitigation and response actions for project users also have the potential to provide drought resiliency benefits to the Dolores River fisheries. If new non-structural actions are developed to increase the resiliency of project users, those actions should include and consider opportunities for all project users (including the base flow pool).

Public stakeholder concerns and comments specific to this section:

- Table 7 does not reflect the entire amount water available to the fishery of 31,798 AF. (Table 7 is revised to show Project and Non-Project water supply.)
- Firming Project water supply through greater carryover storage will provide operational flexibility to help meet important downstream aquatic needs. (Carryover storage descriptions are strengthened in various sections.)
- Is the 700 AF for the Paradox augmentation water included as a fishery release shorted? (It is not shorted and is addressed in this section.)

- Concerns by biologists that storage to increase base flow but decrease peak flows is not beneficial to native fishes. (Addressed in this revised Section.)
- Collaborative efforts to address the needs of the fisheries in the Dolores River have identified a gap in the water supply needed for the base flow pool in full supply and shortage years. Supplementing the base flow pool in such years through voluntary agreements is an opportunity identified in the Plan. (Statement made.)
- The fishery is a beneficiary of carryover storage, but there is not an action in Section 5 or 6 for the fishery to contribute to carryover storage. The fishery could contribute to carryover storage in larger spill years by having their Project allocation be accounted at base flow levels during a spill as other Project users are required to do.

4.1.5 Boating Downstream of McPhee Reservoir

Boating is dependent on adequate runoff to provide excess water for a managed spring. Boating does not have a Project water allocation in McPhee and is therefore dependent on the availability of water that cannot be stored in McPhee for Project Purposes. DWCD closely monitors the runoff each spring using data described in Section 3 to assess whether there is the potential for a managed release. DWCD attempts to schedule releases of excess water so that McPhee fills, but all the excess water is released through the outlet works and no water goes over the spillway. The managed releases are aggregated and advertised to maximize the opportunity for boating and to address ecological health. The boating community has been very cooperative in coordinating boating releases with opportunities to use high flows to improve ecological conditions below McPhee.

Managed spring releases generally occur when McPhee has considerable carryover storage. When a spill is anticipated the potential volume of the spill is estimated so that the number of days at a certain flow release can be determined. To the extent possible, the boating days and flow magnitudes are coordinated with boating organizations to provide the best possible boating experience, accomplish ecological objectives and fill McPhee as the managed release is concluded. Years with significant spill volumes gives DWCD more flexibility to match releases with boating and ecological objectives and provide advance notification to boaters and those conducting fish, sediment and floodplain monitoring.

During drought years, there are no spills and no boating because stored water is dedicated to Project users to provide for contractual allocation and carryover storage. The boaters are vulnerable to below average runoff which occurs in approximately half of the years based on historic hydrology.

4.1.6 Municipal and Industrial Users

A total of 8,700 AF of M&I water is allocated to Project users: DWCD's total is 5,120 AF, Dove Creek's total is 280 AF, City of Cortez's total is 2,300 AF, and the Ute Mountain Ute Tribe's total is 1,000 AF. The M&I water users are provided a full supply even if other water users are in shortage, so these users are not susceptible to drought as are the irrigators and fishery. The reason M&I water users are not shorted is due to contact obligations. The 1977 Repayment Contract defines the use and allotment of Project water with the first priority being to deliver M&I commitments in full. Due to these contract obligations, M&I water does not share in water shortages and was not evaluated in the vulnerability assessment. M&I water users also pay the full cost of their Project allocation with interest.

~~4.1.6~~4.1.7 McElmo Creek Irrigation

There is significant acreage irrigated by diversions from McElmo Creek and its tributaries. This Plan addresses drought actions that will improve carryover storage in McPhee, which will reduce the impact of drought on Project water users. McElmo Creek irrigators are not Project water users and cannot contribute to carryover storage. However, three-quarters of the public comments received on the draft Plan came from McElmo Creek irrigators who are concerned that actions listed in the Plan could reduce the McElmo Creek water supply. This sub-section and 5.1.3.3 are included to address the many comments from McElmo Creek water users.

The McElmo Creek water supply is primarily attributed to tailwater, surface accretions, and groundwater accretions attributable to MVIC's transbasin diversions of water from the Dolores River, after beneficial use by MVIC shareholders. Under Colorado law, MVIC's transbasin diversions have a unique status. MVIC and its shareholders can utilize the water to extinction if they can demonstrate dominion and control of the water through either physical control or adequate accounting methodologies. MVIC first started the transbasin diversions in the late 1880's as described in Section 1.3.1.

In the years that MVIC, or its predecessors, has been in operation, they permitted water to accrue to McElmo Creek and its tributaries (e.g. Hartman Draw, Trail Canyon, Mud Creek), after initial beneficial use by MVIC shareholders. MVIC and its shareholders have no claim to this previously released water. There are several hundred adjudicated water rights within the McElmo Creek basin that utilize the MVIC transbasin water accruing to McElmo Creek and its tributaries after initial use by MVIC shareholders. This has permitted the diversion and use of water in the McElmo Creek basin far in excess of what the natural native flows would have permitted. The diversion and use of this water among the McElmo Creek adjudicated water rights are administered by the State and Division Engineers in accordance with the principles of prior appropriation.

Under Colorado law, MVIC does not have an obligation to continue allowing water attributable to its transbasin diversion to accrue to the McElmo Creek basin for the use of the McElmo Creek irrigators under their adjudicated water rights. In fact, MVIC is required to utilize its diversions in a reasonably efficient manner to accomplish the decreed beneficial uses. Over the past decades, MVIC has improved its water delivery system by lining ditches and installation of facilities to better manage the delivery of water. The MVIC shareholders have and continue to change from flood irrigation to more efficient sprinkler irrigation practices. Also, the construction of the Project changed the MVIC water diversion pattern, so less water is now diverted in the spring under MVIC's senior direct flow rights and more water is delivered from MVIC storage accounts in McPhee in July through September. The availability of transbasin water from MVIC operations to McElmo Creek irrigators changed accordingly.

There are two stream gages on McElmo Creek. The first is located at the Colorado and Utah state line (USGS 09372000). The second gage is just downstream of Trail Canyon (USGS 09371520).

Figure 9 depicts the monthly flow at the state line gage prior to the Project (1952 to 1985), since the Project was operational (1986 to 2014), and since the Project was fully providing water to all users (2000 to 2014). This figure suggests the pattern of runoff in McElmo Creek changed with the operation of the Project, with the high flow months changing from March to May to August to October. As discussed above, the reason for the observed change is MVIC no longer diverted a large amount of water in the spring. MVIC previously diverted as much spring runoff as feasible for beneficial use because it lacked adequate storage. However, with McPhee and water available from the Project under its various contractual agreements with Reclamation and DWCD, MVIC obtained access to stored water, and it began taking delivery of that previously stored water later in the irrigation season in a pattern that was more in line with its shareholders' irrigation requirements.

Figure 10 depicts the total flow at the state line gage from 2000 to 2014, with an average of about 30,000 AF per year, but widely varies from 10,000 AF in 2002 to over 50,000 AF in 2009. The average of about 30,000 AF leaving Colorado is largely the result of MVIC water accruing to McElmo Creek that originates from MVIC transbasin diversions from the Dolores River. The native flow in McElmo Creek is minimal. McElmo Creek is a low elevation drainage basin with little precipitation and a small amount of spring runoff. During late summer and fall, monsoonal precipitation can cause flows to be as high as 2,000 cfs for one day. Generally, MVIC transbasin water that is permitted to accrue to McElmo Creek provides the majority of the water during the irrigation season.

The McElmo Creek water users, because of their reliance on transbasin accruals to McElmo Creek and its tributaries, experience a shortfall to demand when the MVIC diversions from the Dolores River are reduced, as shown in Table 8. Due to their reliance on the non-native transbasin water that is permitted to accrue to McElmo Creek and its tributaries, the impact of drought on McElmo Creek water users is very similar to MVIC irrigators as shown in Tables 5 and 6 (see % of average supply).

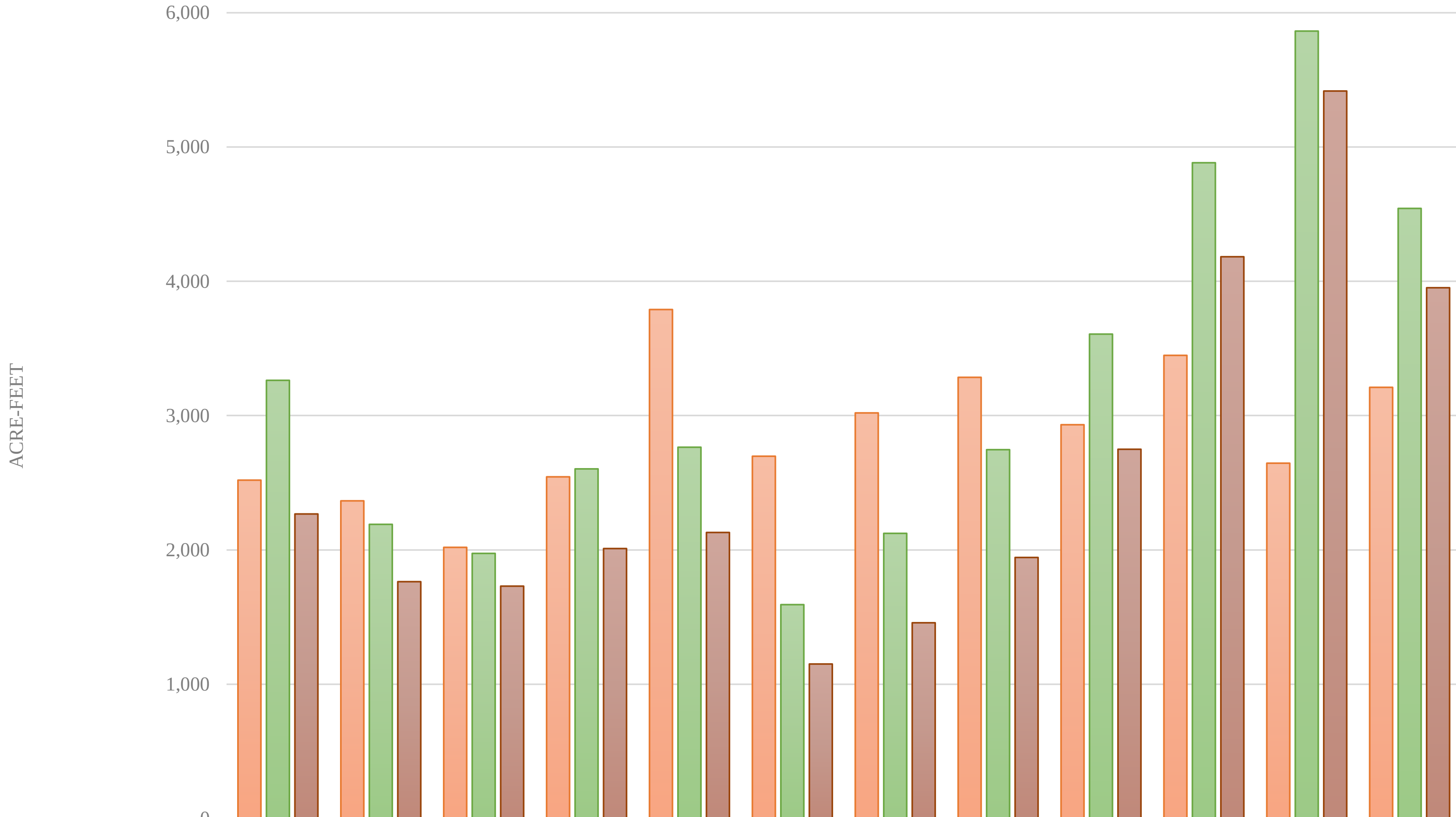
MVIC does not have an obligation to maintain flows in McElmo Creek. The McElmo Creek irrigators have been and will continue to see reductions in the available supply of transbasin water as MVIC implements system improvements and as MVIC shareholders implement on-farm irrigation improvements.

Since there will always be surface and groundwater accruals to the McElmo Creek system from MVIC shareholder use of the transbasin water, it is unlikely that McElmo Creek flows will be completely deprived of this non-native supplement. Data is not available at this time to estimate the irrigation water demand of McElmo Creek irrigators compared to the current and potential future water availability of MVIC transbasin accruals to the McElmo Creek system, so the future shortages to demand cannot be quantified without additional studies. The McElmo Creek irrigation concern is included in the Plan to document the potential impacts of MVIC system improvements and to suggest that McElmo Creek irrigators begin the process to evaluate options to stabilize their water supply as explained in greater detail in Section 5.1.5.3.

<u>Public stakeholder concerns specific to this section:</u>

- Numerous comments and concerns were expressed on the potential impacts of the proposed mitigation actions to McElmo Creek water users. The addition of this section was requested in multiple public comment letters.
- Concerns were expressed over the potential impacts of actions to water quality in McElmo Creek.

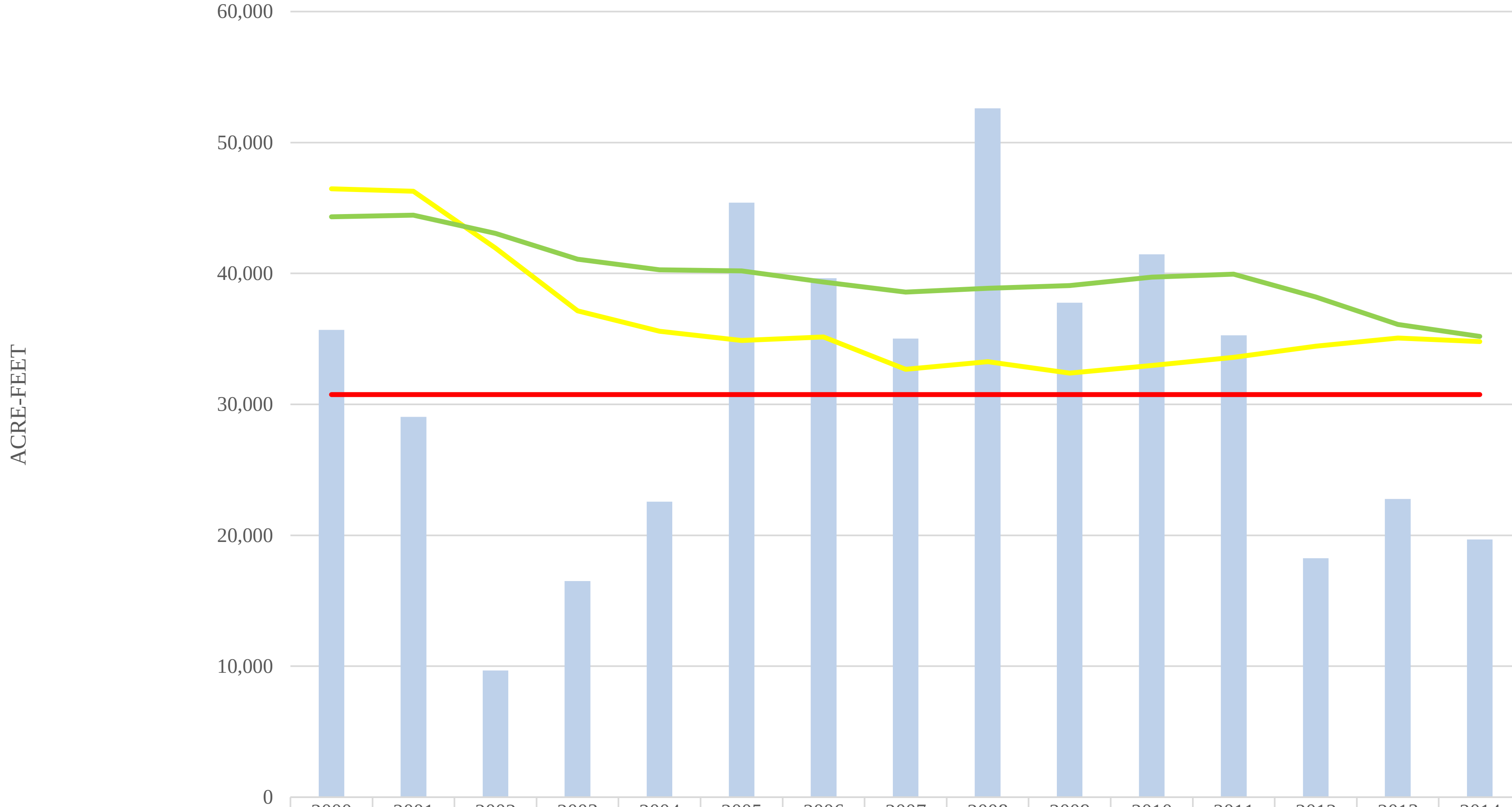
Figure 9. Monthly Streamflow of McElmo Creek at the CO/UT Stateline



	November	December	January	February	March	April	May	June	July	August	September	October
Pre Dam (1952-1985)	2520	2366	2019	2544	3790	2698	3020	3285	2932	3449	2646	3211
Post Dam (1986-2014)	3263	2191	1974	2604	2765	1593	2124	2747	3607	4883	5863	4543
Fully Online (2000-2014)	2268	1764	1731	2010	2130	1151	1458	1944	2750	4183	5417	3952

Pre Dam (1952-1985) Post Dam (1986-2014) Fully Online (2000-2014)

Figure 10. Yearly Streamflow of McElmo Creek at the CO/UT Stateline



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Yearly Total	35695	29050	9674	16493	22575	45410	39635	35015	52608	37766	41459	35269	18244	22782	19685
10 Year Running Average	46456	46286	41946	37142	35589	34879	35143	32677	33250	32392	32969	33590	34447	35076	34787
20 Year Running Average	44318	44443	43065	41093	40280	40201	39345	38567	38857	39067	39712	39938	38197	36109	35188
2000-2014 Average	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757	30757

Yearly Total — 10 Year Running Average — 20 Year Running Average — 2000-2014 Average

4.2 Summary of Past and Future Risk of Economic Losses

The estimated economic loss from drought is best estimated by the relative reduction in production and income from the irrigated land. The actual dollar loss is difficult to estimate because the market value of the crop changes significantly from year to year. During the major drought years in 2002, 2003, and 2013, the FRE and FSA irrigators generally sustained economic losses of 70% to 85% of income. Further, discussions with irrigators indicate that it took two to three years or more to fully recover from drought. For instance, if an alfalfa crop was lost during the drought, because of no water, it requires two more years after the drought to get the field back up to full production – one year to re-plant the alfalfa and another year for the stand to mature. It can take several more years to replace lost income and loss of markets.

There is no data to estimate the economic impacts to the fishery, native and non-native. The reduction in trout biomass during drought periods is the best indicator of loss of sports fishing opportunity and economic input. Downriver boating is not possible in drought years with no resulting economic input.

4.3 Summary of Past and Future Risk of Social and Environmental Losses

Reduced agricultural production has economic ripple effects throughout Montezuma County and Dolores County. Since agriculture is the largest segment of the economy, Dolores County is especially economically affected by reduced crop production. The most recent economic reports that could be found for the two counties is the 2011 "Economic Development Strategy" (CEDS) which quantified the employment by sectors in each county. The assessment for each county is described in this section.

4.3.1 Montezuma County

The following are quotes and information from the CEDS:

> *"Agriculture is a very important base industry in Montezuma County. The county has consistently ranked first in agricultural production in Region 9 (southwest Colorado) based on the Census of Agriculture Statistics."*

> *"It is difficult to obtain accurate data for measuring the economic impact of the agriculture in the county. Traditionally, economic impact is measured by number of jobs, percent of total economy, income generated, and average annual wage. The numbers for agriculture are often among the lowest when compared with other sectors. However, agriculture continues to contribute to the economic development of Montezuma County. An important measure to consider is the amount of total land used in agriculture. Farmland accounted for 52.8% of all land Montezuma County."*

The CEDS report estimates that agriculture directly accounts for 6% of the jobs (684 of 12,045) in Montezuma County. When accounting for secondary jobs due to agricultural production the percentage increases to 7% (841 of 12,045).

Though agriculture is not the largest economic driver in Montezuma County it remains significant because the area began as an agricultural community, employs many people in agriculture, is a major land use on private land, and the community continues to identify strongly with its agricultural roots. When agriculture is short of water, the City of Cortez also institutes water restrictions.

4.3.2 Dolores County

The following are quotes and information from the CEDS:

> *"Over the last 20 years, there has been a significant shift in Dolores County regarding agriculture. In 1990, 70% of the total economy was agricultural based – today it is less than 40%. In the early 1990's, a sophisticated irrigation system (Dolores Project) provided water to the western portion of the county, but the water reaches only 7,600 acres out of a total of 150,000 acres."*

The CEDS report estimates that agriculture directly accounts for 23% of the jobs (150 of 664) in Dolores County and is the largest economic sector in the county. When accounting for secondary jobs due to agricultural production the percentage increases to 29% (190 of 664).

Agriculture is the primary economic driver in Dolores County, and when the production is reduced due to drought, the impact is felt directly throughout the businesses in the county.

4.3.3 Fisheries

As previously discussed, three imperiled native fish species (roundtail chub, bluehead sucker, and flannelmouth sucker) inhabit the Dolores River. Concerns about declines in these three species within the Colorado River Basin prompted resource agencies to draft and adopt the Three Species Agreement, a multi-state, multi-agency conservation agreement for the management of these species. The Three Species Agreement is predicated on the concept that collectively local, state, tribal, federal agencies, and other willing partners can work together with the communities most affected by a potential federal Endangered Species Act listing to develop and implement voluntary actions that pre-empt the need for such a listing.

These three native fish species are vulnerable to drought in the Dolores River and throughout their range in the Colorado River Basin. There are significant risks of future social and environmental losses to water users and resources in the Dolores River if any of these species declines to the point that it is listed under the Endangered Species Act.

The presence of the three native fish species in the Dolores River below McPhee varies according to ecological conditions and available water supplies. Monitoring data indicate that the reach from McPhee Dam to the San Miguel confluence supports stable roundtail chub populations while evidence of viable flannelmouth sucker or bluehead sucker populations in this reach has not been substantiated to date. This is understandable since the two sucker species require higher flows and water availability and this reach is limited by longstanding Dolores Project contractual obligations to full service irrigators, water allocations in settlement of the Colorado Ute Indian Water Rights claims, supplemental water to MVIC, and domestic water supply commitments. There are also predatory non-native fish in this reach, most notably the smallmouth bass. However, if the bass is controlled or eliminated, it could improve the prospects for the native fish.

The base flows below the San Miguel River confluence with the Dolores are approximately double the Dolores River base flows above the San Miguel. The increased base flows below the San Miguel are more in line with the runs and riffles needed to support flannelmouth sucker and bluehead sucker native fish populations. The roundtail chub is the only one of the three native fish species that has demonstrated viable populations above the San Miguel confluence, due to the pool habitats in this part of the river that are important to the roundtail. The Dolores River runs approximately 200 miles, below McPhee, before it joins the Colorado River. A critical step in strengthening the ability of native fish populations to weather drought conditions is to look at the presence of each of the three native fish species along the entire 200 miles of the Dolores River, below McPhee, to determine where viable populations of each of these species exist and how to identify and support native fish strongholds during periods of drought and shortage. Coordinated monitoring and assessment of native fish populations in the lower Dolores and lower San Miguel Rivers will create a much stronger basis for alignment of work on the Dolores with the Three Species Agreement.

The Three Species Agreement addresses the three native fish species on a range-wide Colorado River basin basis. Efforts to monitor the presence of these species throughout their range will provide a basis for identifying and investing in stream reaches that provide the best opportunity to support viable populations of the three native fish species. Opportunities for these fish appear to be very limited on the Dolores River above the San Miguel confluence due to limited water availability and an expanding population of non-native predators in portions of this reach. Eradication of non-natives above the San Miguel confluence, particularly the predatory smallmouth bass, is considered by fishery managers to be extremely difficult and cost prohibitive, with environmental impacts that would require an extensive NEPA process. There are very likely other streams in the range of these three species, particularly the sucker species, that would make better habitat improvement investments.

In the meantime, the Native Fish Monitoring and Recommendation Team will continue to support rigorous monitoring of the native fish populations on the Dolores, above the San Miguel confluence, to provide data that allows opportunities in this reach to be compared with opportunities on other streams in the range of these fish in accordance with the Three Species Agreement.

4.4 Assessment of Climate Change on Future Risk

The CWCB prepared the "Colorado River Water Availability Study Phase I Report" in March of 2012. The analysis in that report for southwest Colorado, not specifically the Dolores River basin, projected a 5% to 10% reduction in precipitation (Table 3-8, page 3-27) from April through October and a 10% to 15% increase in temperature (Table 3-4, page 3-15) for 2070. The analysis also projected a 9% decrease in consumptive use (Table 3-17, page 3-74).

However, the impact on precipitation from climate change is not well defined, especially for southwest Colorado that is on a "boundary" between downscaled global climate models. Colorado is comprised of multiple mountain ranges which are typically not included in large scale climate models. To exasperate this, the San Juan mountains are orientated east to west while much of other ranges in the state run north to south.

Since 2012, more recent climate change models indicate that southwest Colorado may have less, more or the same precipitation. However, the precipitation is more likely to be as rainfall rather than snowfall. Depending upon which climate models turn out to be accurate, ~~and~~ McPhee is storing both rain and snow~~, there~~ which may not ~~be~~ lead to a noticeable impact on the future water supply and number of droughts. Even if average precipitation is lower than historically recorded, McPhee is located to make maximum use of whatever water is available, though if climate models predicting less precipitation are accurate, the frequency of drought may increase.

The "Colorado River Water Availability Study Phase I Report" projects increasing temperatures which would likely result in higher crop consumptive use. Therefore, the water availability into McPhee may not change, but the irrigation water demand may increase due to temperature and/or a longer growing season. The water allocations from the Project are set by contracts and the water delivery cannot increase even though the demand may increase. The farmers would have to implement on-farm measures described in Sections 5 and 6 to be more efficient with the available water supply. Due to the contract limitations that allocate water no matter the supply available, ~~T~~the Plan focuses on ~~supports~~ on-farm efficiency improvements as a top priority to help farmer become more resilient to reduced supplies whether normal drought or the results of climate change.

The Laboratory of Tree-Ring Research at the University of Arizona has developed a "Long Term Streamflow Reconstruction from Tree Ring Data" from 762 to 1906 at Lee Ferry on the Colorado River. Though this analysis was for the entire Upper Colorado River Basin, the results can be assumed to indicate that the Dolores River basin has had significant droughts in the last 1,200 years. The worst period of flow was in 1100's when a 70 years drought occurred. The tree ring research shows that the Project will have to adjust and adapt to periodic droughts and resulting irrigation and fishery shortages that are projected to be exacerbated by climate change.

In addition to ~~assess~~ climate change model~~s~~ results, water managers in the area have results of the DPR to reflect upon. The DPR utilized a 46-year period of 1928 through 1973 to study water supply availability for the Project. This study assumed that runoff as it occurred in the past is the best indication of what is to be reasonably expected to occur in the future and representative of the conditions within which the Project will operate; however this assumption is turning out to be overly optimistic and 46 years period is not necessarily representative of future hydrology. This study resulted in a worst case condition of ~~only~~ a 50% shortage in any ~~once every~~ 10 year~~s~~ period. However, since the Project has been fully online users have experienced more severe and frequent shortages that originally estimated.

To respond to the variable water, supply the Plan establishes both mitigation and response actions that improve on-farm efficiency, improve delivery system efficiencies, or improve operations as the highest priority. These actions are listed in Table 18 in Section 9 and were developed to respond to lower water supplies than were estimated in the DPR. Since the contracts limit the maximum supply, the irrigators must use the water they receive more efficiently to attempt to maintain production.

As the actual effects of climate change unfold over the future decades, the potential impact will be continually monitored.

5 Mitigation Actions Prior to a Drought

The following potential mitigation actions aim to mitigate the risks posed by drought and build long-term resiliency to drought. This section identifies structural and/or non-structural actions that can be implemented prior to a drought to better utilize the available water supply and/or make the water users more resilient to drought. The Plan is not a decisional document and as such the potential mitigation actions described in this section are a general list and not meant to indicate that they will be pursued by Project stakeholders after the Plan is finalized. The actions will be considered by the responsible entities and pursued if and when each entity decides, in its sole discretion, to do so.

Per the assistance agreement with Reclamation for funding of the Plan, regulatory compliance and responsibility for content are clearly defined. For the Plan, the:

"consideration under National Environmental Policy Act (NEPA), Endangered Species Act (ESA), or National Historical Preservation Act (NHPA), is not required…Further, implementation of the contingency plan – in part or in whole – may require additional compliance with federal, state, tribal or local requirements priors to such implementation."

Any future implementation of actions requiring Reclamation involvement will be coordinated with the appropriate Reclamation office with Reclamation determining any compliance requirements with NEPA, ESA, or NHPA. The content of the Plan is solely the responsibility of grant recipient DWCD. Reclamation's participation in this agreement is limited to:

"The provision of funding and technical assistance for the development of a Drought Contingency Plan that strives to anticipate and mitigate impacts and conflicts that arise from drought. Reclamation does not exercise control over the content or approval of the plan under this award. Reclamation review of the Work Plan and Drought Contingency Plan is only to ensure compliance with Drought Response Program requirements. The Drought Contingency Plan or plan update developed under this Agreement is a water management planning document and does not provide recommendations or represent a statement of policy or position of the Bureau of Reclamation, or the Department of the Interior. The plan does not propose or address the feasibility of any specific project, and does not represent a commitment for provision of Federal funds for projects identified in the plan."

Along with input from the entities they represent, the Task Force developed the following potential mitigation actions as part of the Plan's development process. Multiple discussions were conducted pertaining to a specific action including steps for evaluation, cost and potential funding sources, feasibility, and priority relative to other actions. Since the Project has been subject to multiple droughts in recent years, many of these actions are response actions based on lessons learned during those water short years. Mitigation and response actions will always be intertwined; learning from each experience leads to a variety of actions, and the timing of implementing these actions is the biggest distinguishing factor between a mitigation versus a response action.

The potential mitigation actions are described herein in no particular order. The potential mitigation actions are categorized by structural and non-structural actions. These actions will require additional work to be implemented. This Plan does not improve the likelihood of implementation but organizes the actions for consideration by the appropriate Project stakeholder entities. At a minimum the actions will require some form of entity (e.g. board, shareholder, etc.) approval to be implemented and, if there is a federal nexus, may also require NEPA and/or ESA review and approval. As part of the stakeholder process, general and specific concerns were raised for some of these actions. The general concerns are listed below, and the specific concerns are listed with each action.

<u>Public stakeholder concerns that apply to all of the actions in Section 5 include:</u>

- What is the approval process to implement the actions? (Addressed above in Section 5.)
- Will NEPA compliance be required? (Addressed above in Section 5.)
- The water saved by these actions is not allocated to carryover storage but, in the case of MVIC, can be used for expanded acreage or to increase supply to existing users. (Addressed in Section 5.1.2.)
- Actions that increase carryover storage and capitalize on creating peak flows that benefit native fish, habitat and recreation are best. (A comment, not a question, but supported in numerous sections of this Plan.)
- Can McPhee outlet be used to provide water temperature that is best for native fish?
- Actions that are multipurpose, such as to improve both irrigation and fishery water supply, are more likely to obtain public and private (e.g. The Nature Conservancy) funding to implement the action. (A statement and concern.)
- Assumptions and underline data used for implementation of the action will be updated prior to implementing. (Statement made.)
- Groundwater is not described as a potential source during times of drought.

5.1 Structural Mitigation Actions

The proposed structural mitigation actions are described below for FRE, MVIC, DWCD, and system wide efforts. Each entity has the potential for structural improvements in their system, while MVIC shareholders and DWCD irrigators also have on-farm opportunities. Actions are listed below in no particular priority.

To implement an action, the applicable entity will develop plans that include proposed funding source(s) (e.g. loans and grants), cost estimates, permitting, preliminary and final designs. Individual irrigators could implement their on-farm improvements without involvement by DWCD or MVIC. To implement certain actions involvement and support from all, or a combination of specific entities and individuals may be necessary. The actions are not prioritized since each entity, should it choose to do so, will implement actions based on their own priorities and needs.

5.1.1 Ute Mountain Farm and Ranch Enterprise Actions

Representatives from FRE attended the Task Force meetings and individual meetings with consultants to develop their actions. The FRE operates a 7,500 acre irrigated farm using 108 center pivot sprinklers on the west side of the Tribe's Reservation. The farm was allocated approximately 23,300 AF subject to shortages.

The FRE conducts routine OM&R of the farm's infrastructure. This OM&R has been an ongoing process for many years which has led to pivot upgrades, delivery system improvements, and improved water runoff management. While many improvements have been performed, some areas of concern were identified after a water short year. The need for more localized control of irrigation blocks and pressurization of other Tribal irrigated lands were identified as top priorities. These actions are described in detail below.

5.1.1.1 Control Valves

Isolation valves are needed to better control the delivery system to handle water fluctuations within some of the irrigation blocks (a total of 6 blocks serve the entire 7,500 acres). An irrigation block consists of lands that are served from a main delivery pipeline. There is potential for the installation of two valves on the main lateral #39.9. The proposed gate valves would be located along blocks 2 and 3. The valves will be 33 inches and be an equivalent standard as the current equipment. Figure 11 below depicts the location of the two proposed valves and Table ~~8~~ 9 provides a general cost estimate.

Block 2 irrigates approximately 1,070 acres and block 3 irrigates approximately 1,784 acres. These acres are under crop rotation, with crops including grass pasture, alfalfa, small grains, and corn.

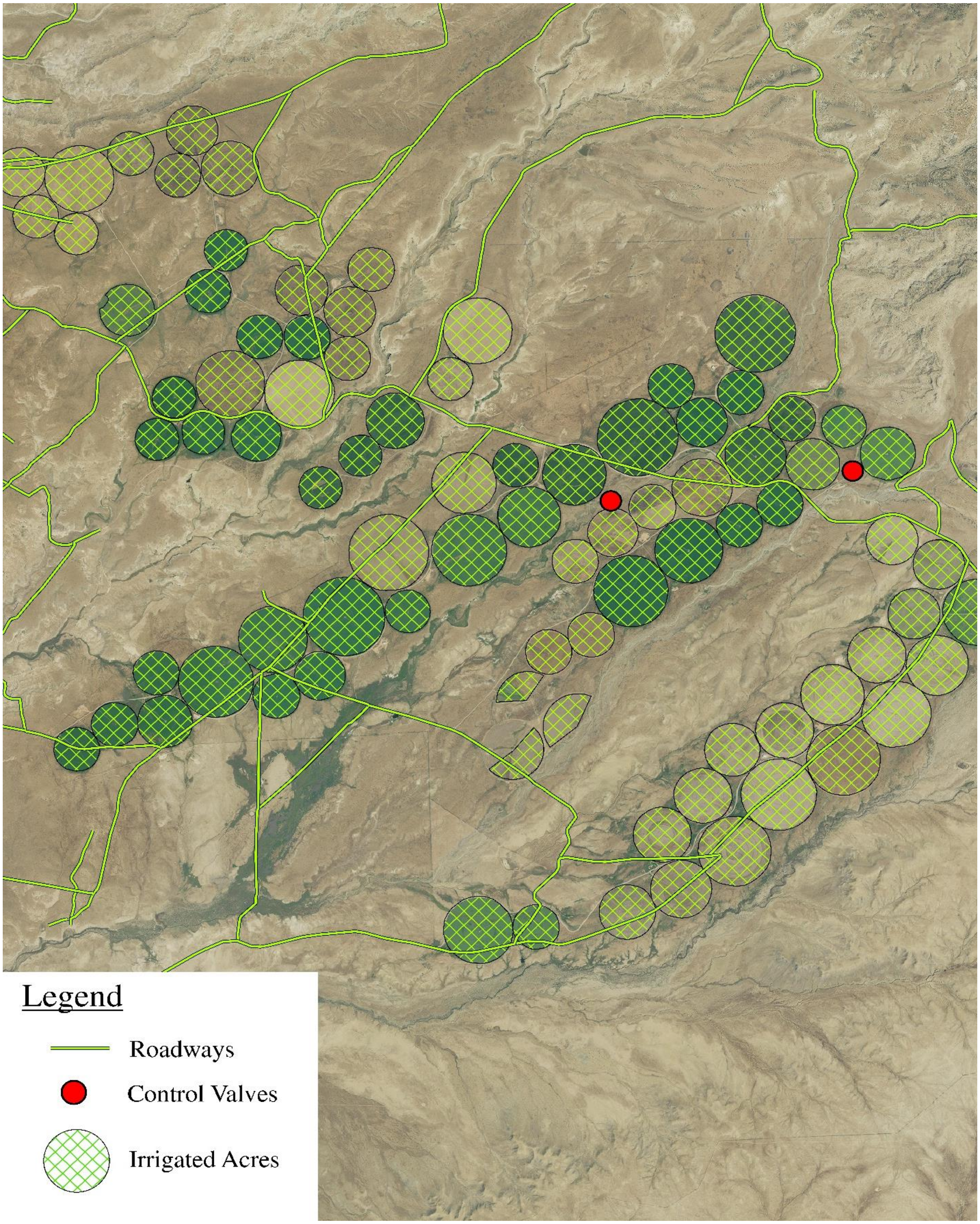
Public stakeholder concerns specific to this action:

- None raised.

Table 9. Installation Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Excavate, backfill & compact	LS	2	$3,000	$6,000
2	Installation of valve(s) & associated parts	LS	2	$50,000	$100,000
3	Furnish 33" butterfly valve(s)	LF	2	$95,000	$190,000
				Sub-Total	$296,000
				Construction Administration (5%)	$14,800
				Sub-Total	$310,800
				Contingency (10%)	$31,080
				Total	$341,880

Figure 11. General Location of Valves



5.1.1.2 Connect Irrigated Lands Near the Casino Directly to Rocky Ford Lateral

FRE uses a center pivot and three side roll sprinklers to irrigate land north of the Ute Mountain Casino. These sprinklers are currently served by pumping from a small reservoir. The irrigated lands are used to produce pasture grass for a total of approximately 122 acres; a single pivot irrigates 49 acres while side rolls irrigate a total of 73 acres on three fields. These sprinklers are currently served by pumping from a small reservoir.

The action proposes installing an 8-inch pipeline along the southeast edge of the reservoir connecting the reservoir's delivery pipeline to the existing suction pump on the reservoir's outlet, which would eliminate the need for the reservoir. While it could not be quantified at this time, the potential exists for water savings by eliminating some evaporation. Figure 12 depicts the location of the connection, pipeline, and Table ~~9~~ 10 provides general cost estimates.

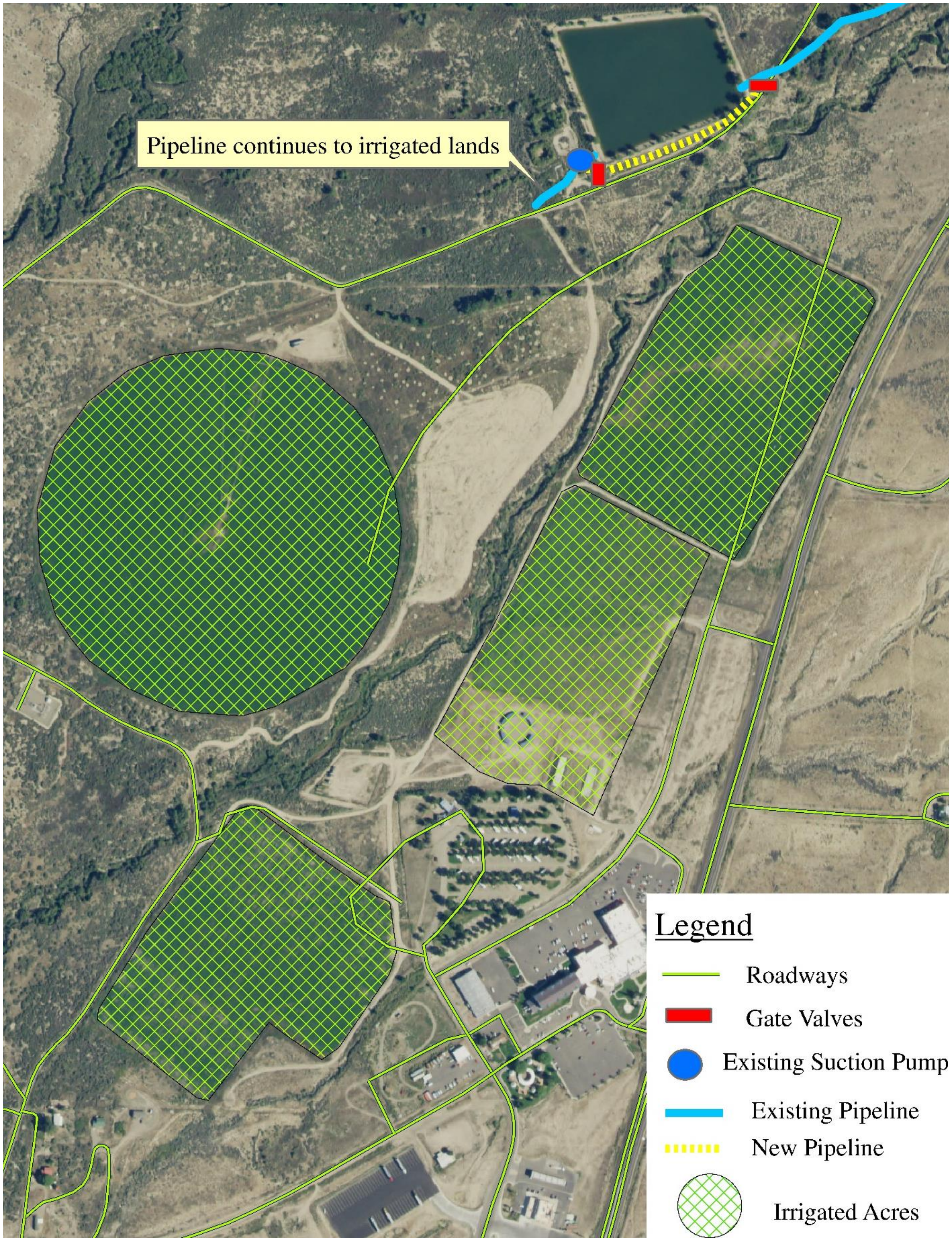
Public stakeholder concerns specific to this action:

- None raised.

Table 10. Connection of Irrigated Lands to Rocky Ford Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Mobilization	LS	1	$1,390	$1,390
2	Clear & Grub	LS	1	$250	$250
3	Connection to existing lateral	A	1	$2,400	$2,400
4	Excavate, install, backfill, & compact 8" C-900 DR-18 pipe	LF	965	$30	$28,950
5	Furnish & install 8" gate valve	EA	2	$1,250	$2,500
7	Reseed disturbed area	SF	9,750	$0.06	$585
				Sub-Total	$36,075
				Design/Inspection (8%)	$2,886
				Construction Administration (5%)	$1,804
				Sub-Total	$40,765
				Contingency (10%)	$4,076
				Total	$44,841

Figure 12. General Location of Pipeline Improvements



5.1.2 MVIC Service Area and Shareholder Actions

Representatives from MVIC attended Task Force meetings and individual meetings with consultants to develop the actions. The MVIC delivery system provides Project and Non-Project water to over 1,500 shareholders. MVIC shareholders primarily utilize gravity flow irrigation. Many opportunities exist for infrastructure upgrades to improve water delivery, water management and provide MVIC shareholders with pressurized water. Possible opportunities include improvement in water measurement by the addition of satellite measuring stations, remote system controls, and piping of existing laterals. The extent of reductions in transbasin accruals to McElmo Creek that may result from the potential actions identified in this section is beyond the scope of the Plan and not quantified.

Due to aging MVIC infrastructure, and the need to replace certain components of that infrastructure, there are opportunities to improve the MVIC delivery system. These improvements include piping open ditches, installing pipeline valves, installation of equipment for better control and management, and investigating areas of bottleneck within the distribution system. MVIC has been and will continue to evaluate its system and identify areas of need, the most important of which are included in this report. The primary limitation for MVIC is funding for identified actions. A total of 27 actions were identified and prioritized by the MVIC. MVIC staff provided input on the willingness of landowners, funding opportunities, and identified areas of need for better water management for the numerous actions. Below are actions ranked as current priorities for future implementation. These potential actions focus on better water management through measurement, monitoring, and infrastructure improvements within the MVIC delivery system. To the extent required by Colorado law, or by MVIC's Articles and Bylaws, a vote of approval by the shareholders may be necessary for some of the proposed actions to be implemented.

The MVIC water supply is a combination of senior water rights and a contractual supply from the Project. MVIC can use the water savings from these actions for its shareholders' own use, for expansion of irrigation allowed by its water right, or can allow the water to be used for carryover storage.

<u>Public stakeholder concerns that apply to Section 5.1.2:</u>

- Water saved from the MVIC actions should only be used for carryover storage. (Addressed in the above paragraph.)
- McElmo Creek irrigators expressed concern with a reduction in return flow that would, in turn, reduce their water supply. (Addressed in Section 4.1.6.)
- The reduction in return flow from the actions in this section should be estimated. (Addressed in Section 5.1.2.)

5.1.2.1 Measuring Stations with Remote Monitoring in MVIC Delivery System

Specific locations within the MVIC delivery system need measuring stations that are monitored remotely to allow for better water management. For example, monitoring could reduce operational spills. The measuring stations would serve, initially, as a mitigation action until installed but will then become a tool in implementing response actions by providing better water management data.

MVIC also identified existing measuring stations that should be moved to another location. The existing stations are in areas that lack reliable signal service. The new locations will provide better data and benefit water management. All work and labor would be done by MVIC, or parties contracting with MVIC.

Public stakeholder concerns specific to this action:

- No specific concern.

5.1.2.2 Upgrade Canal Communication System

MVIC needs to upgrade its canal communication system from the current analog audio signals to digital systems. The market has converted entirely to digital systems, and as analog components deteriorate, their replacement is extremely expensive due to replacement parts no longer being manufactured. Also, as a system ages, the computer signals become less reliable. Digital systems will improve measurement reliability and therefore delivery efficiency, water management, and water conservation. A more reliable communication system would also decrease long term costs because less time is spent in the field by staff.

Public stakeholder concerns specific to this action:

- No specific concern.

5.1.2.3 Piping Improvements for Existing Infrastructure

As described above, improvements and replacements to MVIC's delivery infrastructure are necessary in the upcoming years due to the aging infrastructure of the MVIC system. The following paragraphs and tables identify the highest improvement priorities currently identified by the MVIC Board for the delivery system. These tables are not a list of all potential improvements to the MVIC system but those currently deemed to be of higher priority.

Potential water savings and salt reductions were calculated for each section of canal. Appendix B of the "Water Supply/Hydrosalinity" part of the supplement to DPR, was used to estimate seepage and salt loading quantities. The summary table is found on Page 111 of the appendix and attached to this report as an excerpt. These estimates assumed "*future conditions with salinity control features*" already in place. This assumes "*the Dolores Project will provide a full water supply to MVIC supplemental lands and that the salinity features are built. This includes combining the Towaoc Canal with MVIC's Lower Hermana Lateral and Rocky Ford and Highline Ditches… providing pipe laterals from the Towaoc Canal to serve areas along the abandoned Rocky Ford Ditch, and lining portions of the Lone Pine and Upper Hermana Laterals*." It was assumed the ground water concentrations remain constant and the reduction in the volume of water that enters the ground water system results in less salt loading. This table is attached in Appendix A to the Plan.

For all canal piping actions, high density polyethylene (HDPE) is the recommended piping material. This pipe is made from petroleum and has a high strength-to-density ratio. The standard dimension ratio is a method of rating a pipe's durability against pressure. This ratio describes the correlation between a pipe's dimension and the pipe's wall thickness. The higher the ratio means the pipe's wall is thinner compared to the pipe's diameter. For all improvement projects, a standard dimension ratio of 32.5 is recommended.

General pricing for improvement materials was solicited from vendors. The Engineering News Record (ENR) and the Colorado Department of Transportation (CDOT) Construction Cost Indices were utilized to adjust various costs from prior estimates. Costs for fusing HDPE pipe, labor, equipment and general production information came from the following quoted sources: HDPE.com, WL Plastics, Grand Junction Pipe, and average cost data from recently constructed projects of a similar nature. Maps, GIS, and Google Earth images were used to assist with quantities. These quantities are appraisal level estimates and lack detail until further ground truthing is conducted. For that reason, they will need to be refreshed when specific projects are identified to include minor details which have been generalized and incorporated in the cost estimates provided below. The costs should regularly be reviewed as HDPE costs are volatile and tied to the cost of petroleum products, which fluctuate daily.

Public stakeholder concerns pertaining to the three canal lining actions below:

- How were the three canal improvement projects listed below selected over other potential canal projects? (Addressed in 5.1.2.3.)
- Will MVIC shareholders vote on the implementation of these actions? (As determined by MVIC Board.)
- The water savings estimate is based on old Bureau of Reclamation studies and may no longer be appropriate. (Based on only and best available data available.)
- Priorities should be in place on canals where the cost-benefit ratio is high and/or where the tailwater is completely lost, and a pipeline would solve this problem. (Priorities are decided by the Board.)

A. Lower Arickaree Canal

a. Site Description

The Lower Arickaree Canal (Lower Arickaree) is in Sections 4 and 3 of Township 36 North and Section 33 of Township 37 North in Range 16 West and Prime Meridian New Mexico in the MVIC service area. The Lower Arickaree has a single roadway crossing with Road P at about the half way point of the canal's total length. The Lower Arickaree currently serves 19 headgates in total with some headgates serving multiple users. The headgates range in sizes from six to 36 inches. Some users may want their own individual headgate instead of a combined gate when the new pipeline is installed. See Figure 13 for the location map and further details.

Water is typically released from Narraguinnep Reservoir to the Hermana Canal (Hermana) which feeds water to the Lower Arickaree. The Lower Arickaree is 10,400 feet in length and delivers 10 cfs. In addition to the water needed by the users of the Lower Arickaree, an additional 2 to 4 cfs must be conveyed to operate the ditch and is turned out at the end of that structure. This operational water is about 2 cfs during the shoulder months of the season (from April to May and September to October 15) and increases to 4 cfs during the hottest time of year (June, July, and August).

b. Recommend Improvements

It is recommended that a pipeline be constructed for the entire length of the Lower Arickaree. The amount of water lost due to seepage is estimated at 89 AF. Piping would result in conservation of 1,240 AF of water and an average savings of 350 tons per year in salinity pickup (salt loading). The seepage conserved water and reduction in salt loading is based on estimates presented in Appendix A.

The 2 to 4 cfs of operational water now being lost would be stored in Narraguinnep Reservoir and results in retained storage of up to 1,151 AF. The estimated cost of this action is $1,935,296 as shown in Table ~~10~~11. This action would cost $1,561 per AF of water conserved.

It is recommended that 32.5 standard dimension ratio 36 inch HDPE pipe be installed for a total length of 10,400 feet. The pipe was sized to provide a minimum of 10 cfs. In addition to piping the canal, other equipment is proposed to improve ease of access and water management. An isolation valve is proposed south of Road P to allow the canal to be isolated in sections. A flow meter and isolation valve are proposed at the start of the Lower Arickaree from the Hermana. A drain will also be included at the end of the pipeline.

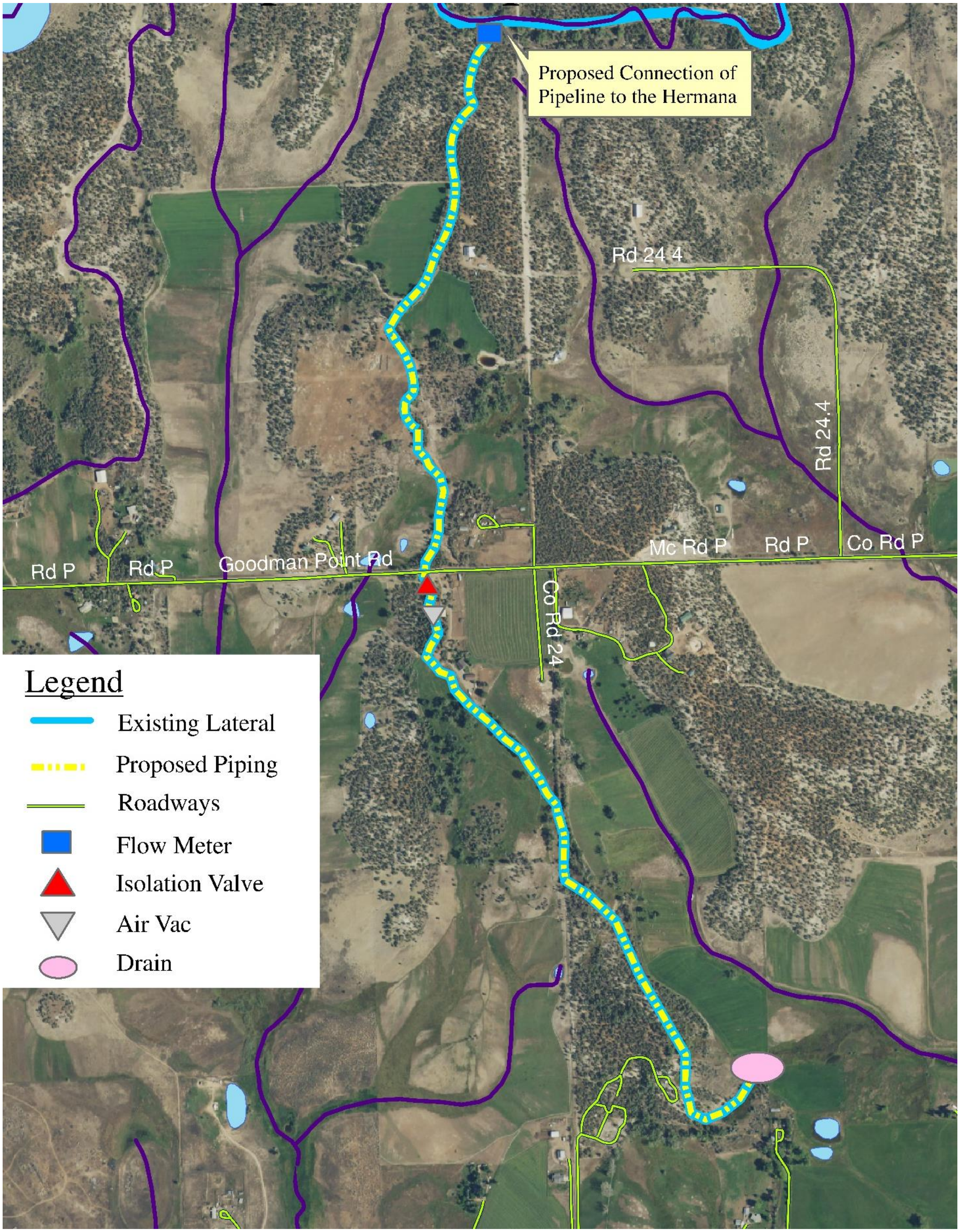
Public stakeholder concerns specific to this action:

- None raised.

Table 11. Lower Arickaree Canal Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Mobilization	LS	1	$59,000	$59,000
2	Clear & Grub	LS	1	$11,000	$11,000
3	Connection to Existing Lateral	EA	1	$11,000	$11,000
4	Excavate, install, backfill, & compact 36" SDR 32.5 HDPE pipe	LF	10,400	$30	$312,000
5	Furnish 36" SDR 32.5 HDPE pipe	LF	10,400	$74	$769,600
6	Excavate, install, backfill, & compact 30" SDR 32.5 HDPE pipe Manholes (400')	EA	25	$330	$8,250
7	Furnish & install 3" combination air vacuum valve	LF	10	$3,000	$30,000
8	Mainline flow meter 36" Ø	EA	1	$4,000	$4,000
9	Furnish & install isolation valves	EA	2	$86,000	$172,000
10	Furnish & install 6" turnout tees, 2 butterfly valves, and flow meter	EA	19	$4,000	$76,000
11	Reseed disturbed area	SF	345,000	$0.06	$20,700
12	Roadway surface repair	SF	100	$6.00	$600
13	Import backfill material	CY	0	$6.00	$0
14	Traffic Control @ County Road crossings	LS	1	$1,800	$1,800
15	Driveway Crossings	LS	2	$910	$1,820
				Sub-Total	$1,478,000
				Design/Inspection (8%)	$118,000
				Cultural Resources (5%)	$74,000
				NEPA Compliance (1.5%)	$22,000
				Construction Administration (5%)	$74,000
				Sub-Total	$1,766,000
				Contingency (10%)	$177,000
				Total	$1,943,000

Figure 13. Lower Arickaree General Location of Pipeline Improvements



B. Goodland Canal

a. Site Description

The Goodland Canal (Goodland) is in Sections 4 and 9 of Township 36 North and Sections 29, 32, and 33 of Township 37 North in Range 15 West and Prime Meridian New Mexico. Improvements are proposed in all sections of the canal. The Goodland crosses multiple roadways. See Figure 14 for the location map and further details. Water is released from McPhee through the Dolores Tunnel to the East Lateral which feeds water to the Goodland. The total length of the Goodland is about 17,000 feet in length and delivers 18 cfs. This canal suffers from severe erosion starting at Road P to the end of the canal. Any remaining water is turned out at the end of Goodland to the old Rocky Ford Ditch. The tailwater eventually makes its way to Totten Reservoir, which is currently owned by DWCD.

b. Recommend Improvements

It is recommended that the entire length of Goodland be piped. The draw where tailwater collects will also be piped to the THC in order to capture tailwater so that it may be used elsewhere in the MVIC system. The length of this pipeline is about 4,300 feet. Piping of the Goodland would result in conservation of an average of 164 AF and an average savings of 282 tons per year in salinity pickup (salt loading). Piping of the tailwater would result in saving of 66 AF and an average saving of 180 tons per year in salinity pickup (salt loading). The average amount of conserved water and saved salt loading is based on estimates presented in Appendix A.

It is recommended that 32.5 standard dimension ratio 36 inch HDPE pipe be installed for a total length of 17,000 feet. This canal has a relatively steep grade, so a small pipe size is proposed to improve hydraulics when flowing a minimum of 18 cfs. In addition to piping the canal, other equipment is proposed to improve ease of access and water management. Isolation valves are proposed intermittently throughout the pipeline. A flow meter and isolation valve are proposed at the start of the Goodland from the East Lateral. An energy dissipating structure and flow measurement are necessary at the connection of the Goodland to the THC.

Cost estimates were prepared for piping the entire existing Goodland in Table ~~11~~ 12 and piping the tailwater of the Goodland to the THC in Table ~~12~~13. The costs may be reduced if the sections were combined into a single project. At this time, the priority would be to pipe the tailwater of the Goodland to the THC with no improvements to the existing Goodland.

The total water savings of piping the entire Goodland is 164 AF with a total project cost estimate of $3,170,986. These improvements cost $19,335 per AF of water conserved. The total water savings of piping the tailwater of the Goodland to the THC is 66 AF with a total project cost estimate of $994,808. This improvement costs $15,072 per AF of water conserved.

<u>Public stakeholder concerns specific to this action:</u>

- The amount of water saved is small compared to the cost. (No criteria on what cost is acceptable for the Plan.)

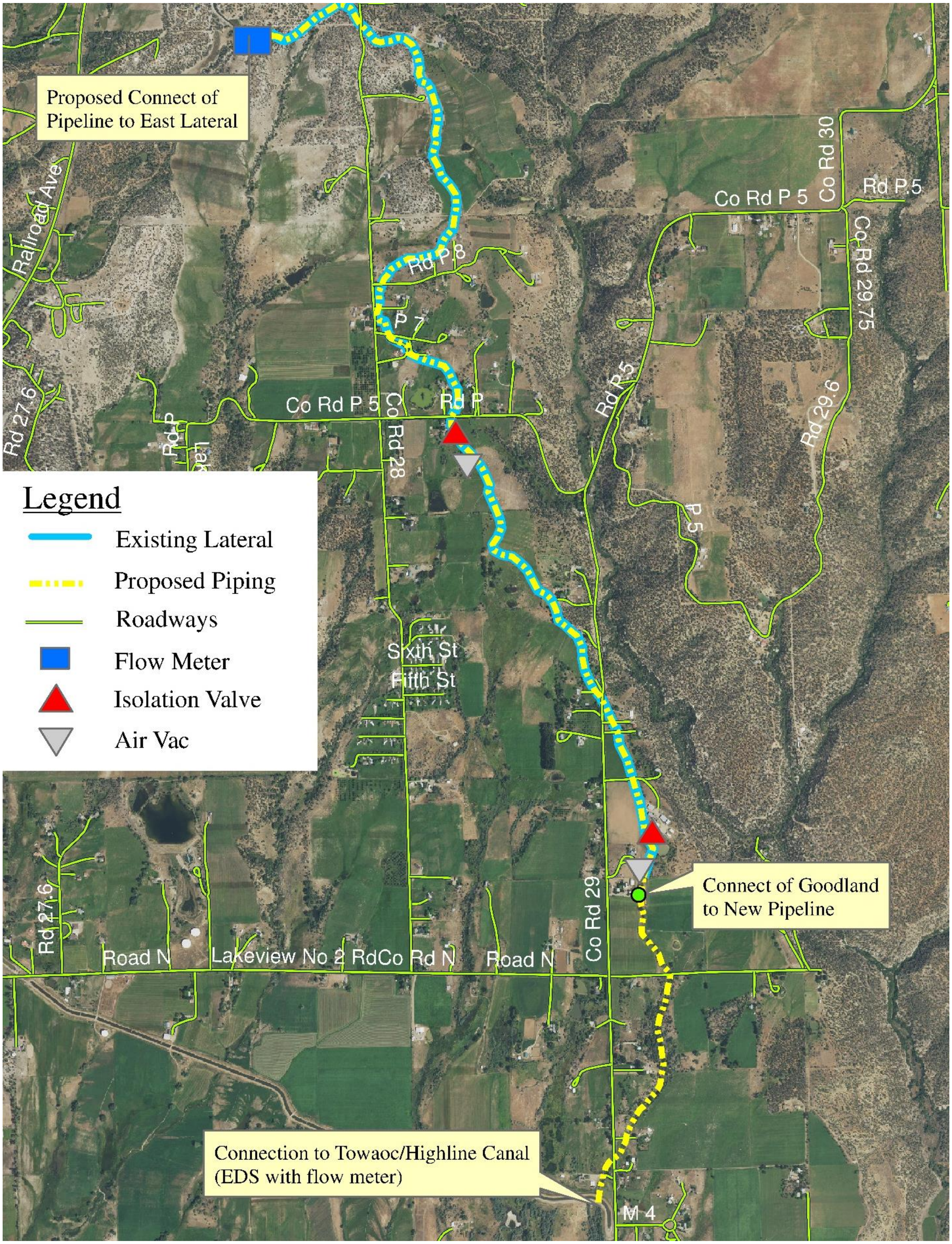
Table 12. Piping of Existing Goodland Canal Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Mobilization	LS	1	$97,000	$97,000
2	Clear & Grub	LS	1	$17,000	$17,000
3	Connection to Existing Lateral	EA	1	$11,000	$11,000
4	Excavate, install, backfill, & compact 36" SDR 32.5 HDPE pipe	LF	17,000	$104	$1,768,000
5	Excavate, install, backfill & compact 30" SDR 32.5 HDPE pipe manholes @ 1,000'	EA	20	$327	$6,540
6	Furnish & install 3" combination air vacuum valve	LF	40	$2,800	$112,000
7	Mainline flow meter 36" Ø	EA	1	$4,100	$4,100
8	Furnish & install isolation gate valves	EA	2	$86,000	$172,000
9	Furnish & install 6" turnout tees, 2 butterfly valves, and flow meter	EA	45	$4,000	$180,000
10	Reseed disturbed area	SF	350,000	$0.06	$21,000
11	Roadway surface repair	SF	500	$6.00	$3,000
12	Import backfill material	CY	0	$6.00	$0
13	Traffic Control @ County Road crossings	LS	2	$1,800	$3,600
14	Driveway Crossings	LS	25	$910	$22,750
				Sub-Total	$2,418,000
				Design/Inspection (8%)	$193,000
				Cultural Resources (5%)	$121,000
				NEPA Compliance (1.5%)	$36,000
				Construction Administration (5%)	$121,000
				Sub-Total	$2,889,000
				Contingency (10%)	$289,000
				Total	$3,178,000

Table 13. Piping of Goodland Canal Tailwaters to THC Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Mobilization	LS	1	$24,000	$24,000
2	Clear & Grub	LS	1	$4,000	$4,000
3	Connection to Existing Lateral	EA	1	$11,000	$11,000
4	Excavate, install, backfill, & compact 36" SDR 32.5 HDPE pipe for Towaoc/Highline connection	LF	4,300	$104	$447,200
5	Excavate, install, backfill & compact 30" SDR 32.5 HDPE pipe manholes @ 1,000'	EA	4	$327	$1,308
6	Energy Dissipating Structure	LS	1	$40,000	$40,000
7	Furnish & install 3" combination air vacuum valve	LF	6	$3,000	$18,000
8	Mainline flow meter 36" Ø	EA	1	$4,000	$4,000
9	Furnish & install isolation gate valves	EA	2	$86,000	$172,000
10	Furnish & install 6" turnout tees, 2 butterfly valves, and flow meter	EA	6	$4,000	$24,000
11	Reseed disturbed area	SF	86,000	$0 0.6	$5,160
12	Import backfill material	CY	0	$6.00	$0
13	Traffic Control @ County Road crossings	LS	2	$2,000	$4,000
14	Driveway Crossings	LS	4	$900	$3,600
				Sub-Total	$758,000
				Design/Inspection (8%)	$61,000
				Cultural Resources (5%)	$38,000
				NEPA Compliance (1.5%)	$11,000
				Construction Administration (5%)	$38,000
				Sub-Total	$906,000
				Contingency (10%)	$91,000
				Total	$997,000

Figure 14. Goodland General Location of Pipeline Improvements



C. Moonlight Canal

a. Site Description

The Moonlight Canal (Moonlight) is in Sections 3, 4, and 6 of Township 37 North and Section 34 of Township 38 North in Range 16 West and Prime Meridian New Mexico. See Figure 15 for the location map and further details. Improvements are proposed in Section 3 of Township 37 North and Section 34 of Township 38 North. Water is typically released from McPhee through Great Cut Dike to the U Lateral. The U Lateral delivers water to Moonlight beginning with a siphon that releases water into an open ditch. The open earth lined ditch meanders around Narraguinnep Reservoir approximately 9,000 feet until changing to a concrete lined ditch that continues 5,200 feet before connecting to a 26 inch HDPE pipeline. The open ditch only serves a single headgate.

b. Recommended Improvements

It is recommended that a pipeline be constructed connecting the existing siphon to the beginning of the piped section of the Moonlight. This would eliminate the earth lined open ditch and all of the concrete lined open ditch. Piping of this canal would improve delivery efficiencies and water management operations. Piping of the Moonlight (9,000 feet of open ditch) would result in an average 33 AF savings of conserved water and an average savings of 121 tons per year in salinity pickup (salt loading). The total water savings of piping Moonlight is 33 AF, with a total project cost estimate of $973,861. This improvement costs $29,511 per AF of water conserved. The average amount of conserved water and saved salt loading is based on estimates presented in Appendix A.

It is recommended that 32.5 standard dimension ratio 26 inch HDPE pipe be installed for a total length of 8,400 feet. The pipe was sized to provide a minimum of 13 cfs. A turnout for the single headgate and piping to existing user's delivery system is needed. A four-inch pipe for a length of 2,600 feet is proposed for the connection of this single user. In addition to the piping improvements, a flow meter is proposed at the beginning of the Moonlight for better management of the water.

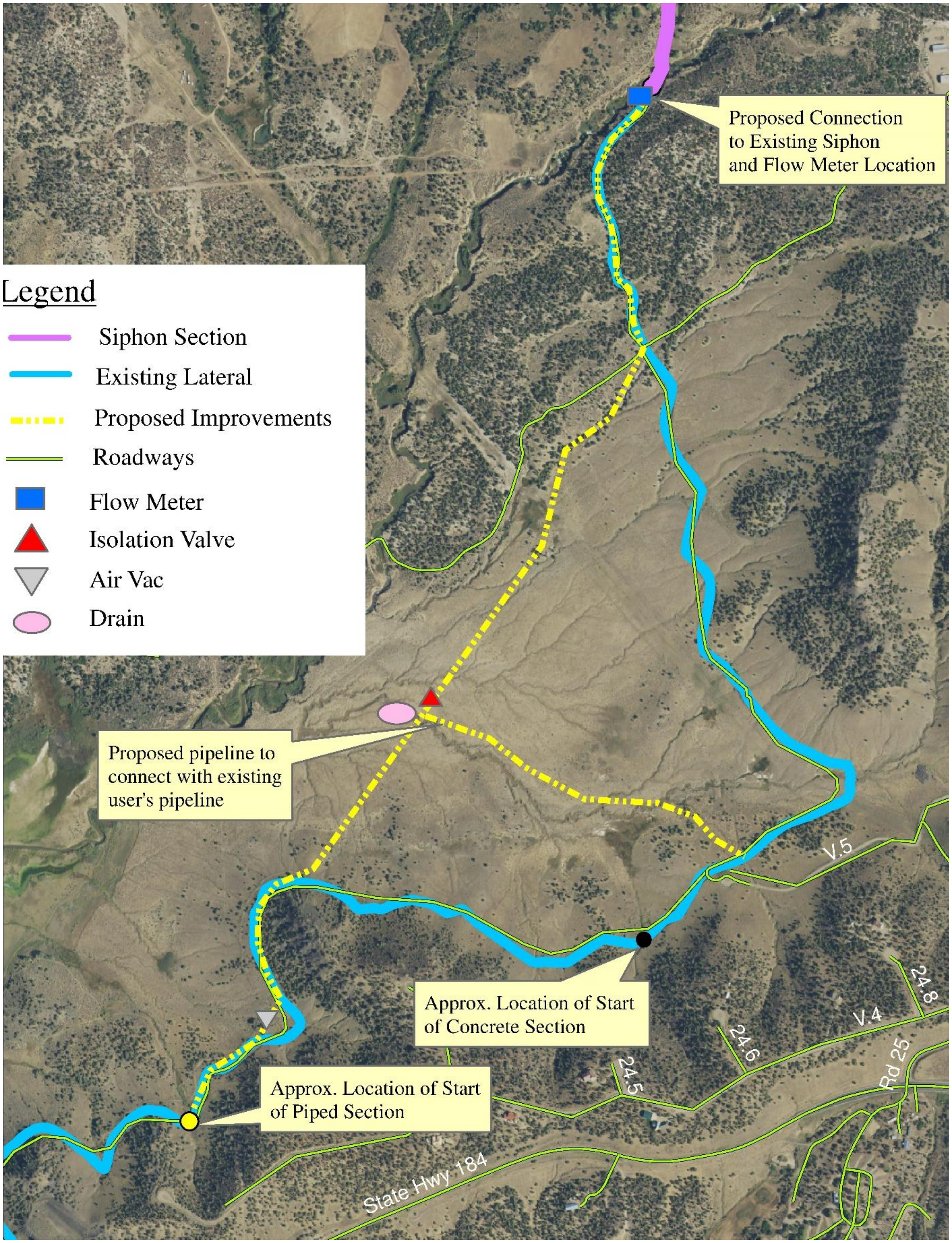
<u>Public stakeholder concerns with this action:</u>

- The amount of water saved is small compared to the cost. (No criteria for cost versus saved water for this Plan.)
- Costs associated with obtaining easements across private property for realignment were not specifically called out. (Easement costs not specifically identified. but are included in "contingency" in Table ~~13~~<u>14</u>.)
- No mention of required EPA or the regulatory reviews to address potential remediation or mitigation actions or costs. Alternatives should be considered. (Addressed in Section 5 introduction.)

Table 14. Moonlight Canal Cost Estimate

Item	Description	Unit	Est. Quantity	Unit Price	Total Price
1	Mobilization	LS	1	$48,000	$48,000
2	Clear & Grub	LS	1	$6,000	$6,000
3	Connection to Existing Lateral	EA	1	$11,000	$11,000
4	Siphon (Existing)	LF	1,000	$0	$0
5	Drain	LS	1	$0	$0
6	Excavate, install, backfill & compact 26"Ø SDR 32.5 HDPE	LF	8,400	$20	$166,908
7	Furnish 26"Ø SDR 32.5 HDPE	LF	8,400	$38	$319,200
8	Furnish & Install 3" Combination Air Vacuum Valve	LF	2	$3,000	$6,000
9	Mainline Flow Meter 26"Ø	EA	1	$3,000	$3,000
10	Furnish & Install isolation valves	EA	2	$48,000	$96,000
11	Furnish & Install 6" turnout tees, 2 butterfly valves and flow meter	EA	20	$1,800	$36,000
12	Reseed Disturbed Areas	SF	346,500	$0.06	$20,790
13	Roadway Surface Repair	SF	0	$6.00	$0
14	Import Backfill Material	CY	0	$6.00	$0
15	Traffic Control @ County Road Crossings	LS	2	$1,800	$3,600
16	RV User Pipeline 4"Ø DR 32.5 Furnish and Install	LF	2,600	$8.00	$20,800
				Sub-Total	$737,000
				Design/Inspection (8%)	$59,000
				Cultural Resources (5%)	$37,000
				NEPA Compliance (1.5%)	$11,000
				Construction Administration (5%)	$37,000
				Sub-Total	$881,000
				Contingency (10%)	$88,000
				Total	$969,000

Figure 15. Moonlight General Location of Pipeline Improvements



5.1.2.4 MVIC Service Area On-Farm Efficiency Improvements

In addition to identifying delivery system efficiency improvements, on-farm opportunities by MVIC shareholders also exist. As a greater proportion of MVIC delivery canals are piped there is the potential to deliver pressurized water to MVIC shareholders which allows for a transition from flood irrigation to sprinkler irrigation. This irrigation transition typically increases efficiency from 40% for flood to 75% for side rolls or 90% for center pivots. The water savings from changing from flood to sprinkler irrigation are substantial and the water conserved by these improvements may be used to better irrigate crops or increase saved water storage.

The biggest hurdle for MVIC shareholders is the cost of investment in sprinkler equipment and piping from the canal pipe to sprinkler. Programs supported by NRCS and Reclamation's McElmo Salinity Unit have made funds available to irrigators for system improvements since the 1980s. Costs range widely for different systems, with pivot packages costing upwards of $100,000. Unlike other areas of the Project, MVIC shareholders have the opportunity to apply for cost sharing funds through NRCS Environmental Quality Incentives Program (EQIP). EQIP provides financial and technical assistance to agricultural producers implementing conservation practices. While a variety of funding programs exist, the MVIC service area is located in a designated area of the Colorado River Salinity Program. This allows MVIC shareholders to apply to this specific program for cost sharing of improvement projects.

Piping of the May Canal is the most recent example of MVIC delivery system improvement. Taking delivery along the piped portion, the May Canal now provides pressurized water to the MVIC shareholders. The shareholders in this area now have the potential to upgrade on-farm systems to pressurized irrigation systems.

<u>Public stakeholder concerns with this action:</u>

- Both delivery and on-farm efficiency improvements that are designed to save water have complex consequences to MVIC shareholders and McElmo Creek water users. (Comment with no response necessary.)
- Unintended consequences of improvements include reduced runoff and water table; lagged return flows; replacement of lost water supply; and decreased environmental benefits. (Comment with no response necessary.) Generally, on-farm efficiency improvements are the biggest contributor to decreased return flows. By improving the application of the water to the crop(s), this decreases surface and subsurface runoff that would normally return to natural stream ways. (Comment with no response necessary.)
- On-farm efficiency improvements could focus on increased on-farm storage to help individual farmers be more resilient to drought. (Statement made.)

5.1.2.5 Hydropower Development Opportunities

Potential exists within the MVIC delivery system for hydropower generation. A study is recommended to analyze the potential for hydropower generation. The study should evaluate the feasibility of possible sites based on the projected yearly income from the generated power relative to the combined costs of OM&R and the loan payment to finance the construction. The study would probably cost between $15,000 and $25,000.

For site evaluation, the head and flow characteristics should be measured. Actual flow data records are used to create a flow duration curve. The curve displays the range of flows and their occurrence throughout the period of record allowing for design sizing to maximize the kilowatt hours generated. Potential revenue from the sale of the power would be estimated using the most recent power payment rates available from electric utilities. Proposed site cost estimates should include total construction cost for the site including an annual OM&R expense.

A comparison of the annual cost with the annual income could be generated for a 20-year period in order to evaluate the feasibility of a site. The annual income needs to be greater than the annual cost. Some sites may be feasible when different power payment rates or loan repayment rates are applied.

<u>Public stakeholder concerns specific to this action:</u>

- None raised.

5.1.3 DWCD Service Area Actions

Representatives from DWCD attended the Task Force meetings and individual meetings with consultants to develop the below actions. The FSA irrigators represent 40% of the Project's irrigated area, consisting of irrigated lands within northern Montezuma and Dolores counties. The delivery system is 100% pressurized allowing FSA irrigators flexibility in how and when they take their Project water as well as supporting the use of pivot or side roll irrigation. Opportunities exist for infrastructure improvements to improve water delivery and management.

The DWCD recently prepared a Water Management and Conservation Plan (WMCP) to address present and future water uses. The WMCP helped the DWCD Board and staff identify water management and conservation measures that could be implemented. Many of the mitigation actions were identified in the WMCP and further evaluated as part of this Plan's development process.

The need will always exist within the DWCD delivery system to improve water deliveries and water conservation. Aging infrastructure coupled with innovative technologies create opportunities for significant improvements. These improvements range from lessening seepage, evaporation, preservation of canal lining, installing flow controls, and DCC regulating reservoirs.

5.1.3.1 Dove Creek Canal (DCC)

The DCC has a clay liner throughout its length which is eroding in some locations, especially on bends. Reducing the erosion and replacing the clay liner is a mitigation action. Areas of erosion have been identified.

Also, regulating reservoirs along the DCC would provide a means to handle water fluctuations that are caused by individual irrigators changing of side roll sprinklers (on/off). If locations can be identified, these reservoir(s) would provide better spill management at the end of the DCC.

Through routine monitoring, DWCD will continue to evaluate their system and identify areas of improvement. While many needs for mitigation may be identified for further investigation and determined beneficial, funding for projects may be the limiting factor for implementation.

Public stakeholder concerns specific to this action:

- None raised.

5.1.3.2 Full Service Allocation Area On-Farm Efficiency Improvements

On-farm efficiency improvement opportunities exist in the FSA irrigated lands. FSA irrigators have maximum flexibly in how and when they take their Project water, which allows for greater on-farm efficiencies compared to historic irrigation practices. The use of center pivot and side roll irrigation are possible on the 100% pressurized Project delivery system. The delivery system efficiency to the irrigator is approximately 94% on average. The greatest improvement potential exists on-farm.

The on-farm action is the structural component of the non-structural mitigation action in Section 5.2.5. One outcome of the non-structural mitigation action is for FSA irrigators to identify areas of improvement on their farms. Improvements may include better use of existing irrigation technologies, enhanced soil health management, and adjusting or changing cropping patterns to lower water demand and usage. When improvements are made, water savings is not the only benefit. Additional benefits include decreased labor, potential yield increases, and decreased energy demand.

For instance, nozzles packages used by any sprinkler degrade over time. Poor application increases water pumping time and thus energy use. Routine assessment determines if components have worn out, are clogging, or not producing the desired wetted perimeter or droplet size. Improvements made to the nozzles have a positive effect on the soils by allowing faster movement of the pivot and reducing the risk of surface sealing.

Water conserved when upgrading from side roll irrigation to center pivots is substantial, going from 75% efficient to 90% efficient. Costs range widely for different systems, with pivot packages costing upwards of $100,000.

Soil health also affects how well water is used and applied to the crop. By decreasing excess water in pivot wheel tracks, issues with rutting of the tracks may be prevented. This, in turn, decreases soil erosion. Soil management may improve water infiltration when correct tillage strategies are used or cover crops are planted. Working through the assessments described in Section 5.2.5 will identify areas of opportunity within a farm's current soil management practices.

Public stakeholder concerns specific to this action:

- None raised.

5.1.3.3 Hovenweep Delivery System Improvements

The Hovenweep delivery system gravity feeds 2,688 acres and is part of the Project Full Service Irrigation system. The Hovenweep pipe lateral has a length of 10.6 miles. Except for the Hovenweep area where 2.15 AF per acre are allocated, Full Service land is allocated a maximum annual supply of 1.96 AF per acre on all Project lands. The pipe system has very high pressure and actions to reduce the pressure along the pipeline and to individual irrigators would improve operation. These actions are primarily for improved operation, but there would be water conservation as well.

Public stakeholder concerns specific to this action:

- On-farm efficiency improvements could focus on increased on-farm storage to help individual farmers be more resilient to drought. (Statement made.)

5.1.3.4 Promote Crops that Use Less Water

The primary crop grown in the FSA is alfalfa hay because it has the best market and is most easily sold. Also, due to the higher protein content, the high elevation alfalfa hay is desirable for high end livestock such as dairy cattle and horses. This demand for alfalfa results in a greater income for irrigators. The water supply from the Project is not quite adequate to grow alfalfa on all of the FSA lands, especially during shortages that have occurred regularly in the last 15 years. There have been studies by the Colorado State University Extension Service, of area farm crops (e.g. sunflowers, corn, or hemp) that use less water than alfalfa. Pinto beans are a standard dry land crop with an existing market. The problem with growing alternative crops is in full water supply years alfalfa has much better income potential. A stand of alfalfa takes at least a year to become fully productive and can then produce for multiple years before rotating out. Due to its growth cycle alfalfa cannot be changed quickly to respond to drought conditions. Rotating out alfalfa must occur prior to a drought, but the loss of income prohibits farmers from using other crops. Until other crops can provide an income similar to alfalfa, it is unlikely that farmers will change their cropping pattern.

Public stakeholder concerns specific to this action:

- Would like to see less alfalfa and more crops that use less water to improve carryover storage in McPhee. (Addressed in 5.1.3.4.)
- A section on alternative crops should be added. (Addressed in 5.1.3.4.)

5.1.4 Storage Actions

5.1.4.1 New Plateau Reservoir and Pump Storage Project

Upper Plateau Creek Reservoir (Plateau) would be a new dam and reservoir upstream of McPhee on Plateau Creek. The embankment is on United States Forest Service land and the reservoir basin is primarily on CPW land (Lone Mesa State Park) with a small amount of the basin on BLM land. The DWCD has been evaluating Plateau to increase the water supply for the fishery downstream of McPhee.

Plateau was first evaluated in a 1998 Reconnaissance Report (1998 Report) which investigated options for increasing the water supply to all Dolores Project water users, especially for the downstream fishery. Based on the findings in the 1998 Report, the DWCD obtained aerial topography for Plateau that is suitable for designs and development. In June 1999, the DWCD also arranged for 15 test pits located in the reservoir basin to be excavated and logged to assess the availability of material to construct an earthfill dam. The test logs and lab results are available upon request. All the testing indicated that there is adequate and suitable material to construct an earthfill dam. Test borings at the dam site were not conducted to assess the dam foundation.

As a result of the 1998 Report, DWCD obtained a water right for 21,000 AF of storage for Plateau Creek Reservoir in Division 7 Water Court Case No. 00CW97. The decreed purposes are recreation, domestic, municipal, industrial, and piscatorial for the fishery downstream of McPhee. Irrigation was purposely not included to indicate that the reservoir was primarily for fishery releases to the Dolores River downstream of McPhee.

The preliminary planning for the dam indicates the dam crest elevation would be 7,625 feet and the streambed at the center of the dam would be 7,500 feet resulting in a 125 foot high dam. The reservoir normal maximum water surface would be at elevation 7,610 feet which will have 20,500 AF of total capacity and 710 surface acres. The county road presently through the reservoir basin would be routed over the top of the dam.

To estimate the yield from Plateau, DWCD installed a measuring gage on Plateau Creek in 1997 and has recorded flows in most years since then. The average inflow is approximately 5,360 AF during the period, with a high of 11,200 AF in 2008 and a low of 305 AF in 2002. Plateau Creek is a fairly low elevation drainage area with high runoff in March, April, and sometimes May. There is nearly no runoff in the other months. The Plateau Creek runoff ends about the time the high runoff is beginning into McPhee from the Dolores River.

Plateau has a very junior water right priority and can only retain water in storage in water years that McPhee spills. Plateau would be operated to store the early runoff from Plateau Creek if McPhee is likely to spill. However, if McPhee does not spill the volume of water stored in the current water year (November 1 to October 31) would be gradually released to McPhee by October 31. The release of water from Plateau to McPhee can be scheduled to support a fishery in Plateau Creek.

An evaluation of the yield from the 20,000 AF Plateau was prepared using the stream gage data at the Plateau dam site, actual McPhee spill amounts, and data from 1997 to present (inclusive of the major 2002 drought). The results of the yield evaluation showed that approximately 3,000 AF per year would be available for the fishery downstream of McPhee. The study showed that filling the reservoir would require multiple years because there is not sufficient runoff to fill in one year. Further, the reservoir would also be lowered over multiple years. The multiple year filling and release is important in considering the benefits from Plateau for recreation and fishery. Also, the multiple year fills will minimize the reduction of the McPhee managed spill amount in any one year. Though small, the filling of Plateau will reduce the spill volume during spill years.

Since the estimated 3,000 AF of annual yield is not Dolores Project water, releases are not constrained by Project purposes and criteria. Plateau will have significant flexibility to release water in a pattern that is most beneficial to the fishery. For instance, the 3,000 AF per year could be released in each year or could be “slugged” so that more than 3,000 AF is released in drought years and less in wet years. The fishery interests would be able to use the storage in the reservoir to maximize the benefits to the fish. The release and storage of water would be coordinated with CPW which has responsibility for both management of the fishery downstream of McPhee and the management of the Lone Mesa State Park where Plateau Reservoir would be located.

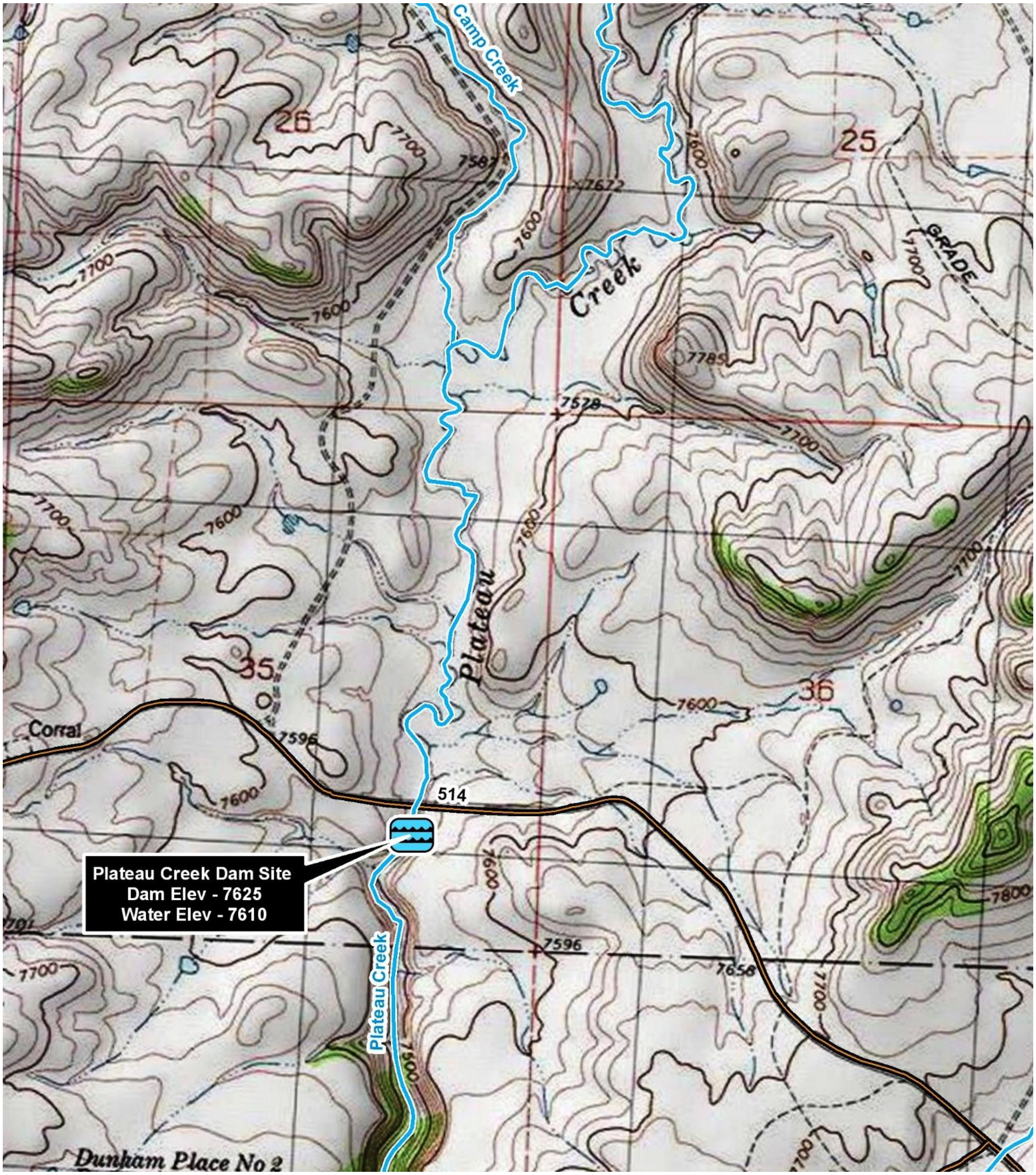
Plateau Dam is very similar in size to a recently constructed Long Hollow Dam in the La Plata River drainage. Based on the construction costs of Long Hollow, the construction of the dam cost approximately $32 million.

Numerous studies and evaluations have been conducted to determine how best to increase the water supply for the fishery downstream of McPhee. Plateau is the most reliable option to increase the yield from the Dolores River and provide an average of approximately 3,000 AF per year to the downstream fishery on a long term basis. Initially, the most important consideration for the Plateau was increasing the annual fishery pool to 36,500 AF for, primarily, non-native fishery. Recently, the availability of spill water to support the native fishery has become an equal consideration; therefore, the initial reason for Plateau may not be as important as previously thought. Also, CPW has concerns about the impact of the reservoir on Lone Mesa State Park. Plateau is meant to improve the fishery below McPhee and if not supported by CPW, DWCD is not likely to pursue this action.

<u>Public stakeholder concerns specific to this action:</u>

- The reservoir would reduce spill which could impact the peak flows downstream of McPhee needed to keep the Dolores River channel healthy and help the native fishery. (Addressed in 5.1.4.1.)
- The reservoir would provide additional water to meet the goal of 36,500 AF for the fishery pool to improve the base flow in the Dolores River, but this is primarily for the non-native fishery (trout) and less so for the more important native fishery. (Addressed in 5.1.4.1.)
- The reservoir would be within the Lone Mesa State Park, a "crown jewel" of CPW. (Addressed in 5.1.4.1.)
- The reservoir would inundate native plants. (Addressed in 5.1.4.1.)
- The reservoir would change the flow in Plateau Creek between Plateau and McPhee. (Addressed in 5.1.4.1.)
- The county road through the reservoir may not be replaced. (Addressed in 5.1.4.1)
- The reservoir may decrease the income potential from hunting within the Park. (Addressed in 5.1.4.1.)
- The estimated 3,000 AF per year for the fishery is uncertain. (Addressed in 5.1.4.1.)

Figure 16. Location Map of Reservoir and Project



5.1.4.2 Increase Totten Reservoir Inflow

Totten Reservoir is shown on Figure 1 to the east of Cortez. Totten was acquired by the DWCD in 2002 from MVIC and is currently used for recreation and releases to augment the flow in McElmo Creek for irrigators in McElmo Canyon. Currently, Totten has a small amount of inflow from natural runoff, return flow from MVIC irrigation, and occasionally Dolores River water conveyed through the Dolores Tunnel and THC then discharged into Totten.

Project and Non-Project water users would benefit from the increased water supply at Totten with potential uses including lease to McElmo Canyon irrigators, pump to THC to increase the Project supply such as FRE, and augmentation water for water critical areas (such as the McElmo basin in the early irrigation season). To make any of these leases permanent multiple steps must be completed to:

1) Measure Totten inflow(s);
2) Satisfy all Division of Water Resources Dam Safety requirements;
3) Contract development and negotiations between DWCD and lessee; and
4) Increase the inflow to Totten.

Pumping water from Totten into the THC could provide additional water during shortage situations to reduce, but not alleviate, the impacts of drought.

Totten is located near the THC. Totten is lower in elevation and water would have to be pumped into the THC. Options have been evaluated to increase the inflow into Totten to increase the reservoir yield and the amount pumped to the THC for use by Project water users. These options were evaluated in the January 2012 "Reconnaissance Study to Evaluate Potential Water Needs and Supplies" for the Ute Mountain Ute Tribe and DWCD; summarized herein.

The inflow would be increased by the diversion of flows from Simon and Ritter Draws into Totten. Simon Draw is located south and east of Totten and water would be pumped into Totten. DWCD holds water rights for the diversions from Simon and Ritter Draws which will be administered in priority within the McElmo Creek basin. Ritter Draw is located west of Totten and water could be gravity diverted into Totten through a pipeline. The combined average annual inflow from the two draws is estimated to be 1,450 AF. The cost of the diversions from the draws and the pump and pipeline THC is in the range of $4.5 to $5 million.

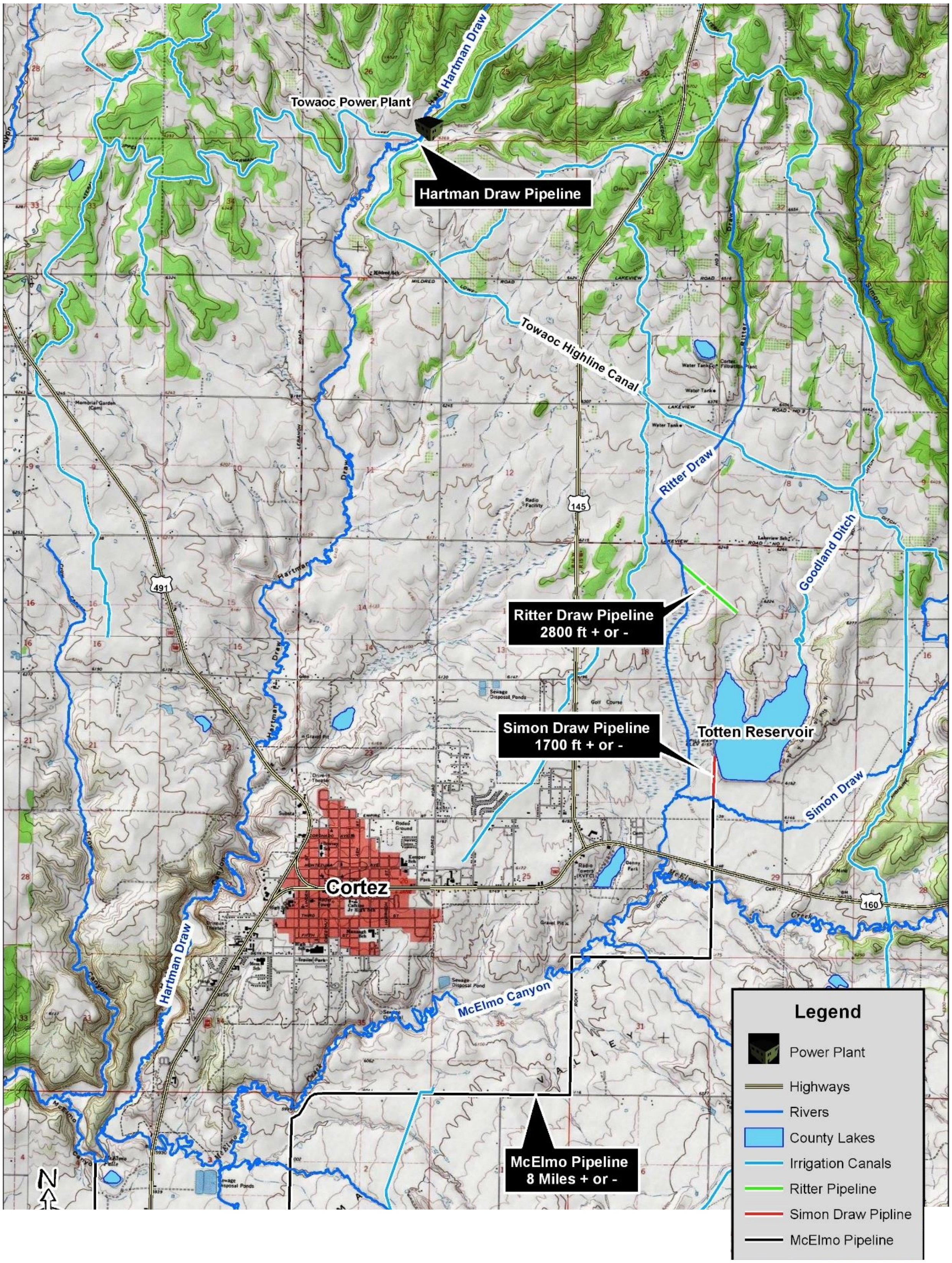
McElmo Creek flows out of Colorado west of Cortez with an average annual volume of about 30,000 AF leaving the state. (See Section 4.1.6 for further detail.) Most of this water is return flow from MVIC irrigation. Reuse of a portion of this water might be achieved through a pump and pipeline from McElmo Creek downstream of Hartman Draw, west of Cortez. This plan is called the McElmo Pumpback and would increase the inflow into Totten by 4,500 AF per year. The increased reservoir yield would be pumped again into the THC to increase the water supply to Project users. The cost of the McElmo and the THC pump and pipeline is in the range of $15 to $16 million. This pumpback concept does not presently have a water right but, if implemented, will require a water right that will be administered in priority within the McElmo Creek basin and will be junior to any water rights that exist when the water is obtained in the future. This pumpback concept will require NEPA compliance, financing, repayment capability, determination of who receives water, and other permits to be implemented that will be addressed if the action is pursued in the future.

DWCD has a water right to divert flows in upper Hartman Draw near the beginning of the THC into the THC for direct use in the canal or conveyance to Totten. The Hartman Draw water right will be administered in priority within the McElmo Creek basin. Winter diversions (December through February) into the THC are assumed to not be possible due to conveyance problems caused by icing. The potential diversion volume is roughly estimated to be 2 cfs for six months; approximately 700 AF.

Public stakeholder concerns and comments specific to this action:

- The water diverted into Totten Reservoir will be administered according to the priority of water rights but will be senior to existing water rights. (Addressed in 5.1.4.2.)
- McElmo Creek water users are concerned with the impacts of the pumpback project and its effects on the baseflow, potential legal obligations to downstream users, and future management of the facility. (Addressed in 5.1.4.2.)
- Water pumped from the pumpback should be made available for sale to water users along the delivery lines (e.g. irrigated lands within McElmo canyon). (Addressed in 5.1.4.2.)
- McElmo Creek water users would support additional water supply and/or drought reserve for Totten Reservoir if some of the water was used for irrigation along McElmo Creek, especially during a drought.

Figure 17. Totten Reservoir and Potential Inflows



5.1.4.3 Totten Reservoir Pump to THC

This action is required to utilize the yield from Totten by pumping into the THC. The capacity of the pump would be approximately 8 to 9 cfs. The THC flow where the water would enter is commonly over 250 cfs. The Totten water would reduce the releases from McPhee which can then be used at any location within the Project or kept in storage for future years. A carriage contract with Reclamation may be required depending on which facilities are used to deliver water.

An additional consideration in the use of Totten is the impact on water quality when the elevated levels of salinity in the reservoir (compared to Dolores River water) combine with the lower salinity water in THC. An evaluation of the impact of the Totten water quality mixed with the THC water was conducted. In three of the four years with available data, the conductivity reading for the mixed water is projected to be below 300 which is excellent water quality. In the fourth year, the conductivity is between 300 and 350, still decent quality. The data shows the potential for increased salinity levels in the THC is not significant for any of the options.

Finally, all dam infrastructure should comply with DWR requirements. This includes repairing the transverse cracking in a section of the embankment to utilize the entire capacity of the reservoir. Additional measuring equipment may be necessary to monitor inflows and releases.

The cost of the pump and pipeline from Totten to THC is estimated at $3 to $5 million. Costs for needed repairs to the Totten embankment are approximately $1 million. The Totten drought water supply would cost in the range of $4 to $6 million to be able to use up to 2,200 AF.

Public stakeholder concerns specific to this action:

- Concerns included in the Section 5.1.4.2.

5.1.4.4 Groundhog Reservoir Enlargement/ Increased Capacity

A recent bathymetric survey of Groundhog has shown additional capacity exists within the reservoir. MVIC has worked with DWR to meet dam safety requirements and has filed a water court application to secure the additional volume. Based on this survey, DWR recommends storage be allowed up to 73 feet. MVIC plans to store up to 72.3 feet. The remaining 0.7 feet of water amounts to approximately 520 AF and was offered to DWCD for their own interests and ownership.

The additional storage for the top 0.7 feet will inundate land currently not impacted. Based on the survey approximately 11.2 acres would be inundated. Much of the inundated lands are undeveloped and mostly utilized for grazing. Only a single house and a small structure may be affected by the expansion. In order to fill the 520 AF, a reservoir operation agreement is needed between MVIC and DWCD which is not being contemplated at this time.

Public stakeholder comments specific to this action:

- Support for increased storage in Groundhog was given. This increased storage would provide additional return flows to McElmo Creek.

5.1.5 Other Structural Actions

5.1.5.1 Pump San Juan River Water to FRE

In the 1988 water rights settlement, the Tribe received 10 cfs of water rights from the San Juan River where the river crosses the reservation. A pump and pipeline to convey water from the San Juan River to the FRE lands during a shortage are physically possible, but very expensive because of the distance and elevation difference. The cost of the facilities was not estimated because the cost appears to be extremely high.

Public stakeholder concerns specific to this action:

- None raised.

5.1.5.2 Hydropower Development Opportunities

In December 2010 Harris Water Engineering, Inc., with funding from the Colorado Water Resources and Power Development Authority, prepared the DWCD's "Hydropower Feasibility Study of Potential Sites Within the Dolores Project Water Delivery System." The report provides an extensive evaluation of the locations within the Project canals that have hydropower potential and evaluates which should be pursued based on cost and potential power sales. Hydropower development does not increase the water supply during a drought but provides additional funds for DWCD to both develop drought mitigation measures and replace revenue lost during a drought.

The report identified installation of a turbine and generator at the Energy Dissipating Structure (EDS) at the discharge end of the 2 miles of pipe drop at the beginning of Reach 3 of the THC. The EDS is on Tribally owned land and all of the water through the power plant is for delivery to FRE for irrigation. DWCD and the Tribe have been in discussions to develop the site but have not pursued it to construction.

Public stakeholder concerns specific to this action:

- None raised.

5.1.5.3 McElmo Creek Irrigation Actions

As explained in Section 4.1.6, McElmo Creek irrigators are vulnerable to some of the structural actions listed in Section 5.1.2 that might reduce the accruals of transbasin water to McElmo Creek. McElmo Creek is not a part of this Plan but, due to the considerable number of comments and concerns from McElmo Creek irrigators, this sub-section has been included to provide an outline of how they might proceed to reduce some of their vulnerability.

McElmo Creek irrigators have expended considerable amounts of money to improve their diversion facilities and change to sprinkler irrigation to better utilize water that has traditionally been available from McElmo Creek and its tributaries.

Actions to attempt to stabilize the supply of water available to McElmo Creek irrigators might include:

a. Formation of an organization, or multiple organizations, that represent McElmo Creek water users. The organization(s) could then pursue funding to investigate options and implement actions to stabilize the water supply.

b. Participation in the committee formed by MVIC to investigate options for McElmo Creek that MVIC might be able to implement without injury to the rights and interest of MVIC shareholders.
c. Investigation of options and development of a plan to attempt to stabilize the water supply in McElmo Canyon.
d. Investigate methods to utilize some of the 30,000 AF leaving Colorado in McElmo Creek.
e. Investigate methods to develop new storage and/or utilize the existing Totten Reservoir to provide water during shortage periods.
f. Continue to improve the water diversion and delivery facilities of ditches.
g. Continue to install more efficient on-farm irrigation systems, such as sprinklers.
h. Investigate other options that might stabilize the McElmo Creek water supply.

Public stakeholder concerns specific to this action:

- This section was added in response to concerns.
- Wilson Ditch provides water to properties within the DWCD boundaries, and these property owners pay taxes to DWCD. (Statement made.)

5.2 Non-Structural Mitigation Actions

5.2.1 Improve Joint Operations of McPhee and Other Reservoirs

As part of the Plan, options for better use of existing reservoirs and water supplies to provide drought mitigation were evaluated. Modeling scenarios were created from historic McPhee inflow and outflow data sheets. The runs were done on a daily time step basis. The time step did not yield results that were meaningful when summarized on a yearly basis. Modeling was also done on a yearly basis. These results were more easily summarized, and the scenarios were presented and discussed at a joint Board meeting between DWCD and MVIC. The following concepts were presented and discussed.

Potential drought reserve operations, where water would be stored during times of large runoff then held over multiple years for use in times of drought. The reservoirs being evaluated are Groundhog, Narraguinnep, and Totten reservoirs. Each reservoir has a different potential to provide a drought reserve. Actions specific to Groundhog and Totten reservoirs are mitigation actions. Whereas, the action specific to Narraguinnep would be a response action. See Section 6.4 for the description of the Narraguinnep response action. All reservoirs operate under Colorado law and existing contracts. Contracts and water rights limit the times and amount of storage in each reservoir.

Groundhog and Narraguinnep Reservoirs are owned and operated by MVIC, on behalf of and for the benefits of its shareholders. Totten Reservoir and its water rights are owned by DWCD. One option to maximize the use of these reservoirs is to designate pools within each that are to be used only in drought situations to increase water supply when needed the most. These drought situations would be determined by specific targets set by MVIC and the DWCD when the action is implemented.

Public stakeholder concerns specific to this action:

- An oopportunity exists to amend contracts and/or water rights to allow more flexibility in how and when water is stored. (Statement made.)

5.2.1.1 Drought Reserve using Groundhog Reservoir

Subject to further discussion and formulation of a plan that provides benefits to both the Project water users and MVIC, Groundhog appears to have the potential for a drought reserve. The reservoir has a senior capacity of 21,710 AF and MVIC is seeking a junior capacity of 4,410 AF for a total of 26,120 AF. There is a 3,960 AF minimum fish pool agreement between MVIC and CPW. Groundhog capacity is more than double the average annual inflow which is approximately 9,000 to 11,000 AF. The period of record (1972 to present) shows a minimum inflow of 277 AF and a maximum of 19,000 AF.

Historically, MVIC has used the "top half" of Groundhog's available capacity. Only in the wettest of years would Groundhog fill if it was drained to the fish pool the previous year. With the 3,960 AF fish pool, an inflow is needed of 22,160 AF to fill. The period of record indicates this is a rare occurrence.

The concept for the Groundhog drought reserve is to operate the approximately 13,000 AF "top half" of the reservoir. While keeping the "bottom half" of the reservoir, a net of 9,040 AF less the fish pool, as a drought reservoir. An agreement would be needed for MVIC to leave water in Groundhog without it counting against their Non-Project water calculations (used to determine MVICs annual Project water entitlement) in Exhibit A. This would provide the maximum use of their existing water rights and open up for fills under their junior capacity water right. Implementation of such operations would require MVIC Board approval and, potentially, MVIC shareholder approval depending on the terms of operation proposed. Approval of this Plan by MVIC's Board does not constitute such approval. No new facilities would need to be constructed for implementation.

Public stakeholder concerns specific to this action:

- Support the use of Groundhog for a drought reserve because it doesn't affect McElmo Creek water users.
- Any re-operation of Groundhog will benefit MVIC.

5.2.1.2 Drought Reserve using Totten Reservoir

Totten has the potential to provide additional water during a drought subject to construction of new facilities to convey water from Totten to the THC. This action is described in detail in Section 5.1.4.3. The Totten drought reserve cost would be in the range of $4 to $6 million to be able to use up to 2,200 AF.

Public stakeholder concerns specific to this action:

- McElmo Creek water users might support this action if some of the water is used for their drought reserve. (Statement made.)

5.2.2 Water Users Leasing Water to Other Users

The potential exists in the Project contracts, and physically for Project allocations, for an individual or group of individuals to be leased to another Project irrigation user on a voluntary and compensated basis. This would require approval by the DWCD Board and concurrence by Reclamation. The leases may be made on either a year or multi-year basis. The actions described below include the possibility of leasing. The DWCD Board presently has a policy that FSA irrigation water can only be leased to other FSA irrigators.

Public stakeholder concerns specific to this action:

- If water can be leased between irrigators, can water be leased to the fishery? (Addressed in 5.2.2.)

5.2.2.1 FRE Leasing Water From DWCD

For many years, the FRE has been seeking an additional permanent supply of irrigation water in the amount of 4,000 AF. In order to secure the water, it will be necessary to utilize temporary leases until such time that a permanent supply is developed.

Potential sources of water to meet FRE needs exist. DWCD may provide water from reallocation of senior downstream water rights, allocation of Class B shares to exchange with Project water, reallocation of Project water, and/or Totten releases through the THC.

Public stakeholder concerns specific to this action:

- None raised.

5.2.2.2 MVIC Supply Opportunities

In order for MVIC to lease Non-Project water to another user, a methodology would be developed to integrate the leased water into accounting for MVICs contractual entitlement to Project water, and any other contractual rights and obligations. The methodology could provide a basis for determining in the future if MVIC has water supplies that might be leased for purposes allowed by MVICs water right decrees, without injury to MVIC shareholders. Any such operations would be subject to MVIC Board approval and must be consistent with MVIC Articles and Bylaws. Since MVIC water is Non-Project water, a carriage contract may be required with the Reclamation to convey the water through Project facilities; a carriage contract exists for the DCC but not for any other Project facilities. Historic delivery patterns and tribal sovereignty may affect the need for a carriage contract for facilities on the FRE.

Opportunity exists for the creation of Class C shares within MVIC. he potential supply for this class of shares would be the conserved water saved by MVIC system-wide efficiency improvements, or by tracking and accounting for accruals of transbasin water to McElmo Creek system after first use by MVIC Class A and B shareholders. A need exists for additional water supply to the Redlands, McElmo Creek and/or Goodman Point irrigators. Those water users could acquire, for a cost, rights to the use of such water by the purchase of Class C share from MVIC. Implementation of such operations would require compliance with MVIC Articles and Bylaws and may also require both MVIC Board and shareholder approval. Further water court approval may be required depending on the terms of operation proposed.

Public stakeholder concern specific to this action:

- Conserved water should go to carryover storage and not used to provide water for additional lands such as Class C shares. (Addressed in 5.2.2.2.)
- Any leasing should follow existing MVIC Articles of Incorporation. (Addressed in 5.2.2.2.)

5.2.2.3 M&I Leasing Opportunities

A total of 8,700 AF of M&I water is allocated to Project users: DWCD's total is 5,120 AF, Dove Creek's total is 280 AF, City of Cortez's total is 2,300 AF, and the Ute Mountain Ute Tribe's total is 1,000 AF.

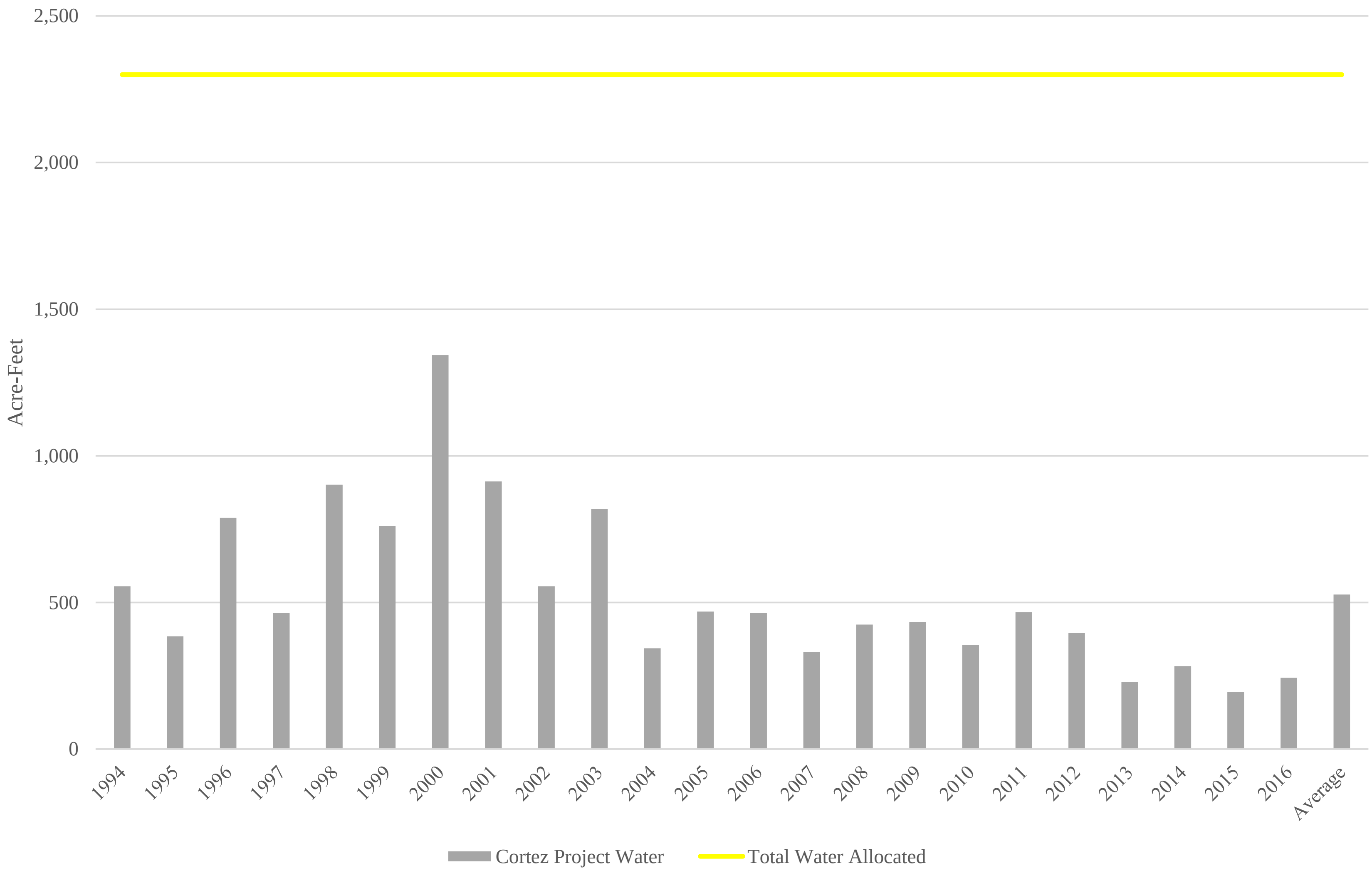
The DWCD owns 5,120 AF of M&I water from the Project of which approximately 4,500 AF is not contracted and available for lease. Although the water is not committed to a specific contracted user, the DWCD is repaying the cost of the water to the federal government through a property tax mill levy approved by the DWCD voters. The contracted water is utilized by providing 318 lawn and garden taps, augmenting 155 upstream users and truck haulers for various stock and construction purposes. As M&I water is permanently committed to upstream and/or lawn and garden users, the repayment obligation for each AF is moved from the tax role to the new payors that have contracted for M&I water. Uncommitted supplies are either often leased to FRE, used to supplement the FSA irrigator pool, or left in McPhee storage.

The City of Cortez owns 2,300 AF of Project water. Figure 15 below depicts the annual amount of Project water the City of Cortez has used. Since 1994, the City of Cortez has used on average 556 AF leaving an average of 1,744 AF of Project water not currently used by the city. The available unused Project water ranges from a minimum of 956 AF in 2000 to a maximum of 2,071 AF available in 2014. Unused supplies may be leased to other Project water users by arrangement through DWCD.

Public stakeholder concerns specific to this action:

- None raised.

Figure 18. City of Cortez Annual Municipal Use



Acre-Feet
2,500
2,000
1,500
1,000
500
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Average
Cortez Project Water
Total Water Allocated

5.2.2.4 Class B Shares

In 2002, the DWCD purchased a water supply in the form of 1,500 Class B shares providing up to 4.0 AF per share from MVIC Non-Project supplies. These shares equate to a maximum delivery of up to 6,000 AF annually. This water is subject to shortages similar to Project water. If all of the Class B shares are not needed on allocated acres, the balance of Class B shares is used to either increase the supply in the FSA irrigation pool for use when needed by the irrigators, or for added carryover storage in McPhee.

Class B shares may also be used as a drought response action. See Section 6.3.1 for further details and descriptions.

Public stakeholder concerns specific to this action:

- None raised.

5.2.2.5 Additional Water Availability via the FSA Water Bank

The Reclamation DPR projected a specific average crop mix for the FSA irrigators that did not come to pass. Alfalfa became the best economical crop under irrigation for the FSA irrigators to raise and support themselves and the Dolores Project. Also, any individual farmer likely does not routinely follow the projected average crop mix. To address this mismatch of water supply to economic need, the DWCD Board initiated an FSA "Water Bank."

The basic Water Bank supply assumption is that not every farmer will use a full supply due to crop mix, fallowing, crop rotation, variable climate conditions, etc.; thus, providing additional available water to the larger group of FSA irrigators.

First, since individual irrigators are not allowed to lease water directly from other irrigators, the Board allowed each individual farmer to pool the lands under their control by ownership or lease. The Board action allows an individual to have multiple irrigated parcels (delivery boxes) with their individual water allotments can be pooled and spread in any manner among the several parcels to the most economically advantageous amounts within the total allocation for all the parcels.

Second, the unused allocations from individual irrigators would be put to use by other FSA irrigators that need the water via changing the individual parcel allotment limits. This allows extension of late season water as the Water Bank develops through an irrigation season.

The DWCD Board has several ways to direct the Water Bank:

1. The Board can set the maximum allowed water cap, inches per allocated acre.
2. When the Board sets or adjusts the cap (early versus late season) may determine how much and how effectively the additional water is used.
3. The Board sets the pricing for water deliveries above the minimum contract delivery up to the higher cap, inches per acre, which can generate additional revenue and encourage higher or lower water use.

The additional revenue is generally placed in reserve and can be used to alleviate drought impacts. Historically, this has been done by using the water supply reserve account to alleviate FSA irrigator charges and, therefore, farmer economic hardship during Board determined individual water short years. The revenue could also be used to improve a facility to save water, improve supplies or better deliver water during shortages. Other drought mitigation measures could also be funded from these FSA fund reserves.

Public stakeholder concerns specific to this action:

- None raised.

5.2.3 Hermana Canal Coordination with THC Operations

The Hermana receives 7 cfs of water from Narraguinnep. The tailwater of the Hermana enters the THC and bypasses the Dolores Tunnel and Towaoc Power Plant. Any flows through the Hermana not utilized by turnouts along the canal could be diverted through the Dolores Tunnel to the Towaoc Power Plant to produce power.

An existing flume is located at the downstream end of the Hermana. This flume is back-flooded, making it difficult to measure the flows in the Hermana. By not having accurate measurements it is difficult to regulate these flows, especially when water needs to be well managed during years of short supply. For example, an isolated rainstorm will occur and, due to the lack of measurement of the Hermana, releases will not be decreased. This leads to wasted tailwater and upset shareholders. In 2013, approximately 5 to 10 AF were wasted, which is a significant amount during drought conditions.

Sedimentation buildup has resulted in back-flooding in the Hermana, downstream of the flume. The back-flooding issue has worsened over the years and was very noticeable in 2016. Currently, the original discharge measuring equipment is non-functional allowing only a simple bob and meter to provide flow measurements. Intermediate attempts have been made to induce ideal free-flow conditions in the flume, but this method is inconvenient for control room technicians and is not a long-term solution.

There are several options for resolving the back-flooding issues. These options are listed below.

1. Repair the original equipment at the flume; allowing for submergence and stage data to be collected. The discharge would be estimated, but with some inaccuracy, as using a submergence to measure under back-flooding conditions is an imperfect system. This option is likely the most convenient and quickest to implement, even if it is only part of the solution.
2. If, after investigation, the original flume equipment is inoperable, a new collection of equipment would be installed to collect the information separately from the flume's equipment while still utilizing the submergence to estimate back-flooding. Personnel to periodically collect the date would need to be identified. The same level of accuracy would be achieved as in option 1.
3. Mechanical removal of the sediment downstream of the flume. This may be the best option to potentially eliminate the problems associated with back-flooding entirely. However, routine maintenance would be required into the future to keep the sediment accumulation from reoccurring.

4. Instead of rehabilitating the existing flume, install an “up-looker” in the flume. An “up-looker” is a sonic device capable of measuring the velocity profile of the flow in the canal. This would provide a discharge value not influenced by submergence.

To implement this action, coordination between DWCD and MVIC would be necessary to investigate, identify, discuss, and implement the best option to improve water management of the Hermana.

Benefits of this action would include conserved water, increased power production, and better water management of the delivery system. This action provides for more operational control and generates more power.

Public stakeholder concerns specific to this action:

- None raised.

5.2.4 Precipitation Augmentation

The DWCD provides annual funding to cloud seeding programs sponsored by SWCD, Colorado Water Conservation Board (CWCB), Lower Colorado River Basin and other interests. In 2004, CWCB initiated a grant program to cost share cloud seeding operations with local sponsors. Recently, grants from the Lower Colorado River Basin to the CWCB state to increase the Colorado River water supply.

Cloud seeding is the process of burning silver iodide through an ice nucleus generator that is carried up into the clouds to stimulate the precipitation process. The type of weather modification utilized in the West Dolores and Telluride Resort Ski Area Program is ground-based targeting the upper regions of the West Dolores and San Miguel River drainage basins. Yearly monitoring of the program is necessary to gage the effectiveness of cloud seeding, quantity efforts, and determine the best locations and technologies that should be used.

Future program efforts include funding new meteorological instrumentation, new remote generators to maximize the effectiveness of seeding operations, carefully reviewed and approved new manual generators, and on-going scientific evaluations of seeding effectiveness and generation equipment location and type. Existing funds are not adequate to take advantage of all opportunities; whether that be seeding events or utilization of new technologies. Currently, the program seeks to create a strategic plan that investigates program modernization strategies and priorities.

Public stakeholder concerns specific to this action:

- None raised.

5.2.5 Full Service Area Assessments

Irrigators face many hurdles when they try to improve on-farm efficiency, but the cost of equipment appears to be the most limiting factor. If funding were made available to help cost share improvements, then irrigators will be in a stronger position to invest in efficiencies. Potential exists in the FSA for upgraded systems from side roll to center pivot irrigation. Understanding what applicable equipment to use and best management practices to promote conservation are key outcomes. This action is the non-structural component of the structural mitigation action in Section 5.1.3.2.

One source of funding is through the Natural Resources Conservation Service (NRCS) through their Environmental Quality Incentives Program (EQIP). The EQIP is

"A voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land."

DWCD partnered with High Desert Conservation District (HDCD) in an effort to expand outreach to the FSA irrigators and to investigate eligibility requirements. Under existing CO NRCS Standard 442 for center pivots specifications for fine and coarse textured soils, land exceeding 3% slope on 50% or more of the field, or 5% slope on 50% or more of the field, are not eligible for funding. Collected data, present, and future will be used by the local NRCS engineer to assess slope criteria and if variances may be given to individuals.

Data collection began in the 2016 irrigation season. HDCD worked with approximately 20 volunteer farms utilizing center pivots or farms wanting to upgrade to pivot packages. A total of 1,089 acres were assessed in 2016. Assessments looked at pivot design, nozzle packages, soils information, system data, and catch can collection data. (Reference Appendix A for the first year's assessment report.) By using center pivots and system packages, the benefits are labor savings, potential yield increases, and potential water conservation. Assessments should be continued in the future until enough data is collected for NRCS to evaluate the slope criteria.

From the assessment, the following conclusions should be considered for existing and additional pivot assessments:

- Soils Data: Soil texture dictates the slope criteria, and more soil data is needed. During the 2016 season, only one site's soil data was collected.
- Infiltration Rates: While average area soil infiltration rates are typically used, more site-specific rates, coupled with soil data, will better inform system design and management considerations.
- Follow-up Assessments: Assessing sites over time will yield data on how systems and their operations change over time.

<u>Public stakeholder concerns specific to this action:</u>

- None raised.

5.2.6 McElmo Transit Water Loss Study

To better manage water delivery from Totten to McElmo Creek users, a field study to better estimate the transit water loss is necessary. A pilot program to lease Totten water was conducted recently, but the transit water losses were estimated based on the lack of field study verification. A study is proposed to better quantify the water lost in transit to prevent releases greater than needed. Any over-releases of water from Totten flow out of Colorado and cannot be recovered.

The proposed study would segment the length of McElmo Creek that is used to convey water. Dependent upon the available funding, the number of multiple measurements' locations will be determined, and data collected at each location including width and depth of the channel. The study will involve an attempt to measure a steady flow rate throughout the segment (no diversions) with flow measurements at each location to assess any reduction in flow. The data collected in the field, through evaluation, will result in transit loss rates for the study area.

Public stakeholder concerns and concerns specific to this action:

- General support was received for further evaluation of flows in McElmo Creek.
- The study may include a definition of water amounts greater than necessary to accomplish delivery to downstream users and discuss timing of flows and potential releases.
- The study may include analysis of losses in McElmo Creek tributaries as well.

5.2.7 DWCD Drought Financial Reserves

The DWCD invested monies into reserves as part of the initial Project development. These reserves are used to reduce the financial burden of paying the water base cost to FSA irrigators when there is insufficient water to raise a full crop during a drought. Due to the reduced income from water sales during recent droughts, the DWCD's reserve accounts were depleted by nearly $1 million. After the most recent drought, a long-term strategy was implemented to replenish these reserves. The farmers supported an incremental assessment per AF on water purchased over a ten-year period. These payments will equal the amount expended from the existing reserves during the last drought year.

Public stakeholder concerns specific to this action:

- None raised.

5.3 Summary Tables of Potential Mitigation Actions

The below tables list and summarize the structural and/or non-structural mitigation actions in the order that they are described in this section. The table is to assist in organizing the actions for future discussion, consideration, and/or prioritization.

Table 15. Potential Structural Mitigation Actions

Section	Action	Description
FRE Actions		
5.1.1.1	Control Valves	The need for isolation valves exists in the delivery system to handle water fluctuations.
5.1.1.2	Connect Irrigated Lands near Casino directly to Rocky Ford Lateral	Connect existing irrigated lands near the Ute Mountain Casino in Towaoc to the Rocky Ford Lateral.
MVIC Actions		
5.1.2.1	Measuring Stations with Remote Monitoring in MVIC Delivery System	Satellite measuring stations in MVIC delivery system to reduce operational spills.
5.1.2.2	Upgrade Canal Communication System	Convert canal communication system control to a digital SCADA system.
5.1.2.3	Piping Improvements for Existing Infrastructure	Priority piping improvements for MVIC delivery system. This action includes three site specific projects.
5.1.2.4	MVIC Service Area On-Farm Efficiency Improvements	On-farm efficiency improvement opportunities exist in the MVIC service area.
5.1.2.5	Hydropower Development Opportunities	Potential hydropower development exists on MVIC facilities.
DWCD Actions		
5.1.3.1	Dove Creek Canal	Routinely monitor and address clay liners for erosion.
5.1.3.2	Full Service Allocation Area On-Farm Efficiency Improvements	On-farm efficiency improvement opportunities exist in the FSA irrigated lands.
5.1.3.3	Hovenweep Delivery System Improvements	The need for Hovenweep delivery system high pressure improvements.
5.1.3.4	Promote Crops that Use Less Water	Promote crops other than alfalfa to become more resilient against droughts.
Storage Actions		
5.1.4.1	New Plateau Reservoir & Pump Storage Project	Construction of a new reservoir to increase water supplies for the fishery and M&I.
5.1.4.2	Increase Totten Reservoir Inflow	A pumpback project to pump water from McElmo Creek back to Totten Reservoir for Project uses.
5.1.4.3	Totten Reservoir pump to THC	A pumpback project to pump water from Totten Reservoir into the THC for Project uses.
5.1.4.4	Groundhog Reservoir Enlargement/Increased Capacity	Enlargement of Groundhog for additional pool of water for use as drought mitigation.
Other Structural Actions		
5.1.5.1	Pump San Juan River Water to FRE	A pumpback project to pump water from the San Juan River to FRE.
5.1.5.2	Hydropower Development Opportunities	Potential hydropower development exists within the Project's delivery system.
5.1.5.3	McElmo Creek Irrigation Actions	Proposed actions to stabilize the water supply to McElmo Creek irrigators.

Table 16 . Potential Non-Structural Mitigation Actions

Section	Action	Description
5.2.1	Improve Joint Operations of McPhee and Other Reservoirs	Opportunity for better use of existing reservoirs and water supplies by jointly managing facilities.
5.2.1.1	Drought Reserve using Groundhog Reservoir	Opportunity for better use and management of existing reservoir and water supply.
5.2.1.2	Drought Reserve using Totten Reservoir	Opportunity for better use and management of existing reservoir and water supply.
5.2.2	Water Users Leasing Water to Other Users	The potential exists in the Project contracts, and physically for Project allocations, for an individual or group of individuals to be leased to another Project irrigation user on a voluntary and compensated basis.
5.2.2.1	FRE Leasing Water From DWCD	FRE is seeking an additional permanent supply of irrigation water in the amount of 4,000 AF.
5.2.2.2	MVIC Supply Opportunities	Potential to create Class C MVIC shares supplied with conserved water or transbasin water by reuse and successive use, after initial Class A and B shareholder use.
5.2.2.3	M&I Leasing Opportunities	Potential to lease Cortez M&I water to Project users (on either a yearly or multi-year basis).
5.2.2.4	Class B Shares	MVIC use of Class B shares when spill of Call Storage water occurs.
5.2.2.5	Additional Water Availability via the FSA Water Bank	In years that the amount of water allocated to some FSA irrigators is not fully used, the available water could be provided to other irrigators that need additional water.
5.2.3	Hermana Canal Coordination with THC Operations	Improve Hermana Canal operations, including during rain events.
5.2.4	Precipitation Augmentation	Provide annual funding to cloud seeding programs.
5.2.5	Full Service Area Assessments	Opportunity to conduct assessments for individual irrigators or entities interested in evaluating their current irrigation practices. Programs could collect valuable information about irrigation practices and provide feedback on efficiency improvements.
5.2.6	McElmo Transit Water Loss Study	A field study to better estimate the transit water losses in McElmo Creek as it relates to releases from Totten Reservoir downstream.
5.2.7	DWCD Drought Financial Reserves	Replenish drought financial reserves used to reduce the financial burden on FSA irrigators during a drought.

6 Response Actions to a Drought

This section identifies potential non-structural response actions to be implemented during a drought year. The potential response actions may be implemented during stages of drought to better manage the limited supply and decrease the severity of immediate drought related impacts. As stated previously, the Plan is not a decisional document and, as such, the actions described in this section are a general list and not meant to indicate that they will be pursued after the Plan is finalized. The actions will be considered by the responsible entities and pursued if and when each entity decides to do so, at its sole discretion.

The Project and its users experience two types of droughts: (1) hydrological and (2) operational shortages. A hydrological drought occurs when minimal water supply is available in the streams resulting in minimal inflow into the McPhee. This type of drought, such as 2002, affects all Project users. An operational shortage drought is due to specific users legally allowed water supply. For instance, since Project water storage takes precedent, during a managed spill year all or a portion of MVIC's stored water in McPhee will be released, causing MVIC to be water short in the latter portion of the irrigation season. While this is occurring, McPhee is either full or nearly full which provides other Project users a full supply.

Along with input from the entities they represent, the Task Force brainstormed and developed the following proposed response actions as part of the Plan's development process. Multiple discussions were conducted pertaining to a specific action including steps for evaluation, cost and potential funding sources, feasibility, and priority relative to other actions.

Response actions for both types of droughts are described herein in no particular order. While some actions are applicable no matter the severity or type of drought, others are only applicable during one type of drought. Some actions will require some form of board(s) approval for action implementation when necessary.

6.1 Active Communication Structure

Communication is key during any drought regardless of the severity. Active communication provides Project users with up to date information to better inform themselves of how best to manage a limited water supply. Close communication among all water management entities associated with McPhee is critical to the coordination of drought response by managers and field crews, as they work together to make the most of the scarce water availability. This structure encourages communication amongst all Project water users. While communication is necessary throughout any water year, during a drought year communication should be increased proportionally to the decrease in available supply. DWCD staff will meet regularly to monitor water supply forecasts and projections and communicate the latest projections to FSA irrigators, MVIC, FRE, and others. MVIC staff will meet regularly with ditch riders to monitor their facilities and shareholders. FRE staff will meet regularly to monitor facilities and assess drought related changes in cropping pattern. Direct phone calls will regularly be made between DWCD, MVIC, and FRE. If necessary, monthly or bi-monthly meetings may be held to discuss the water supply.

Public stakeholder concerns specific to this action:

- None raised.

6.2 Improve Water Supply Projections and Timing

DWCD currently does a plethora of monitoring (See Section 3: Drought Monitoring) using their own data (e.g. low snow measurement) and information from NOAA's CBRFC. As this information accumulates over the course of the winter, the following time periods are used by DWCD to track the likelihood of shortages to water users during the next irrigation season.

- November – If the McPhee active content in November is less than 60,000 AF there is a potential for shortage the following irrigation season. Based on Figure 7, if the active McPhee content was more than 60,000 AF there was never a shortage the next irrigation season but, if the content was less than 60,000 AF, shortages could occur such as in 2002, 2003 and 2013. Though the McPhee content criteria does not accurately predict shortages, it does indicate if there is a possibility.

- January – The January forecast of the April through July runoff volume is provided by the CBRFC and is the first projection that is useful to DWCD. If the snowpack is high, the chance of shortage is lower, but if the snowpack is low, then more careful monitoring will occur from then on.

- February – Similar to January, if the snowpack is high, the chance of shortage is lower, but if the snowpack is low, then more careful monitoring and communication with water users will occur. In addition to the CBRFC, DWCD also maintains low snow measurement sites which provide an indication of the amount of low snow. February provides a good indication of low snow moisture.

- March 1 – In March, though still early in the season, the amount of runoff and the potential for shortage is better predicted. If shortage is a possibility, the DWCD will begin to notify the water users of the potential and the amount of shortage.

- March 15 – If a shortage is a possibility, a mid-March runoff forecast will be used and new estimates of the chance and amount of shortage prepared. Particularly for FRE, the mid-March forecast provides an indication of the water supply and is used in order to begin to determine the cropping pattern. Direct and continuous contact will begin with all of the irrigators and the fishery interests as the potential for shortage unfolds. Though DWCD has made these contacts in the past droughts, as a result of the Plan, there will be a greater effort to keep water users as knowledgeable as possible. DWCD will be in constant communication with FRE as conditions change.

- April 1 – ~~The April 1 forecast is especially critical to the FRE because the cropping pattern for the next irrigation season is planned based on the water supply. If there is a shortage predicted FRE will take steps to reduce water use. Adjusting the cropping pattern afterward is difficult, if not impossible. DWCD will, of course, be in constant contact with FRE but~~ DWCD will continue notification of FSA irrigators of the potential and amount of shortage. The first estimate of the irrigation water cap to FSA irrigators will be determined. DWCD contact with water users will increase, possibly weekly.

- April 1 to 30 – If there is a potential shortage, DWCD will constantly monitor the runoff forecast throughout April and notify the FRE, MVIC, and FSA irrigators of the situation. The estimated FSA irrigator water cap will be adjusted, as appropriate, to reflect the changing runoff conditions.

- May 1 – The final amount of water available to all of the irrigators and the fishery will be established based on DWCD collected data and informed by the CBRFC's April through July runoff volume forecasts. If the weather is extremely wet or includes extended dry periods after May 1, the projection may change as occurred in May and June of 2015. By this date, the FRE has already determined the cropping pattern, but the FSA irrigators will now finalize their cropping plans based on the water supply.

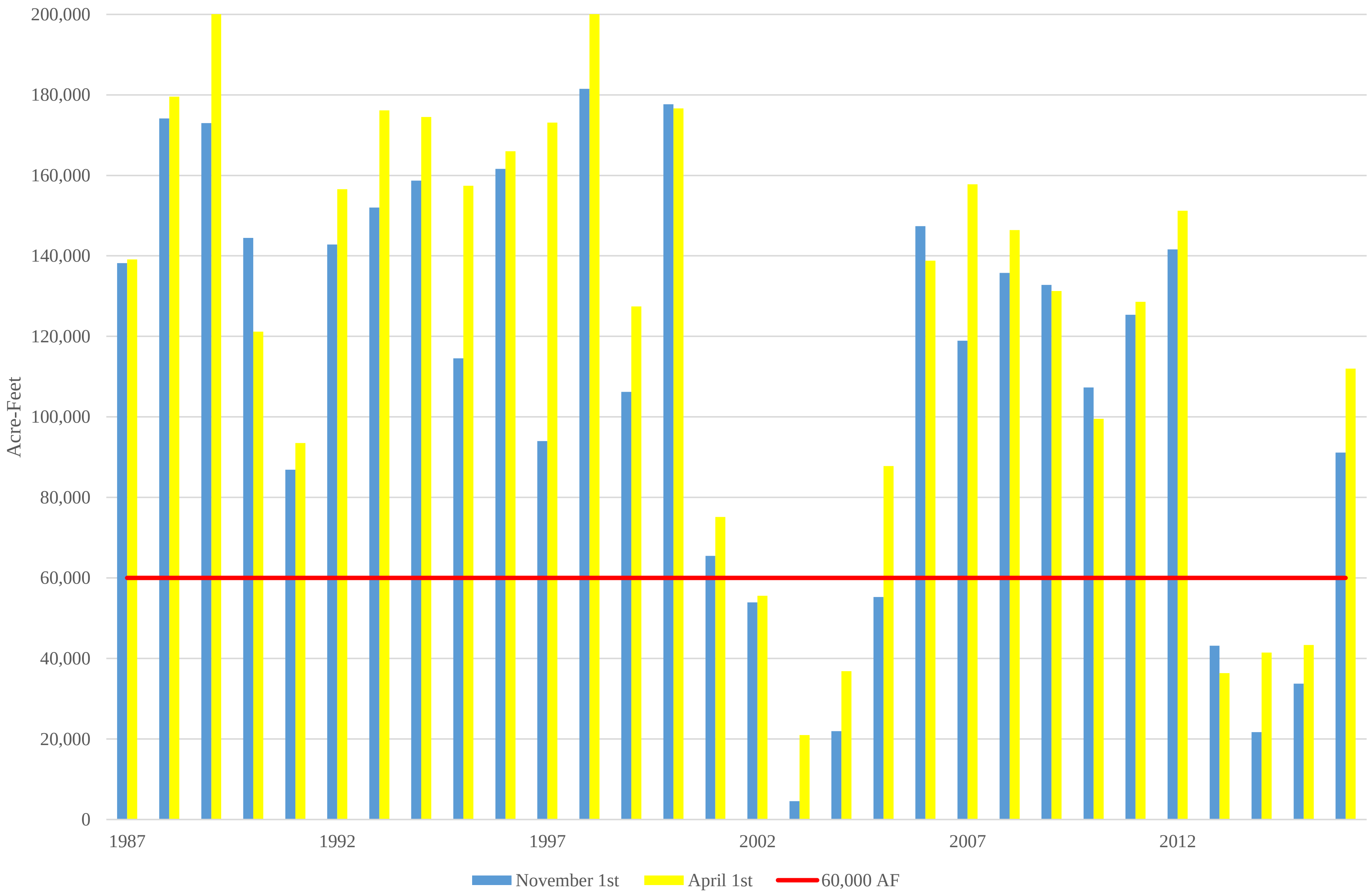
Due to the variability of spring storms, it is hard to forecast the available water supply before the April 1 forecast, and even after that time, the runoff can change for better or worse. As seen in the above time periods, there is little opportunity to improve the forecasting of water supply projections. The greatest opportunity to reduce the impact of shortage is in communication with users so they can make the best possible decisions on how to utilize the available water supply. Figure 19 depicts the active capacity found on November 1 versus April 1 for the McPhee.

DWCD and Reclamation are currently using the best available data and information to Project water supply and spills but is still inadequate in many instances. Attempts are continually being made to improve the projections. Potential multi-year indicators, such as reservoir content, were also evaluated, but none could be identified as one year is not indicative of shortage two years later.

Public stakeholder concern specific to this action:

- Water supply projections should be improved to increase certainty. (Addressed in 6.2.)
- The drought indicators should also be over years and not just in the same year. (Addressed in 6.2.)

Figure 19. November 1 vs. April 1 McPhee Active Capacity



6.3 Use of DWCD Water Portfolio for Other Project Uses During a Drought

6.3.1 Class B Shares

As discussed above, in 2002 the DWCD purchased a water supply in the form of 1,500 Class B shares with a supply of up to 6,000 AF, but this supply is shorted the same as FSA irrigators from Project supply. During an operational shortage, when MVIC is experiencing shortage while the Project water supply is not, a potential exists for DWCD to lease Class B shares to MVIC. During these years, MVIC would benefit if the Class B water was used by MVIC shareholders. Under the circumstances, DWCD does not need the Class B supply.

MVIC Class A shares are not subject to the same shortages as Class B shares. The contract calls for Class B diversions to the Project's FSA irrigators to be shorted in the same proportion as Project water. During a hydrologic shortage, when direct river flows only satisfy MVIC's water rights and provide no additional flow for storage in McPhee, shorting Class B shares the same as Class A shares would benefit Project water users.

The ability of MVIC to use Class B water when spilling of Call Water constrains MVIC supplies, and for DWCD FSA irrigators to receive Class B water that is only shorted in drought years to the same degree as MVIC Class A shares, may provide the basis for a tradeoff that is beneficial to both organizations. Details on when such benefits would be implemented, related water accounting procedures, and what changes would be needed in the Class B contract, will require further discussion and evaluation based on the board(s) direction. Implementation of such operations would require both MVIC Board approval and MVIC shareholder approval. Approval of this Plan by MVIC's Board does not constitute such approval.

<u>Public stakeholder concerns specific to this action:</u>

- Any changes to use of Class B shares should be done so with an amendment to the contract and Class B shares would be defined in the contract. (Statement made.)

6.3.2 Water Exchange Between Users

An FSA irrigator's water payments include a base rate and a cost per AF used. Regardless of the volume of water purchased, an irrigator pays the base water charge. During a shortage, an irrigator's water supply will only be sufficient for decreased acreage, or only available for one cutting of alfalfa. Because of this lack of production and subsequent income, an irrigator may wish to not irrigate at all that year.

Thus, a potential exists during a shortage for FSA irrigators to be relieved of their water and water charges in exchange for leaving their allocated share of water in the pool. This would require administrative mechanisms that don't currently exist. To the extent that such forgone water contributes to a revenue generating lease by DWCD, the proceeds will be reinvested in the OM&R of the Project using revenue that is not generated by water charges from FSA irrigators.

<u>Public stakeholder concerns specific to this action:</u>

- None raised.

6.4 Narraguinnep Reservoir Re-Operations

Narraguinnep has the potential to provide additional water during a drought through exchange storage in McPhee. The response action would be to store water typically stored in Narraguinnep in McPhee at specific times of year as necessary for drought protection. In a year when space is available in McPhee, for example in a drought year, a volume of water is stored in McPhee during the run-off season would be treated as Narraguinnep water and would not be physically stored in Narraguinnep. The Narraguinnep water would be available for use by MVIC as it would be if stored in Narraguinnep.

There are Project wide benefits for storing Narraguinnep water in McPhee. Since the lake elevation of McPhee would be increased it will reduce pumping costs at Great Cut Dike and delay, or avoid, reaching elevations in McPhee that make it impossible to pump water to the DCC, U Lateral, and Lone Pine. Also, in times when water from Narraguinnep cannot reach all MVIC shareholders, it can be released to MVIC shareholders from McPhee through the Dolores Tunnel. Therefore, storage of Narraguinnep water in McPhee increases the versatility for MVIC, especially during a water short year. This also results in the option to release more water through the Towaoc Power Plant subsequently producing more power for Western Colorado.

While storing Narraguinnep water in McPhee leads to more flexible water management it may come at additional costs. There may be a carriage cost by Reclamation for MVIC use of Project facilities and these costs will be distributed to parties benefiting from the change in storage. The increased surface area of McPhee may lead to greater evaporation losses. The decision to store Narraguinnep water in McPhee would have to be made prior to the run-off season, before physically filling Narraguinnep, which may be too early in the season to identify the year as a "Drought Year." Implementation of such operations would require MVIC Board approval and, potentially, MVIC shareholder. Further, to the extent such operations constitute a change in point of diversion and storage, water court approval will be necessary. Approval of this Plan by MVIC's Board does not constitute such approval.

Public stakeholder concerns specific to this action:

- If Reclamation requires large storage fee payments, MVIC should not be solely responsible for these payments when the re-operation benefits multiple parties. (Statement made.)

6.5 Municipal Water Conservation

The municipal water users from the Project have firm allocations that are not shorted during a drought. However, the City of Cortez and the Town of Dove Creek, the two municipalities that receive water from the Project, voluntarily implement water restrictions, primarily lawn irrigation, when the irrigators are short.

Public stakeholder comment specific to this action:

- A section on municipal conservation should be added. (This section was added.)

6.6 Summary Table of Potential Response Actions

The below tables list and summarize the response actions in the order that they are described in this section. The table is to assist in organizing the actions for future discussion, consideration, and/or prioritization.

Table 17. Potential Response Actions

Section	**Action**	**Description**
6.1	Active Communication Structure	Evaluations of the available water supply communicated between farmers, DWCD staff, MVIC staff, FRE staff, and other Project users.
6.2	Improve Water Supply Projections and Timing	Continue to work on improving application of forecast and projections to the available water supply.
6.3	Use of DWCD Water Portfolio for Other Project Uses During a Drought	Potential during a declared shortage for FSA irrigators to be relieved of water and water charges when a willing payer exists that would utilize their water supply.
6.4	Narraguinnep Reservoir Re-Operations	Store Narraguinnep water in McPhee at specific times as necessary for drought protection.
6.5	Municipal Water Conservation	The two municipalities that receive water from the Project, voluntarily implement water restrictions, primarily lawn irrigation, when the irrigators are short.

7 Operation and Administrative Framework

The Task Force members were responsible for the decision making and development process of the Plan. The Task Force met regularly to provide guidance to contractors on analysis, work products, and stakeholder outreach efforts. Final review of the Plan and approval will be done by the Boards, the Task Force and input from stakeholders.

7.1 Roles

The operational and administrative framework to implement the Plan will be led by DWCD who is responsible for Project operations and the delivery of water to the users. DWCD already has an administrative framework established with the water users that rely on McPhee. The current framework involves coordination on a near daily basis beginning in early February as projections of the yearly water supply are being made. The daily coordination continues during the irrigation season and other critical times.

7.2 Responsibilities & Procedures

Project users are responsible for implementing actions specific to their structural and non-structural water management needs. Procedures needed to implement actions may vary by action or by Project user responsible for implementation. When an action involves policy agreement between multiple parties, staff will facilitate coordination to seek common alignment among the parties.

DWCD drought responsibilities will include:

- Drought monitoring and notification directly to Project water users,
- Drought notification to general public and second level stakeholders,
- Notification of the potential and amount of water shortage due to drought,
- Notification of Colorado Parks and Wildlife of a shortage to the fishery releases,
- Notification to boating interests that there is not sufficient water for a boating season,
- Implementation of drought response actions described in the Plan with MVIC and FRE,
- Initiate securing resources to assist during drought other than DWCD resources,
- Request for State and/or National Disaster Declaration, and
- Following the drought, review and evaluation of the Plan's effectiveness with MVIC and FRE to determine if updates are necessary.

MVIC drought responsibilities will include:

- Drought monitoring of its reservoirs and other facilities,
- Drought notification to shareholders,
- Notification of the potential and amount of water shortage due to drought,
- Implementation of drought response actions described in the Plan with DWCD and FRE,
- Initiate securing resources to assist during drought other than MVIC resources,
- Request for State and/or National Disaster Declaration, and
- Following the drought, review and evaluation of the Plan's effectiveness with DWCD and FRE to determine if updates are necessary.

FRE drought responsibilities will include:

- Drought monitoring of facilities and cropping pattern,
- Implementation of drought response actions described in the Plan with MVIC and DWCD,
- Initiate securing resources to assist during drought other than FRE resources,
- Request for State and/or National Disaster Declaration, and
- Following the drought, review and evaluation of the Plan's effectiveness with DWCD and FRE to determine if updates are necessary.

8 Plan Update Process

8.1 Plan Evaluation Process

The Plan is aspirational and viewed as a process, not a static document that will apply indefinitely into the future. The Plan should not be considered the last word on mitigation and response actions that may be implemented by the Dolores Project and its users. The Plan will be reviewed annually to assess if conditions have changed that warrant revision but will be updated no less than every ten years.

The National Drought Mitigation Center 10 step drought planning process provided guidance for how the Plan evaluation will be conducted to test the Plan effectiveness. The evaluations will address climatic and environmental aspects, how pre-drought planning was useful, and weaknesses or problems with the Plan.

<u>Public stakeholder comment specific to this action:</u>

- A time frame for updating the Plan should be included. (Addressed in Section 8.1.)

8.2 Measuring the Effectiveness of the Plan

The Plan's purpose is to reduce risk to all Project users due to drought related impacts. The DWCD and other users have already begun to transition from crisis management approach to a more proactive risk-based management approach. This has taken place over many years since the first drought induced Project shortages in 2002 and 2003, followed by severe drought and Project water shortages in 2013.The Plan is another step towards that risk-based management approach built on the foundation of lessons learned from previous droughts. The plan will be measured for effectiveness and adapted based on:

1) Ongoing evaluation of progress on mitigation measures and
2) Post drought evaluations.

Each Project user is responsible for implementing and measuring the effectiveness of actions specific to their structural and non-structural water management needs, to the extent that they determine to undertake such actions. The Task Force may work together in the future to assess actions in the Plan if the action relates to more than one user. All entities will work together to measure the effectiveness of the Plan after a drought to discuss and determine what actions were effective, which were not, and reasons why some measures may not have been as effective, as a basis for identifying future actions to help manage future drought risk.

8.2.1 Ongoing Evaluation

The ongoing evaluation will track how changes in technology, forecasting, laws, and political context may affect the Project's operations and drought risk. While drought risk may be evaluated frequently, this does not mean the Plan needs to be updated as often. Using the risk-based management approach, any lessons learned may be implemented without needing to update the Plan.

8.2.2 Post-Drought Evaluation

A post-drought evaluation is necessary to assess the effectiveness of the Plan's response actions to a drought. Without an evaluation, it is hard to learn from past success, mistakes, and identify future needed actions. The evaluation should include:

- Analysis and assessment of climate, hydrology, and environmental impacts;
- Identify any economic or social consequences;
- Assess the extent the Plan's actions were useful (or not) in mitigating impacts; and
- Identify any other weaknesses or problems caused by or not coved by the Plan.

Once the evaluation is completed, individual entities and the Task Force should identify any future mitigation and/or response actions that address any outstanding needs. By working together and approaching drought planning as an ongoing process, Project users collectively lessen the potential risks associated with drought.

8.3 Timing of Updates to the Plan

Drought planning, as stated previously, is an ongoing process that continues to evolve over time. It is necessary to continually evaluate changing vulnerabilities and how Project users may work together to lessen the risk. The Plan should be updated as needed which may not occur on a regular basis. At a minimum, the ongoing evaluation should help inform the need of an update and identify the applicable timing of when an update should occur. It is recommended anytime a post-drought evaluation is prompted, the Plan should be updated with this latest information.

9 Summary Priorities of Drought Plan Actions

The Task Force generated the below list of potential actions that may be implemented. The Board considered setting priorities and decided against it since the actions were not likely to be pursued in any particular order. Many factors affect the ability to implement an action and if, or when, an action is pursued will be on a case by case evaluation by the appropriate entity. This Plan does not pre-suppose that any one of the actions will be pursued nor when decisions will be made by the participating Project stakeholders. The Task Force generated the below list of prioritized and non-prioritized actions that may be implemented. Many factors affect the ability to implement an action. While an action may be a top priority for an entity or entities, factors still affect implementation such as legal obligations, financial needs, or political climate surrounding an action. All actions involve at least one party while many include up to four parties needing to support an action prior to implementation. This creates another implementation layer in addition to the legal, financial, and political factors. This Plan does not pre-suppose the timing in which any one of the actions will be pursued nor when decisions will be made by the participating Project stakeholders.

9.1 Table of Priorities of Potential Mitigation and Response Actions

The below table lists the structural and/or non-structural actions in the order that they are described in Sections 5 and 6. The table is to assist in organizing the actions for future consideration. of priority. The actions were prioritized based on the top three goals of the Plan: (1) on-farm efficiency improvements; (2) delivery system improvements; and (3) operational opportunities. Any action that was not proposed as a priority under these categories was listed as a non-prioritized action.

Table 18. Potential Mitigation Actions Priorities

Section	Priority and Action	Description
Priority: On Farm Efficiency Improvements		
5.1.3.2	Full Service Allocation Area On-Farm Efficiency Improvements	On-farm efficiency improvement opportunities exist in the FSA irrigated lands.
5.2.5	Full Service Area Assessments	Opportunity to conduct assessments for individual irrigators or entities interested in evaluating their current irrigation practices. Programs could collect valuable information about irrigation practices and provide feedback on efficiency improvements.
5.1.3.4	Promote Crops that Use Less Water	Promote crops other than alfalfa to become more resilient against droughts.
5.1.2.4	MVIC Service Area On-Farm Efficiency Improvements	On-farm efficiency improvement opportunities exist in the MVIC service area.
Priority: Delivery System Improvements		
5.1.2.3	Piping Improvements for Existing Infrastructure	Priority piping improvements for MVIC delivery system. This action includes three site specific projects.
5.1.2.1	Measuring Stations with Remote Monitoring in MVIC Delivery System	Satellite measuring stations in MVIC delivery system to reduce operational spills.
5.1.2.2	Upgrade Canal Communication System	Convert canal communication system control to a digital SCADA system.
5.1.1.1	Control Valves	The need for isolation valves exists in the delivery system to handle water fluctuations.
5.1.1.2	Connect Irrigated Lands near Casino directly to Rocky Ford Lateral	Connect existing irrigated lands near the Ute Mountain Casino in Towaoc to the Rocky Ford Lateral.
5.1.3.1	Dove Creek Canal	Routinely monitor and address clay liners for erosion.
5.1.5.1	Pump San Juan River Water to FRE	A pumpback project to pump water from the San Juan River to FRE.
Priority: Operation Opportunities		
5.2.7	DWCD Drought Financial Reserves	Replenish drought financial reserves used to reduce the financial burden on FSA irrigators during a drought.
5.2.4	Precipitation Augmentation	Provide annual funding to cloud seeding programs.
5.2.3	Hermana Canal Coordination with THC Operations	Improve Hermana Canal operations, including during rain events.
5.1.3.3	Hovenweep Delivery System Improvements	The need for Hovenweep delivery system high pressure improvements.
5.2.1.1	Drought Reserve using Groundhog Reservoir	Opportunity for better use and management of existing reservoir and water supply.

Table 19. Potential Mitigation Actions Priorities Continued…

Section	Priority and Action	Description
Priority: Operation Opportunities Continued…		
5.2.2	Water Users Leasing Water to Other Users	The potential exists in the Project contracts, and physically for Project allocations, for an individual or group of individuals to be leased to another Project irrigation user on a voluntary and compensated basis. This action represents five sub-actions that all relate to water leasing opportunities.
5.1.5.3	McElmo Creek Irrigation Actions	Proposed actions to stabilize the water supply to McElmo Creek irrigators.
5.1.5.2	Hydropower Development Opportunities	Potential hydropower development exists within the DWCD's delivery system.
5.1.2.5	Hydropower Development Opportunities	Potential hydropower development exists on MVIC facilities.
5.1.4.2	Increase Totten Reservoir Inflow	A pumpback project to pump water from McElmo Creek back to Totten Reservoir for Project uses.
5.1.4.3	Totten Reservoir pump to THC	A pumpback project to pump water from Totten Reservoir into the THC for Project uses.
Non-Prioritized Actions		
5.1.4.1	New Plateau Reservoir & Pump Storage Project	Construction of a new reservoir to increase water supplies for the fishery and M&I.
5.2.1.2	Drought Reserve using Totten Reservoir	Opportunity for better use and management of existing reservoir and water supply.
5.2.6	McElmo Transit Water Loss Study	A field study to better estimate the transit water losses in McElmo Creek as it relates to releases from Totten Reservoir downstream.
5.1.4.4	Groundhog Reservoir Enlargement/Increased Capacity	Enlargement of Groundhog for additional pool of water for use as drought mitigation.

9.2 Priorities of Potential Response Actions

The below table prioritizes ~~non-structural~~ response actions that may be implemented during a drought year. The response actions ~~would~~ may be implemented during stages of drought to better manage the limited supply and decrease the severity of immediate drought related impacts.

Table 20. Potential Response Actions Priorities

Section	Action	Description
6.4	Narraguinnep Reservoir Re-Operations	Store Narraguinnep water in McPhee at specific times as necessary for drought protection.
6.2	Improve Water Supply Projections and Timing	Continue to work on improving application of forecast and projections to the available water supply.
6.1	Active Communication Structure	Evaluations of the available water supply communicated between farmers, DWCD staff, MVIC staff, FRE staff, and other Project users.
6.5	Municipal Water Conservation	The two municipalities that receive water from the Project, voluntarily implement water restrictions, primarily lawn irrigation, when the irrigators are short.
6.3	Use of DWCD Water Portfolio for Other Project Uses During a Drought	Potential during a declared shortage for FSA irrigators to be relieved of water and water charges when a willing payer exists that would utilize their water supply.