H.B. 13-1248 Catlin Canal Company Rotational Land Fallowing-Municipal Leasing Pilot Project

2016 Annual Report

Submitted by

The Lower Arkansas Valley Water Conservancy District
The Lower Arkansas Valley Super Ditch Company

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TABLE OF CONTENTS

I. Executive Summary 1

II. Background 4

III. Project Operations Summary 6

A. Hydrologic Conditions in 2016 6

B. Fallowed Lands and Shares for 2016 7

C. Water Generated from 2016 Operations 8

D. Deliveries to Municipal Participants 10

1. Deliveries to Fountain and Security 11

2. Deliveries to Fowler 12

IV. Operation of Exchanges 15

A. Generally 15

B. Setting the Exchange Rate 16

C. Potential Benefit of an "Owe-the-River Account" 16

V. Return Flow Obligations 18

A. Deliveries to Recharge 19

B. Augmentation Station Deliveries 20

C. Use of Pay As You Go Approach 21

D. Number of Days Return Flow Obligations Unmet 23

E. Reduced Challenges in Operating Hanagan Recharge Pond 24

F. Weed Evapotranspiration and Surface Evaporation 25

VI. Efficacy of the Lease-Fallow Tool 27

A. Calculation of CU Volumetric Limits 27

B. Conservativeness of HB 1248 & the Lease-Fallow Tool 29

VII. Compliance with Dry-Up Requirements 31

A. Efficacy of Prevention of Blowing Soils, Erosion and Noxious Weeds 33

B. Efficacy of Re-Irrigation 34

VIII. Accounting Modifications & Errors 35

A. Accounting Modifications Made 35

B. Accounting Error and Proposed Modification 35

IX. Financial Information 36

A. Operational Expenses 36

B. Lease Payments 38

C. Costs Associated with Fallowed Fields 39

D. Summary 40

X. Conclusion & Recommendation 41

A. Recommendation 41

INDEX OF TABLES & FIGURES

Tables

Table 1 – Fallowed Shares, Acreage and Parcel ID for 2016 7
Table 2 – Deliveries, Consumptive Use and Return Flow Obligations (AF) 10
Table 3 – Monthly Deliveries to Municipal Participants (AF) 11
Table 4 – Transfers into Fountain/Security Excess Capacity Accounts 12
Table 5 – City of Fowler Well Depletions 13
Table 6 – Consumptive Use Water Available to Fowler and Dedicated to CWPDA 13
Table 7 – Summary of Exchanges to Pueblo Reservoir 15
Table 8 – Return Flow Deliveries (AF) 18
Table 9 – Deep Percolation Return Flow Deliveries to Recharge (AF) 20
Table 10 – Deliveries to the Timpas Creek Augmentation Station 21
Table 11 – % Deep Percolation Deliveries 22
Table 12 – Un-met Return Flow Obligations 24
Table 13 – Summary of Recharge Pond Evaporation 25
Table 14 – Estimated Net Weed ET and Consumptive Use Credit Releases (AF) 26
Table 15 – Consumptive Use Limit Comparison (AF) 28
Table 16 – Comparison of 2016 CU Delivery with Deliveries under Revised CU Limits (AF) .. 29
Table 17 – Comparison of H.B. 13-1248 and HI Model Methods (AF) 30
Table 18 – Dry-up Method by Parcel 31
Table 19 – Noxious Weed Control by Farm 33
Table 20 – 2016 Operational Expenses (March – November) 37
Table 21 – 2016 Equipment & Supplies 37
Table 22 – Payments to Participating Farmers 39
Table 23 – Estimated Costs Associated with Weed Control 39

Figures

Figure 1 – Catlin Pilot Project Overview Map 3
Figure 2 – Location Map of Participating Farms 8
Figure 3 – Catlin Canal, Fowler, and Rule 14 Well Depletion Reaches 14

LIST OF APPENDICES

Appendix A – Aerials Showing 2016 Fallowed Acreage

Appendix B – Tracking of Dry-up, Fallowed Acreage & Fallowed Shares

Appendix C – Pay As You Go Target Deliveries

Appendix D – Weed Evapotranspiration Calculations

Appendix E – Summary of 2016 Accounting Tables

I. Executive Summary

The Catlin Pilot Project is a ten-year undertaking to make senior water rights available for municipal use through the rotational fallowing of irrigated lands in the Lower Arkansas River Basin. The Catlin Pilot Project provides up to 500 acre-feet of water per year to three municipal water providers – the Town of Fowler, the City of Fountain, and the Security Water District. It uses 1046.83 shares in the Catlin Canal Company that historically have irrigated approximately 1,000 acres of land on six farms. The Colorado Water Conservation Board (CWCB) approved the Catlin Pilot in 2015 and this was the second year of operations. Figure 1 on page 3 shows the general locations of the Catlin Pilot Project components.

"From my point of view as a farmer, the pilot project has been operated very smoothly and efficiently and I feel fortunate to be a part of it" ~Philip Chavez, participating farmer

By all accounts, the Catlin Pilot Project was again operated successfully in 2016. Over 400 acre-feet of water was supplied to the Municipal Participants. The Catlin Pilot Project consistently met all return flow obligations and the recharge ponds used to make those return flows performed well. Exchanges into Pueblo Reservoir were operated at all times requested to deliver water supplies to Fountain and Security. The fallowing of fields went smoothly and the participating farms received an average of $1,004.00 per fallowed acre.

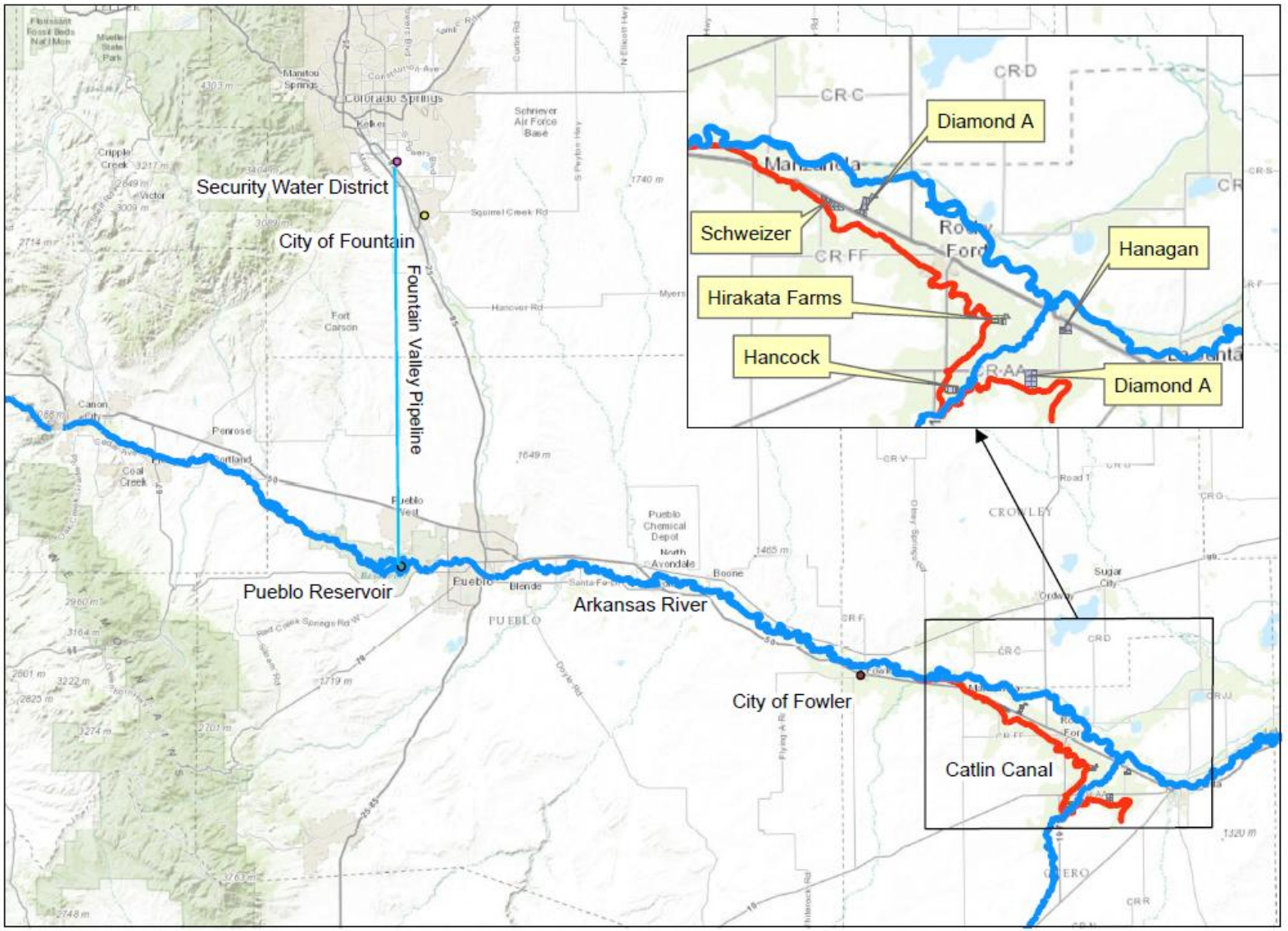
The continued experience gained during Catlin Pilot Project operations is identifying ways to streamline operations and administration for this and future rotational fallowing-leasing projects. In 2016, virtually no obstacles to operation of rotational fallowing-leasing occurred. Importantly, 2016 operations continued to increase irrigators' interest in rotational fallowing-municipal leasing and further demonstrated to municipal users that temporary transfers for municipal use can be accomplished through the successful exchange and delivery of wet water. The continued success of the Catlin Pilot Project is significant in that it reflects the first "proof of concept" in Colorado for rotational land fallowing-municipal leasing as a viable alternative to the permanent buy-and-dry of agricultural lands.

The Catlin Pilot Project is already successfully meeting the legislative policy goals articulated in H.B. 13-1248. The streamlined approach embodied in the Lease Fallow Tool (LFT) proved to be an efficient means to calculate water available for lease and to determine return flows owed to avoid injury to other water rights holders and to ensure compliance with the Arkansas River Compact. Just as significant, the LFT facilitated and expedited the application and approval process. The

innovative H.B.13-1248 conference process involving the applicants, commenting parties, the CWCB, and State and Division Engineers capitalized on the common technical platform of the LFT, and proved to be an especially efficient and useful forum to define issues and develop operating terms and conditions.

The Catlin Pilot Project continues to demonstrate that rotational land fallowing - municipal leasing can be a viable alternative to permanent buy-and-dry. This is a critical mission of the Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Valley Super Ditch Company. It is also central to the goals of the Colorado Water Plan, the CWCB, the Interbasin Compact Committee, and basin roundtables. The Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Valley Super Ditch Company are excited about the 2016 results of the Catlin Pilot Project and remain committed to continuing operation of this important and pioneering project in 2017.

Figure 1 – Catlin Pilot Project Overview Map



II. Background

On January 27, 2015, the CWCB approved the Catlin Pilot Project – the first rotational land fallowing – municipal leasing pilot project under HB 13-1248 (codified at C.R.S. § 37-60-115(8)) and the *Criteria and Guidelines for Fallowing-Leasing Pilot Project*s (amended January 25, 2016) (Criteria and Guidelines). The Lower Arkansas Valley Water Conservancy District (Lower Ark) and the Lower Arkansas Valley Super Ditch Company, Inc. (Super Ditch) were co-applicants. As required by statute, the State Engineer issued a written determination on January 16, 2015, outlining terms and conditions upon which the Catlin Pilot Project could operate without causing injury and without impairing compliance with any interstate compact. The CWCB's approval is subject to the terms and conditions contained in the State Engineer's Written Determination, and an additional term set forth in a letter dated January 26, 2015, from the Colorado Division of Parks and Wildlife (CWCB Approval).

This annual report is being submitted pursuant to Condition No. 52 of the CWCB Approval:

> *Applicants shall annually prepare a report of Pilot Project operations that will be submitted to the CWCB and the State and Division Engineer on or before January 15 of each year, which shall reflect a reporting year of November 16 of the prior plan year through November 15 of the current plan year for which the report is being prepared. This annual report will present: (a) a summary of plan year accounting, including the total amount of acres and Subject Shares fallowed, plan-year deliveries to the Subject Shares, HCU credits generated, water exchanged for Fowler-CWPDA Municipal Well Replacement, water exchanged to Pueblo Reservoir for Fountain and Security, water exchanged to Pueblo Reservoir for lagged return flow replacement, tail water return flow obligation replaced and un-replaced, lagged return flow obligation replaced and un-replaced, sources of water used to meet lagged return flow obligation, future lagged return flow obligation and firm yield source of water that will be used to meet lagged return flow obligation; (b) any accounting errors or deficiencies discovered during the plan year and any accounting modifications that were made during the plan year or are proposed to be made for the upcoming year; (c) the number of days, if any, when there were un-replaced return flow obligations; (d) efficacy of the LFT, temporary dry-up, prevention of erosion, blowing soils and noxious weeds and re-irrigation of temporarily fallowed lands; (e) information regarding the parcels that have been dried up to date and years of such dry up to demonstrate that the limitations contained in term and condition 2 have not been exceeded; (f) a summary of costs associated with pilot project operations, including lease payments made/received, operational costs, and to the extent available costs of erosion prevention and noxious weed management; (g) identification of any obstacles encountered in pilot project operations; (h) any additional terms and conditions that Applicants believe may be necessary to prevent future material injury to other water rights or contract rights to water; and (i) any proposed minor operational modifications for the upcoming plan year, including and limited to the addition/modification of accounting forms, projection forms, storage locations, recharge facilities, and/or augmentation stations. Any proposed operational modifications shall be accompanied by such information and analysis as is necessary for the State and Division Engineer and any interested parties to evaluate the potential for injury resulting from such proposed changes.*

Lower Ark and Super Ditch submitted the first annual report for the Catlin Pilot Project on January 15, 2016 (2015 Annual Report), which provided detailed information on the successful first year of operations. This annual report for 2016 operations provides the information required by the CWCB Approval and generally follows the same model from the 2015 Annual Report.

III. Project Operations Summary

The Catlin Pilot Project involves the rotational fallowing of lands located on six farms irrigated under the Catlin Canal in the Arkansas River Basin. This project makes available up to 500 acre-feet of water for lease to three municipal water providers – the Town of Fowler, the City of Fountain, and the Security Water District (Municipal Participants). The Catlin Pilot Project uses shares historically used to irrigate lands located on the Schweizer, Diamond A West, Hirakata, Hancock, Diamond A East, and Hanagan Farms (Participating Farms). The Participating Farms currently are entitled to use a total of 1046.83 shares of the Catlin Canal Company and the fallowing of up to 902.2 associated acres is authorized by the CWCB Approval.

Water deliveries for 2016 Catlin Pilot Project operations began on March 16, 2016, which corresponded with the first water deliveries made to the Catlin Canal. Catlin Pilot Project operations ended on November 14, 2016, which corresponded with the end of the season for deliveries under the Catlin Canal Company direct flow water rights and the beginning of the Winter Water Storage Season for Pueblo Reservoir.

In advance of operations and as required by the CWCB Approval, Applicants notified and provided mapping to the Division Engineer of: (a) those parcels to be fallowed and the associated shares for the upcoming plan year; (b) how and where the non-fallowed Catlin Pilot Project Subject Shares will be used for the upcoming plan year (i.e. surface irrigation, dry-up under Rule 14 Plan, etc.), including the location of irrigated lands; and (c) the water supplies that will be used on the non-fallowed portions of the Catlin Pilot Project farms. Lands and shares that may be fallowed as part of the Catlin Pilot Project are limited to those identified in the September 25, 2014 Application.

A. Hydrologic Conditions in 2016

As the Catlin Pilot Project began operations in mid-March, snowpack in the Arkansas Basin hovered near the historical average, but began to fall off sharply during late March and throughout April. However, late snowstorms in May increased snowpack to 110% and resulted in an above average water year in the Arkansas River Basin. The Catlin Canal diversions followed this trend and totaled approximately 108,000 acre-feet during 2016, which represents approximately ten percent above the Canal's 30-year average diversion of 98,500 acre-feet. 2016 diversions by the Catlin Canal exceeded 2015 diversions, which were four percent above average (102,500 acre-feet). Local precipitation during 2016 (as measured at the Arkansas Valley Research Farm outside of Rocky Ford) totaled 15.7 inches, which was noticeably above the long-term average of 11.7 inches.

B. Fallowed Lands and Shares for 2016

For 2016 operations, the Participating Farms fallowed 237.9 acres, consisting of 13 distinct parcels, as shown on the aerial photos included in **Appendix A** (2016 Fallowed Acreage). Figure 2 on the following page shows the general location of each Participating Farm. The fallowed acreage for the Schweizer,[1] Hanagan, and Hancock farms was identical in 2016 to that fallowed for 2015 operations, while different acreage was fallowed in Diamond A East, Diamond A West, and the Hirakata farms. There were 255.33 shares associated with the 2016 Fallowed Acreage (2016 Shares), as compared to the 252.14 shares in 2015 operations. H.B. 13-1248 and the Criteria and Guidelines limit the fallowing of lands in a pilot project to no more than three years in ten, or 30% of each farm. In 2016, fallowed land represented 26% of the total historically irrigated acreage included in the Catlin Pilot Project and no more than 30% of the acreage of any farm was included in 2016 operations. The 2016 Fallowed Acreage and 2016 Shares are summarized by Participating Farm on Table 1:

26% of the historically irrigated lands included in the Catlin Pilot Project were fallowed during 2016.

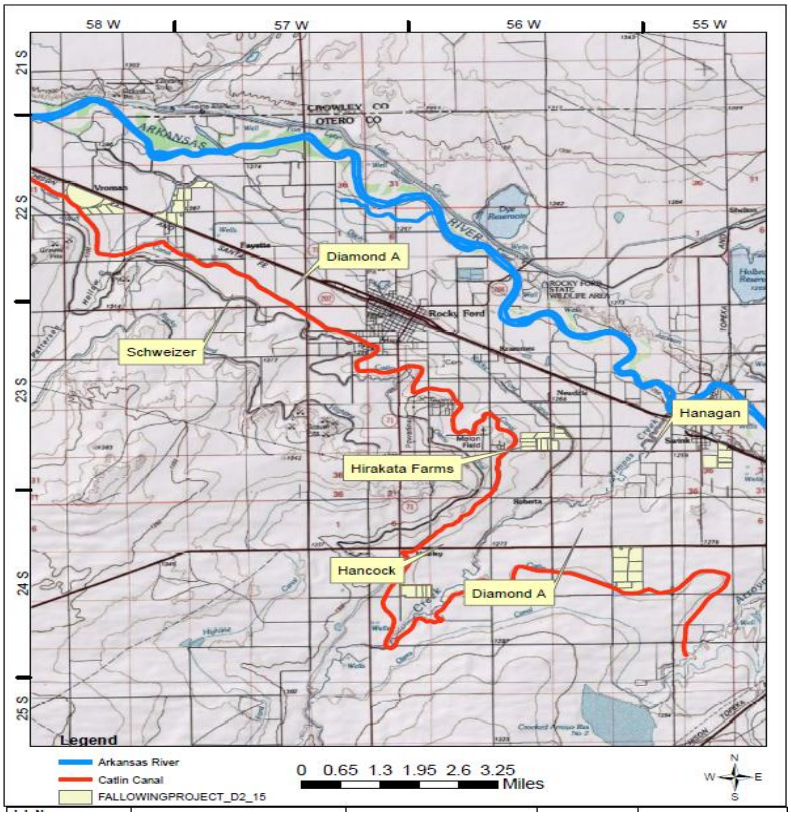
Table 1 – Fallowed Shares, Acreage and Parcel ID for 2016

Farm Name	# Shares Fallow	Pilot Project Fallowed Acreage	Measured Fallow Fields	Fallowed Parcels by Parcel ID
Schweizer	30.59	30.1	30.6	22573220 & 22573224
Diamond A West	48.53	36.1	36.1	23570402 & most of 22573309
Hirakata Farms	41.99	39.9	39.9	23562827, 23562812 & 23562828
Hancock	24.52	22.7	22.7	24560711 & most of 24560722
Diamond A East	76.01	76.3	76.3	24561108, 24561117 & most of 24561116
Hanagan	33.69	32.8	32.8	Most of 23563603
Total	**255.33**	**237.9**	**238.4**	

In 2015, Lower Ark developed a spreadsheet-based tool to track parcels fallowed during the ten-year Catlin Pilot Project to ensure compliance with statutory limits on the frequency and extent of fallowing. Lower Ark added the new parcels to this tool that were included in 2016 and will do the same for future years' operations. This tool, updated to reflect inclusion of these lands, is included in **Appendix B**.

[1] For the Schweizer farm, the 2016 acreage was reduced from 2015 to create a 0.5 acre buffer (and thus a 0.5 acre reduction in parcel size for Parcel 22573224) between fallowed and irrigated parcels.

Figure 2 – Location Map of Participating Farms



C. Water Generated from 2016 Operations

In 2016, the Catlin Pilot Project delivered a total of 1165.17 acre-feet of water. This represented nearly all of the Participating Farms' pro-rata portion of Catlin Canal headgate deliveries associated with their 2016 Shares. As discussed in later sections of this report, the Catlin Pilot Project delivered slightly less than the total pro-rata entitlements of the Participating Farms due to typical challenges associated with monitoring deliveries to various locations while not exceeding pro-rata deliveries. Deliveries were assigned to one of three categories: (1) consumptive use water available to the Municipal Participants; (2) tailwater return flow obligations; and (3) deep percolation return flow obligations (see text box on the next page for definitions). Summary tables for 2016 accounting covering all aspects of 2016 operations is presented in **Appendix E**.

Key Terms

Consumptive Use Water. The portion of the water delivered to the shares included in the Catlin Pilot Project that is available for municipal use by the Municipal Participants. It is calculated by applying a "consumptive use factor" to the deliveries to arrive at the portion of the delivery that was historically consumed through irrigation of the parcels that were fallowed as part of the Catlin Pilot Project.

Tailwater Return Flow Obligations. The portion of the water delivered to the shares included in the Catlin Pilot Project that was applied to the fallowed parcels, but was not consumed by the crop being irrigated and historically returned to the Arkansas River as surface runoff. The tailwater return flow obligations were required by the Criteria and Guidelines to be calculated as the total pilot project farm headgate deliveries minus the maximum consumptive use portion of the delivery, multiplied by 20%.

Deep Percolation Return Flow Obligations. The portion of the water delivered to the shares included in the Catlin Pilot Project that was applied to the fallowed parcels and infiltrated the soil, but was not consumed by the crop being irrigated and historically returned to the Arkansas River as deep percolation. The deep percolation return flow obligations required by the Criteria and Guidelines to be calculated as the total pilot project farm headgate deliveries minus the maximum consumptive use portion of the delivery, multiplied by 80%.

The results of the historical consumptive use analysis conducted for the Catlin Pilot Project application indicated that the 2016 Shares associated with the 2016 Fallowed Acreage would provide 373.8 acre-feet per year on average. In fact, results for 2016 operations were above average because the 2016 water year was wetter than average. The Catlin Pilot Project 2016 operations delivered 422.41 acre-feet in consumptive use water. Table 2 on the next page provides an overview of water delivered to the Catlin Pilot Project during 2016 operations.

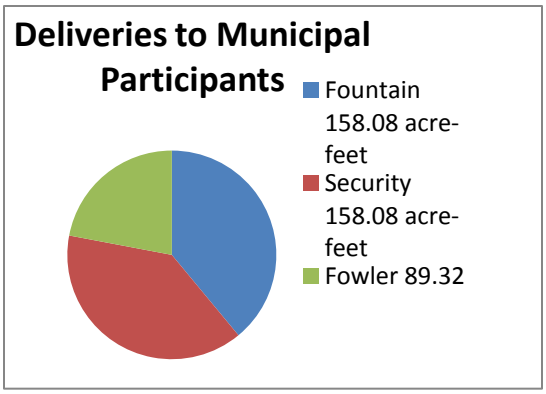
Table 2 - Deliveries, Consumptive Use and Return Flow Obligations (AF)

Month	Pro-Rata Total Pilot Project Deliveries	Actual Total Pilot Project Deliveries	Maximum Consumptive Use Portion of Pro-Rata Delivery	Maximum Consumptive Use Portion of Actual Delivery	Delivered CU Water	Tailwater Return Flow Obligation	Deep Percolation Return Flow Obligation
March	88.11	74.83	8.57	7.28	7.28	13.51	54.04
April	149.81	149.10	22.66	22.56	22.56	25.31	101.23
May	160.20	159.26	52.85	52.54	52.54	21.34	85.38
June	155.30	151.86	79.39	77.63	75.67	14.72	58.87
July	180.41	173.22	94.72	90.94	90.28	16.35	65.39
August	180.32	180.93	94.27	94.59	94.27	17.27	69.07
September	122.00	121.43	49.92	49.68	49.68	14.35	57.40
October	103.82	86.25	21.78	18.10	18.08	13.63	54.52
November	68.30	68.30	12.06	12.06	12.06	11.25	44.99
Total	**1208.28**	**1165.17**	**436.23**	**425.38**	**422.41**	**147.72**	**590.90**

The variation between the pro-rata deliveries that were available to the 2016 Shares and the actual deliveries made under pilot project operations resulted in slightly less water (436.23 – 425.38 = 10.85 acre-feet) being available for delivery to the Municipal Participants in 2016. This variation was due to operational constraints – e.g., ensuring that on any given day, the actual deliveries did not exceed the pro-rata deliveries. This water was therefore returned to the river system unused. In addition, the slight difference between the maximum consumptive use portion of actual delivers and the delivered consumptive use water (452.38 – 422.41 = 2.97) was unavailable as result of operational constraints associated with managing the "Pay As You Go" target deliveries (see Section V.B) and constituted excess deep percolation return flow deliveries.

D. Deliveries to Municipal Participants

The Catlin Pilot Project successfully delivered a total of 405.48 acre-feet of the 436.23 acre-feet of available consumptive use water to the three Municipal Participants. The difference between the 405.48 acre-feet delivered to the Municipal Participants and the maximum consumptive use portion of pro-rata deliveries of 436.26 acre-feet reflects the 10.85 acre-foot and 2.97 acre-foot variations discussed in section C, above, as well as 16.93 acre-feet that was either allocated to evaporation in the recharge ponds, transit losses from the Timpas Creek augmentation station to the Arkansas River, or as an offset to recharge pond deliveries as a result of weeds in the recharge ponds.



Each of these items is discussed later in this report. The Municipal Participants used all consumptive use water delivered in 2016.

Table 3 provides a summary of consumptive use water deliveries to Municipal Participants:

Table 3 – Monthly Deliveries to Municipal Participants (AF)

	Fowler	Fountain	Security
March	2.27	2.34	2.34
April	4.26	8.63	8.63
May	19.48	15.73	15.73
June	19.53	26.78	26.78
July	14.99	35.70	35.70
August	11.29	39.87	39.87
September	10.08	18.62	18.62
October	4.99	5.95	5.95
November	2.43	4.46	4.46
Total	**89.32**	**158.08**	**158.08**

1. Deliveries to Fountain and Security

Both Fountain and Security received delivery of their entire 158.08 acre-feet portion of the consumptive use water from Catlin Pilot Project operations at Pueblo Reservoir and moved this water to their municipal systems via the Fountain Valley Conduit. Just as in 2015 operations, the Catlin Pilot Project exchanged consumptive use water from the confluence of Timpas Creek (where augmentation station deliveries accrue to the Arkansas River) upstream to Pueblo Reservoir to make deliveries to both Fountain and Security.

Lower Ark received consumptive use water exchanged to Pueblo Reservoir for delivery to Fountain and Security in its Municipal and Industrial (M&I) Excess Capacity account. Transfers were then made from Lower Ark's account into Fountain and/or Security accounts at times requested by Fountain and/or Security. Fountain and Security would then hold the water in their respective storage accounts until needed. The table on the following page shows transfers from the Lower Ark Excess Capacity account to Fountain and Security's Excess Capacity accounts:

Table 4 – Transfers into Fountain/Security Excess Capacity Accounts

Transfer Date	Transfer Amount (AF)	
	Fountain	**Security**
4/14/2016	2.34	2.34
5/11/2016	8.63	8.63
6/16/2016	15.73	15.73
7/20/2016	0.00	26.78
8/12/2016	62.48	35.70
9/9/2016	0.00	39.87
10/11/2016	0.00	18.62
10/19/2016	30.00	0.00
10/26/2016	28.49	0.00
11/7/2016	5.95	5.95
11/18/2016	4.46	4.46
Total	**158.08**	**158.08**

Fountain delivered its Catlin Pilot Project water from its account via the Fountain Valley Conduit for use in its municipal system during the periods of July 15 – 17, August 22 – November 9, and November 19. Security delivered its water from its account via the Fountain Valley Conduit for use in its municipal system generally during the periods of July 15 – 29, September 14 – 21, October 24 – 27, November 8 – 9, and November 19 – 20.

2. Deliveries to Fowler

Like 2016, deliveries to Fowler were used to make replacements owed from the pumping of Fowler's junior wells. Fowler's wells are included in the Rule 14 Plan operated by the Colorado Water Protection and Development Association (CWPDA). If not for the wet conditions during 2016, the consumptive use water available to Fowler through the Catlin Pilot Project would likely have been used to allow Fowler to increase pumping of its wells and allow continued outdoor irrigation at times when Fowler is typically forced to impose watering restrictions

What is a Rule 14 Plan?

A Rule 14 Plan is an administrative approval that allows for tributary wells in the Arkansas Basin to continue to pump out-of-priority and replace associated well depletions to prevent injury to senior water rights and to prevent depletions to usable Stateline flow that would otherwise occur as a result to comply with the Arkansas River Compact, as required by the Amended Rules and Regulations Governing the Diversion and Use of Tributary Groundwater in the Arkansas Basin (1995). Currently, there are 11 Rule 14 Plans approved in the Arkansas basin. Three of these in the Lower Arkansas River basin are operated and administered by well augmentation groups that provide well replacements for a large number of member wells, where members are required to dedicate water supplies to provide well replacements to the plans.

on its customers. However, because of the wet conditions, watering restrictions were not required in Fowler during 2016 and therefore the water available from the Catlin Pilot Project allowed Fowler to preserve its Fryingpan-Arkansas Project water in Pueblo Reservoir for later use while still meeting its municipal demands. Fowler's total well depletions owed during operations are summarized on the following Table 5:

Table 5 – City of Fowler Well Depletions

Month	Depletions (AF)
March	21.67
April	24.59
May	33.47
June	39.67
July	43.26
August	45.00
September	42.60
October	39.84
November	75.39
Total	**365.48**

Of Fowler's amount owed, Catlin Pilot Project water replaced 89.32 acre-feet - more than 20% of Fowler's depletions. The following table shows the credits for consumptive use water that were delivered to Fowler and subsequently dedicated to CWPDA's Rule 14 Plan for use.

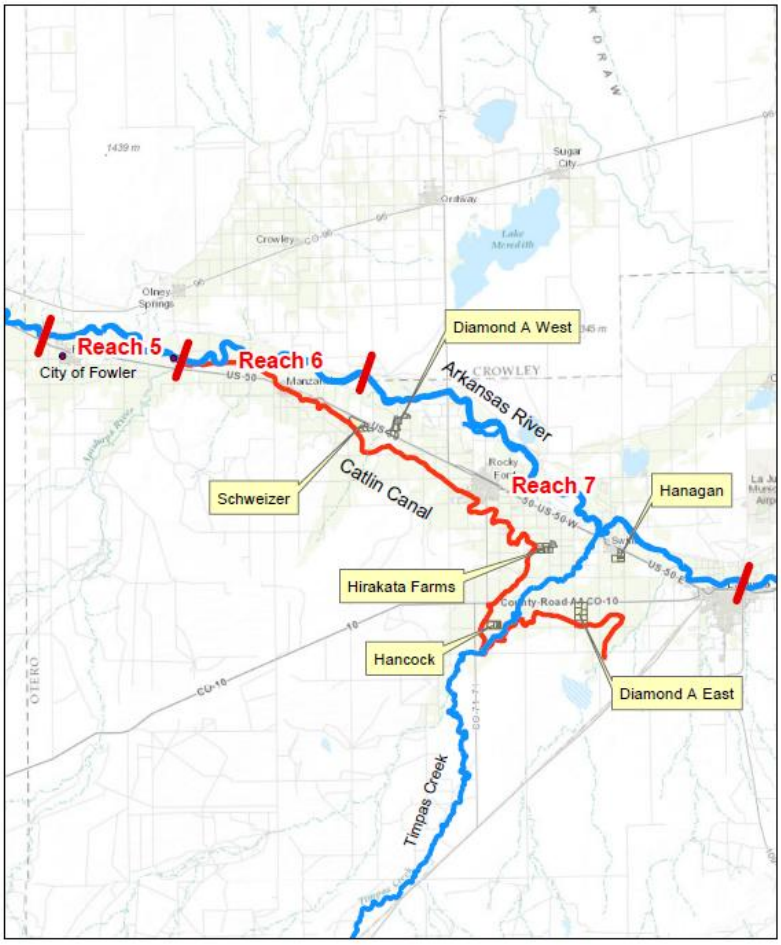
Table 6 – Consumptive Use Water Available to Fowler and Dedicated to CWPDA

	Consumptive Use Water Delivered to Fowler (AF)	Consumptive Use Water Applied to CWPDA Rule 14 Plan (AF)
March	2.27	2.27
April	4.26	4.26
May	19.48	19.48
June	19.53	19.53
July	14.99	14.99
August	11.29	11.29
September	10.08	10.08
October	4.99	4.99
November	2.43	2.43
Total	**89.32**	**89.32**

Consistent with 2015 operations, CWPDA traded the consumptive use water for other of CWPDA's water supplies available above Fowler's depletions rather than separately account for an exchange of that water from the confluence of Timpas Creek and the Arkansas River to the slightly upstream point of depletion of Fowler's wells. The Catlin Pilot Project specifically includes the flexibility to operate in this manner.[2] The use of the credits of consumptive use water made available to Fowler through the Catlin Pilot Project within CWPDA's Rule 14 Plan was regularly discussed as part of the Well Augmentation Coordination monthly meetings with the Division Engineer.

CWPDA's Rule 14 monthly accounting provided to the Division Engineer shows that CWPDA used Fowler's consumptive use water to replace well depletions affecting HI-Model Reach 7 on the Arkansas River. CWPDA then accounted for the replacement of Fowler's depletions owed in Reach 5 with other upstream supplies available to CWPDA. These reaches and their locations relative to Fowler and the Catlin Canal are shown on Figure 3.

Figure 3 – Catlin Canal, Fowler, and Rule 14 Well Depletion Reaches



[2] CWPDA's Rule 14 Plan has historically been operated and accounted for in this manner - applying replacement supplies to the reach where they are available irrespective of the location of the well for which those supplies were dedicated by a member.

IV. Operation of Exchanges

A. Generally

In order to make deliveries to both Fountain and Security, the Catlin Pilot Project exchanged consumptive use water from the confluence of Timpas Creek and the Arkansas River upstream to Pueblo Reservoir. The rate of exchange varied because it was limited to the amount of consumptive use water being delivered to the Timpas Creek Augmentation Station on any given day. The lowest operated rate of exchange was 0.17 cfs and the highest was 1.35 cfs. The average rate of exchange for all months was 0.68 cfs. The following Table 7 provides an overview of the exchanges operated:

Table 7 – Summary of Exchanges to Pueblo Reservoir

Date	Days with Pueblo Reservoir Exchange	Range of Exchanges Operated (cfs)	Average Exchange Rate (cfs)	Average Exchange Rate (AF/day)	Volume of Pueblo Reservoir Exchange (AF)
March	11	0.17 – 0.24	0.21	0.43	4.69
April	30	0.23 – 0.35	0.29	0.58	17.26
May	31	0.17 – 0.9	0.51	1.01	31.46
June	28	0.6 – 1.20	0.96	1.91	53.56
July	30	1.20	1.20	2.38	71.41
August	31	1.20 – 1.35	1.30	2.57	79.74
September	21	0.5 – 1.00	0.89	1.77	37.23
October	14	0.3 – 0.5	0.43	0.85	11.90
November	12	0.35 – 0.40	0.38	0.74	8.93
Total	**208**				**316.16**
Average			**0.69**	**1.36**	**35.116**

The total number of dates with exchange potential into Pueblo Reservoir in 2016 (208 days) exceeded that in 2015 (150 days) and there was sufficient exchange potential to operate the exchange of consumptive use water into Pueblo Reservoir to Fountain and Security at all times requested by Lower Ark throughout the entire 2016 operating season. During the first few weeks of May, exchange amounts were reduced as a result of the exercise of the City of Pueblo's decreed recreational in-channel diversion water right. On a limited number of days, the Catlin Pilot Project did not operate an exchange and the Catlin Pilot Project delivered all consumptive use water to Fowler at the point where Timpas Creek Augmentation Station deliveries return to the Arkansas River.

B. Setting the Exchange Rate

Based on the operational experience gained during 2015 operations, setting the exchange rate did not present the same challenge it had during the Catlin Pilot Project's first year of operations. Because advance approval of an exchange is required, the Catlin Pilot Project needed to estimate the amount of water that would be available for exchange on any given day and the associated rate of exchange to move that water to Pueblo Reservoir. A discussion on how this estimate is made utilizing the Catlin Pilot Project accounting is provided in the 2015 Annual Report (Section IV.C).

Because precisely matching actual deliveries to the theoretical deliveries that are established for planning purposes is not possible even under ideal conditions, exchanges were requested based on communication with both the Catlin Canal Company superintendent and the Division Engineer staff, and Lower Ark staff experience. Lower Ark typically set the exchange rate for approximately 85-90% of the expected CU delivery to reduce the number of adjustments required. The Catlin Pilot Project then delivered any excess consumptive use water not exchanged to Pueblo Reservoir to Fowler at the Timpas Creek Augmentation station. This way, little to no consumptive use water was not delivered to one of the Municipal Participants. This highlights that having multiple Municipal Participants with demands in different locations facilitated operations and the use of all of the historical consumptive use water available, and little went unused.

C. Potential Benefit of an "Owe-the-River Account"

An "Owe-the-River" reservoir account is sometimes used to balance the accounting in similar situations when exchanges may have been operated at rates higher than ultimately available. An "Owe-the-River" account is an administrative storage account that is used to balance accounting for water storage using the change in storage information to determine the amount of storage. If the amount of storage exceeds the amount that was stored either directly or by exchange, releases will be made to replace that excess storage. This release could be required one day in arrears, which is what was authorized for 2016 pilot project operations. However, more beneficial is an "Owe-the-River" account that allows for reservoir releases to be made once the account balance (excess amount stored) reaches 1% of the amount allowed to be stored in the reservoir. Water Division One typically allows for this type of "Owe-the-River" account, and this approach typically results in less frequent corrective releases while still ensuring that the river is kept whole. This type of administrative account is really an accounting tool and allows excess storage made by direct diversion or exchange to be managed on a more realistic basis than daily.

During 2016, the Division Engineer's Office did permit Lower Ark to make adjustments one day in arrears during weekdays and on Mondays following the weekend, which assisted in simplifying exchange operations, but still required close monitoring and frequent adjustments by

staff. However, the Division Engineer did not allow use of such an account operating on a 1% balance basis in Catlin Pilot Project operations during either 2015 or 2016.

Lower Ark recommends that Catlin Pilot Project operations be permitted to utilize an "Owe-the-River" account that would provide for releases of water stored by exchange in excess of available water when the excess exceeds 1% of the monthly consumptive use estimate for the fallowed shares in an average year. Based on the average monthly Catlin Pilot Project exchanges in 2016 and a modest 10% increase in the average exchanges, it would have taken between 1 and 4.5 days to reach the proposed 1% "Owe-the-River" account limit. Use of such an "Owe-the River" account in future years' operations would be even more beneficial in addressing any excess storage by exchange. This would benefit the Catlin Pilot Project by alleviating the need for regularly operating overly-conservative exchange rates and would thereby increase the ability of the Municipal Participants to take advantage of a greater portion of the consumptive use water generated through operations.

V. Return Flow Obligations

All return flow obligations for 2016 operations of the Catlin Pilot Project were met using farm headgate deliveries of the water attributable to the 2016 Shares associated with the 2016 Fallowed Acreage. Operations to meet return flow obligations in 2016 mirrored the successful operations in 2015. Augmentation station deliveries were made to the Timpas Creek Augmentation Station[3] and two recharge ponds (the Schweizer Recharge Pond and the Hanagan Recharge Pond) to meet return flow obligations. All tailwater return flow obligations were delivered through the Timpas Creek Augmentation Station. Deep percolation return flows continued to be replaced through the use of the recharge ponds and, to a lesser extent, Timpas Creek Augmentation Station deliveries. The Catlin Pilot Project used the Timpas Creek Augmentation Station to replace a portion of deep percolation return flows that historically accrued to the Arkansas River more quickly than recharge accretions from the recharge ponds reach the Arkansas River.

In 2016, all return flows were successfully replaced

Based on the revised LFT analysis conducted pursuant to the CWCB Approval, return flow obligations for 2016 pilot operations totaled 738.62 acre-feet. Of this amount, 147.71 acre-feet was due for tailwater return flows and 590.90 acre-feet was due for deep percolation return flows. The following table shows the deliveries made to meet return flow obligations.

Table 8 – Return Flow Deliveries (AF)

Month	Tailwater Return Flow		Deep Percolation Return Flow	
	Delivery	Excess(+)/ Deficit(-) Delivery from Obligation	Delivery	Excess(+)/ Deficit(-) Delivery from Obligation
March	13.51	0.00	54.04	0.00
April	25.31	0.00	101.23	0.00
May	21.34	0.00	85.38	0.00
June	14.77	+ 0.05	61.41	+2.55
July	16.34	- 0.01	66.61	+1.21
August	17.27	0.00	69.39	+0.32
September	14.35	0.00	57.40	0.00
October	13.63	0.00	54.54	+0.01
November	11.25	0.00	44.99	0.00
Total	**147.77**	**0.04**	**594.99**	**4.09**

[3] The Crooked Arroyo Augmentation Station is approved for use in the Catlin Pilot Project, but was not used in either 2015 or 2016.

Table 8 shows that there were four months in which deep percolation deliveries exceeded deep percolation return flow obligations, resulting in 4.09 acre-feet of excess water being delivered to the Arkansas River. In addition, there was one month in which tailwater deliveries exceeded tailwater return flow obligations by 0.05 acre-feet and one month where tailwater obligations exceeded deliveries by 0.01 acre-feet, resulting in 0.04 acre-feet of excess water being delivered to the Arkansas River.

A. Deliveries to Recharge

Use of recharge to replace deep percolation return flow obligations was again successful in 2016. Prior to 2015 operations, Applicants modified and adjusted divider boxes along a shared lateral ditch to facilitate deliveries to the Hanagan Recharge Pond to facilitate the delivery of water. The Schweizer Recharge Pond is served by a buried pipeline that diverts directly off the Catlin Canal.

Because there are no decreed diversions from the Arkansas River between the point of return flow from the Schweizer and Hanagan Recharge Ponds and the confluence of Timpas Creek and the Arkansas River, return flows from either pond can be used to make return flow obligations from all of the 2016 Fallowed Acreage to prevent injury to other water rights.

Recharge pond deliveries are summarized by month in Table 9 on the next page. As detailed in the prior section, these deliveries exceeded the amounts necessary to meet return flow obligations in some months. These deliveries account for the net infiltration amounts sometimes being in excess of deliveries.

Why is recharge valuable in meeting return flow obligations?

Just as in a permanent change of water right proceeding, ensuring that return flows are properly maintained is a key issue in any rotational fallowing project. In particular, deep percolation return flow obligations can present challenges in replicating the return flow pattern. Use of properly-located recharge can frequently be used to closely replicate the timing of return flows and has the added benefit of managing future return flow replacement obligations at the same time that water is made available under the changed water right. The other primary means of replacing lagged return flows is by having approved sources of replacement water available for delivery either directly or through releases from storage and then to project when those replacements must be made. The challenge in this latter approach is to manage the replacement sources in a manner that closely mimics the return flow pattern.

Schweizer Recharge Pond

Hanagan Recharge Pond

Table 9 – Deep Percolation Return Flow Deliveries to Recharge (AF)

Month	Schweizer Pond		Hanagan Pond	
	Deep Percolation Delivery	**Recharge (Net Infiltration)**	**Deep Percolation Delivery**	**Recharge (Net Infiltration)**
March	24.62	24.62	17.00	16.49
April	41.77	41.77	36.18	36.14
May	29.79	29.81	41.49	41.16
June	9.94	10.04	38.55	39.01
July	12.63	12.94	41.51	42.31
August	12.96	0.00	48.53	0.83
September	15.55	0.00	32.72	0.17
October	23.23	32.95	18.77	0.41
November	19.61	0.00	20.68	0.00
Total	**190.10**	**152.14**	**295.43**	**176.51**

Both ponds adequately recharged water throughout 2016. Daily checks were conducted to remove sediment from the flumes measuring inflows. In addition, the Radar Level Recorder for the Schweizer Pond required repairs, which meant that manual pond level readings were taken for about one month. Overall, both recharge ponds performed very well throughout 2016 operations, which is crucial to the successful operation of the Catlin Pilot Project.

B. Augmentation Station Deliveries

No operational changes with respect to augmentation station deliveries were made for 2016. The deliveries to the Timpas Creek Augmentation Station (shown in the photo) were made for consumptive use water for the Municipal Participants, tailwater return flows, and deep percolation return flows. Deep percolation return flow deliveries were

necessary because neither recharge pond was capable of providing recharge to the Arkansas River as quickly as the historical deep percolation from the Diamond A West Farm returned to the river. The augmentation station deliveries were allocated first to return flow obligations and the remainder was allocated to consumptive use water. Nearly all consumptive use water delivered to the augmentation station was subsequently delivered to the Municipal Participants. The deliveries were charged a transit loss from the point of delivery on Timpas Creek to its confluence with the Arkansas River, a distance of approximately 3.6 miles. A summary of augmentation station deliveries is provided in Table 10:

Table 10 - Deliveries to the Timpas Creek Augmentation Station

Month	Total Augmentation Station to Arkansas River	Consumptive Use to Municipal Participants	Return Flow Delivery	Transit Losses
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
March	33.13	6.95	25.94	0.24
April	70.67	21.52	48.59	0.56
May	87.20	50.94	35.44	0.82
June	101.87	73.09	27.70	1.09
July	116.45	86.40	28.80	1.25
August	117.44	91.02	25.17	1.25
September	71.51	47.31	23.49	0.71
October	43.43	16.89	26.17	0.37
November	27.50	11.35	15.94	0.20
Total	**669.20**	**405.47**	**257.23**	**6.50**

C. Use of Pay As You Go Approach

Just as in 2015, the Catlin Pilot Project's 2016 operations utilized the "Pay As You Go" approach for replacing deep percolation return flow obligations, which involves making contemporaneous deliveries of water to meet those obligations to properly located recharge facilities.[4] Condition No. 31 of the CWCB Approval authorized "Pay As You Go" to meet deep percolation return flow obligations. Background and details concerning the Pay As You Go approach are included in Section V.B of the 2015 Annual Report and are not repeated here.

[4] In order to utilize this approach, Lower Ark needed to demonstrate that deliveries to the two recharge ponds and augmentation stations would meet return flow obligations within 10 acre-feet per month, assuming 10 years of operations and average-year deliveries. Ten acre-feet per month was assumed to be a reasonable range of variation in deep percolation return flow accretions that may occur when Catlin Canal shares have historically been moved from one farm headgate to another or individual fields were fallowed from year to year.

In 2016, Pay As You Go consisted of deliveries to the recharge ponds and the Timpas Creek Augmentation Station based on the ranges of deliveries expressed as percentages of deep percolation return flow obligations at the farm, and are designed so that the difference in the timing of deep percolation return flow between historical return flow obligations and deep percolation deliveries to the Arkansas River would not exceed ten acre-feet in any month. The accounting utilizes a target value within the ranges for each structure to which Catlin Pilot Project water is delivered. So long as the actual delivery range is within the stated ranges deep percolation return flows are considered to have been replaced in accordance with Pay As You Go.

Table 11 illustrates the monthly percentage of deep percolation deliveries to each point of delivery during 2016 operations of the Catlin Pilot Project. Sums greater than 100% indicate over-delivery of deep percolation return flows.

Table 11 - % Deep Percolation Deliveries

Month	Schweizer Pond	Hanagan Pond	Timpas Creek Augmentation Station	Sum of All Delivery Points
	10%-50%	**30%-80%**	**8%-23%**	**100%**
	%	**%**	**%**	**%**
March	46%	31%	23%	100%
April	41%	36%	23%	100%
May	35%	49%	17%	100%
June	17%	65%	22%	103%
July	19%	63%	19%	101%
August	19%	70%	11%	100%
September	27%	57%	16%	100%
October	43%	34%	23%	100%
November	44%	46%	10%	100%

This Table shows that 2016 operations of the Catlin Pilot Project provided the required deep percolation deliveries during all months.

At the conclusion of 2016 operations, Lower Ark conducted a review of how the Pay As You Go target deliveries worked at staying within the 10 acre-feet per month limitation. A summary table of this analysis is provided in **Appendix C**. This analysis demonstrated that the delivery targets were successful at maintaining deliveries within the 10 acre-feet per month limitation in all months except one month (April) where approximately 10.4 acre-feet of return flow deliveries in excess of obligations were made. This excess was due to deliveries at the augmentation station being at the

high end of the delivery range for both March and April (the range for the Timpas Creek Augmentation Station is 9% to 23% and deliveries during that time were at 23%), which resulted in providing deep percolation return flows that were delivered through that augmentation station to the Arkansas River slightly sooner than historical deliveries would have accrued in an average year.

D. Number of Days Return Flow Obligations Unmet

Because Applicants elected to use Pay As You Go for deep percolation return flow replacement in 2016, the Catlin Pilot Project was not required to meet daily return flow obligations for deep percolation. With respect to tailwater return flow obligations, Condition No. 19 of the CWCB Approval requires tailwater return flow obligations to be calculated daily and that Applicants demonstrate on a monthly basis that all tailwater return flow obligations were replaced. In recognition of the operational constraints and variability of deliveries, this condition goes on to provide that the Catlin Pilot Project shall *endeavor* to replace the calculated amount of tailwater return flow on a daily basis. Nevertheless, in compliance with the annual reporting requirements, Lower Ark calculated the days of unmet return flows in 2016.[5]

As shown in Table 12 on the next page, these return flow obligations were consistently met on a daily basis. There were two instances, occurring on June 1, 2016 and July 26, 2016, where there was an apparent shortage of tailwater deliveries (amounting to 0.23 acre-feet) to the Arkansas River. However, upon review of the accounting it was noted that only a very small amount of consumptive use credits were claimed on these days due to inadequate deliveries at the Timpas Creek Augmentation Station and therefore return flow obligations were less than those calculated by the accounting, resulting only in a 0.01 acre-foot under-delivery of tailwater return flows on July 26.

[5] For this analysis, un-met return flows were defined as the difference between the return flow obligations and return flow deliveries. Return flow obligations were calculated in the monthly accounting for the pilot project. As required by the CWCB Approval, consumptive use water was calculated as a percentage of measured farm headgate deliveries, and tailwater and deep percolation obligations were calculated as 20% and 80%, respectively, of farm headgate deliveries minus consumptive use. Farm headgate deliveries were determined by adding the deliveries to the recharge ponds and augmentation stations. Deep percolation deliveries were based on the actual deliveries to the recharge ponds and the augmentation station. Therefore, return flow obligations were met by application of the accounting, which divides the deliveries such that the amount of water allocated to return flows is in correct proportion to the amount allocated to consumptive use water.

Table 12 - Un-met Return Flow Obligations

Month	Deep Percolation Deliveries Short	Deep Percolation Deliveries Monthly Excess/Deficit	Tailwater Deliveries Short	Tailwater Deliveries Monthly Excess/Deficit
	# days	**(acre-feet)**	**# days**	**(acre-feet)**
March	0	0.00	0	0.00
April	0	0.00	0	0.00
May	0	0.00	0	0.00
June	0	+2.55	0	+0.05
July	0	+1.21	1	-0.01
August	0	+0.32	0	0.00
September	0	0.00	0	0.00
October	0	+0.01	0	0.00
November	0	0.00	0	0.00
Total	**0**	**+4.09**	**0**	**+0.04**
Delivery shortages are negative (-) and excess deliveries are (+).				

E. Reduced Challenges in Operating Hanagan Recharge Pond

Challenges encountered and addressed in operating the Hanagan Recharge Pond during 2015 served to ease operation of the Hanagan Recharge Pond during 2016. Because the Hanagan Recharge Pond is located at the end of a farm lateral that is utilized by five other farms, deliveries to this structure require continuous monitoring to ensure that deliveries to the pond were on target. No significant problems were encountered with respect to other irrigators on the lateral making adjustments to divide boxes that impacted deliveries to the pond. Monitoring of deliveries was aided by telemetry equipment installed in June of 2015. This allowed Lower Ark to quickly respond to unanticipated changes in deliveries to the recharge ponds and have adjustments made.

After 2015 operations ceased, there was a report of possible seepage from the Hanagan Recharge Pond into a nearby field (detailed in the 2015 Annual Report). Seepage would be a concern because water rising to the surface could indicate a portion of the recharged water might be consumed by plants and/or evaporation before returning to the Arkansas River. There was no opportunity to confirm the validity of this report since the seepage was reported after project operations ended for 2015. Lower Ark monitored the Hanagan Recharge Pond during 2016 for

any potential surfacing of recharged water at locations near and down-gradient of the ponds in the direction of the Arkansas River and did not observe any seepage surfacing on nearby fields. In addition, there were no reports of seepage during 2016.

F. Weed Evapotranspiration and Surface Evaporation

The CWCB Approval provides that replacements must be made at times when standing water is present in the recharge ponds to replace evaporation. Standing water rarely occurred in the Schweizer Recharge Pond. However, the Hanagan Recharge Pond did regularly have standing water. Consumptive use water generated from the Catlin Pilot Project was used to make replacements for this surface evaporation. In total, the amount of water owed for surface evaporation from the ponds was minimal – 6.8 acre-feet for 2016 operations. Surface evaporation owed by month to the Schweizer and Hanagan Recharge Ponds is shown on Table 13.

Table 13 – Summary of Recharge Pond Evaporation

Month	Schweizer Recharge Pond Evaporation	Hanagan Recharge Pond Evaporation
	(ac-ft)	**(ac-ft)**
March	0.00	0.08
April	0.00	0.47
May	0.00	0.74
June	0.04	0.95
July	0.09	1.30
August	0.03	1.24
September	0.10	0.91
October	0.16	0.24
November	0.10	0.23
Total	**0.52**	**6.17**

In addition, the CWCB Approval (condition 42(c)) requires replacement of weed evapotranspiration (ET) if weeds are present. Both recharge ponds experienced some weed growth during 2016. Therefore, weed ET was estimated monthly in order to make replacements of the ET to the Arkansas River using credits from consumptive use water (water that would have otherwise been available for delivery to Municipal Participants for that month). These weed ET estimates are described and illustrated in **Appendix D**.

Following calculation of these estimates, Lower Ark monitored the ponds for the presence of weeds and to assure that deliveries were being made at the prescribed rates and that measurement devices were operating correctly. Weed ET was offset by monthly consumptive use deliveries to

the recharge ponds from May through November. Table 14 presents a summary of estimated monthly net weed ET and the associated consumptive use water releases made to replace that weed ET.

Table 14 - Estimated Net Weed ET and Consumptive Use Credit Releases (AF)

Month	Estimated Net Weed ET Depletion	CU to Recharge Ponds for Weed ET	CU Balance
March	0.00	0.00	0.00
April	0.00	0.00	0.00
May	0.03	0.03	0.00
June	0.77	0.50	0.26
July	0.98	1.24	-0.26
August	0.73	0.73	0.00
September	0.66	0.66	0.00
October	0.42	0.42	0.00
November	0.17	0.17	0.00
Total (AF)	**3.76**	**3.76**	**0.00**

Efforts were taken to control weed growth in both ponds. Because of the low water level in the Schweizer Recharge Pond, weeds were disked every few months to limit their growth. The photo to the left shows the Schweizer Pond after the weeds had been disked. However, a higher water level in the Hanagan Recharge Pond did not allow for disking of weeds and instead weeds were sprayed with herbicide at least twice during 2016. In order to try and reduce the weed growth and associated loss of consumptive use water to replace weed ET, Lower Ark plans to aggressively work to control weeds early in 2017 through the use of herbicides.

VI. Efficacy of the Lease-Fallow Tool

The Criteria and Guidelines require the use of the Lease-Fallowing Tool (LFT), developed by the State Engineer, to estimate the historical consumptive use of water included in a lease-fallowing pilot project. The Criteria and Guidelines also require the use of specific data, methodologies and factors in the LFT for the purposes of providing a streamlined and conservative analysis of consumptive use. 2016 operations demonstrated that the LFT methodology for calculating consumptive use water is, in fact, quite conservative. This section uses 2016 operations as an illustration of certain conservative aspects of the LFT and the Criteria and Guidelines.

A. Calculation of CU Volumetric Limits

Pursuant to the Criteria & Guidelines, the CWCB Approval incorporates monthly volumetric consumptive use (CU) limits on the amount of consumptive use water that can be delivered to the Catlin Pilot Project. During 2015 operations, there were four months (April, July, August and September) of Catlin Pilot Project operations, wherein deliveries reached monthly volumetric consumptive use limits. This required cessation of deliveries of consumptive use water to the Catlin Pilot Project. This was in spite of the fact that the Catlin Canal Company water rights remained in priority and continued to be diverted for use by other Catlin Canal Company shareholders.

During 2015 Operations, conservative monthly consumptive use limits resulted in 10.8 acre-feet less of consumptive use water being delivered to the Catlin Pilot Project

This curtailment was due to the manner of calculating the monthly consumptive use limitations, which were based on the average monthly consumptive use of each month in the three years with the highest annual consumptive use for the period of record, as required by the original version of the Criteria and Guidelines. This method of determining the CU Limit is not what is typically done for a change of use application or substitute water supply plan. Rather, this method is more conservative than the standard method of calculating CU limits, which uses the highest months or the average of the three highest months during the period of record. This is because it is unlikely that the three maximum years of record would also contain all of the highest months of record.

Lower Ark presented an analysis of the overly conservative nature of this requirement in the 2015 Annual Report for the Catlin Pilot Project and requested the CWCB modify the Criteria and Guidelines accordingly. The CWCB subsequently modified the manner of calculating these limits in the Criteria and Guidelines (amended January 25, 2016). As a result, there were no

months during 2016 operations wherein cessation of deliveries was required due to attainment of the limits.

To demonstrate the difference that this change in the Criteria and Guidelines made to the consumptive use water available to the Catlin Pilot Project in 2016, Lower Ark conducted an analysis to compare the CU limits under the prior vs. current methodology. Table 15 compares the monthly consumptive use limits for 2016 derived using the original Criteria and Guidelines (CU Limit – 3 Highest Years) with the updated methodology of using the three highest months in the study period to derive the CU limits.

Table 15 - Consumptive Use Limit Comparison (AF)

Month	CU Limit - 3 Highest Years	CU Limit - 3 Highest Months	ΔCU Limit
March	11.6	33.6	-22.0
April	21.5	46.2	-24.7
May	43.4	72.9	-29.5
June	97.8	117.2	-19.4
July	108.6	119.7	-11.1
August	99.5	120.8	-21.3
September	52.1	72.2	-20.1
October	38.5	53.7	-15.2
November	9.8	36.8	-27.0

The former Criteria and Guidelines CU monthly limits range from 11.1 acre-feet to 29.5 acre-feet lower than the limits developed using the three highest years of record during the study period.[6] Use of the three-highest month methodology allowed for increased consumptive use water available for the Municipal Participants in the months for 2016 operations that would have been constrained by the former CU limits.

Table 16 on the next page presents a comparison of the Actual CU delivery for 2016 with the Estimated Delivery allowable under the former monthly CU limits. Use of the more realistic CU limits resulted in an increase in consumptive use credits of 12.39 acre-feet (422.41 – 410.0 = 12.39).

[6] Under either method for calculating the monthly CU limit, the annual limit will be the same because the annual limit is based on an average of the three highest years in the period of record.

Table 16 - Comparison of 2016 CU Delivery with Deliveries under Revised CU Limits (AF)

Month	Actual CU Delivery for 2016 – 3 Highest Months Limits	Estimated CU Delivery – 3 Highest Years Limits
March	7.28	7.28
April	22.56	21.55
May	52.54	43.44
June	75.67	75.67
July	90.28	90.28
August	94.27	94.27
September	49.68	49.68
October	18.08	18.08
November	12.06	9.76
Total	**422.41**	**410.02**

B. Conservativeness of HB 1248 & the Lease-Fallow Tool

As part of the 2015 Annual Report, Lower Ark and Super Ditch conducted a comparison of the amount of historical consumptive use water determined using two different sets of inputs available for use in the LFT. The first were those inputs that are those required by the Criteria and Guidelines. The second set of inputs was from the Hydrological Institutional Model (HI Model). Additional detail and information on the HI Model inputs and how this comparison was conducted is set forth in Section VI.B of the 2015 Annual Report and is not repeated here. That comparison illustrated that for the Catlin Canal Pilot Project, the historical consumptive use per acre available when using the Criteria and Guidelines inputs in the LFT ranged from 56% to 90% of the HI Model inputs results in minimum and maximum years, respectively. Therefore, the conservativeness of the LFT and the Criteria and Guidelines could constrain the water available to Municipal Participants by as much as 10% in a wet year and 44% in a dry year.

What is the HI Model?

The HI Model was a model developed and agreed to by the States of Kansas and Colorado in litigation over the replacement of well depletions affecting the Arkansas River in Kansas. This model was vetted by experts from both States and provides the basis for compliance with the Arkansas River Compact through the operation of Rule 10 and Rule 14 Plans.

Using this comparison to evaluate the conservative nature of the Criteria and Guidelines inputs, the HI Model inputs were applied to the 2016 Catlin Pilot Project accounting. A side-by-side

comparison with the 2016 Catlin Pilot Project limits, consumptive use deliveries and potential consumptive use deliveries is provided in Table 17:

Table 17 - Comparison of H.B. 13-1248 and HI Model Methods (AF)

Month	H.B. 13-1248 Method (reflects actual operations in 2016)				HI Model Method (simulated 2016 operations)		
	CU Limit	**CU Actual**	**Potential CU Delivery**		**CU Limit**	**CU Delivered**	**Potential CU Delivery**
March	33.6	7.28	8.57		41.7	16.49	20.67
April	46.2	22.56	22.66		65.1	39.17	39.59
May	72.9	52.54	52.85		89.6	63.06	63.77
June	117.2	75.67	79.39		131.2	80.34	83.31
July	119.7	90.28	94.72		134.8	93.52	96.86
August	120.8	94.27	94.27		130.7	96.09	94.84
September	72.2	49.68	49.92		81.5	55.28	54.81
October	53.7	18.08	21.78		51.9	14.12	16.75
November	36.8	12.06	12.06		43.3	14.61	14.43
Total	**488.4**	**422.41**	**436.23**		**566.6**	**472.68**	**485.04**

The potential CU delivery that would have been available to 2016 operations using the HI Model inputs was 48.41 acre-feet greater (485.04 - 436.23 = 48.41) than what was actually available 2016 operations, which is an 11% difference. The consumptive use that would have been delivered if the 2016 operations had been based on the LFT utilizing the HI Model inputs would have been 50.27 acre-feet greater (472.68 - 422.41 = 50.27) than actual deliveries in 2016, which is a 12% difference. This evidences the conservative nature of the LFT, which is underscored by the widespread belief that the HI Model itself produces a very conservative estimate of historical consumptive use.

VII. Compliance with Dry-Up Requirements

The CWCB Approval contains a number of terms and conditions regarding how dry-up is conducted and monitored. Dry-up of 2016 Fallowed Acreage was successful. As required by Condition No. 6, signs were posted on all parcels included in the 2016 Fallowed Acreage. 2016 Fallowed Acreage was fallowed as shown in Table 18 and illustrated in the photos on the next page:

Table 18 – Dry-up Method by Parcel

Participating Farm	Parcel ID	Dry-Up Method
Diamond A East	24561108	winter wheat
	24561116	winter wheat
	24561117	winter wheat
Diamond A West	23570402	winter wheat
	22573309	winter wheat
Hanagan	23563603	disked
Hancock	24560722	winter oats
	24560711	winter oats
Hirakata	23562812	winter wheat
	23562827	winter wheat
	23562828	winter wheat
Schweizer	22573220	disked
	22573224	winter wheat

Disked and Sprayed Fields

Winter Wheat

Winter Oats

Corn Stalks

Separation of Fallowed Fields

Inspections of the 2016 Fallowed Acreage were generally conducted by Lower Ark approximately twice per month. The Division Engineer conducted periodic inspections. In addition, the State of Kansas conducted inspections of the 2016 Fallowed Acreage in June and September to confirm compliance with the dry-up conditions of the CWCB Approval. No deviations were discovered as a result of these inspections.

Fallowing allowed farmers to laser level fields, install drip systems, and repair tile drains that would otherwise have been difficult to accomplish without losing productivity during the irrigation season

A. Efficacy of Prevention of Blowing Soils, Erosion and Noxious Weeds

Participating Farmers in the Catlin Pilot Project are contractually bound to undertake actions necessary to prevent blowing soils and erosion and to prevent noxious weeds. There were no reported problems with blowing soils or erosion on the 2016 Fallowed Acreage. Participating Farms controlled for noxious weeds in compliance with their obligations. The following actions were taken to control for noxious weeds on the 2016 Fallowed Acreage:

Table 19 – Noxious Weed Control by Farm

Farm	2016 Acres	Activity
Diamond A East	76.3	Winter wheat, sprayed weeds after harvest
Diamond A West	36.1	Winter wheat, sprayed weeds after harvest
Hancock	22.7	Winter oats, sprayed and disked after harvest
Schweizer	30.1	Disked winter wheat and weeds
Hanagan	32.8	Disked weeds and 2014 corn stalks
Hirakata	39.9	Winter wheat, sprayed weeds after harvest

In sum, the Catlin Pilot Project effectively achieved temporary dry-up, prevented blowing soils and erosion, and controlled noxious weeds on the 2016 Fallowed Acreage. Participating Farmers also commented that it allowed them to be more aggressive with weed control, with beneficial effects in subsequent years and also allowed them to level fallowed fields and install drip systems for use in future years.

B. Efficacy of Re-Irrigation

Approximately two thirds of the acreage fallowed in 2015 was re-irrigated in 2016. Operators of the Diamond A West, Diamond A East, and Hirakata farms (those farms that undertook re-irrigation in 2016) all indicated that no problems were encountered in bringing previously fallowed fields back under irrigation and the re-irrigated fields appeared to perform similar to fields that had not been fallowed. It is possible that the wetter than average conditions during 2015 helped to maintain the soil moisture in the fallowed fields, which would likely assist in crop success in following years. In addition, one of the operators planted the previously fallowed fields with alfalfa in 2016 and because yields of alfalfa are typically somewhat low in the first year of planting, the experience with these fields' performance in subsequent years may be more informative as to the possible impacts of temporary fallow.

Re-irrigation of fields fallowed in 2015 operations was successful during 2016

For those parcels that were fallowed in both 2015 and 2016, information regarding the efficacy of re-irrigation of the 2016 temporarily fallowed lands is not yet available. Catlin Pilot Project operations will continue to track and document the re-irrigation of those parcels temporarily fallowed at such time that they are brought back under irrigation, and the efficacy of re-irrigation will be monitored and discussed with the irrigators. In subsequent years, Participating Farms will be asked to track progress and provide information regarding any difficulties encountered during re-irrigation or conversely, any benefits realized during re-irrigation as a result of prior years' fallowing.

VIII. Accounting Modifications & Errors

As required by Condition No. 52 of the CWCB Approval, this section discusses accounting modifications made during 2016 operations, proposed accounting modification, and any errors identified in accounting.

The accounting developed and approved for the Catlin Pilot Project, as modified in response to recommendations made after 2015 operations and during the course of 2016 operations, has worked extremely well. A set of summary tables for the annual accounting is provided in **Appendix E**. Revised accounting – consistent with the recommended modifications proposed in the 2015 Annual Report – was submitted to the Division Engineer's Office on March 1, 2016 and was provided to all commenting parties for their review. The revised monthly accounting and other Catlin Pilot Project submittals for 2016 were all posted online, as required by Condition No. 3 of the CWCB Approval. These are located on the Colorado Division of Water Resources Laserfiche Weblink (WDID 1707700) at http://dwrweblink.state.co.us/dwrweblink/search.aspx?dbid=0.

A. Accounting Modifications Made

Over the course of 2016 operations, Applicants worked with the Division Engineer to modify one column in the accounting. This was a refinement of a proposed modification that was made in response to the 2015 operations that added a column to account for deliveries of water for weed evapotranspiration (as discussed in Section V.E) labeled "CU Release to River." However, in order to account for deliveries of water for weed ET during 2016 Operations, the weed ET was included in the consumptive use deliveries to the recharge ponds for evaporation on the Actual Accting tab, which was modified to "CU Portion of Delivery for Evap/Weed ET." The "CU Release to River" column added to the Actual Accting tab for 2015 operation was deleted since CU was delivered to the recharge ponds rather than delivered to the river. This change is appropriate since weed ET occurring at ponds has the effect of decreasing deliveries to deep percolation if not replaced by consumptive use delivered to the ponds.

B. Accounting Error and Proposed Modification

Only one accounting error was identified in the 2016 accounting. This error occurred on the "Actual Delivery Running Total" tab. This cell references "Total Pilot Project Deliveries" on the Actual Accting tab, but should reference the "Pilot Project FHG Deliveries" (also on the Actual Accting tab). This error had no effect on 2016 operations because farm headgate delivery limits were not exceeded and therefore the "Total Pilot Project Deliveries" functioned in the same manner it would have if the reference had been properly linked to the "Pilot Project FHG Deliveries." The correction of this reference in the only proposed modification to the Catlin Pilot Project accounting.

IX. Financial Information

The Catlin Pilot Project was the first application to be submitted and approved through the CWCB's H.B. 13-1248 pilot program. This meant that the Catlin Pilot Project application was the first to go through the process established in the CWCB's Criteria and Guidelines and was also the first to conduct an analysis using the LFT that was developed by the State Engineer. As a result, the process of putting together the Catlin Pilot Project application, working through the comments of nine parties, preparing a joint conference report with proposed terms and conditions, obtaining the CWCB Approval and then complying with the "conditions precedent" to 2016 operations that were set out in that approval, was an arduous one that involved significant commitment of time and financial resources by the Lower Ark District.

As a result of the costs incurred in developing the first pilot project application, the Lower Ark District requested and obtained grant funding from the CWCB's Alternative Transfer Methods Grant Program in May 2016. The grant money covers certain operational expenses incurred as a part of 2016 Catlin Pilot Project operations, including accounting and reporting. Lower Ark and Super Ditch are deeply appreciative for this financial support.

A. Operational Expenses

Expenses incurred during 2016 operations primarily consisted of costs associated with Lower Ark personnel time and support work conducted by Martin and Wood Water Consultants, Inc. These efforts generally included such things as regular monitoring of the recharge facilities and deliveries; compiling and reviewing data on recharge and augmentation station deliveries; preparing both planning and actual accounting; repairing and maintaining equipment; setting exchanges and associated coordination with the Catlin Canal Company superintendent and the Division Engineer monitoring of 2016 Fallowed Acreage; communicating with pilot project participants; modifying the Security and Fountain lease agreements; and addressing operations issues/concerns as they arose.

Operational costs (labor and mileage) associated with 2016 operations are summarized on Table 20 on the next page:

Table 20 – 2016 Operational Expenses (March – November)

Category	Hours	Amount
Engineering – Lower Ark Staff	582	$34,920.00
Field Tech – Lower Ark Staff	240*	$1,400.00
Engineering – M&W Consulting	35	$6,550.52
Legal - BHGR	7	$1,680.00
Administrative – Lower Ark Staff	45**	$1,125.00
Mileage – Lower Ark Staff	10,370 miles*	$5,599.80
Total		**$51,275.32**
*Note that because the Schweizer Recharge Pond equipment was damaged and was not usable for approximately 6 weeks while sent out for repair, daily trips to make measurements of the Schweizer Recharge Pond were necessary and resulted in increased labor/mileage costs.		
** Administrative time estimated at 45 hours.		

In addition, engineering costs incurred in January and February 2016 to work with irrigators to identify acreage for fallow for 2016 and to comply with submittal requirements for 2016 operations were $11,165.44 (59 hours). Costs associated with preparation of the 2015 Annual Report were not compiled for purposes of this 2016 Annual Report.

Minor expenses were also incurred for the maintenance of equipment previously purchased and installed to facilitate use of the Schweizer and Hanagan Recharge Ponds. In 2014, both of these ponds were equipped with a Parshall flume with stage discharge recorder to measure and record pond infiltration and a staff gauge to measure pond water surface elevation. In June 2015, both ponds were equipped with a radar level recorder to measure pond water surface elevation and with GPRSLink logging transmitters. These use telemetry to transmit pond inflow volumes and to record and transmit pond water surface elevations to SutronLink computer software used by Lower Ark. No major equipment costs were incurred during 2016 and expenses reflected only the maintenance and repair of the systems previously put in place for the recharge ponds. These 2016 equipment costs are summarized in the following table.

Table 21 – 2016 Equipment & Supplies

Equipment & Supplies	No.	Unit Cost	Total Cost
Sutron RLR Repair	1	$287.66	$287.66
Miscellaneous Maintenance Supplies	1	$100.22	$100.22
SutronWIN Annual Subscription	4	$365.00	$1,460.00
Total			**$1,847.88**

Equipment installed on Schweizer Recharge Pond

Finally Lower Ark used a portion of storage space available in Pueblo Reservoir pursuant to its M&I Excess Capacity Contract with the Bureau of Reclamation.. The cost associated with this storage account is $18,770.00.

B. Lease Payments

From the perspective of the Participating Farmers and the Municipal Participants, the Catlin Pilot Project was a success. All farms will participate again in 2017 and a number have offered to include additional irrigated acreage in future operations. Table 22 on the next page summarizes the payments made to Participating Farms.

The average payment per fallowed acre in 2016 was $1,004.42

Table 22 - Payments to Participating Farmers

Farm [7]	C.U. Delivered (AF)	Delivery Payment ($500/AF)	Option Payment ($150/acre)	Total Payment	Payment per acre
A	127.73	$ 63,864,08	$ 11,445.00	$ 75,309.08	$ 987.01
B	65.16	$ 32,580.49	$ 5,415.00	$ 37,995.49	$ 1,052.51
C	55.39	$ 27,694,18	$ 4,920.00	$ 32,614.18	$ 994.33
D	38.58	$ 19,290.01	$ 3,411.00	$ 22,701.01	$ 998.29
E	67.67	$ 33,833.46	$ 5,985.00	$ 39,818.46	$ 997.96
F	50.96	$ 25,477.78	$ 4,515.00	$ 29,992.78	$ 1996.44
Totals	**405.48**	**$ 202,740.00**	**$ 35,691.00**	**$ 240,098.58**	**$ 1,004.42**

Both Fountain and Security paid a total of $79,040 ($500 per acre-foot). For 2016 operations, the Lease Agreement entered into between Fowler and Super Ditch did not require a lease payment for water received and payments to Participating Farms associated with those deliveries were made by Lower Ark. All three Municipal Participants currently anticipate continued participation on the Catlin Pilot Project.

C. Costs Associated with Fallowed Fields

Lower Ark requested information from Participating Farms regarding the costs associated with fallowing the 2016 Fallowed Acreage and compliance with requirements concerning erosion, blowing soils, and noxious weeds. All six Participating Farms responded. Table 23 shows the costs associated with fallowing the fields and controlling for weeds were modest.

Table 23 – Estimated Costs Associated with Weed Control

Farm	2016 Acres	Est. Cost per Acre	Total Est. Cost	Activity
Diamond A East	76.3	$40.00	$3,052.00	Winter wheat parcel, sprayed after harvest
Diamond A West	36.1	$40.00	$1,444.00	Winter wheat parcel, sprayed after harvest
Hancock	22.7	$35.00	$795.90	Winter oats, sprayed and disked weeds after harvest
Schweizer	30.6	$50.00	$1,505.00	Disked winter wheat and weeds
Hanagan	32.8	$16.00	$524.80	Disked weeds and 2014 corn stalks
Hirakata	39.9	$40.00	$1,596.00	Disked winter wheat and weeds
Total	**237.94**		**$8,917.70**	

[7] In the interest of privacy, we have withheld the name of the farm associated with the specific payment amount.

In addition, Mr. Hanagan and Mr. Schweizer each expended approximately $1,000.00 to disk and/or spray the weeds in and around their respective recharge ponds.

D. Summary

The available financial information for 2016 generally demonstrates that rotational leasing-fallowing is a financially attractive means for farmers to provide temporary water supplies for municipal users, while keeping the associated water in agricultural communities. In coming years, operational costs for the Catlin Pilot Project will decline from the 2016 costs with additional experience and the development of new tools to streamline and simplify operations. Importantly, much of the operating expense is unrelated to the volume of water delivered, and scale-up of the pilot project concept would not correspondingly increase costs.

X. Conclusion & Recommendation

2016 marked a second highly successful year of Catlin Pilot Project operations. Over 400 acre-feet of water was supplied to the Town of Fowler, the City of Fountain, and the Security Water District. Operations were able to consistently meet all return flow obligations through the use of project facilities, including two recharge ponds that performed well. The Catlin Pilot Project operated exchanges into Pueblo Reservoir at all times desired to make deliveries to Fountain and Security. The fallowing of historically irrigated fields went smoothly without problems with erosion or noxious weeds. An aspect of project design that proved particularly helpful in utilizing all water generated by operations was differing delivery locations for the multiple municipal participants (Fountain and Security by exchange in Pueblo Reservoir and Fowler at the point of delivery to the Arkansas River) such that operation of an exchange was not always necessary. Participating Farms received an average of $1,004 per fallowed acre. Fountain and Security obtained water during times of high demand for $500 per acre-foot. Experience gained during 2015 operations was used to fine-tune accounting and streamline operations, which were successfully implemented in 2016. The cooperation and communication among the State and Division Engineers, water users, Kansas, and the Catlin Pilot Project facilitated identification and resolution of obstacles to operation of rotational fallowing-leasing.

In addition to meeting the legislative policy goals of H.B. 13-1248, the Catlin Pilot Project is significant to the entire State of Colorado because it is the first "proof of concept" in the State of rotational land fallowing-municipal leasing. This second year of operations successfully demonstrated that rotational land fallowing-municipal leasing can be a viable alternative to permanent buy-and-dry. Specifically, the success of the Catlin Pilot Project in 2016 increased irrigators' interest in rotational fallowing-municipal leasing. It has also reduced other water users' anxiety about temporary transfers for municipal use and demonstrated the successful exchange and delivery of wet water at a reasonable cost.

Rotational land fallowing-municipal leasing is central to the goals of the Colorado Water Plan, the CWCB, the IBCC, and basin roundtables. The Catlin Pilot Project's success means those goals are not misplaced, and are achievable with leadership, determination, and cooperation.

A. Recommendation

As a result of the Catlin Pilot Project's continued success in delivering consumptive use water through exchanges while consistently meeting return flow obligations, Lower Ark recommends that use of an "Owe-the-River" account be permitted in future years' operations to allow the limited storage of any excess exchange water to maximize exchanges of consumptive use water into storage in Pueblo Reservoir. Any such excess would be released to the river as proposed in Section IV.C to balance the storage account. Such limited storage of exchange water is important because precisely matching actual deliveries to the river for exchange with desired

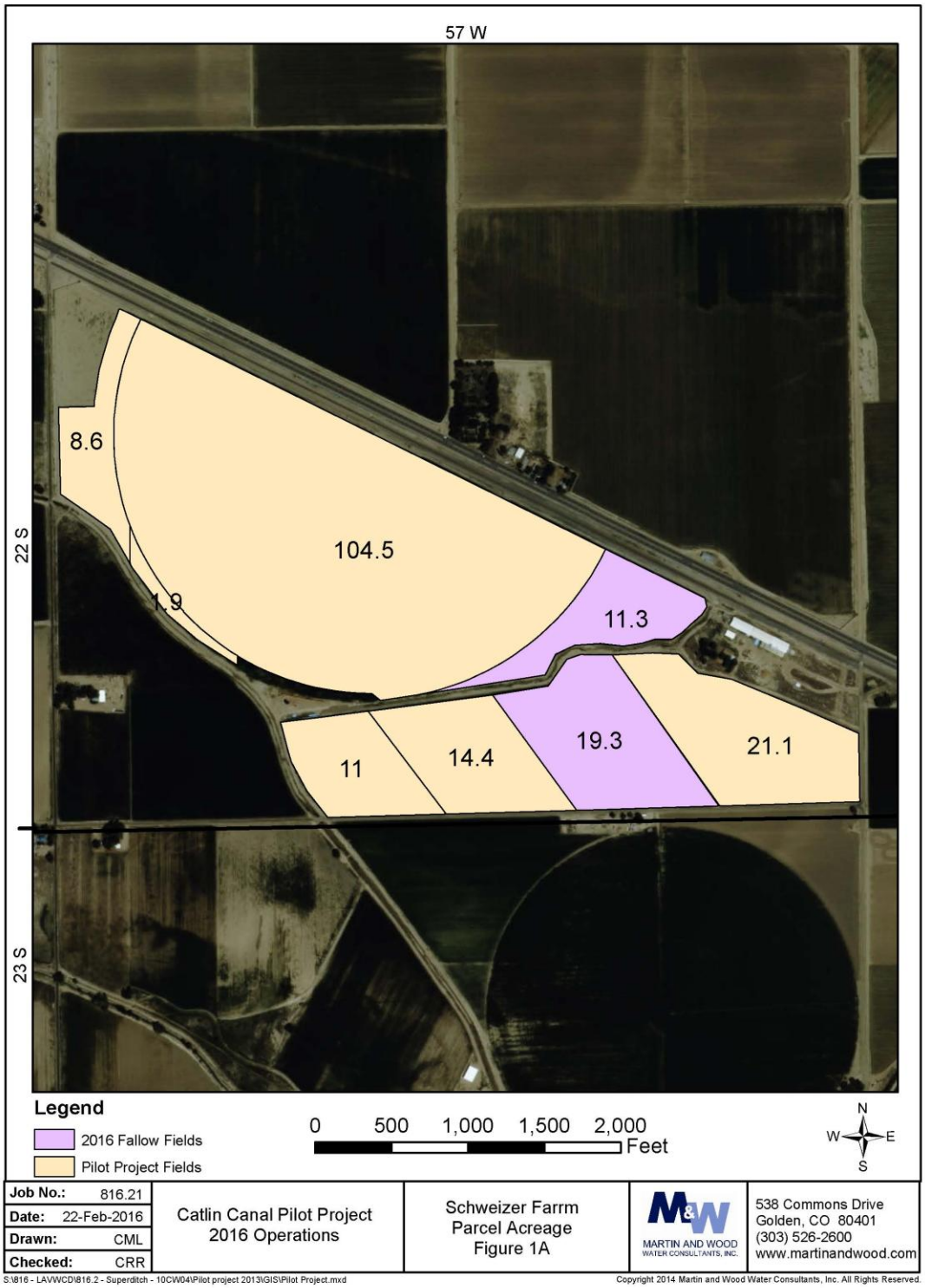
deliveries is not possible under ideal conditions. An "Owe-the-River" reservoir account is often used to balance the accounting in situations such as these, but was not permitted in Catlin Pilot Project operations for 2016. This would have alleviated the need for the Catlin Pilot Project to operate overly-conservative exchange rates and would thereby increase the ability to take advantage of a greater portion of the consumptive use water generated through fallowing operations.

Appendix A

Aerials Showing 2016 Fallowed Acreage

Appear on the Following Pages

1. **Schweizer Figure 1A**
2. **Diamond A West Figure 2A**
3. **Hirakata Farms Figure 3A**
4. **Hancock Figure 4A**
5. **Diamond A East Figure 5A**
6. **Hanagan Figure 6A**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Catlin Canal Pilot Project
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Figure 1A
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Catlin Canal Pilot Project
2016 Operations
Diamond A West
Parcel Acreage
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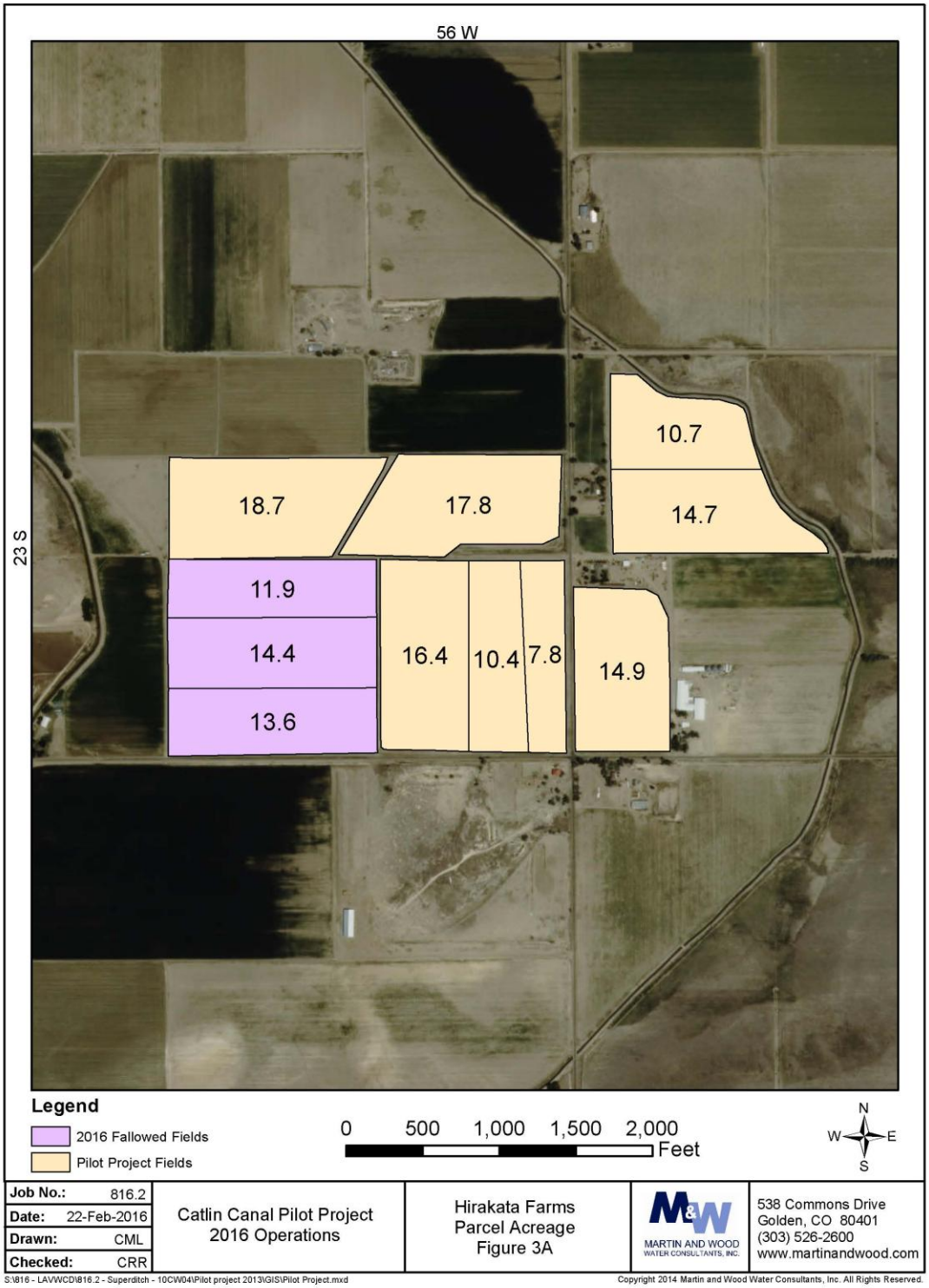
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Catlin Canal Pilot Project
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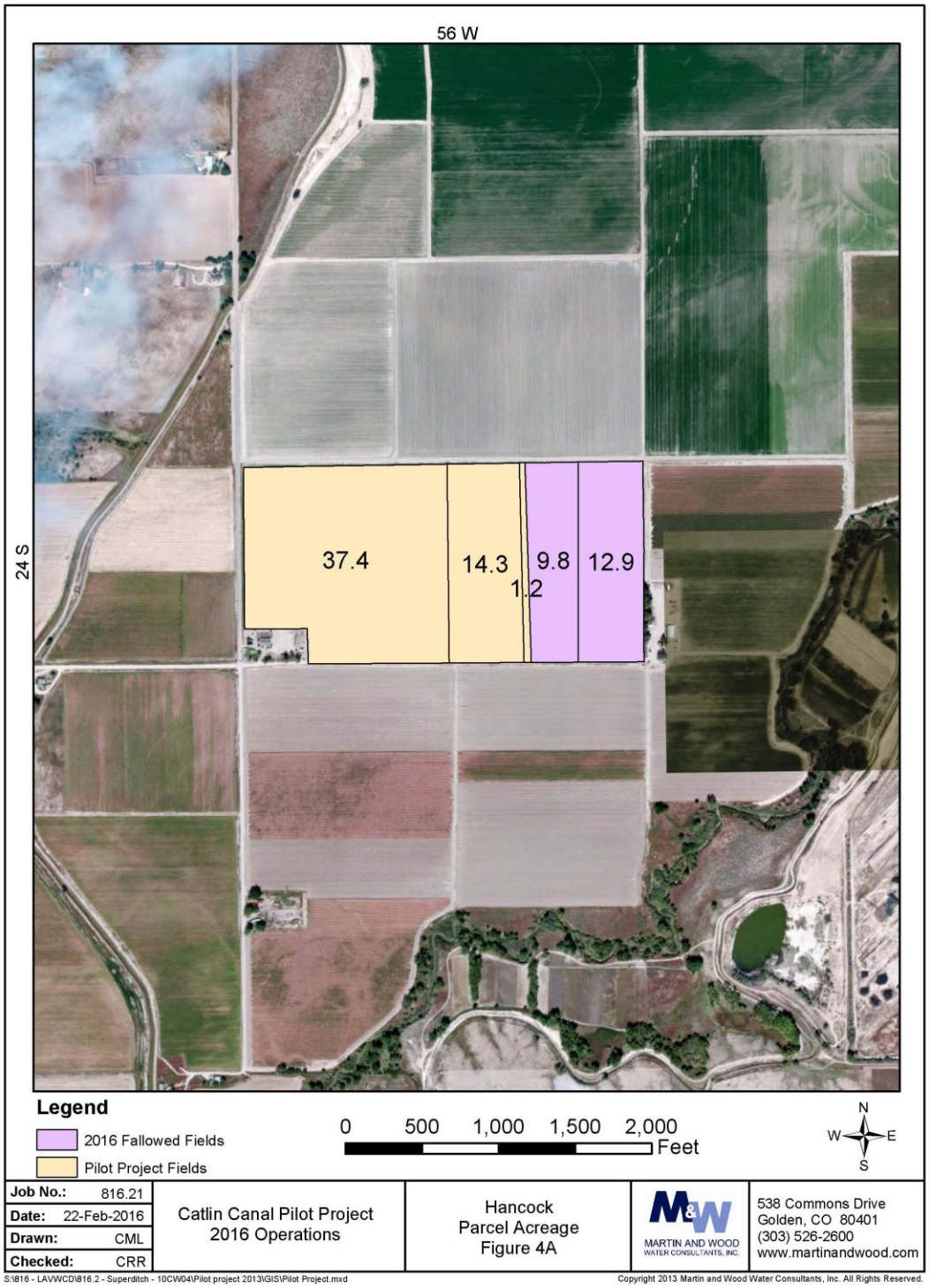
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Catlin Canal Pilot Project
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Hancock
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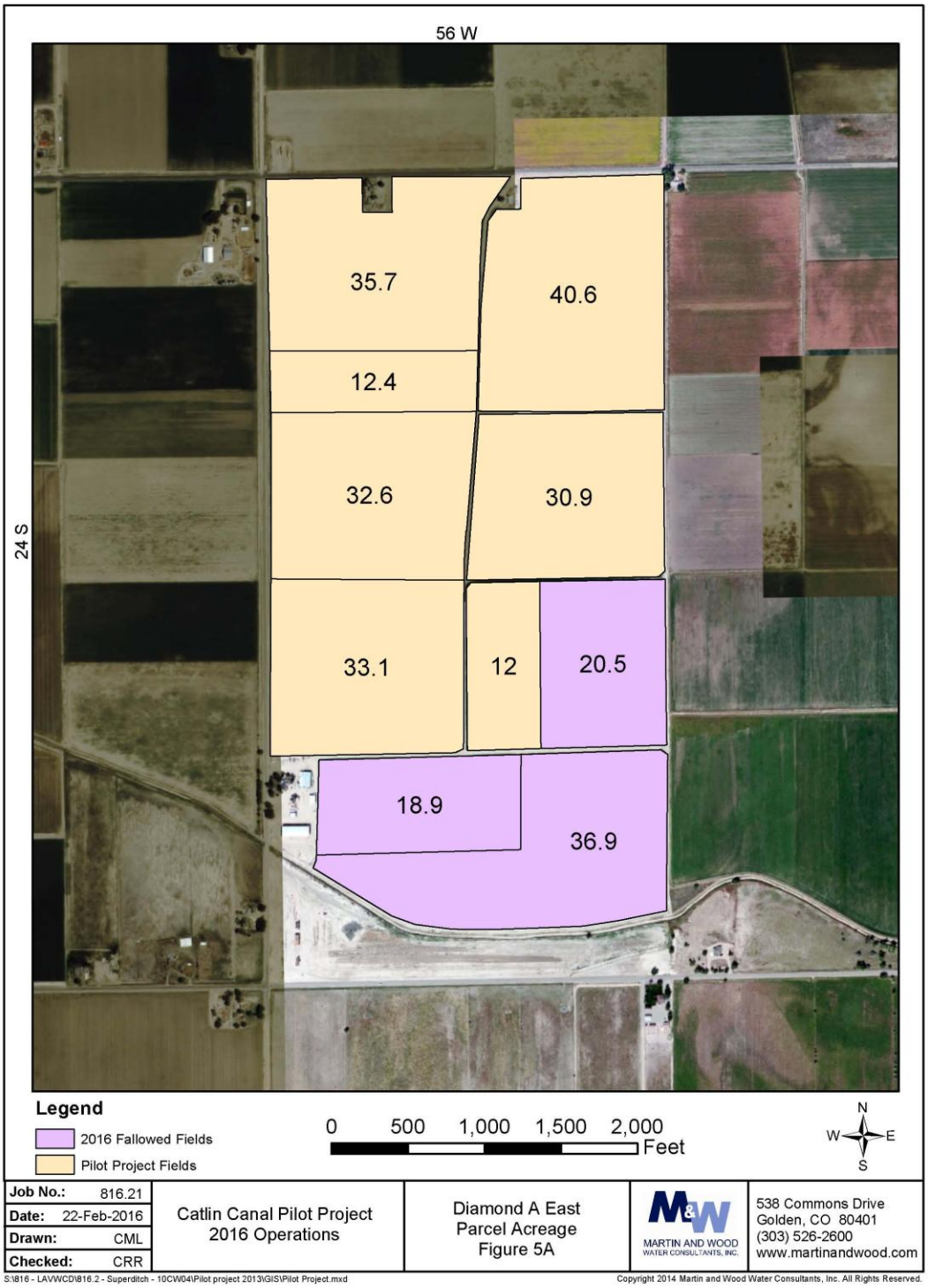
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Catlin Canal Pilot Project
2016 Operations
Diamond A East
Parcel Acreage
Figure 5A
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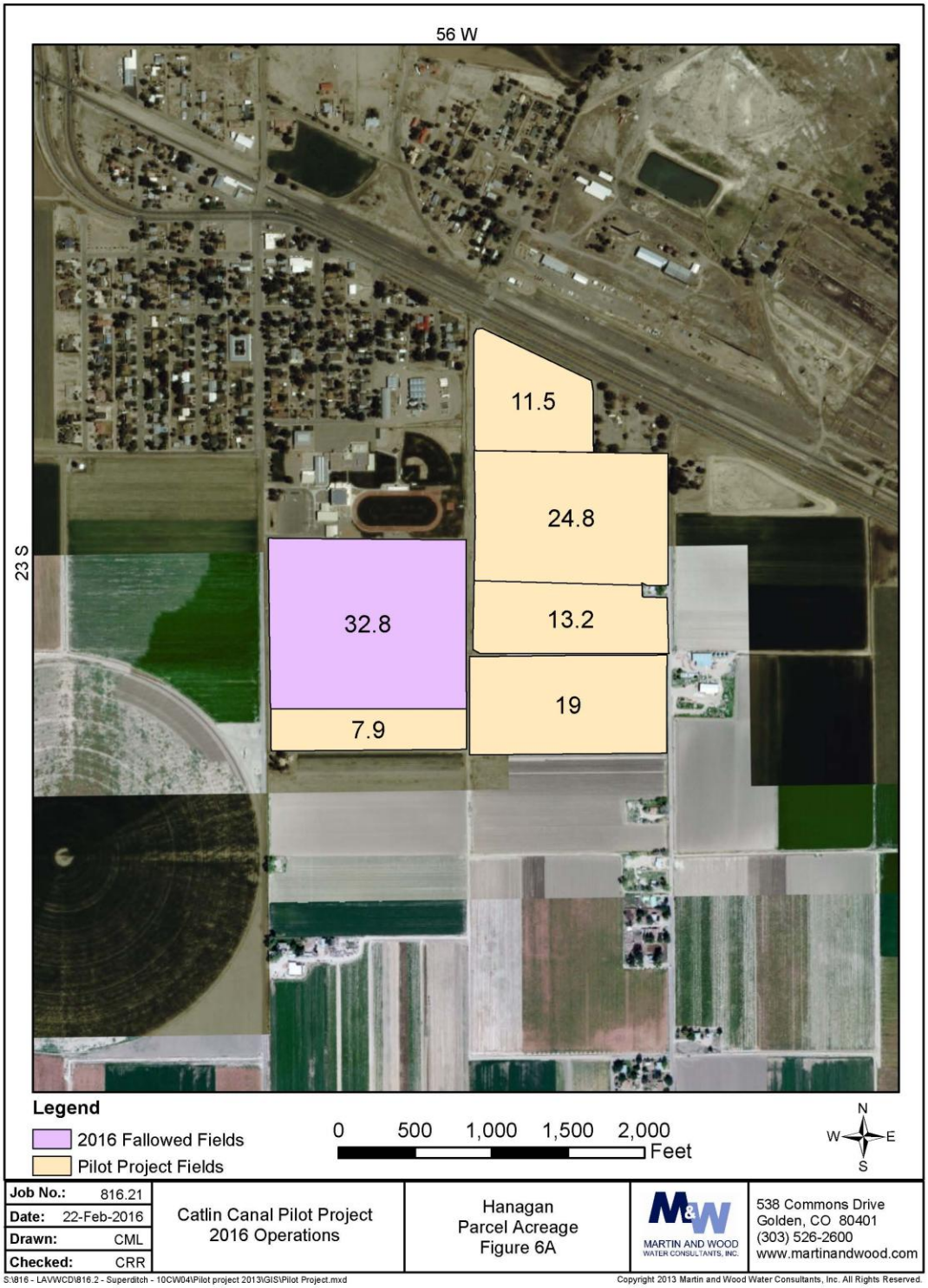

Job No.: 816.21 Date: 22-Feb-2016 Drawn: CML Checked: CRR	Catlin Canal Pilot Project 2016 Operations	Hanagan Parcel Acreage Figure 6A	MARTIN AND WOOD WATER CONSULTANTS, INC.	538 Commons Drive Golden, CO 80401 (303) 526-2600 www.martinandwood.com

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APPENDIX B

Tracking of Dry-up, Fallowed Acreage, & Fallowed Shares

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Schweizer	**22573025**	**8.6**	**8.69**										
	22573207	**11**	**11.11**										
	22573215	**1.9**	**1.92**										
	22573217	**104.5**	**105.53**										
	22573220	**11.3**	**11.41**	11.3	11.3								
	22573224	**19.3**	**19.49**	18.8	19.3								
	22573225	**21.1**	**21.31**										
	22573228	**14.4**	**14.54**										
	*												
	Total	**192.1**	**194.00**	30.1	30.6								
			.										
Fallowed Credit				30.1	30.11								
Shares	**194**			30.58	30.59								
Shares/acre	**1.02**												

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Diamond A West	**22573309**	**28.4**	**40.34**		21.7								
	22573321	**8.9**	**12.64**										
	22573328	**16.5**	**23.44**										
	22573411	**19.3**	**27.42**										
	22573412	**18.5**	**26.28**										
	22573417	**2.1**	**2.98**										
	22573425	**5**	**7.10**										
	22573426	**6.9**	**9.80**										
	23570402	**14.4**	**20.45**		14.4								
	23570414	**19.6**	**27.84**	19.6									
	23570415	**17.6**	**25.00**	17.6									
	*												
	Total	**157.2**	**223.30**	37.2	36.1								
Fallowed Credit				36.1	36.1								
Shares	**223.3**			48.53	48.53								
Shares/acre	**1.35**												

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Hirakata Farms	**23562715**	**14.7**	**14.72**										
	23562716	**14.9**	**14.92**										
	23562725	**10.7**	**10.71**										
	23562808	**18.2**	**18.22**	18.2									
	23562812	**14.4**	**14.42**		14.4								
	23562813	**15.4**	**15.42**										
	23562823	**7.8**	**7.81**	7.89									
	23562824	**11.4**	**11.42**	10.4									
	23562827	**11.9**	**11.92**		11.9								
	23562828	**13.6**	**13.62**		13.6								
	23562829	**17.8**	**17.82**										
	*****												
	Total	**150.8**	**151.00**	36.49	39.9								
Fallowed Credit				36.40	39.9								
Shares	**151**			38.30	41.99								
Shares/acre	**1.05**												

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Hancock	**24560711**	**12.9**		12.9	12.9								
	24560722	**11**		9.8	9.8								
	24560723	**37.4**											
	24560724	**14.3**	**15.13**										
	*****												
	Total	**75.6**	**15.13**	22.7	22.7								
Fallowed Credit				22.7	22.7								
Shares	**80**			24.52	24.52								
Shares/acre	**1.08**												

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Diamond A East	**24561101**	**58.1**	**57.06**	35.7									
	24561102	**40.6**	**39.87**	40.6									
	24561103	**32.6**	**32.02**										
	24561104	**30.9**	**30.35**										
	24561108	**18.9**	**18.56**		18.9								
	24561116	**32.5**	**31.92**		20.5								
	24561117	**36.9**	**36.24**		36.9								
	24561118	**33.1**	**32.51**										
	*												
	Total	**283.6**	**278.53**	76.3	76.3								
Fallowed Credit				76.30	76.3								
Shares	**278.53**			76.01	76.01								
Shares/acre	**1.00**												

Farm	Parcel ID	Acreage	Shares	Dry-up									
				2016	2016	2017	2018	2019	2020	2021	2022	2023	2024
Hanagan	**23562509**	**11.5**	**12.64**										
	23563604	**24.8**	**27.25**										
	23566603	**40.7**	**44.73**	32.8	32.8								
	23563632	**13.2**	**14.51**										
	23563608	**19**	**20.88**										
	*												
	Total	**109.2**	**120.00**	32.8	32.8								
Fallowed Credit				32.8	32.8								
Shares	**120**			33.69	33.69								
Shares/acre	**1.03**												

Totals for All Farms													
Fallowed Credit				234.30	237.91								
Shares	**1046.83**			251.63	255.33								
Shares/acre (weighted value)				1.07	1.07								

*Reserved for additional parcel ID entry. Additional lines will be added as needed.

APPENDIX C – PAY AS YOU GO TARGET DELIVERIES

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Depletion	Accretion
2016	0.00	0.00	7.88	10.41	-3.38	-3.71	-3.19	-8.02	-5.95	-1.10	-7.54	-7.86	-22.46	-22.46	0.00
2017	-4.39	-3.32	-2.68	-2.14	-1.66	-1.25	-0.93	-0.66	-0.41	-0.21	-0.13	-0.08	-17.86	-17.86	0.00
2018	-0.10	-0.12	-0.12	-0.12	-0.12	-0.11	-0.10	-0.09	-0.08	-0.06	0.01	0.11	-0.90	-0.90	0.00
2019	0.19	0.24	0.30	0.35	0.39	0.42	0.44	0.42	0.40	0.39	0.43	0.50	4.47	0.00	4.47
2020	0.56	0.60	0.64	0.68	0.70	0.72	0.73	0.70	0.67	0.64	0.61	0.58	7.83	0.00	7.83
2021	0.56	0.54	0.52	0.50	0.48	0.46	0.34	0.15	0.03	-0.02	-0.07	-0.12	3.37	0.00	3.37
2022	-0.17	-0.26	-0.33	-0.31	-0.29	-0.28	-0.26	-0.24	-0.23	-0.21	-0.20	-0.18	-2.96	-2.96	0.00
2023	-0.17	-0.16	-0.14	-0.13	-0.07	0.04	0.12	0.18	0.24	0.30	0.35	0.40	0.96	0.00	0.96
2024	0.44	0.43	0.43	0.43	0.42	0.42	0.41	0.41	0.41	0.40	0.40	0.40	5.00	0.00	5.00
2025	0.39	0.39	0.39	0.38	0.38	0.38	0.37	0.37	0.37	0.37	0.36	0.36	4.51	0.00	4.51
2026	0.36	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.33	4.10	0.00	4.10
2027	0.32	0.32	0.32	0.32	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.29	3.69	0.00	3.69
2028	0.30	0.30	0.29	0.30	0.29	0.28	0.28	0.28	0.28	0.28	0.27	0.27	3.42	0.00	3.42
2029	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.25	3.09	0.00	3.09
2030	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.22	2.84	0.00	2.84
2031	0.22	0.22	0.21	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	2.57	0.00	2.57
2032	0.20	0.20	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.16	0.13	2.24	0.00	2.24
2033	0.11	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.26
2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total														-44.18	48.35

APPENDIX D

Weed Evapotranspiration Calculations

Based on the observation of vegetation in the Recharge Ponds, ET from weed cover was estimated using State CU as described in the below table and notes.

April			
	Hanagan	Schweizer	Total
Average Vegetative Cover			-
PET feet)		0.000	-
Effective Precipitation (feet)		0.000	-
IWR (feet)	0.000	0.000	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	0.000	0.000	0.000
Weed ET (cfs)	0.000	0.000	0.000

May			
	Hanagan	Schweizer	Total
Average Vegetative Cover	3%	5%	-
PET feet)	0.246	0.246	-
Effective Precipitation (feet)	0.155	0.155	-
IWR (feet)	0.091	0.091	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	0.116	0.258	0.373
Weed ET (cfs)	0.005	0.012	0.017

June			
	Hanagan	Schweizer	Total
Average Vegetative Cover	36%	12%	-
PET feet)	0.549	0.549	-
Effective Precipitation (feet)	0.168	0.168	-
IWR (feet)	0.381	0.381	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.390	0.618	2.008
Weed ET (cfs)	0.267	0.119	0.386

July			
	Hanagan	Schweizer	Total
Average Vegetative Cover	42%	6%	-
PET feet)	0.637	0.637	-
Effective Precipitation (feet)	0.130	0.130	-
IWR (feet)	0.507	0.507	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.622	0.309	1.931
Weed ET (cfs)	0.415	0.079	0.494

August			
	Hanagan	Schweizer	Total
Average Vegetative Cover	45%	5%	-
PET feet)	0.502	0.502	-
Effective Precipitation (feet)	0.138	0.138	-
IWR (feet)	0.364	0.364	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.738	0.258	1.995
Weed ET (cfs)	0.319	0.047	0.366

September			
	Hanagan	Schweizer	Total
Average Vegetative Cover	45%	5%	-
PET feet)	0.369	0.369	-
Effective Precipitation (feet)	0.040	0.040	-
IWR (feet)	0.329	0.329	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.738	0.258	1.995
Weed ET (cfs)	0.288	0.043	0.331

October			
	Hanagan	Schweizer	Total
Average Vegetative Cover	45%	5%	-
PET feet)	0.211	0.211	-
Effective Precipitation (feet)	0.000	0.000	-
IWR (feet)	0.211	0.211	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.738	0.258	1.995
Weed ET (cfs)	0.185	0.027	0.212

November			
	Hanagan	Schweizer	Total
Average Vegetative Cover	45%	5%	-
PET feet)	0.088	0.088	-
Effective Precipitation (feet)	0.000	0.000	-
IWR (feet)	0.088	0.088	-
Maximum Pond Surface (acres)	3.862	5.150	-
Vegetative Cover (acres)	1.738	0.258	1.995
Weed ET (cfs)	0.077	0.011	0.089

State CU Notes

Pasture Grass SCS TR21 Crop Coefficients

USBR Effective Precipitation Method

No Altitude Adjustment

Entered Average Precipitation and Temperature for July through December to force computations for 2016

Rocky Ford 2SE Climate Station when available, CSU Expt Stn Rocky Ford used when Rocky Ford 2SE data not available

Additional Notes

The accounting calculates the full water surface for each pond.

No deductions to the water surface were made for the Vegetative Cover.

Pond Evaporation Credit is credit for evaporation calculated by the accounting for days when there was no water surface per observation by Lower Ark personnel.

Average Vegetative Cover provided per observation by Lower Ark personnel.

APPENDIX E

SUMMARY OF 2016 ACCOUNTING TABLES

Month	Deliveries			
	Pro-rata Delivery	Timpas Creek Augmentation Station	Schweizer Pond	Hanagan Pond
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
March	74.83	33.13	24.62	17.08
April	149.10	70.67	41.77	36.66
May	159.26	87.20	29.81	42.25
June	151.86	101.87	10.10	39.89
July	173.22	116.45	12.99	43.78
August	180.93	117.44	13.09	50.40
September	121.43	71.51	15.73	34.20
October	86.25	43.43	23.44	19.38
November	68.30	27.50	19.74	21.06
Total	1165.17	669.20	191.29	304.69
%Delivery	100.00%	57.43%	16.42%	26.15%

Month	Timpas Creek Augmentation Station											
	Total Augmentation Station to Arkansas River	Total Consumptive Use to Municipal Participants	Town of Fowler CU Credits	City of Fountain CU Credits	Security Water District CU Credits	Return Flow Delivery	Deep Percolation Portion of Delivery	Tailwater Portion of Delivery	CU to Transit Losses for Deep Perc	CU Delivery for Transit Losses for CU	Total CU Delivery to Offset Transit Losses	Unused CU Delivered to River
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
March	33.13	6.95	2.27	2.34	2.34	26.09	12.43	13.51	0.16	0.09	0.24	0.00
April	70.67	21.52	4.26	8.63	8.63	48.88	23.28	25.31	0.29	0.27	0.56	0.00
May	87.20	50.94	19.48	15.73	15.73	35.62	14.09	21.34	0.18	0.64	0.82	0.00
June	101.87	73.09	19.53	26.78	26.78	27.86	12.93	14.77	0.16	0.93	1.09	0.00
July	116.45	86.40	14.99	35.70	35.70	28.96	12.47	16.34	0.16	1.09	1.25	0.00
August	117.44	91.02	11.29	39.87	39.87	25.27	7.90	17.27	0.10	1.15	1.25	0.00
September	71.51	47.31	10.08	18.62	18.62	23.60	9.14	14.35	0.11	0.60	0.71	0.00
October	43.43	16.89	4.99	5.95	5.95	26.32	12.53	13.63	0.16	0.21	0.37	0.00
November	27.50	11.35	2.43	4.46	4.46	16.00	4.70	11.25	0.06	0.14	0.20	0.00
Total	669.20	405.47	89.31	158.08	158.08	258.60	109.46	147.77	1.37	5.13	6.50	0.00
%Delivery	100.00%	60.59%	13.35%	23.62%	23.62%	38.64%	16.36%	22.08%	0.20%	0.77%	0.97%	0.00%

Month	Schweizer Recharge Pond				Hanagan Recharge Pond			
	Total Deliveries	Deep Percolation Delivery	Recharge (Net Infiltration)	CU to Evaporative Losses	Total Deliveries	Deep Percolation Delivery	Recharge (Net Infiltration)	CU to Evaporative Losses
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
March	24.62	24.62	24.62	0.00	17.08	17.00	16.49	0.08
April	41.77	41.77	41.77	0.00	36.66	36.18	36.14	0.47
May	29.81	29.79	29.81	0.02	42.25	41.49	41.16	0.75
June	10.10	9.94	10.04	0.16	39.89	38.55	39.01	1.34
July	12.99	12.63	12.94	0.36	43.78	41.51	42.31	2.27
August	13.09	12.96	13.05	0.13	2.97	48.53	49.12	1.87
September	15.73	15.55	15.66	0.18	0.65	32.72	34.81	1.48
October	23.44	23.23	23.24	0.21	2.50	18.77	19.36	0.61
November	19.74	19.61	19.69	0.12	0.00	20.68	21.06	0.38
Total	191.29	190.10	190.82	1.19	185.76	295.43	299.46	9.26
%Delivery	100.00%	99.38%	99.76%	0.62%	100.00%	159.04%	161.20%	4.98%

Month	Total Consumptive Use to Municipal Participants	Town of Fowler CU Credits		City of Fountain CU Credits		Security Water District CU Credits	
		Delivered to Arkansas River HIM Reach 7	Credits Applied to CWPDA R-14 Plan	Exchanged to LAVWCD Account in Pueblo Reservoir	City of Fountain	Exchange Water Delivered to Participant's Pueblo Reservoir Accounts	Security Water District
	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)
March	6.95	2.27	2.27	2.34	0.00	2.34	0.00
April	21.52	4.26	4.26	8.63	2.34	8.63	2.34
May	50.94	19.48	19.48	15.73	8.63	15.73	8.63
June	73.09	19.53	19.53	26.78	15.73	26.78	15.73
July	86.40	14.99	14.99	35.70	0.00	35.70	26.78
August	91.02	11.29	11.29	39.87	62.48	39.87	35.70
September	47.31	10.08	10.08	18.62	0.00	18.62	39.87
October	16.89	4.99	4.99	5.95	58.49	5.95	18.62
November	11.35	2.43	2.43	4.46	10.41	4.46	10.41
Total	405.47	89.32	89.32	158.08	158.08	158.08	158.08
%Delivery	100.00%	22.03%	22.03%	38.99%	38.99%	38.99%	38.99%