Project Background

This document is one of four separate reports created under a grant from the Walton Family Foundation to investigate ways to minimize harm to agriculture as water scarcity in the Colorado River Basin forces growing municipal and environmental water users to look at existing uses as potential sources of supply. Agriculture, the largest water user in the basin, is a frequent target in these efforts. The project, "Agricultural Water Conservation in the Colorado River Basin: Alternatives to Permanent Fallowing Research Synthesis and Outreach Workshops" was undertaken to create detailed reports of the four common methods used to temporarily transfer water from agriculture to other purposes. The four reports consider the following methods:

- Deficit Irrigation of Alfalfa and other Forages
- Rotational Fallowing
- Crop Switching
- Irrigation Efficiency and Water Conservation

After the reports were drafted, three workshops were held, one in the Upper Basin in Grand Junction on November 4, 2016, one in the Lower Basin in Tucson on March 29, 2017, and one in Washington, D.C. on May 16, 2017. All of the reports are available from the Colorado Water Institute website.

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We thank Senator Michael Bennet and his staff for acquiring a room at the Capitol Visitor Center for the DC event. Finally, we extend our sincere appreciation to the approximately 100 participants who shared their precious time to join us for our outreach workshops. Thank you, all.
Brad Udall

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Abbreviations

ALWT	Arizona Land and Water Trust
CAGRD	Central Arizona Groundwater Replenishment District
CAP	Central Arizona Project
CBT	Colorado Big Thompson Project
CEQA	California Environmental Quality Act
CRA	Colorado River Aqueduct
CRS	Colorado Revised Statutes
CVWD	Coachella Valley Water District
CWCB	Colorado Water Conservation Board
CWIC	Colorado Water Innovation Cluster
DWR	Colorado Division of Water Resources
ICS	Intentionally Created Surplus
IID	Imperial Irrigation District
IWSA	Interruptible Water Supply Agreement
LAVWCD	Lower Arkansas Valley Water Conservancy District
LCOLP	Larimer County Open Lands Program
LFT	Lease Fallowing Tool
kaf	Thousand Acre-feet
maf	Million Acre-feet
MVIC	Montezuma Valley Irrigation Company
MWD	Metropolitan Water District of Southern California
NEPA	National Environmental Policy Act
NSID	North Sterling Irrigation District
PVID	Palo Verde Irrigation District
QSA	Quantification Settlement Agreement
SDCWA	San Diego County Water Authority
SDS	Southern Delivery System
SWSP	Substitute Water Supply Plan
WMIDD	Wellton-Mohawk Irrigation and Drainage District
YMIDD	Yuma Mesa Irrigation and Drainage District

1 Summary

Rotational fallowing, also known as lease-fallowing, is the act of temporarily fallowing farm land to save water for other purposes. Rotational fallowing has been used for more than twenty-five years in the Colorado River Basin. Unlike some of the other methods of saving water, such as crop switching and deficit irrigation, temporary land fallowing is a proven, successful strategy for conserving significant amounts of water with a long history of on-the-ground projects in the Colorado River Basin. Although there can be significant issues with quantifying the actual water savings from fallowing, there is little doubt that fallowing does save water.

1.1 Negotiations are Complex

Leasing-fallowing negotiations often take a long time before finding a successful combination of price, land, water amounts, agreement length, and other terms. These agreements are three-party agreements with each party -- the buyer, the sellers, and the irrigation district – having distinct needs. The Metropolitan Water District of Southern California (MWD) – Palo Verde Irrigation District (PVID) agreement in 2004 was preceded by a two-year trial, nearly ten years earlier. Persistence has been key for the Colorado's Lower Arkansas Valley Super Ditch[1] which suffered several false starts but now has on-the-ground projects. Fallowing in the Imperial Irrigation District was part of the larger California Quantification Settlement Agreement in 2003. The agreements are unique to each area and cannot easily be replicated. Efforts generally require complex negotiations, multiple studies on environmental and tax consequences among others, and complicated legal documents to enact.

1.2 Impacts to Nearby Communities

Fallowing agreements need to consider the impact to nearby communities. Agricultural communities and irrigation districts have important economic ties and the impacts of fallowing go beyond the irrigation district and individual farmers. Local agricultural suppliers can suffer from decreased purchases of crop inputs and services, as well as the displacement of jobs associated with the fallowed fields. Other, broad third-party impacts are also in play, including decreased retail sales, sales taxes, and property taxes, which can negatively impact and harm the overall community. In some recent fallowing agreements, relatively large community funds provided by the purchaser have been a part of the arrangement to provide economic support and mitigation for displaced individuals and businesses.

1.3 Agronomic Advantages and Disadvantages of Rotational Fallowing

Rotational fallowing to conserve water should provide many of the benefits of traditional land fallowing for soil health, future yield increases and pest management. These benefits, however, have been much less studied than the water conservation savings, and remain mostly unquantified. Rotational fallowing could be part of a larger, purposeful crop rotation plan to provide these additional benefits, while producing income for a farmer from a fallowed field.

One negative soil impact seems clear. In areas with salty subsurface moisture, which includes most areas

[1] The term "Super Ditch" implies a single physical ditch. The program is, in fact, a joint effort of shareholders on multiple existing ditches in the region.

in the Colorado River Basin, capillary action can move subsurface salt to the soil surface during fallowing and hence a pre-planting leaching irrigation to remove these salts following the fallowing period is often necessary. This leaching water reduces the water savings from fallowing, to the extent that it was not otherwise needed.

1.4 Field Management Issues

All fallowing programs require that bare fields be managed to prevent weeds, avoid topsoil erosion, and control dust. Most agreements require the landowners to sign documents stating that they will perform this work at their cost, or else fallowing payments will be either reduced or withheld. Monitoring efforts need to make sure that the enrolled fields are actually fallowed, and that proper land management activities are undertaken.

1.5 Quantification of Water Savings

Quantifying the water savings of fallowing can be complicated. Several different approaches have been used. A generic, but difficult approach, would be to make assumptions about the exact crop that would have been grown, its expected yield (thus, total crop consumptive water use) reduced by precipitation supplied by nature. In small fallowing arrangements, a per-acre water savings has often been stipulated. In large irrigation districts with substantial acreage devoted to fallowing such as PVID, the difference in headgate diversions in fallowed years versus non-fallowed years, minus assumed return flows, can be used as an approximation.

In Colorado's Arkansas River Basin, the State Engineer developed a spreadsheet-based tool to perform calculations on each enrolled tract to determine consumptive use, and the return flows needed to keep downriver users whole.

1.6 Case Studies

Rotational fallowing was originally pursued by the Metropolitan Water District of Southern California in the Palo Verde Irrigation District in the early 1990s. This test case led to a 35-year agreement signed in 2004. Total fallowed acreage has ranged from 6,500 to almost 40,000 acres[2] with water savings ranging from 25,000 to almost 120,000 acre-feet per year. Metropolitan has more recently pursued a small test summer fallowing with the Bard Irrigation District near Yuma. As part of its agreement with the San Diego County Water Authority, since 2003 the Imperial Irrigation District has also been fallowing lands to provide mitigation flows into the Salton Sea with over 700,000 acre-feet generated for the Sea and another 700,000 acre-feet for municipal purposes. This fallowing ends in 2017, with further municipal deliveries to San Diego provided by efficiency improvements. In Colorado, the SuperDitch, a collection of ditches, has been created by farmers in the Arkansas River valley to provide income for farmers and water for cities. In 2004, the city of Aurora, Colorado successfully pursued fallowing in the Arkansas Basin in the midst of a severe drought to provide about 7,500 acre-feet for emergency supplies. In 2005, Colorado Springs joined with Aurora to extend the agreement for an additional year. The extension was used to refill depleted reservoirs with about 10,000 acre-feet of water.

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[2] The 2004 agreement only allows for a maximum of 26,000 fallowed acres. A later additional emergency fallowing agreement increased this amount by an additional 13,000 acres in one year.

2 Introduction

Since the early 1990s, within the Colorado River Basin and elsewhere in the West, paid temporary rotational fallowing[3] has proven to be an effective strategy for providing drought supplies for municipalities, for increasing environmental flows and for maintaining reservoir levels. For this chapter, rotational fallowing is defined as the process of not planting and not irrigating an annual crop for a season or multiple seasons with the intention of resuming irrigation at some future point[4]. The act of not irrigating perennial crops such as alfalfa and grasses is a similar concept except that these crops can enter dormancy and survive despite the lack of irrigation if done properly. This related, but in practice very different concept, is covered in the chapter on Deficit Irrigation.

Temporary land fallowing as part of a purposeful crop rotation plan has a long agricultural history and was historically used to improve soil health, improve yields, and reduce crop pests and plant diseases. In recent decades in the West, however, rotational fallowing has been used on irrigated lands for a new purpose: to conserve water. Rotational fallowing to conserve water on irrigated land now exists in many places and in a variety of forms across the West.

The original 1992-1994 MWD-PVID test fallowing program began twenty-four years ago, ten years later a thirty-five-year program covering approximately 25 percent of all PVID Valley lands[5] was established. In 2003, IID agreed to a 15-year fallowing program to provide water for San Diego County Water Authority and for the Salton Sea through an exchange with MWD. Other programs in Yuma, Arizona and the Lower Arkansas Valley in Colorado were established more recently, cover less acreage, and will last for a much shorter period. In 2016, MWD and the Bard Water District near Yuma implemented a pilot seasonal fallowing program (MWD, 2016b). In the last decade, some short-term fallowing agreements have been created to handle an immediate crisis. In response to a statewide drought, for example, the Arkansas Valley High Line Canal Company transferred water to Aurora, Colorado in 2004 and 2005 and in 2009 MWD and PVID agreed to a one-year emergency program. The High Line – Aurora agreement led to a longer-term arrangement which put in place an already successful, known mechanism for minimizing a potential municipal future water supply crisis, be it from drought or infrastructure failure.

The focus of this chapter is to investigate how rotational fallowing programs have been implemented, and their benefits and disadvantages. The case studies make up a large portion of the material. Two cases discussed were not successful, but were included because they provide important insights into some of the obstacles that must be overcome.

[3] This practice is also referred to as “lease-fallowing.” The “rotation” in “rotational fallowing” signifies that participating farmers must not fallow the same piece of ground repeatedly. For example, in the PVID-MWD agreement, the same tract is to be fallowed for a minimum of twelve consecutive months and a maximum of five consecutive years. In the case of the Arkansas Valley Super Ditch, however, there has been some interest in fallowing potentially the same, less productive, ground over time.

[4] There has also been some recent interest in providing farmers with a limited amount of water to plant a low water use cover crop on the fallowed ground. A cover crop would provide erosion and weed protection, and some soil benefits at the cost of increased water use. While the field would not be completely fallowed, most of the same concepts and issues arise. In the recent Catlin Pilot Project (see below) at least one farm planted a cover crop.

[5] 25,947 acres out of 104,500 total acres. See http://www.pvid.org/pviddocs/acreagemap.pdf

3 Traditional Fallowing vs. Rotational Fallowing

Temporary land fallowing for at least part of the year as part of normal crop rotations is not a new concept. It has a long agricultural history and many agronomic benefits (Karlen et al., 1994). Fallowing is the practice where during a growing season no crop is grown and instead all plant growth is controlled by cultivation or chemicals (Haas, Willis, and Bond, 1974). Fallowing techniques have been practiced for centuries and are still used in semi-arid and arid regions throughout the world (Karlen et al., 1994). Due to varying precipitation in the Great Plains, fallowing has been regularly used in dryland farming Western Canada and the United States (Greb et al., 1974). By forgoing a year of crop production, farmers can somewhat stabilize production instead of producing a variable amount every year. In the Great Plains, fallowing allows maximum water storage by increasing moisture content, trapping snow, and decreasing evaporation (Greb, 1979). Fallowing systems can vary in frequency by fallowing once every two years, every three years, or every four, etc. The frequency of fallowing, tillage, and weed control all have effects on the surface soil residue or crop residue, which are the materials left in a field after harvest (i.e. stalks, stems, leave, seed, husks, roots). This, in turn, affects the soil structure, moisture storage, nutrients, microorganisms, erosion, and crop production, which have all been noted to be factors in plant growth (Nielsen and Calderon, 2011).

In different regions and with a variety of crops, fallowing can increase the soil water content over continuously cropped systems (Nielsen and Calderon, 2011). Uncontrolled weeds in fallowed fields can, however, deplete soil moisture. Depending on the soil management practices, the water use efficiency of crops can increase by 25 to 40 percent after fallowing (Hatfield, Sauer, and Prueger, 2001). Fallowing also maintains and can even increase the level of nitrogen in the soil through mineralization of organic matter (Smika, 1983; Campbell et al., 1990; Nielsen and Calderon, 2011). The amount of added nitrogen can be significant, sometimes allowing farmers to forego application of fertilizer (Cabot, 2014a). Unfortunately, fallowing is sometimes consistent with increases in soil salinity, although this can often be easily handled by leaching soil salts with pre-planting irrigation (Cusimano, 2013a; Cabot, 2014a). Some fallowing systems can also result in erosion risk because bare soil is exposed to both wind and water (Nielsen and Calderon, 2011) but residue management, clod plowing, and other techniques can minimize this risk. Organized fallowing programs call for farmers to control for weeds, erosion, and dust.

4 Land, Economic and Social Considerations

Fallowing has multiple land, economic, and social impacts, some of which can be detrimental. If fallowing is done at large scale these impacts need to be understood and mitigated to the best extent possible. The PVID – MWD 1992-1994 fallowing test case resulted in a post-event analysis of these impacts (Great Western Research, 1995) and before the 2004 agreement was signed, a California Environmental Quality Act (CEQA) analysis was performed (PVID 2002). Both documents provide interesting analyses of the multiple impacts of fallowing, and the ways in which such impacts can be reduced. In the case of Colorado's Super Ditch a number of studies were also performed prior to the creation of the program (Nichols, 2011). This section briefly summarizes these issues, and they are also discussed under the Case Studies below.

4.1 Land Management Issues

Converting productive agricultural land into bare ground, even temporarily, creates several land management issues. Bare ground is subject to colonization by weeds, and those weeds can utilize beneficial soil moisture and shallow groundwater, as well as spread to nearby cultivated fields. The weeds can also cause future weed control issues when the field is replanted. Bare ground is also subject to wind and water erosion of valuable topsoil. Fallowing programs generally require that the landowner control weeds and prevent erosion at the expense of the landowner. MWD, in fallowing agreements executed with PVID landowners, has the right to withhold payments if such control is not performed, or even perform the necessary actions and subtract the costs from the fallowing payments. Generally, landowner agreements spell out in detail the duties required to be performed by the farmer.

4.2 Effects on Land Productivity

There have been only two studies on the agronomic effects of rotational fallowing to conserve water on future crop yields and soil health.

A University of Arizona Master's thesis in 2013 on the Palo Verde Fallowing Program found that fallowing has actually increased the quantity of nitrogen and carbon within soil, which helps plant growth (Cusimano, 2013b). The study noted that increased concentrations of surface salt from capillary action would require an application of leaching water prior to planting. Soils from fallowed and non-fallowed fields were tested throughout the valley, and then the plots were planted with broccoli in the fall to determine the effect on yield. The fields that were previously fallowed produced broccoli with a significantly higher marketable yield and total plant biomass than the fields that were continuously planted with crops. On average, the fallowed field produced more broccoli per acre (14,757 lbs./acre) than the fields that were not fallowed (13,803 lbs./acre), an increase of 7 percent (Cusimano, 2013a).

From 2009 to 2012 a fallowing study using irrigated corn as a control crop was performed to investigate changes in yield, nutrient availability, and profitability in Colorado's Lower Arkansas Valley (Cabot, 2014b). The study was conducted as part of the Colorado Water Conservation Board's (CWCB) Alternative Agricultural Water Transfer Methods Grant Program. Over the course of four years, a continuous corn plot was compared to 3 other fields with differing numbers of corn/fallow periods. Weeds dominated some of the fallowed sites despite significant expenditures on herbicides. The experimental program stipulated that no additional nitrogen would be applied to the fields after the first year, complicating yield comparisons with the nearby irrigated and fertilized corn control plot. Furthermore, droughts in 2011 and 2012 make yield comparisons difficult. Yields on fallowed plots were comparable to the control plot. Organic matter showed modest increases on fallowed fields compared to continuous corn. Nitrogen was retained on the fallowed fields, suggesting that nitrogen can carry over the winter months. Soil salinity increased modestly on most of the fallowed fields.

4.3 Community Socioeconomic Aspects of Rotational Fallowing

Community socioeconomic concerns need to be understood and potentially addressed for rotational fallowing to be a viable option. Often in specialized agricultural regions with little other economic activity, water transfers can have severe social and economic impacts with these regions incurring higher direct and indirect losses of income, tax receipts and jobs. In these communities, the losses will be greater on a per capita basis and will tend to persist over a longer period of time (Howe and Goemans, 2003). In some cases, however, more diverse local economies can be more severely impacted by water transfers because they may rely on local agricultural inputs for added-value production. Thus local agricultural service industries can be affected from large amounts of land fallowing (Thorvaldson and Pritchett, 2006).

The 1992 MWD-PVID test fallowing program did not plan for or attempt to compensate for community socio-economic impacts. Overall, an analysis of the regional economic impacts of the test fallowing program indicated that the program contributed to a modest decrease in regional employment—approximately 1.3 percent of average employment for 1991-92—but did not result in measurable changes in other regional economic performance indicators such as taxable sales, property tax revenues, and construction activity (M.Cubed, 1994). Approximately 61 percent of program payments were reportedly spent locally. MWD, in conjunction with its approval of the MWD-PVID 2004 agreement, provided $6 million for an economic development community improvement fund in the Palo Verde Valley. The SDCWA-IID agreement in 2003 provided for several actions including a large $50m fund, and the creation of a board to monitor and model these impacts. It should be noted that PVID is about 1/5 the size of IID in terms of acreage, and the Imperial Valley has several towns compared to the single town in PVID.

4.4 Measurements of Water Savings

Although it may seem simple to calculate the water saved by fallowing land, several complications arise which confound the quantification of water savings. First, in some cases there is the desire to quantify the actual consumptive use if farming had occurred. This requires knowing what would have been grown, what the weather was, and what the yield would have been. One could alternatively compare water diversions between years in which fallowing occurred and years in which it did not. However, weather, crop changes, changes in application efficiency and resulting return flows, and system operations can easily overwhelm numerical year-to-year differences, especially if the fallowed amount of land is a relatively small portion of the total ditch diversions. This method also must rely on knowing the return flows to net the consumptive use from diversions less return flows.

Different areas have derived different methods to calculate these savings. For PVID, Reclamation, PVID, and MWD generate an annual report using three different methods to calculate the savings (PVID, MWD, and Reclamation, 2014). For the Super Ditch, the Colorado State Engineer uses the Lease Fallowing Tool to calculate the savings (DWR, 2015a). In the case of the relatively minor fallowing in the Yuma area, a stipulated amount based on historical consumptive use per acre measured on a district-wide basis was part of the agreement (Reclamation and YMIDD, 2008).

4.5 Tax Considerations of Fallowing Payments

Fallowing payments to farmers can generate unusual tax consequences. Prior to the 2004 MWD-PVID fallowing program, lawyers issued guidelines to farmers about how to handle these payments (Downey Brand LLP, 2015). The memo indicated that the one-time sign-up payments could be subject to a lower capital gains tax rate rather than be considered ordinary income. The memo also indicated that annual rental payments would be considered ordinary income, but that the income could be offset by any management expenses associated with the fallowed land including weed control and dust measures. Tax issues also arose during the investigations into the Super Ditch in Colorado but these dealt with the tax implications of the corporate structure of the Super Ditch entity (Nichols, 2011).

5 Case Studies

5.1 California Cases

5.1.1 Palo Verde Irrigation District – MWD Land Management, Crop Rotation, and Water Supply Program

The original, best known, and most studied case of rotational fallowing in the Colorado River Basin involves an agreement between the Palo Verde Irrigation District (PVID) and The Metropolitan Water District of Southern California (MWD). The PVID is located in southeastern California along the Colorado River near Blythe, California, a city of approximately 20,000 residents, although 8,000 of these are prison inmates at two nearby state prisons. The district covers 189 square miles of land (~94,000 irrigated acres) in a valley approximately 30 miles long and 9 miles wide, and consists of 80 farmers farming an average of 1,250 acres (PVID, 2016). A long growing season, reliable and plentiful water supplies, and high temperatures have allowed the region to become a hub of agricultural production throughout the year. In recent years, crop values have ranged from $60m to nearly $160m ("PVID History", 2016). While some high-value crops — such as lettuce, melons and citrus — are grown in the valley, two-thirds of irrigated acreage grows forage crops like alfalfa ("PVID 2014 Crop Report", 2014). PVID diverts approximately 900 kaf/year from a single structure at the head of the valley and consumes about 450 kaf/year, with the remainder returning to the river through a large network of surface drains and subsurface return flows.

The PVID has the most senior California Colorado River water right and is unique in that it is quantified as the amount of water needed to irrigate 104,500 acres of land rather than a fixed volumetric amount[6]. In order of decreasing seniority, this right is senior to the Yuma Project Reservation Division, the Imperial Irrigation District (IID), the Coachella Valley Water District (CVWD), and the Metropolitan Water District of Southern California. First appropriations in the area began in 1877, over thirty years before IID was established. The Palo Verde Valley forms a narrow, flat, fertile floodplain of the Colorado River and hence the irrigation infrastructure was relatively easy and inexpensive to construct. The Imperial Valley, by contrast, is a wide valley necessitating sub-canals, and many laterals, all of which are fed by a lengthy canal. The PVID Board is controlled by the farmers, with votes allocated on an acreage basis. This is unlike IID where all citizens can vote for the IID Board of Directors. This difference in governance has led to very different outcomes with respect to fallowing and relationships with MWD (Glennon, 2009b; Zetland, 2015).

MWD is the largest public utility in the United States and includes 26 cities, districts, and a county water authority in the Southern California region that supply 18.7 million people with water. MWD obtains its water from Northern California via the State Water Project and from the Colorado River via their Colorado River Aqueduct (CRA), and provides financial incentives to develop additional local supplies in

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[6] Thomas Blythe filed the first California water right on the Colorado River in 1877 in the Palo Verde Valley. Although some early attempts were made to farm in the valley in the 1870s, farming at scale did not commence until much later in the early 20th century, contemporaneous with development in the Imperial Valley ("PVID History" 2016; Reclamation 1921). But because of Blythe's early filing and a provision in PVID's 1933 contract for delivery of water with the U.S. Bureau of Reclamation, it has the senior Colorado River right in California.

Southern California. The aqueduct was built from 1933 to 1939 and transports up to 1.2 maf/year 242 miles from Lake Havasu on the Colorado River into Lake Mathews in Riverside County (MWD, 2017).

MWD's Colorado River water rights and use of the CRA are complicated by several factors. In 1929, California agreed to limit its water use from the Colorado River to 4.4 maf of the waters apportioned to the Lower Basin states by paragraph (a) of Article 3 of the Colorado River Compact annually, plus not more than one-half of any excess or surplus waters unapportioned by the Compact. But Compact paragraph (e) of Article 3 provides that the States of the Upper Division (Colorado, New Mexico, Utah, and Wyoming) shall not withhold water, and the States of the Lower Division (Arizona, California, and Nevada) shall not require the delivery of water, which cannot reasonably be applied to domestic and agricultural uses. MWD has (1) a 550 kaf/year Colorado River entitlement under a fourth priority within California's 4.4 maf/year normal apportionment; (2) an additional 662 kaf/year entitlement under a fifth priority; and (3) a 180 kaf/year surplus entitlement. Prior to 2004, approximately half of the capacity in the CRA was subject to the 4.4 maf/year limitation. Between 1994 and 2002, the state's average annual consumptive use was over 5.1 maf/year using water apportioned to, but unused by neighboring Arizona[7] and Nevada and surplus water, which was made available by the Bureau of Reclamation in accordance with the U.S. Supreme Court Decree in Arizona v. California — with MWD being one of the beneficiaries of the available supply. In the 2003 Quantification Settlement Agreement, the California water contractors agreed to live within 4.4 maf/year except in 'surplus' years, with the burden of this limitation falling on MWD. MWD is assisted in meeting its obligations by nearly 300,000 af/year of ag-to-urban water transfers from IID to SDCWA, an MWD member agency.

Retail water demand in MWD's service area varies from year to year, as does the availability of other water supplies. For example, total retail demand in MWD's service area increased from 3.33 maf in 1995 to 3.94 maf in 2000, and declined to 3.80 maf in 2005, 3.35 maf in 2010, and 3.14 maf in 2015 as population increased from 15.7 million in 1995 to an estimated 18.7 million in 2015. Between 1994 and 2002, local supplies (surface water, groundwater, and recycled water) varied from 1.53 maf to 1.89 maf, Los Angeles Aqueduct supplies varied from 133,000 to 467,000 af, and State Water Project supplies varied from 0.45 maf to 1.80 maf.

Due to the variability in both retail demand and other water supplies available to MWD's service area, MWD needed to use between 0.93 and 1.26 maf of Colorado River water in its service area between 1994 and 2002, a portion of which was water apportioned to, but unused by Arizona or Nevada, or surplus water. Thus, MWD has sought ways to keep the CRA full despite their water right limitations in non-surplus years.

5.1.1.1 1992-1994 Two-Year Fallowing Test Agreement[8]

In the late 1980s, MWD and PVID began to discuss a program to implement a rotational fallowing program in the Palo Verde Valley. The original negotiations stalled on price and other terms. A severe drought in California, along with depressed agricultural prices, brought the two parties to agreement in

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[7] When Arizona's Central Arizona Project Canal was completed in 1994, Arizona was able to utilize 1.9 maf of its 2.8 maf annual apportionment. Between 1994 and 2002 California's average consumptive use was over 5.1 maf/year. This water use, along with other factors, prompted the 2003 Quantification Settlement Agreement.

[8] A complete chapter in *Rivers of Gold* (Chapter 6, Haddad, 2000) is devoted to the details of this transaction, including the history before and after the program.

1992. A two-year test fallowing program began in 1992. Over sixty farmers participated and 22 percent of the total irrigated acreage in the PVID was fallowed. A post-event environmental analysis was conducted and it determined that there were no significant negative impacts from fallowing, mainly because the district implemented approved mitigation measures to preserve fallowed land (Great Western Research, 1995). The district, landowners, and the MWD were all satisfied with the results of the test program, which generated about 186 kaf at a cost of $25m in program payments to participating farmers or $135/acre-foot (MWD, 1995).

Farmers were paid $1240 per acre over the two-year period, or $620 per acre each year. The program ran from August 1, 1992 to July 31, 1994. Sixty-three contracts were executed, covering 20,215 acres out of the 80,336 "base" acres owned by the participating farmers. Fallowed acreage was thus 25 percent of the total base acreage, and 22 percent of the total cropped acreage of 93,000 acres. Over 73 percent of the fallowed acreage would have been planted in forages including alfalfa, Sudan grass and Bermuda grass. Of the remaining fallowed acreage, 16 percent would have been planted with cotton and small grains, and 11 percent would have been planted with melons and vegetables. The program was estimated to have generated 4.6 af/acre/year over the two years. This resulted in annual savings of 92,989 acre-feet and a two-year total of 185,978 acre-feet. Three different methods were used to calculate the actual water savings but at the outset the parties agreed to credit a fixed amount, 4.6 af per acre per year.

A post fallowing analysis completed in 1995 indicated that there were few economic impacts in Blythe during the test period (Great Western Research, 1995). This was in part due to the city's successful attempts to obtain state funding for two state prisons nearby beginning in the late 1980s. The principal findings of the study conducted to evaluate the economic impacts to program non-participants as well as the program's overall impact on the regional economy were:

- The program was not found to have affected overall regional economic performance to any significant degree.
- The program was not found to have caused non-farm-related businesses in the region to reduce employment or lose revenue,
- Negative economic impacts of the program were concentrated within farm-related businesses providing services or supplies to the region's farmers.
- The program was found to be only one of several causes for a reduced regional demand for farm-related labor, services, and manufactured inputs.
- A high proportion of program payments were injected into the local economy.

The saved water was protected by an agreement among PVID, IID, MWD and CVWD and the Bureau of Reclamation which allowed the water saved to be stored in Lake Mead for use by MWD (Haddad, 1999). At the time, the Secretary of the Interior had not issued conditions as to the accumulation, retention, release, and withdrawal of water in Lake Mead by Metropolitan, to which Metropolitan had the exclusive right in California by its 1931 Reclamation water delivery contract. In 1997, during a very large El Nino event, the water was spilled from Lake Mead when the Lake was drawn down for flood control (Haddad, 1999).

The issue of storage of water by a contractor in Lake Mead is now less problematic. First, the Department of the Interior's 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead allow for "intentionally created surplus" (ICS) water which can now be legally stored (Department of Interior, 2007). In addition, the existing supply and demand imbalance in the Colorado River Basin will grow in the future if the potential effects of climate change are realized and demands continue to increase. Lake Mead levels may not ever rise to the point where flood control becomes a problem. A different kind of problem, however, now exists with stored water. The ICS guidelines prevent the delivery of stored ICS water when the Secretary of the Interior has declared a shortage condition and could limit the amount of stored ICS water delivered when the Lake nears declared shortage levels. In 2015, for example, based on the May runoff forecast, the end of December projection of the elevation of Lake Mead was only 0.9 feet above the elevation at which a shortage condition would be declared for 2016, then a wet May in Colorado increased the June runoff forecast, resulting in the end of December projection of the elevation of Lake Mead being 6.6 feet above the shortage condition elevation. This allowed MWD to access water in 2015 that it had previously stored as ICS. From 2013 to 2015, MWD diverted water saved by the PVID-MWD fallowing program in the year it was saved. However, the inability to take delivery of ICS water during a shortage condition serves as a disincentive for future creation of ICS and storage of that water in Lake Mead.

5.1.1.2 2004 Long-Term Agreement

In August of 2004, PVID came to an agreement with MWD for a 35-year fallowing and forbearance program beginning January 1, 2005 and running until July 31, 2040 (PVID and IID, 2004). Participating farmers would fallow between 7 and 35 percent of their land on a rotating basis[9]. From 6,493 to 25,947 acres can be fallowed in a given year depending on the amount of water required by the MWD. Landowners were paid an initial one time payment of $3,170 per water toll acre of the Landowner's Maximum Fallowing Commitment (total $73.5 m) and an annual escalating payment of $602 ($789.89 in 2016) for each fallowed acre. In return, landowners must implement agreed upon land management practices on fallowed land, provide program related data, and pay PVID's water toll and taxes. PVID is compensated annually by MWD to administer the program, a total of $225,000 in 2016. MWD estimates that the program will provide from 25,000 to 118,000 acre-feet/year (MWD, 2015) (MWD Brochure, Agreement). Nearly 90 percent of PVID landowners elected to participate in the program (Perry, 2015).

There were potentially significant tax implications of the agreement to local farmers. PVID commissioned a study to assist farmers with tax planning to handle these issues (Downey Brand LLP, 2015). To mitigate third party effects of rotational fallowing, the MWD provided $6 million to offset any local economic losses. The Community Improvement Fund, a nine-voting-member ad-hoc committee, developed a local and regional business plan to adapt to the decrease in agricultural activity. The money provided by the MWD has been used to provide loans to local business and grants to various nonprofit entities that serve the local community. As of July 2015, the fund has made available $5.4 million in loans to 23 local businesses and has provided more than $0.9 million in grants to various nonprofit

[9] The August 2004 agreement provided for landowners to make Landowner Participation Offers to Metropolitan and PVID in two tiers within 75 days of the Solicitation Notice. The first tier of a Landowner Participation Offer was to specify a Maximum Fallowing Commitment the landowner proposed to make, which was to not exceed an amount equal to 29 percent of the total Program Qualified Land then owned by the landowner. If the first tier of the Landowner Participation Offer specified the maximum acreage permitted, the Landowner Participation Offer could contain a second tier specifying an additional Maximum Fallowing Commitment the landowner proposed to make, the acreage of which, when added to the acreage in the first tier, was to not exceed an amount equal to 35 percent of the total Program Qualified Land then owned by the landowner.

entities serving the Blythe community. Through August 2016, the MWD has made $141.3 million in annual fallowing payments to landowners and $3.9 million to PVID for administrative costs.

Prior to the program agreement in 2004, PVID issued an Environmental Impact Report under the California Environmental Quality Act in 2002 (PVID, 2002). The study investigated impacts to agricultural resources, geology and soils, air quality, hydrology and water quality, biological resources, growth inducement, and cumulative impacts. The report found no significant impacts to any of the studied areas.

Although it might seem simple to calculate the water savings associated with this fallowing – clearly a field that could be irrigated is not being irrigated – there are many ways to calculate the savings, but no clear best way. In theory, the savings should be based on the consumptive use of the crops that would have been grown, which, in turn, is a function of weather and water deliveries. With a large fallowing program, further complexities arise because there would have been multiple crops on multiple fields with different savings associated with each crop. Every year Reclamation, PVID and MWD address these quantification issues by jointly issuing a report (PVID, MWD, and Reclamation, 2015). The 2015 version of this report calculated saved water using 3 different averaging periods (12-year 1988-2002, 5-year 1998-2002, and 3-year 2000-2002), and an actual use method for 2015. These numbers varied from 77,143 af to 94,477 af. The report indicates that actual use in 2015 (94,477 af) was the best estimate based on agronomic, weather, and market conditions. This represented 5.29 acre-feet of saved water per acre of fallowed land.

5.1.1.3 2009 Emergency Fallowing Agreement

On March 24, 2009 MWD and PVID issued a joint call for emergency fallowing above and beyond the fallowing under the 2004 agreement (MWD and PVID 2009; MWD 2009b, 2009a). This call, in response to the 2009 California drought, allowed farmers one month (from April 1 to 30) to allocate up to 15% of their land toward a one-year continuous fallowing, to commence between April 15 and August 1. Landowners were to control weeds and prevent wind erosion per the 2004 agreement. For each fallowed acre, MWD paid $1,665 and additional $35 to PVID to reduce future increases in water tolls that would otherwise be required. Under the program, MWD paid a total of $22m for 13,222 acres. At the time, 25,947 acres were already enrolled under the 2004 agreement (Hasencamp, 2016b). The payments under this agreement to the famers were more than twice the amount paid per acre under the 2004 agreement, although there was no sign-up fee. PVID received approximately the same amount per acre as under the 2004 agreement to manage the transactions.

5.1.1.4 Analysis

For farmers in the PVID, this has been considered a successful program (Perry, 2015). There has been no change in their water rights, and landowners control their destiny after the 35-year term. Farmers have made considerable financial gains, especially since the initial upfront payment of $3,170 was the average market value of the land in 2004. (A recent 2016 purchase of almost 2,000 acres by a Saudi dairy company planning to export forage was for $18,000 per acre, with an estimated water use of 4.5 acre-feet/acre. Given that in 2014, approximately two-thirds of the valley was planted in forages which provide relatively low dollar returns, the fallowing payments seem to provide a reasonable return compared to current crops. Were higher-valued crops more commonly planted, the payments might not cover the opportunity cost of forgone production).

MWD receives a reliable source and significant quantity of water from the agreement (Glennon, 2009b). A 2014 study commissioned by MWD determined that the water leases have been a net economic positive for the valley, and that there has not been an overall job loss (Perry, 2015). However, there has been criticism that $6m was not enough money to offset third-party economic losses, and a lot of the initial bonuses for fallowed land went to out-of-state, absentee owners. (SDCWA is providing IID with a total of $40m through 2017 to be used for socioeconomic mitigation under their 2007 settlement agreement, although it should be noted that the IID is five times the acreage. IID is contributing another $10m to the fund). Since the Board of the PVID is controlled by property owners and votes were based on property values, there is concern that a board dominated by farmers will make choices that solely benefit landowners, but may harm the larger community (Glennon, 2009b). In 2013, the Governor approved Assembly Bill No. 1156, amending the Palo Verde Irrigation District Act to entitle each property owner to one vote for every one acre of land owned, rather than one vote for every $100 of assessed valuation.

In terms of agronomic effects of rotational fallowing, there has only been a single study. A University of Arizona Master's thesis on PVID fallowing found that fallowing has increased the quantity of essential nutrients like nitrogen, and has improved soil carbon, which helps plant growth. The study noted increased concentrations of salt that require a post-fallowing and pre-planting application of "leaching" water. The soil from fallowed and non-fallowed fields was tested throughout the valley, and then plots were planted with broccoli in the fall to determine the effect on yield. The fields that were previously fallowed produced broccoli with a significantly higher marketable yield and total plant biomass than the fields that were continuously planted with crops. On average, the fallowed field produced more broccoli per acre (14,757 lbs./acre) than the fields that were not fallowed (13,803 lbs./acre), an increase of 7% (Cusimano, 2013a). The study concluded that land fallowing enhanced soil quality including nutrients and microbial communities, and such enhanced soil quality led to increased crop growth. These benefits are likely short-lived, however, and could be masked by producer decisions.

Recently, irrigators in the valley have become concerned about a large land purchase by MWD. In late 2015, MWD purchased 12,000 acres for $256m, ($21,300/acre), adding to the 8,000 acres acquired in 2001 (MWD). MWD now owns about 25 percent of the land in the valley. A late 2015 article in the *Palo Verde Valley Times* described how farmers in the area were concerned about MWD's actions and were worried that it may lead to drying up the valley (Steele, 2015). In April 2016, Metropolitan's Board of Directors authorized Metropolitan's staff to negotiate new leases with HayDay Farms and River Valley Ranches, with lease terms to meet the objectives stated in the General Manager and Manager, Water Resource Management's letter to the Board with respect to consumptive water use and positive revenue, and pursue leasing the remaining Metropolitan-owned lands through a generalized request for proposals process. All leases will be brought back to the Board for final approval.

In recent years, despite the success of the program, MWD has expressed concerns about the time lags and inflexibility in the agreement. Every year on August 1, MWD issues a fallowing call good for the next two years. Within this two-year call is (1) a possible adjustment upward to last year's 2nd year call (which is now the call for the coming year), and (2) an estimated call for the 2nd year which could be revised upward, but not downward, the following year as in item (1).

In this way, farmers know what the call will be for the current year, and a minimum call for the 2nd year which might be increased. MWD is limited to a 100% call for 10 years of the thirty-five-year program. The maximum call otherwise is 90%. Due to the severe California drought of 2012-2015 (and ongoing) and MWD's subsequent limited supply of State Water Project Water (a record low 5 percent of the contractual amount in 2014 and 20 percent of the contractual amount in 2015) MWD has been forced to rely heavily on their Colorado River supplies including the PVID agreement. MWD would like more flexibility in this agreement in order to handle fast changing drought water supply issues (Hasencamp, 2016a).

Table 1: MWD Fallowing in PVID by Year. Source: Hasencamp, MWD. Note: See Section 5.1.1.3 for payment rate for 2009 Emergency Fallowing Agreement.

Contract Year	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Acres	23,349	23,349	11,682	25,947	25,947	25,947	25,947	6,493	6,493	12,974	25,947	25,947
Extra Acres		3,070	2,925		13,222*							
Payment Rate (per fallowed acre)	602.00	617.05	632.48	648.292	664.50	681.11	698.14	715.59	733.48	751.82	770.62	789.89

5.1.2 1998 Imperial Irrigation District – SDCWA Transfer Fallowing

From 1992-94, California endured a severe drought, and during that time, MWD imposed substantial water cutbacks on its member agencies. After these impacts, the San Diego Country Water Authority (SDCWA) decided to pursue more secure Colorado River supplies to avoid future cutbacks, and thus began negotiations with IID about possible water transfers. In 1998, after several years of negotiations, IID and SDCWA signed an agreement to transfer conserved water from IID to SDWCA ("Water Authority–Imperial Irrigation District Water Transfer San Diego County Water Authority", 2015; IID and SDWCA, 1998). The agreement anticipated a transfer of between 130 kaf and 200 kaf /year to SDCWA to be delivered via MWD's Colorado River Aqueduct, which is the only way to move Colorado River water into San Diego County. The agreement was for a 45-year term with a potential 30-year renewal. There is a 10-year early exit option for SDWCA if it can't come to agreement with MWD about water wheeling terms for the final 30 years). The agreement anticipated the need for both CEQA and NEPA studies.

Multiple issues arose after the signing of the lengthy 1998 agreement, leading to a complicated process involving several of California's Colorado River diverters now known as the Quantification Settlement Agreement (QSA). The QSA, which was signed in 2003, was supplemented by more than 40 documents dealing with the various rights of California's Colorado River diverters ("Imperial Irrigation District : History of the QSA & Related Agreements", 2015).

In the revised fourth amendment to the IID-SDCWA agreement for transfer of conserved water, SDWCA obtained a commitment from IID based on its earlier 1998 agreement to provide up to 200 kaf/year to SDWCA, ramping up from 10 kaf in the first year to the full amount in year 19 (Revised 4th Amendment, 2003). In separate agreements, SDWCA also obtained the right to 67.7 kaf/year from the All-American Canal and Coachella Canal lining projects for a total potential amount of 277,700 af/year. These canal lining projects are covered in the Efficiency Chapter). From 2003 to 2012, the water savings for SDCWA were from fallowing and from 2013 through 2016 were and are from a combination of on-farm efficiency measures and fallowing. The water saved from fallowing for SDCWA ramped up from 3 kaf in 2003 to 107 kaf in 2012 and then ramps down to 0 in 2017. Starting in 2017, SDWCA will receive the entire 200 kaf/year from on-farm efficiency measures paid for by SDWCA through a program administered by IID (IID, 2015).

In additional to the fallowing water savings transferred to SDWCA, the environmental impact analysis for the QSA required 15 years of environmental flows to the Salton Sea to be obtained by fallowing in the IID. These fallowing flows varied from 14 kaf in 2004 to 153 kaf in 2015. IID reported a remaining obligation of over 236 kaf for the period from 2016 to 2017, after which there is no obligation. A total of 800 kaf for the Salton Sea will ultimately be provided from fallowing (Exhibit 1, IID and SDCWA, 2003). For both the SDWCA and Salton Sea, in 2015-2016 IID fallowed approximately 16,700 acres at a cost of $175/acre (IID 2015-2016 Fallowing Report). In 2010, IID delivered 46,546 af of Colorado River water to the Salton Sea with a stated intention to store the water for use for Salton Sea mitigation requirements in 2011 and half of 2012. IID did not conserve an equivalent amount of water in 2011 and 2012 for delivery to the Salton Sea resulting in a Colorado River system storage depletion of 46,546 af. This matter is the subject of a series of letters between Reclamation and IID, and currently remains under discussion between Reclamation and IID. For both the SDWCA and Salton Sea, in its one-year 2015-2016 fallowing program approximately 16,700 acres lie idle at a cost of $175/acre (IID 2015-2016 Fallowing Report).

IID and SDCWA had a fundamental disagreement concerning the likely socioeconomic impacts to be caused by land fallowing. Under the revised fourth amendment to the IID-SDCWA agreement for transfer of conserved water, in addition to the socioeconomic impact payments to be made by SDCWA and IID, the amendment created a panel of 3 professional economists to establish a Socioeconomic Methodology to estimate and measure the annual and cumulative socioeconomic impacts of land fallowing based on procedures to be developed for combining evidence from different approaches specified in the amendment. A regional economic model was to be built based on credible available information and annual reports were to be issued (Exhibit 2, IID and SDCWA, 2003). At the request of IID, Dr. Rodney T. Smith prepared a December 2005 report on the socioeconomic impacts of land fallowing by the IID for 2003 and 2004 as a model for the correct implementation of the methodology agreed upon by IID and SDCWA in their executed agreement. IID and SDCWA disagreed about how socioeconomic impacts are to be determined under the provisions of the IID/SDCWA Transfer Agreement, as amended.

Pursuant to the provisions of their transfer agreement, IID and SDCWA arbitrated the dispute before a private arbitration panel comprised of three retired judges in the Spring of 2007. Resolution by compromise was reached after the completion of the arbitration, but before the arbitration decision was released. SDWCA agreed to provide a total of $40m through 2017 to be used for socioeconomic mitigation under a 2007 settlement agreement with IID. This fund is administered by a local entity, which was reconstituted in 2009 to be made up of the IID Board of Directors.

The original 1998 agreement was amended three times before 2003, in 2003 for the QSA and then again in 2007 and 2009. The original 1998 agreement set forth a complicated per acre-foot water cost to be paid by SDWCA. In the 2003 and 2009 amendments, the parties changed this computation to an escalating figure. In 2015, the payment was $624 per acre-foot (IID and SDWCA, 2009).

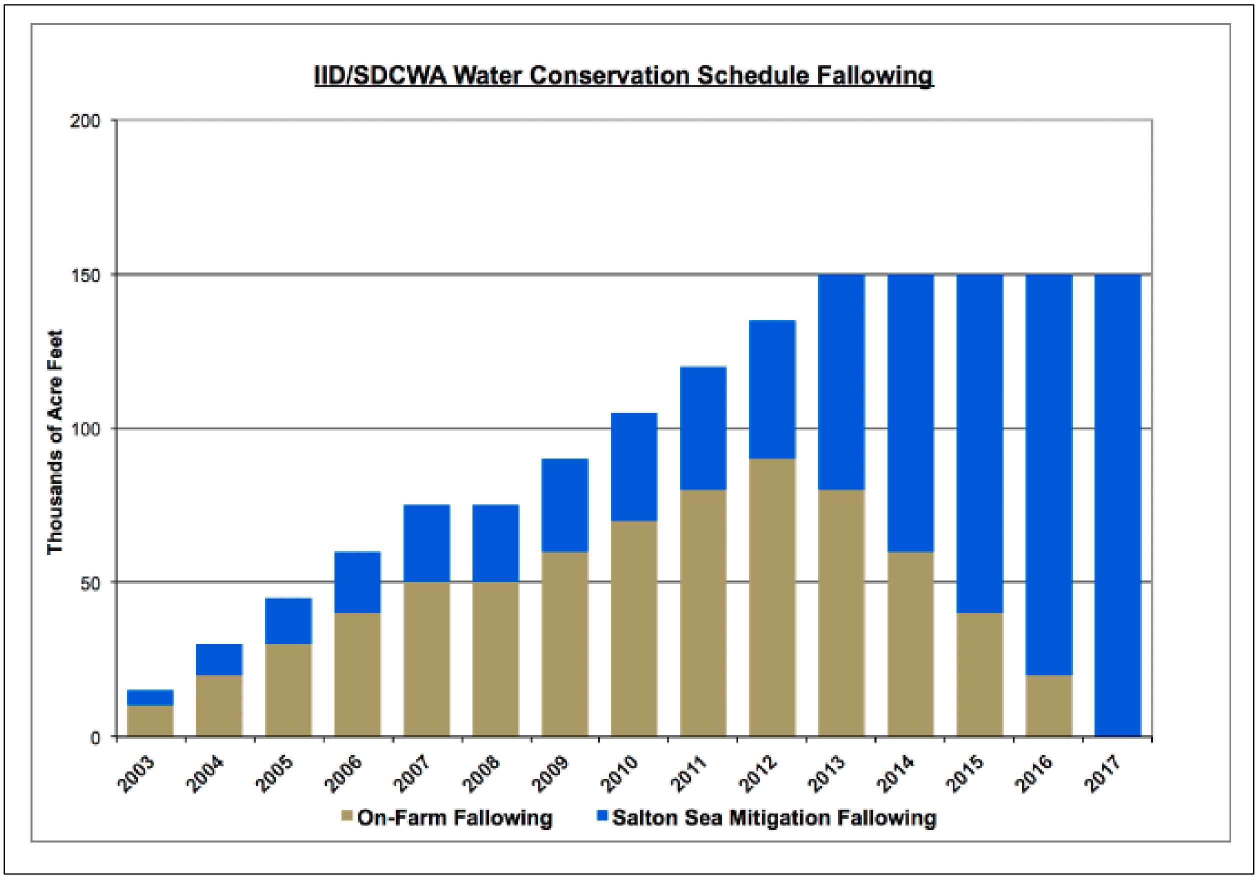

Figure 1: Fallowing in the Imperial Irrigation District. Source: Imperial Irrigation District.

5.1.3 2016-2017 Bard Irrigation District – MWD Fallowing

In 2016, MWD announced a new agreement for a summer fallowing pilot project in the 6,400-acre Bard Water District for 2016 and 2017 (MWD, 2016a). The Bard Unit and the "Quechan" Indian Unit together constitute the Reservation Division of the Yuma Project, a federal Reclamation project located in southeastern California. Over 6,100 acres are irrigable in the Indian Unit. This land is on the California side of the Colorado River a few miles northeast of Yuma. MWD would like to fallow no more than 2,000 acres of land and will pay farmers and Bard Water District a total of $400 per acre to conserve approximately 2 acre-feet per acre during the portion of the spring and summer growing season from April 1 to July 31. Bard area farmers typically grow lower value and higher water using crops during this hot period. About 550 acres of land enrolled in the program for 2016. After the 2016 fallowing program is complete, Metropolitan will again solicit participants to participate in 2017, the final year of the two-year pilot program. MWD believes it can obtain water supplies at lower cost and at little to no harm to farmers with the program given the typical water use during this period.

5.2 Arizona Cases

5.2.1 Yuma Mesa Irrigation and Drainage District – Mead Elevation Support

Yuma, Arizona has one of the longest growing seasons in the country and a nearby, reliable source of year-round water in the Colorado River. Unlike the Imperial Valley or the Palo Verde Valley which are each served by a single irrigation district, the Yuma agricultural area is serviced by 7 different districts operating under two different federal Reclamation projects. The original project, the 1904 Yuma Project, services lower lying gravity-fed areas near Yuma, and in 1978 covered approximately 68,000 acres. This includes Yuma County Water Users Association, Unit B[10], the Bard Water District, and a portion of the Fort Yuma Indian Reservation, the latter two located in California.

The second project, the Gila Project, was authorized in 1937 for about 100,000 acres and generally involves areas upstream of the Yuma Project and areas that require pumping to deliver water, technology that was not possible in 1904. Gila Project lands generally lie north of the Gila River upstream of its confluence with the Colorado River and include the North Gila Valley and South Gila Valley Irrigation and Drainage Districts and the Wellton-Mohawk District. In addition, lands on the Yuma Mesa are served by the projects. These mesa lands are approximately 50 feet above the Colorado River, thus the need for pumping from the main Gila Project Canal (Bureau of Reclamation Project Data*,* 1981; Sauder, 2009).

Since the early 1900s, the Yuma area has slowly adapted to market demands to become the center of winter vegetable production in the United States — providing up to 90 percent of the leafy vegetables consumed from November to March in the United States[11] (Radonic, 2014). Such crops now make up 80 percent of the acreage in the area (Noble, 2015a). Since 1975, the agricultural industry in the area has become quite efficient with their water resources and now use about 20% less water per year than before, a savings of approximately 225 kaf/year (Moving Forward, 2015; Noble, 2015b).

Although Yuma growers have different water rights based on the dates of the two Reclamation projects (1904, 1937, and later), these water rights are senior to the 1968 Central Arizona Project. Were a Lower Basin shortage to occur, fourth priority Colorado River water uses like the CAP would be the first to be shorted and thus CAP has recently looked to Yuma water rights as a way of potentially managing their risk.

[10] Unit B is a small 3000-acre tract of land located on the Yuma Mesa. It was part of the Yuma Auxiliary Project authorized in 1920. It was originally served by a small pumping plant located on a main canal in the valley lands along the river south of Yuma. After the Gila Project was completed the Unit B lands could be better served by the Gila Project pumping and canal system and thus this pumping plant was inactivated. Unit B, thus, has a more senior water right than the later Gila Project even though it uses the Gila Project's facilities.

[11] Some of this 90 percent is produced in the Imperial Irrigation District. A workers' strike in the 1990s in IID encouraged growers there to send produce to Arizona for processing before shipment. This arrangement continues to this day, and thus the 90 percent figure includes all produce from the area, not just Yuma.

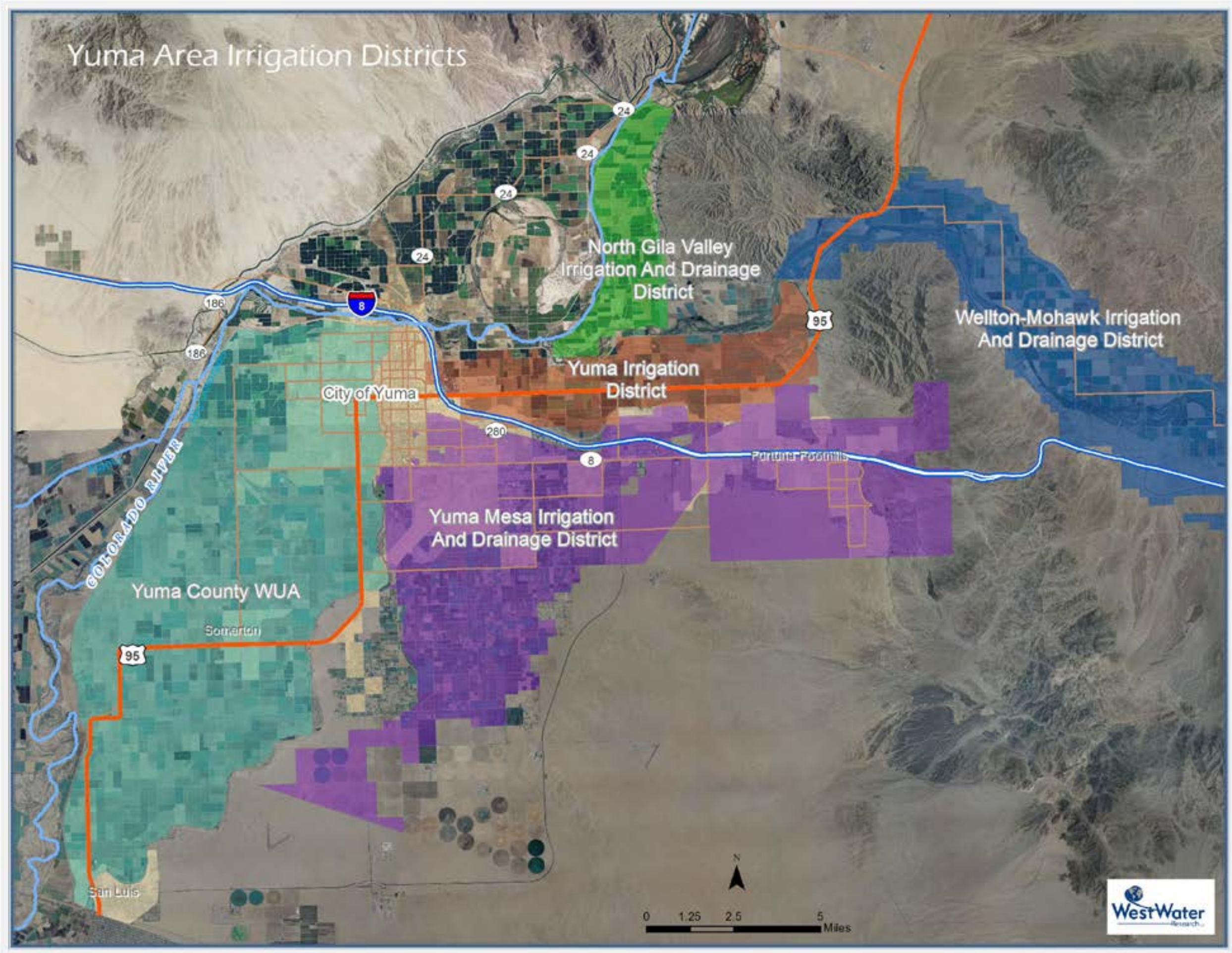

Figure 2: Yuma area irrigation districts. Source: Central Arizona Groundwater Replenishment District.

Established in 1954, the Yuma Mesa Irrigation and Drainage District (YMIDD) is one of the seven irrigation districts in Yuma. The YMIDD, the Yuma Irrigation District, and the North Gila Valley Irrigation and Drainage District share a single consumptive right that is assigned to the Yuma Mesa Division[12] of the 1937 Gila Reclamation Project. Each district has a contract for a share of the total amount (250,000 acre-feet) assigned to the Yuma Mesa Division (Noble, 2015a). YMIDD is entitled to just over 140,000 acre feet (ADWR, 2015). YMIDD is supplied by the Gila Gravity Main Canal, which diverts water from the Colorado River at Imperial Dam. The Yuma Mesa Pumping Plant lifts water 52 feet from the canal near I-10 into the YMIDD system to irrigate approximately 15,500 acres, comprised of citrus, alfalfa, peanuts, cotton, and grains (Noble, 2015a; Morgan, 2015). Their distribution system includes canals (23 miles), laterals (41 miles), and ditches (96 miles) that are entirely lined (Noble, 2015a). Yuma, IID and PVID all use nearby Mexican labor to harvest crops. This cost-effective and highly talented labor is a unique feature of the area, and provides local growers with a significant competitive advantage, at least compared to other U.S. growers.

[12] The other Division of the 1937 act is the Wellton Mohawk Division, located far upstream on the Gila River.

5.2.1.1 2008 Pilot Fallowing Project

In 2008, the YMIDD began a fallowing pilot project with the Bureau of Reclamation (Reclamation and YMIDD, 2008). The Bureau paid $120 per acre-foot conserved through fallowing. The dollar amount was based on Reclamation's farm budget analysis for current crop returns on irrigated alfalfa in the YMIDD. It was estimated that for every acre fallowed, seven acre-feet of consumptive water use was conserved. Under the agreement, the district fallowed 500 acres (out of approximately 15,500) for a total planned water savings of 3500 acre-feet. The total cost of the program was $420,000, paid for by Reclamation. The YMIDD agreed to reduce water diversions at the Imperial Dam by the planned savings. Essentially, the YMIDD would fallow land to reduce water bypassed around the Mexican delivery point (Agreement, 2008). This program was instigated by Reclamation to fulfill the goals a 2006 policy for "System Conservation of Colorado River Water" to replace water not being desalted by the shuttered Yuma Desalting Plant (Agreement, 2008). In effect, the program assisted the Central Arizona Project delivery reliability through higher Lake Mead levels. The program was too small to verify how much water was saved due to fallowing (Walton, 2013).

5.2.1.2 2009-2010 Fallowing Project

The following year, Reclamation signed another agreement with YMIDD using nearly identical terms to fallow another 529 acres, this time at the slightly reduced price of $90 per acre-foot with seven acre-feet of water savings stipulated per acre of fallowed land. The total payment from Reclamation totaled $330,000 (Reclamation and YMIDD, 2009).

5.2.1.3 2014-2017 Fallowing Project

Four years later, the YMIDD and the Central Arizona Water Conservation District (the owner of the Central Arizona Project) on behalf of its Central Arizona Groundwater Replenishment District (CAGRD) launched a pilot program in 2014 consisting of up to six years comprised of two, three-year cycles commending in 2014. The purpose of the pilot program was to develop a methodology to quantify the forgone consumptive crop water use. The CAGRD worked with the Bureau of Reclamation and the Arizona Department of Water Resources to develop an acceptable quantification methodology for the pilot program.

CAGRD exists to ensure the sustainability of various groundwater-dependent entities in Arizona under Arizona's Assured Water Supply rules by replenishing groundwater for its members. It relies on a number of water sources to fulfill its replenishment function, including Colorado River water supplied by the Central Arizona Project and other renewable water supplies (CAGRD, 2014). CAGRD's Water Supply Program was created to acquire diverse water supplies to meet current and projected demands under all operating conditions including Colorado River shortage. CAGRD's recently approved Plan of Operation identifies the need to acquire an additional 50,000 acre-feet of supplies by 2034 to meet its projected replenishment obligations.

Under the agreement, land cannot be taken out of production for more than three years and must be maintained while fallowed. The CAGRD agreed to pay the District $21.36 per acre for lost district revenue from the sale of excess water and $10,000 annually to administer the program. Through the program, YMIDD landowners could fallow a maximum of 1,500 acres of land per year, less than 10 percent of the district's total irrigated acreage. CAGRD paid farmers $750 per acre of fallowed land and increased the payment a minimum of 2% and maximum of 6% each subsequent year based on the change in the consumer price index for All Urban Consumers (SPI-U). Qualified land must have produced irrigated crops in four of the last five years, and no landowner can put more than 18 percent of their land in the program (Agreement, 2013; Radonic, 2014).

For 2014, the YMIDD conserved 6,827 acre-feet, fallowing 1,420 acres of citrus and alfalfa (Colorado River Accounting, 2014). In 2015, 1,410 acres were fallowed conserving 7,180 acre-feet of water. The YMIDD has found willing participants from at least two types of farmers/landowners. Farmers with citrus crops near the end of their useful life have removed trees and fallowed the land without incurring any economic losses. Landowners who rent land at $150 to $200 an acre can fallow that same land and receive $750 an acre.

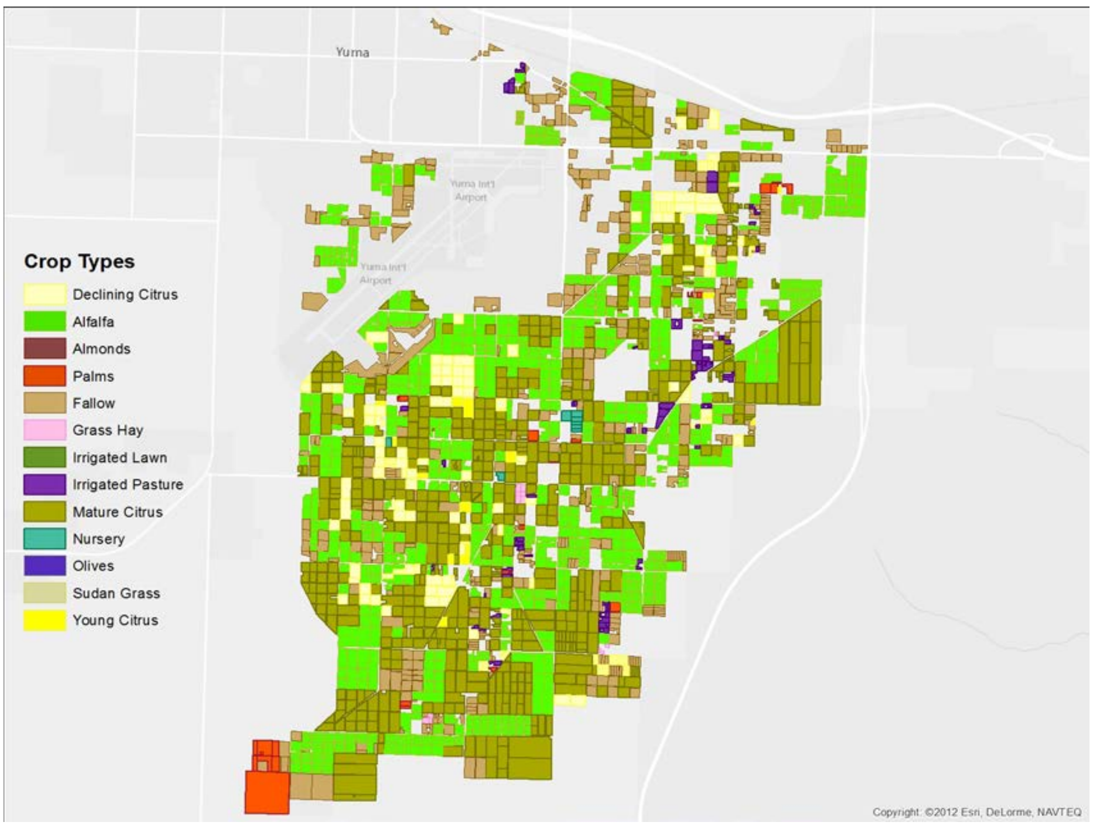

Figure 3: Crop types in Yuma Mesa Irrigation and Drainage Division. Source: Central Arizona Groundwater Replenishment District.

5.2.1.4 Analysis

The pilot program was successful in developing a defensible quantification methodology; CAGRD did not need to renew the program for an additional three-year period. The district is unsure of the value of their water in three to five years, and will wait until they are more certain of the value (Morgan, 2015) before considering another future program. The YMIDD has been able to use the current program to fallow fields and replant crops while earning more money than they would have if they continued to farm. There is a definite economic benefit for members of the YMIDD to participate in this program as they transition to other crops. The program has been relatively small, however, and it is difficult to see how it might be enlarged significantly.

5.2.2 Wellton-Mohawk Permanent Fallowing – Local Urban Transfer

Just before 2008, the Wellton-Mohawk District of the Gila Project near Yuma permanently retired 3000 acres of "mesa" land with lower quality soils to provide a future source of water for municipal and industrial growth in the district. Prior to the 2008 world-wide financial crisis, the district was experiencing significant urban growth and the need to supply water for local growth seemed obvious. Thus, the District decided to retire land to save water for future urban use. This land retirement was estimated to save 12,000 acre-feet of water per year. After 2008, growth in area slowed significantly, and now WMIDD currently does not need the water. The District is currently leaving the water in Lake Mead to raise the lake elevation. To make this water available for M&I uses, WMIDD amended its Reclamation contract to reduce the total allowable acreage for agricultural purposes and to allow M&I use of the saved water. The original WMIDD contract, which called for 75,000 irrigated acres, has now been amended several times. The 1974 Salinity Control Act cut the number back to 65,000 acres, the Pima-Maricopa Indian settlement in 1990 retired another 2200 acres, and this action removed another 3000 acres. Thus, the current allowable irrigated acreage in the District is approximately 60,000 acres.

Unlike other cases in this document, this example involves permanent, not temporary, fallowing. Permanent fallowing has historically been controversial because the water saved was typically moved out of the area and the land was no longer farmable. This is a different case where the water supplies are to be used for local in-basin non-agricultural economic growth and hence the action was less controversial.

5.2.3 Arizona Land and Water Trust – Environmental Water

The Arizona Land and Water Trust (ALWT) has worked to conserve land in the Sonoran Desert in southern Arizona in 1978 using traditional conservation easements and other techniques. Recently they have begun to use water agreements to address both land and water conservation, launching their Desert Rivers Initiative in 2007. The initiative sought to sustain the riparian habitat while maintaining rural livelihoods in the Southern Arizona area including the Gila, San Pedro, and Santa Cruz Rivers. This program is accumulating actual data of water consumption and how fallowing affects the river and riparian habitat.

5.2.3.1 2012 Gila River Project

In 2012, the trust crafted a three-year deal with a local landowner on the Gila River. The ALWT paid the farmer to fallow a 100-acre alfalfa field and not pump 600 acre-feet of groundwater per year. The ALWT hoped that the decrease in groundwater pumping would boost the flow of the Upper Gila River. The ALWT monitored whether reduced pumping increased the river's flow with the assistance of university scientists and consultants (Bates et al., 2014).

In Arizona, a water right can be lost under the abandonment statutes if it is not used for five years. Even though the abandonment statues have not been enforced in the state of Arizona, the parties agreed on a lease time frame that did not exceed the abandonment standard (Torrens, 2015). Fortunately, this transaction did not need state approval because the temporary agreement did not cause a change in use of the underlying water right (Bates et al., 2014).

5.2.3.2 Additional Projects

Since that original project, the ALWT has pursued and signed several different agreements along the upper Gila and San Pedro Rivers. They have reached four water lease agreements on the upper Gila that compensate farmers to completely fallow alfalfa. Another two agreements on the San Pedro River involve water reductions with transitions from alfalfa to native grass. The ALWT believes that paying farmers to fallow while they transition to alternative and native crops will become the majority of their future work and provide the most opportunities (Torrens, 2015).

5.2.3.3 Analysis

The ALWT program highlights the potential for water transfers to meet the needs of agricultural and environmental interests. Participating landowners are benefitting economically from the program and some are using these fallowing payments to transition to alternative crops that use less water. Although the program is too small to generate large increases in river flow, it is clear that less water is being used for agriculture, and the savings should be apparent in higher tributary groundwater and/or river flows even if these are difficult to measure. If this program continues to increase in participation, the ALWT will be closer to its goal of maintaining and preserving the riparian habitat and rural culture of Southern Arizona.

5.3 Colorado Cases

5.3.1 Rocky Ford High Line Canal – Aurora Municipal Transfer

Aurora, Colorado is located just east of and contiguous with Denver. It is the third largest city in Colorado with a population of over 350,000 residents. From 2004-2005, Aurora Water took part in the largest temporary water transfer in Colorado state history. The Rocky Ford High Line Canal Company[13] leased water to the municipality in what is seen as a successful transfer for both the agricultural community and the municipality. This short-term project then led to a long-term agreement to provide Aurora with more reliable supplies during potential future droughts.

In 2002, Colorado was experiencing a severe drought, prompting Colorado Governor Bill Owens to call it "perhaps the worst drought in 350 years" (Henz et al., 2004; Owens, 2003). The May snowpack in the South Platte Basin and Upper Colorado Basin were 23 and 28 percent of normal, respectively (Kenny, Klein, and Clark, 2004). Aurora relies heavily upon the winter snowpack for their raw water supply as do most of Colorado's cities. That July, the city's storage dipped to a level that caused serious concerns (McLane and Dingess, 2014).

5.3.1.1 2004-2005 Drought Agreement

As the drought continued into 2003, Aurora investigated leasing water from the Rocky Ford High Line Canal Company in the Arkansas River Basin. Aurora's reservoirs declined to record low storage of 26% in

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[13] This is the full name of the canal but it is typically referred to as just the "Highline Canal" or alternatively "High Line". There are countless 'Highline Canals' throughout the West with the term referring to a gravity-determined canal layout as high as possible above the source water supply in order to be able to provide water service to as much land as possible.

March 2003 (Aurora Water). Aurora's excess capacity in existing transbasin infrastructure made transfers out of the Arkansas River possible (McLane and Dingess, 2014). After reaching agreement with the canal company, a uniform lease was offered to all High Line Canal shareholders in 2003. Aurora agreed to pay $5,280 every year per share (a share is water for approximately ten acres, thought to yield about 10 acre-feet each year), plus an annual fee of $1,000 per share when land was out of production to offset the agricultural yields from the temporary non-irrigated land. Aurora withheld $500 of the payment to be paid when shareholders controlled weeds and implemented land stabilization measures per the landowner agreement (Agreement Application, 2003). Aurora agreed to develop the required engineering analysis and defray any potential costs the High Line Canal incurred during the leasing process (Aurora-High Line Canal Agreement, 2003).

The State Engineer of Colorado granted approval of the temporary change for up to 840 shares of the High Line Canal under Colorado's Substitute Water Supply Program (CRS 37-92-308)[14]. If Aurora leased all 840 shares, then the High Line Canal would be required to fallow 8,241 acres (McLane and Dingess, 2014). In 2004, Aurora leased 833.3 shares, 36 percent of the High Line Canal Company. Aurora paid nearly $5.3m to the High Line Canal Company and its shareholders, and additional money to use Pueblo Reservoir to transfer the water (Woodka, 2005).

Among the shareholders of the High Line Canal, the transfer was seen as a success. Due to the low water year, Aurora only received about 7,600 acre-feet from the lease, about 10 percent less than the expected 8300 acre-feet (Woodka, 2005). To refill reservoirs diminished by the drought, in 2005, Colorado Springs Utilities joined Aurora with each receiving 50 percent of the transferable yield under the same payment terms. Runoff in 2005 was approximately normal, the first time since 1999, and the jointly leased 833 shares yielded over 10,000 acre-feet (McLane and Dingess, 2014).

5.3.1.2 2008-2018 Long-Term Agreement

The 2004-2005 High Line Canal water transfer was a success for Aurora and the High Line Canal Company. The municipality avoided a potential water crisis, and established a positive relationship with the High Line Canal Company. Three years later, in 2008, the entities signed a new ten-year lease agreement. This renewable agreement called for Aurora to pay in leasing and non-leasing years, and the canal company will support future leasing to Aurora (CWCB, 2011). While the use of Interruptible Water Supply Agreements is good for drought protection and recovery, it less useful tool for municipalities to rely on as a long-term water supply and even less so to supply new demand[15]. The lack of infrastructure in some regions may even make such a transfer technically impossible. For agricultural producers, there is also widespread uncertainty about how temporary leasing water will affect the value of their water right, specifically when calculating the historical consumptive use of the right (McLane and Dingess, 2014).

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[14] Shortly thereafter the Colorado Legislature passed and the Governor signed a bill allowing such transfers under a new program, Interruptible Water Supply Agreements, designed specifically for these kinds of temporary fallowing arrangements, CRS 37-92-309. The Substitute Water Supply Program is one of several ways in which out of priority diversions can be authorized. Diversions approved under this program are designed to be temporary and only need approval of the State Engineer, not water court.

[15] The City of Fountain, however, believes it can use these agreements to provide a dependable source of water by using multiple agreements with fallowing on different cycles.

5.3.2 Arkansas Valley Super Ditch – Municipal Transfers

The Lower Arkansas Valley in southeastern Colorado below Pueblo has lost a quarter of its irrigated lands since the 1950s through the process known as “buy-and-dry” (WGA, 2012). The first major water sale occurred in 1955 to Pueblo. Between 1971 and 1986, there were eight major sales mostly to Aurora, Colorado Springs and Pueblo that totaled over 128,000 acre-feet in a basin with a native supply of approximately 500 kaf/year. Even though there were calls to oppose water transfers, farmers resisted attempts to impose restrictions on their right to sell water. The story of dry up in Crowley County and the resulting economic has been well told (MacDonnell, 1999) and is Colorado’s version of California’s Owen’s Valley buy and dry.

These water sales went to Pueblo, Colorado Springs, and Aurora. Pueblo sits on the Arkansas River and thus can easily take water upstream with existing infrastructure. Colorado Springs and Aurora established infrastructure to move water from the Colorado River Basin into the Arkansas and South Platte basins when they built their joint Homestake Project in 1963-1967. The Homestake project moves water via tunnel from Homestake Reservoir in the Upper Colorado River Basin into upper Arkansas Basin reservoirs, and then via the Otero Pump station on the Arkansas River into the South Platte Basin where it can be delivered to Aurora’s South Platte Reservoir on the South Fork of the South Platte, Spinney Mountain, and onto Colorado Springs via a continuation of the pipeline[16].

This infrastructure is the key to possible Super Ditch transfers to Aurora – without it, there would be no way to physically move Arkansas Basin water to Aurora which exists outside the basin. Colorado Springs, which is far upstream from the river on a small, mostly dry tributary, can obtain water using the same infrastructure or potentially by the newly constructed Southern Delivery System. The $800m Southern Delivery System is a 75-cubic-feet-per-second (cfs) conduit from Pueblo Reservoir on the Arkansas River to Colorado Springs designed to carry approximately 42,000 acre-feet per year. The 50-mile pipeline has a vertical lift of 1500 feet. The SDS is not allowed currently by Pueblo County’s 1041 permit or by the Environmental Impact Statement to move leased water, however.

During the 2000-2002 drought, interest in purchasing shares of the Arkansas Valley’s largest ditch, the Fort Lyon Canal, pushed citizens in five counties to establish the Lower Arkansas Valley Water Conservancy District in 2002 (LAVWCD) (McMahon and Smith, 2013). Unlike almost all other conservancy districts, LAVWCD’s mission is to prevent further buy-and-dry transfers and “acquire, retain, and conserve” water. The district intends to use water for the socio-economic benefit of the citizens of the district and establish methods of meeting municipal water demand both in and out of the basin without the negative effects of buy and dry on rural communities (LAVWCD, 2016).

In 2007, LAVWCD facilitated the creation of the Super Ditch, a Colorado Corporation consisting of shareholders on 7 of the principal ditches in the Lower Arkansas. The District contracted with HDR Engineering to conduct a preliminary proof of concept study on a fallowing-leasing model (Nichols, 2011). The Super Ditch is pursuing a leasing program modeled after the Palo Verde Irrigation District – MWD fallowing program in California. However, instead of one irrigation district, the Super Ditch is a collaboration of shareholders on seven ditch companies located between two reservoirs along the

[16] The continuation of the pipeline takes water out of the South Fork of the South Platte into a small tributary of the Arkansas River.

Lower Arkansas River, Pueblo, and John Martin. Irrigators from different ditches with different characteristics can pool their resources into a larger temporary-fallowing plan (WGA, 2012). The leasing program hopes to generate new sources of income and opportunities in a place where 32 percent of the farms reliant on agriculture operate at a net loss (McMahon and Smith, 2013).

Before incorporation of the Super Ditch, the LAVWCD completed many studies on the potential fallowing. Technical studies included tax considerations, the correct form of entity (taxable, non-profit), how to move the water upstream by exchange and by pipeline, water quality impacts and considerations, the financial aspects of lease-fallowing to both farmers and municipal partners, and the availability of storage to retain the water before its actual transfer (Nichols, 2011).

The first Super Ditch pilot project in 2012 (to supply the City of Fountain and Security Water District) failed due to difficult-to-meet conditions imposed by the State Engineer in his approval of the substitute water supply plan (SWSP). Tri-State Generation and Transmission et al., also filed a lawsuit challenging the State Engineer's authority to approve the SWSP, although insulated from injury by a reservoir located between the project and their water rights. Another time, boards of the Super Ditch and Highline Ditch rejected an offer for water from the City of Aurora because they believed the price to be too low (Woodka, 2014). Negotiations over a higher price ended during the winter when significant snow occurred and Aurora no longer needed the water.

5.3.2.1 2014 Fowler Pilot Project

The first H.B. 13-1248 (discussed below) project, proposed by two shareholders on the Highline Canal, was meant to supply Fowler: a small town on the Arkansas River downstream of Pueblo under water restrictions that needed an outside supply of water to augment their existing wells. Before the pilot project could be launched, however, the irrigators on the Highline Canal backed out of the deal after being threatened by other shareholders. Ironically, most Highline shareholders live in Fowler. However, in 2015 the Super Ditch received approval for the first pilot project. The Super Ditch anticipates several future leasing agreements, and is working on submitting two proposals in 2017 to go into operation in 2018, one involving the U.S. Forest Service's Lake Isabel, and the other involving Colorado Springs.

5.3.2.2 2015 Catlin Canal – Fowler, Security, Fountain Pilot Project

In early 2015, the Colorado Water Conservation Board (CWCB) approved a plan to lease water from the Catlin Canal of the Super Ditch to the municipalities of Fowler, Security Water District, and Fountain. Fowler is on the mainstem of the Arkansas downstream of Pueblo. Security and Fountain are located south of Colorado Springs on Fountain Creek, the Arkansas tributary that leads from Colorado Springs to the Arkansas. The Catlin Pilot Project was the first to go completely through the process established in the CWCB's Lease-Fallowing Criteria and Guidelines (Colorado Water Conservation Board and Colorado Division of Water Resources, 2013) and the first to use the Lease-Fallowing Tool developed by the Division of Water Resources to determine historical consumptive use, assess injury to other water rights, and return flow obligations (DWR, 2015a).

The CWCB's approval, consistent with H.B. 13-1248, stipulates that water can be only transferred three out of ten years and only 30 percent of a farm can be temporarily dried up (Woodka, 2015a). The CWCB adopted all the State Engineer's 59 conditions on the project, and added one requested by Colorado Parks and Wildlife. The pilot project received the full support of the Catlin Canal shareholders (The

Lower Arkansas Valley Water Conservancy District, Berg Hill Greenleaf Ruscitti LLP, and Martin and Wood Water Consultants, Inc., 2016).

During 2015 and 2016 water was exchanged or traded from the Catlin Canal headgate into Pueblo Reservoir for Fountain and Security for $500 per acre-foot. It was then delivered up Fountain Valley Authority Pipeline. Since the infrastructure was already in place, the transport of the water from Pueblo Reservoir to Fountain and Security was relatively easy and only required a little more planning for the municipalities (Fink, 2015).

Water for Fowler was traded with the Colorado Water Protection and Development Association to replace the Town's out-of-priority well depletions. Water for Fountain and Security was similarly traded with so-called Rule 10 Plans, which replace water consumed by increased irrigation efficiency to comply with the Arkansas River Compact with Kansas.

Approximately 1,100 acres of land were fallowed, making up 311 shares of the Catlin Canal. Representatives from Kansas observed every property with fallowed land to ensure compliance with the Arkansas River Compact. (Kansas follows Colorado's Arkansas River water use closely because of the potential for harmful downstream impacts).

In an economy with depressed commodity prices, it was a successful year for famers, who could install improvements on fallowed fields like drip irrigation and laser-leveling (Woodka, 2015c). A post-year water accounting report was released in January of 2016 (LAVWCD, Berg Hill Greenleaf Ruscitti LLP, and Martin and Wood Water Consultants, 2016).

Colorado Springs Utilities has formally offered a partnership with the Super Ditch, hoping that leasing can help top off their water supplies in drought recovery years. Such a deal would not be likely until 2017, going into effect in 2018 (Woodka, 2015b). One preliminary analysis of the Super Ditch projected a loss of $192 in net income per acre for the local economy due to fallowing without considering the benefits of the lease payments. However, these payments could exceed these losses and possible benefits from an increase in dry land farming could mitigate some of the negative impacts (McMahon and Smith 2013).

5.3.2.3 Lease-Fallowing Water Accounting Tool

Anticipating temporary water transfers from the Super Ditch, the state developed the Lease-Fallowing Water Accounting Tool (LFT) to "streamline and standardize the evaluation of the historic use of irrigation water and return flows to streams associated with land parcels in Colorado that may alter irrigation practices as part of a lease-fallow project" (DWR, 2015b). The LFT has been used successfully to evaluate the water transfer between the Catlin Canal and the cities of Fowler, Security, and Fountain in 2015 and 2016. The Excel-based program was developed within the criteria and guidelines of HB13-1248 and can be used to model similar projects in other basins. Data for every land parcel is input into the program, which completes an analysis that simulates the historical water balance and then computes return flows to the stream for historic and altered conditions. The program's analytics take minutes compared to the typical, much longer historical water court process (Thompson, 2015).

5.3.2.4 Analysis

The creation of the LAVWCD and the Super Ditch represent an unusual collaborative effort by local entities historically known for fighting to prevent future impacts to farming and rural lifestyles from out of basin water transfers. The Super Ditch has not yet transferred larger amounts of water on an annual basis, and at times has struggled to form partnerships with municipalities, largely due to the inability to agree on a price for transfers. The successful Catlin Pilot Project, however, appears to have paved a way forward for larger transfers in the future. Aurora and Colorado Springs – both parties to permanent ag transfers in the Lower Arkansas basin since the 1950s – approached the Super Ditch in 2016 to discuss long term leasing-fallowing agreements as part of their future water supply portfolios.

5.3.3 The Lake Canal Transfer – Environmental Transfer (Failed)

The Colorado Water Innovation Cluster (CWIC), a group of public, academic, and private entities, was formed in 2010 to produce innovative solutions to water issues. CWIC set out to temporarily transfer water from agriculture to meet environmental needs. Specifically, they proposed that shareholders of the Lake Canal would fallow, deficit irrigate, or use other methods to conserve water for instream flows on the Cache la Poudre downstream of Fort Collins. As originally envisioned in 2010, this transfer would rely upon an Interruptible Water Supply Agreement (IWSA) under Colorado Water Law (CRS 37-92-309) to transfer water for three years during a ten year term, with use commencing during the 2011 irrigation season (CWIC, 2013). The proposed transfer amount, 60 acre-feet, was to demonstrate the possibility of using such a mechanism (Smith, 2015).

After postponing negotiations due to a low water year in 2012, the project was terminated without ever reaching a transfer agreement. The parties could not agree on a price or amount of water to transfer. The 2012 drought caused the price of leased water and the value of crops such as corn and alfalfa to increase to record highs. Water demand by oil and gas producers was also increasing water prices. Farmers could not economically justify the transfer if they could obtain higher returns by putting that water to agricultural or other use. Agricultural water users were also openly skeptical of the intentions of environmental groups wanting to purchase the water (CWIC, 2013; Smith, 2015).

5.3.3.1 Analysis

The Lake Canal case provides some valuable insight into the difficulties of these agreements. Due to 2012 drought, commodity prices increased along with the value of water, and thus it was not in the interests for landowners to lease water. Droughts may provide both opportunities and problems. If a user does not have enough water to grow a crop, he may be interested in selling the water at a scarcity premium. On the other hand, high commodity prices might encourage the farmer to keep the water, in order to maximize crop and economic returns.

5.3.4 Larimer County Open Lands Program – Land Preservation and Municipal Transfer

The Larimer County Open Lands Program (LCOLP) was created in 1998 to preserve land in Larimer County. LCOLP currently owns 25,000 acres in fee and 8000 acres in conservation easements. Less than 1000 acres of these lands have water rights due to the high cost of water. LCOLP is funded by a ¼ cent sales tax that has been approved by voters twice, most recently in 2014. The county is losing farmland at the rate of 4500 acres per year with the loss of 8.4% of total country farmland in the ten-year period from 1997 to 2007. County citizens recently identified the acquisition of working irrigated farms as a high priority.

In 2015, LCOLP received a $186,000 grant from the Colorado Water Conservation Board to create a test program which combines land conservation with a permanent dry year interruptible water supply agreement for a municipality (Larimer County Open Lands, 2015). The CWCB grant funds legal, engineering, economic, and program management for the acquisition of the two properties. It does not cover the actual land and water cost. LCOLP hopes to establish a model that can be replicated.

LCOLP will offset the high cost of water acquisition by making dry year water available on a permanent basis to a municipal user. LCOLP is looking to acquire the rights for two irrigated farms with the purpose of creating a water sharing agreement(s) with M&I partner(s). One property would have primarily water from the Colorado Big Thompson Project (C-BT) water rights and another with primarily native water rights. Native water rights can be purchased for less, but have higher transaction costs to move the water to a municipal user. CBT rights are more easily moved, but in recent years have been expensive.

In early 2016, LCOLP signed a contract for one 211-acre farm near Berthoud Colorado on the Little Thompson River. The property has 188 irrigated acres, and its water portfolio is made up primarily of C-BT water rights and some local ditch shares ("Larimer Approves Farm, Water Purchase - Loveland Reporter-Herald", 2016) LCOLP has informally discussed this project with several potential M&I water providers in Northern Colorado, and some have confirmed that they would participate in a pilot project (Larimer County, 2015).

5.3.4.1 Analysis

This is still a work in progress. The addition of an experienced but predominantly dry land conservation organization to this effort brings much needed expertise. This water will provide permanent, reliable dry year supplies to a municipality but not base demand water.

5.3.5 Montezuma Valley Irrigation Company – NGO Environmental Transfer (Failed)

The Montezuma Valley Irrigation Company (MVIC) supplies water out of the Delores River in southwestern Colorado, near Cortez, using water from the Delores Project stored in McPhee Dam. In 2011, the board of directors proposed a leasing program for environmental purposes to its shareholders. The plan involved leasing water during the summer months to improve the fish habitat on the Lower Dolores River below McPhee. The farmers would have leased up to 6,000 acre feet of water in three of the next five years to the Colorado Water Conservation Board's instream flow program. The Nature Conservancy, Trout Unlimited, and the San Juan Citizen's Alliance would have put up $1.5m toward the water purchase, and the funds would have been used to improve the MVIC irrigation system. This funding would have helped modernize a system that loses 25 percent of water before it reaches end users (Hartzke, 2011; Smith, 2011).

After initially requesting the board to investigate the possibility of leasing water, the shareholders chose to not participate. The vote failed with 68 percent opposed to the lease agreement and 31 percent in favor (Wright, 2011). There was concern among the irrigators that once they leased water, they may have been forced to continue leasing, especially if Delores River fish were listed under the Environmental Species Act. Also, some farmers were already not getting enough water due to problems with the current irrigation system, and leasing water would have further limited the available water in the system (Smith, 2011). The impact of the 2002 drought was also a strong reminder of low water supply challenges (Benedict, 2011) . After the vote, there was substantial turnover in the MVIC management due to ill feelings about the agreement and the overall process.

Even though there was a willing buyer and a need to repair infrastructure within MVIC, shareholders were unwilling to lease water. Irrigators brought up typical concerns that have been issues with other similar fallowing projects. Most fallowing negotiations take multiple years to reach agreement, especially with such a large amount of water. The Arkansas Valley Super Ditch and the Palo Verde Irrigation District final agreements took many years of discussions. For the Imperial Irrigation District, pressure from the federal government was necessary to create a final comprehensive agreement. A pilot project or small-scale lease may have smoothed the way for a larger project.

5.3.6 North Sterling Irrigation District – Xcel Energy Industrial Water (Energy)

Xcel Energy owns and operates the Pawnee Power Plant, a water-cooled 550 MW coal-fired power plant east of Fort Morgan near Brush, Colorado on the South Platte River. Prior to the 2002 Colorado drought, the State Engineer did not administer South Platte winter water rights. Hence, Xcel had no need for a reliable senior winter water right. After the extreme low flow year of 2002, however, it became apparent that the power plant would need to acquire a senior right for future low flow years. Seeking reliable winter water, Xcel approached the North Sterling Irrigation District (NSID), which owned 74,000 acre-feet of storage in the downstream North Sterling Reservoir. NSID and its shareholders were provided with an opportunity to increase economic returns from their water rights from an unusual source. In contemplating a water sharing deal, NSID management believed that they needed a strong vote of support from its members to pursue the agreement. An agreement would require the district to pursue a change of its water rights, a new concept for the district that would set a precedent and possibly lead to more leases in the future.

The district board voted to pursue the agreement and a strong majority (113/140) of the members agreed in district-wide vote. A new company, Point of Rocks Water Company, was formed among the 113 participating members to contract with Xcel. Under the agreement, from November to March 3,000 acre-feet could be transferred to the power plant if requested. NSID would receive a guarantee $50 per acre-foot per year and additional $425 per acre-foot per year on delivery. The agreement was finalized in 2005 for a 25-year term. NSID paid their own legal and engineering fees to adjudicate a portion of their water rights, but they could not change their entire water rights portfolio due to Colorado's anti-speculation doctrine. The agreement states that Xcel will divert the transferred water at their wells upstream of the district and NSID will forego an equal amount of diversions while maintaining historical seepage and return flows. To date, no water has actually been delivered to the Xcel power plant, but the district has received $632,000 and its members have made over $1m since 2005 (Yahn, 2015).

5.3.6.1 Analysis

The NSID case is unique. The district has significant storage and a valuable senior water rights portfolio. Many other irrigation districts are not as fortunate. To date, they have received significant economic gains for very little cost in dollars to set up the agreement and no cost in water delivered. The NSID-Xcel agreement presents a viable formula of how agriculture and industry can lease water in a way that benefits both parties. In this case, Xcel has managed a significant water risk using money, and the farmers have been compensated for acquiring that risk without, at least so far, having to make water sacrifices. In the case of actual water deliveries, is not clear how the farmers would reduce water use. Fallowing would be one option, as would acquiring other water, planting other types of crops, or deficit irrigating alfalfa or other crops.

5.3.7 House Bill 13-1248 Fallowing-Leasing Pilot Projects

In 2013, the Colorado Legislature enacted HB13-1248, which was signed into law by Governor Hickenlooper on May 13, 2013. The law (C.R.S. 37-60-115(8)) allows for the Colorado Water Conservation Board to administer a pilot program to test the efficacy of lease-fallowing as an alternative to permanent agricultural dry-up. Ten separate pilot projects, each up to ten years in duration, can be selected. On November 19, 2013, the CWCB board approved “Criteria and Guidelines” for the Pilot projects (Colorado Water Conservation Board and Colorado Division of Water Resources, 2013). The guidelines set forth the process and rules by which applications for these pilot projects will be considered.

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