ArkDSS Memorandum
Final

To: Bill Tyner and Kelley Thompson, Colorado Division of Water Resources

From: ParsonsWater Consulting

Subject: Task 2.1 – Colorado Canal Company

Date: April 2019

INTRODUCTION

One of the Task 2 objectives is to:

> *Develop and document an understanding of the operations of key water use facilities in the basin in order to facilitate consumptive use modeling and to support selected data needs for the ArkDSS effort. This understanding will be developed through interviews with DWR personnel, major water users, including operators of large canal and reservoir systems and representatives of federal facilities.*

Key water use facilities include diversion structures, transmountain diversions, and reservoirs. A number of components in the Colorado Canal Company have been identified as key structures for the Arkansas Decision Support System (ArkDSS) consumptive use and surface water modeling efforts. The purpose of this Task 2 memorandum is to document physical, legal, and operational aspects of those key structures.

The information provided in this memorandum was developed from publicly accessible sources, meetings and discussions with Division 2 personnel; DWR Modeling Group personnel; Bruce Hughes, General Managers of the Twin Lakes Reservoir & Canal Company and Colorado Canal Company; Kevin Lusk, President of the Twin Lakes Reservoir and Canal Company, Colorado Canal Company, Lake Meredith Reservoir Company, and Lake Henry Reservoir Company; Rick Kienitz with the City of Aurora; and District 17 Commissioner, Lonnie Spady. Information in this memorandum is believed to be accurate; however, this information should not be relied upon in any legal proceeding.

Table of Contents

SYSTEM OVERVIEW

The Colorado Canal, Lake Meredith and Lake Henry are respectively owned by the Colorado Canal Company, Lake Meredith Reservoir Company and Lake Henry Reservoir Company. These companies have historically operated together to provide irrigation supplies to lands located in Pueblo and Crowley Counties and, since the mid-1980s, have also operated to provide municipal water supply to their municipal shareholders.

The Colorado Canal headgate is located on the Arkansas River near Boone, Colorado about 3 miles upstream of the confluence with the Huerfano River. In addition to providing water for direct irrigation, the Colorado Canal is used to deliver storage diversions to Lake Henry and Lake Meredith. The canal runs to the north and east of Lake Henry and then empties into either Lake Henry or Lake Meredith Reservoir.

All lands under the system have shares in the Colorado Canal Company. Lands down gradient from Lake Henry also have shares in the Lake Henry Reservoir Company, whereas other lands have shares in the Lake Meredith Reservoir Company. Lands under Lake Henry are irrigated by gravity flow from the reservoir. Lake Meredith was originally a natural lake with no tributary connection to the Arkansas River. The lake is topographically too low to irrigate Colorado Canal lands by gravity flow. Therefore, water used from Lake Meredith must be released to the Arkansas River and exchanged up to the Colorado Canal headgate for delivery to irrigated lands under the ditch. Water in storage in Lake Meredith may be owned by other water users since it is a pivotal aspect of Winter Water Storage Program operations. Therefore, releases from Lake Meredith may also be used to deliver water directly into the Fort Lyon Storage Canal and the Holbrook Canal and released to the river for diversion by the Fort Lyon Canal and occasionally by Las Animas Consolidated Canal. Releases from Lake Meredith may also be exchanged up to Pueblo Reservoir or upper Arkansas reservoirs, including Twin Lakes Reservoir, for subsequent use by municipal shareholders.

Approximately 56,000 acres were originally irrigated under the canal and reservoir system. The Twin Lakes Reservoir and the Independence Pass Transmountain Diversion System (IPTDS) were constructed to be supplemental supplies for the Colorado Canal system, and all of these supplies were originally operated as one integrated system. Irrigators under the canal have since sold most of their rights under the Colorado Canal, Lake Meredith, Lake Henry, and Twin Lakes Reservoir and Canal Company. Colorado Springs Utilities (CS-U) and the City of Aurora are the major shareholders in the Colorado Canal Companies; CS-U, Pueblo Water, Pueblo West, and City of Aurora are the major shareholders of the Twin Lakes and IPTDS systems. The municipal shareholders have changed their irrigation and storage rights in Division 2 and Division 5 water courts over approximately the last 40 years. When those entities use these water supplies for municipal uses, approximately 10,000 to 15,000 acres under the canal continue to be irrigated. During wet years when municipal interests have more local water supplies in their systems, up to 30,000 acres may be irrigated under the canal by leasing back excess water supplies consisting of both Canal Company water rights and other water types.

A breakdown of the ownership within the companies, as of 2017, is shown in Table 1.

Table 1: Ownership of Colorado Canal Companies

Entity	Company Shares			Percent Ownership		
	Colorado Canal[1]	Lake Meredith	Lake Henry	Colorado Canal	Lake Meredith	Lake Henry
Colorado Springs	28,012.760	21,084.750	6,923.150	56.4%	51.9%	77.2%
City of Aurora	14,225.380	13,061.800	1,163.580	28.7%	32.2%	13.0%
City of Fountain	512.500	512.500	0.000	1.0%	1.3%	0.0%
Pueblo West	360.330	360.330	0.000	0.7%	0.9%	0.0%
Woodland Park	708.250	336.000	372.250	1.4%	0.8%	4.2%
Other Uses[2]	1,369.894	950.854	419.000	2.8%	2.3%	4.7%
Agricultural	4,449.901	4,315.151	89.600	9.0%	10.6%	1.0%
Total	**49,638.975**	**40,621.385**	**8,967.580**	**100.0%**	**100.0%**	**100.0%**

Source: Kevin Lusk.

Notes:

(1) Colorado Canal shares are typically sold as "paired shares" where a share of Colorado Canal is matched with a share of either Lake Meredith or Lake Henry. Therefore, the number of Colorado Canal shares is generally equal to the sum of Lake Meredith and Lake Henry shares; however, in some cased an entity's shares in the Colorado Canal system does not equal the sum of shares in the Lake Henry and Lake Meredith system.

(2) Includes municipal and industrial uses and uses for augmentation.

Key facilities identified in the Colorado Canal, Lake Meredith and Lake Henry Reservoir system are as follows.

1) Colorado Canal
2) Lake Meredith
3) Lake Henry

Other ditches and reservoirs outside of the Colorado Canal and Reservoir System relate to and are affected by system operations, and are discussed in this document including Pueblo Reservoir, Holbrook Canal, Holbrook Reservoir, Fort Lyon Storage Canal, and Fort Lyon Canal.

The contact information for the Colorado Canal Company is:

Bruce Hughes, General Manager
331 Main Street
Ordway, Colorado
719-267-4411

The general locations of the Colorado Canal, Lake Meredith and Lake Henry Reservoir system and associated structures are shown in Figure 1.

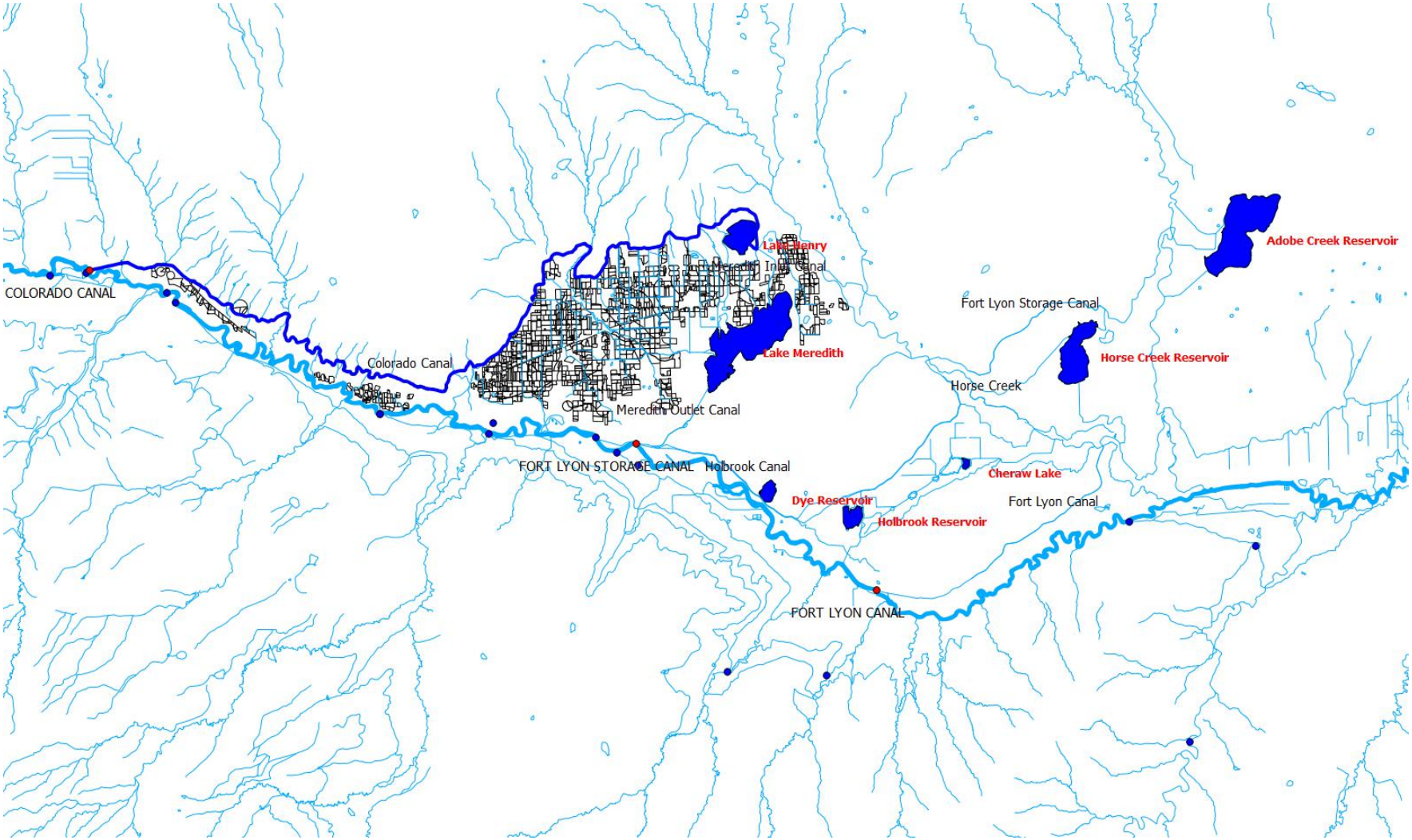

Figure 1: Colorado Canal, Lake Meredith and Lake Henry Reservoir System

PHYSICAL INFORMATION

The major structural elements in the Colorado Mutual Irrigation Company's water resources system include the Colorado Canal, Lake Meredith, and Lake Henry.

The history, operations, and current specifications of the elements of the Colorado Canal's water resources infrastructure are summarized below. The primary source for this information is the water resources data and GIS coverages available on the State of Colorado Decision Support System website (http://cdss.state.co.us/). Sources of data and inputs from other basin models are also included. These data are predominantly from the Hydrological-Institutional (H-I) Model and a 1985 W.W. Wheeler report. A basin model was previously developed to support the Colorado Springs Utilities Southern Delivery System Environmental Impact Statement (EIS) analysis. This model is also being used for the Arkansas Valley Conduit EIS. Documentation regarding the representation of the Colorado Canal off-channel system in the EIS models was provided by Colorado Springs Utilities personnel.

Additional information related to a number of the structural elements and operations in Water District 17 and nearby water districts is listed in the *Where to find more information* section at the end of this memorandum.

1. Colorado Canal (1700540)

The Colorado Canal runs along the north side of the Arkansas River generally parallel to the river. The canal turns away from the river near Olney Springs. Most of the irrigated land and ditch laterals are located between Olney Springs and Sugar City, both north and south of Colorado Highway 96. Data in HydroBase for the Colorado Canal is recorded under Structure ID 1700540 starting in 2000. Structure ID 1400540 was used for Colorado Canal data prior to that time.

Length: The length of the Colorado Canal to the bifurcation gate (Lake Henry inlet) is 47 miles, and from this point to Lake Meredith is 7.7 miles. Approximately 50 percent (26 miles) of the canal is located above Olney Springs and above the majority of irrigated lands under the system.

Capacity: Diversions into the Colorado Canal have been measured as high 850 cfs based on a review of daily records of total diversions over the 1911 to present period. Decreed capacity is 756 cfs, and normal operation is generally limited to this flow rate. The current maximum physical capacity of the canal before the spillway at Kramer Creek is approximately 800 cfs.

Conveyance Efficiency: Total conveyance efficiency was estimated to be 76.5 percent in the 1985 Wheeler report, based on a 15 percent loss in the main canal and a subsequent lateral canal loss of 10 percent [(1 – 0.15) times (1 – 0.1) = 0.765]. The H-I Model uses a main canal loss of 19.1 percent plus additional off-farm and on-farm lateral losses of 3.5 percent and 2.7 percent, respectively, as a proportion of headgate diversion - resulting in conveyance efficiency of a 77.4 and 74.7 percent loss at the farm headgate and parcel, respectively.

Colorado Canal Company personnel indicate ditch losses average approximately 30 percent. For internal modeling purposes, CS-U has estimated a system conveyance efficiency of 70 percent.

Irrigated Acreage and Crop Types: GIS coverages from the State of Colorado's Decision Support System (CDSS) list approximately 7,000 to 8,000 irrigated acres under the Colorado Canal over the past 10 years. Additional acreage under the canal system is listed as fallowed. The two primary crops that are irrigated under the Colorado Canal are alfalfa and grass hay. Additional GIS coverages have been developed as part of the ArkDSS project providing historical snapshots of irrigated acreage back to 1950. The Division 2 office maintains detailed coverages of total acreage, field verifications of dry up acreage, well associations, and augmentation plan assignments.

Ground Water Use: A portion of the land served by the Colorado Canal is also supplied with tributary ground water, and this supplemental supply is included in the CDSS irrigated acreage coverages. Preliminary estimates from the CDSS coverages indicate approximately 1,200 acres (~16 percent) of the lands are supplied solely by tributary wells. These wells are augmented by the Colorado Water Protective and Development Association (CWPDA) and the Arkansas Groundwater Users' Association (AGUA).

Return Flow Locations: Return flows from the ditch system generally accrue to the Arkansas River above the Fort Lyon Storage Canal. Return flows associated with a small amount of acreage returns directly to Horse Creek. Return flows from up to two-thirds of the irrigated lands historically returned to Lake Meredith, which was originally a natural depression located within the Bob Creek tributary basin. The amount of return flows that accrue to Lake Meredith has changed over recent years due to the dry up of irrigated lands.

Return flows from ditch seepage and irrigation application will be accounted for separately in the ArkDSS Surface Water Model. The spatial distribution of losses shown in Table 2 are based on approximate canal length and layout of irrigable lands in relation to locations of gages, reservoirs and ditch headgates included in Water District 17. The H-I Model includes response functions used for timing and location of return flows and estimates that 65 percent of return flows accrue to Lake Meredith.

Table 2: Colorado Canal Return Flow Locations

Model Node	Structure ID	Canal Loss Return Percentage	Irrigated Lands Return Percentage
Arkansas River near Nepesta gage	07117000	---	3%
Rocky Ford Highline Canal	1400542	8%	---
Oxford Farmers Ditch	1400541	14%	---
Otero Canal	1700557	14%	2%
Catlin Canal	1700552	14%	1%
Holbrook Canal	1700554	21%	23%
Fort Lyon Storage Canal	1700648	---	13%
Arkansas R nr Rocky Ford gage	ARKROCCO	14%	18%
Lake Meredith	1703525	15%	33%
Horse Ck near Hwy 194 gage	HRC194CO	---	7%
TOTAL		100%	100%

HydroBase Data: Diversion data are available in HydroBase from the early-1910s to present. Total diversions (shown in Figure 2) and diversions to irrigation (Use 1) are complete over the 1950 to 2015 period. Total annual diversions averaged about 85,000 ac-ft from 1950 to 2017. Monthly diversions to storage (Use 0) are complete starting in 1986.

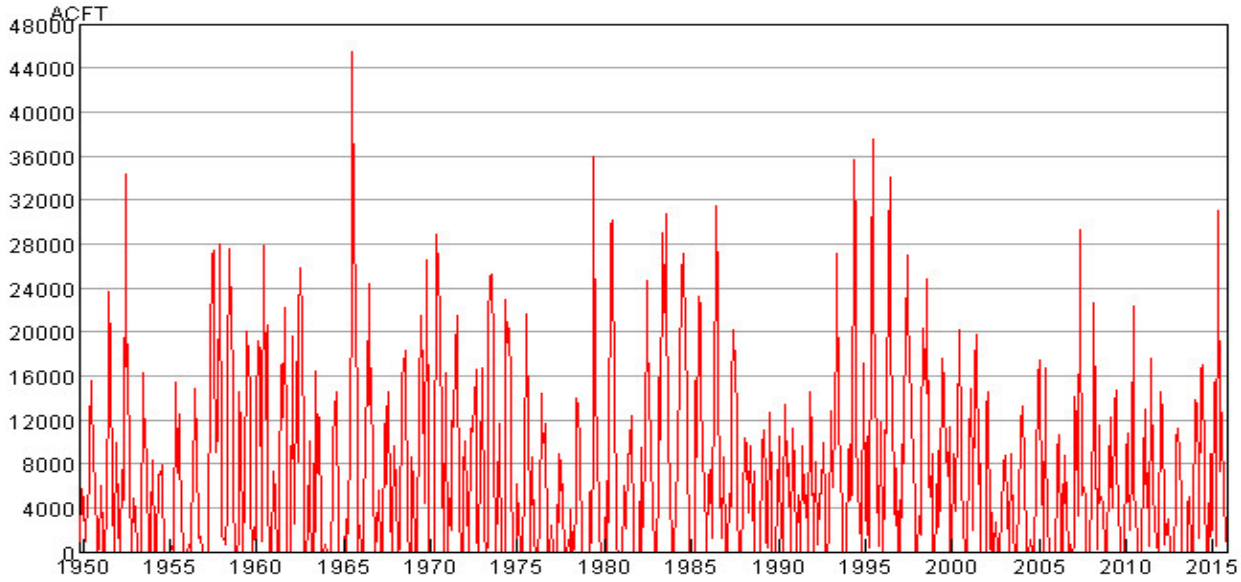

Figure 2: Colorado Canal River Headgate Diversions

Total diversions at the Colorado Canal headgate include diversions of in-priority Colorado Canal direct flow irrigation rights, in-priority diversions of the Lake Henry and Lake Meredith storage rights for delivery to those structures, diversion by exchange of water released from Lake Meredith, and deliveries of other sources for irrigation or storage, including Twin Lakes Company (native and Transmountain), Fry-Ark, and leased reusable water from a wide variety of sources including changed consumptive use credits and reusable return flows.

2. Lake Meredith (1703525)

Lake Meredith is primarily filled by the Colorado Canal. Lake Meredith is the most upstream off-channel reservoir in the Lower Arkansas Valley. Water stored under the Lake Meredith storage rights is available to Lake Meredith Company shareholders. Approximately 41,000 acres of the approximately 56,000 acres under the Colorado Canal cannot be served by Lake Henry and can be considered as being served by Lake Meredith, although based on the location of these lands, they cannot benefit directly from Lake Meredith releases. Storage water is typically released to the river for re-diversion through the Colorado Canal via exchange. In addition to storing changed water rights owned by municipalities, Lake Meredith plays a significant role in the Winter Water storage program.

Capacity:

- Total Storage: 42,905+ ac-ft
- Active Storage: 42,905 ac-ft
- Dead Storage: less than 100 ac-ft

Area/Capacity Data: The area/capacity data in Table 3 were obtained from the Map of Lake Meredith Enlarged and Amended (accepted by State Engineer 3/12/1930). Company representatives noted that low storage levels in recent years indicate the area-capacity table shown in Table 3 may not have been correct; however the values are appropriate for use in the model as they correspond with the historical storage content measurements.

Table 3: Lake Meredith Historical Elevation-Area-Capacity Table (Pre-2004)

Gage Height (ft)	Surface Area (acres)	Cumulative Capacity (ac-ft)
0 - 4	-	-
5	2,017	-
6	2,234	2,264
7	2,511	4,775
8	2,759	7,534
9	3,006	10,539
10	3,253	13,806
11	3,744	17,305
12	4,235	21,295
13	4,727	25,775
14	5,218	26,032
15	5,709	36,211
16	6,314	42,222
17	6,929	48,843
18	7,479	56,047
19	7,896	63,735

In 2004, the reservoir outlet was reconfigured, and a new outlet channel was dug to the deepest part of the reservoir. This allowed access to essentially the full storage capacity of the reservoir, and effectively eliminated any significant dead pool (it is currently estimated to be less than 100 ac-ft). A new survey was completed in 2015. The area/capacity data from the 2015 Survey is included in Table 4.

Table 4: Lake Meredith Current Elevation-Area-Capacity Table (Post-2004)

Gage Height (ft)	Surface Area (acres)	Cumulative Capacity (ac-ft)
0	0	0
3.62	0.4	2.7
5.35	1.7	11.7
7.09	3.5	23.9
8.82	5.9	40.1
10.55	9	61.6
12.29	13.2	89.6
14.02	18.2	124
15.75	51.7	352
17.49	391.5	2666
19.22	933.9	6360
20.95	1676.7	11419
22.69	2603.8	17733
24.42	3696.9	25177
26.15	4926.6	33552
27.89	6300	42905

Note: Base elevation of Gage is 4255.55 feet.

Reservoir Storage Measurement: Storage levels in Lake Meredith are measured using a staff gage.

Reservoir Seepage Information: Seepage from Lake Meredith is not routinely monitored. Seepage from the reservoir accrues mainly to the Lake Meredith Outlet Canal (see Figure 1), with a smaller portion accruing to the Horse Creek drainage.

The Lake Meredith Outlet Canal is used to deliver water to the Holbrook Canal, Fort Lyon Storage Canal, or to the Arkansas River for delivery to downstream water users, or for exchange to the Colorado Canal river headgate and other upstream locations. The maximum capacity of the outlet canal is approximately 800 cfs, but is normally operated at lower flow rates.

HydroBase Data: Historical storage contents data are mostly complete in HydroBase starting in water year 1988, as shown in the red line in Figure 3. The Colorado Canal Company provided a complete record of end-of-month storage contents for the January 1980 to present period (blue line in Figure 3). The Canal Company data are generally consistent with the HydroBase data, with differences likely due to different days when the staff gage was read, minor differences in capacity estimates based on staff gage elevation readings, etc.

The Canal Company data were chosen as the primary source of model input data since these data are complete. The Canal Company also provided a complete record of Lake Meredith releases for the January 1985 to present period. The change in storage contents for Lake Meredith and Lake Henry were used with the Lake Meredith release data to estimate Lake Henry direct releases to irrigation. Some of the river headgate diversion data (total diversions and diversions to storage)

and the storage contents and release data for Lake Meredith and Lake Henry are not consistent. Therefore, some of the colors of water at the river headgate (i.e., to irrigation and to storage) were revised to develop a “best fit” to make the various model input data consistent.

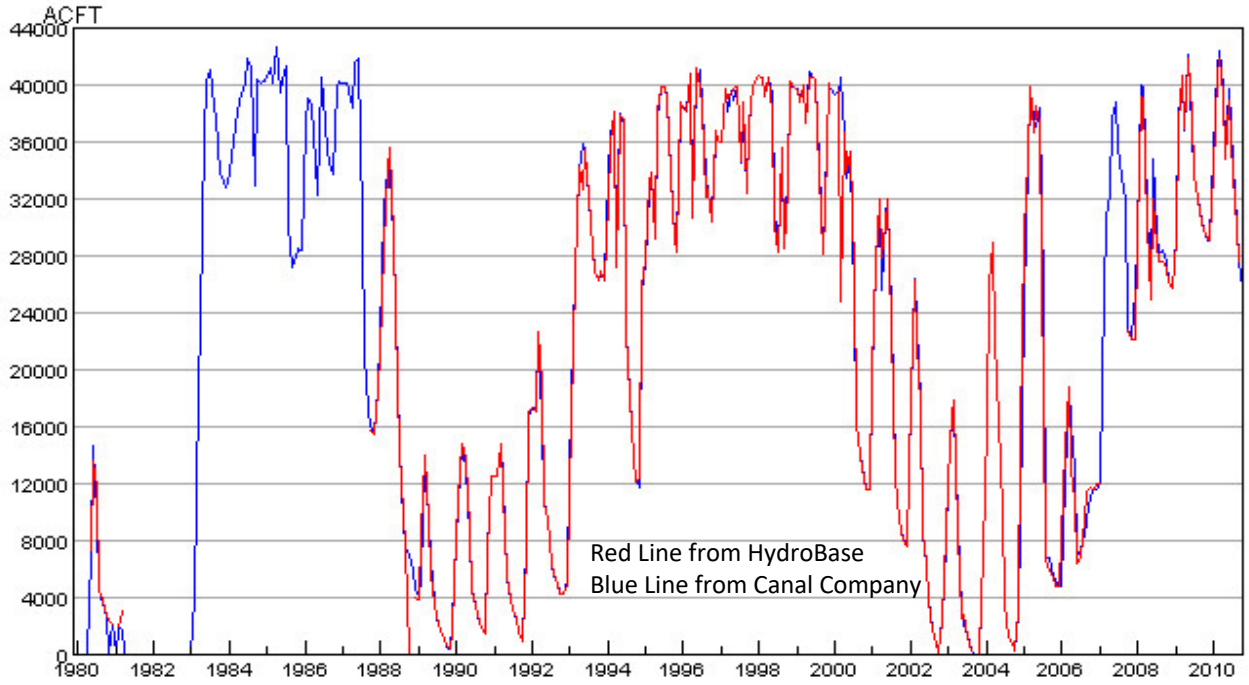

Figure 3: Lake Meredith Storage Contents

Storage in Lake Meredith is allocated to the shareholders pro-rata based on share ownership. Per Company by-laws, in addition to company water, each shareholder can store other water types in their account. Storage in Lake Meredith may include in-priority Lake Meredith storage, consumptive use credits from converted Colorado Canal direct flow irrigation rights, and other water sources, including Twin Lakes Company water (native and Transmountain) and leased reusable water from a variety of sources including changed consumptive use credits and reusable return flows.

3. Lake Henry (1403524)

Lake Henry is filled by the Colorado Canal. Water stored under the Lake Meredith storage rights is available to Lake Meredith Company shareholders. Approximately 9,000 acres of the 50,000 acres under the Colorado Canal are served by Lake Henry.

Lake Henry is operated in concert with Lake Meredith in relation to Winter Water operations and for the storage of changed reservoir company shares. In addition to making releases directly to irrigators, water from Lake Henry can be released to the Arkansas River through Lake Meredith and the Lake Meredith Outlet Canal. There is also a pipeline that can deliver water from Lake Henry directly to the Ordway Feedyard.

Capacity:

- Total Storage: 9,612 ac-ft
- Active Storage: 9,602 ac-ft
- Dead Storage: ~10 ac-ft[1]

Area/Capacity Data: The area/capacity data in Table 5 were obtained from the Plat of the National Sugar Manufacturing Company's Enlargement of its Reservoir No. 1 Map (accepted by State Engineer 3/21/1910). Company representatives noted that low storage levels in recent years indicate the area-capacity table shown in Table 5 may not have been correct; however the values are appropriate for use in the model as they correspond with the historical storage content measurements. A new stage/capacity survey was completed in 2014. Surface area was not reported in the survey table.

Table 5: Lake Henry Historical Elevation-Area-Capacity Table

Gage Height (ft)	Surface Area (acres)	Cumulative Capacity (ac-ft)
0	13	-
1	16	156
2	212	327
3	268	567
4	329	868
5	402	547
6	460	1,667
7	574	2,184
8	644	2,793
9	690	3,460
10	771	4,191
11	836	5,006
12	882	5,864
13	946	6,778
14	1,030	7,766
15	1,079	8,820
15.3	1,114	9,916

Reservoir Storage Measurement: Storage levels in Lake Henry are measured using a staff gage.

Reservoir Seepage Information: Seepage from Lake Henry is not routinely monitored. Seepage from the reservoir accrues mainly to Lake Meredith (see **Figure 1**).

[1] There is approximately 858 ac-ft of storage below the main outlet for Lake Henry. However, essentially all of this water is accessible by a secondary outlet that is dedicated for use by the feedlot. Storage below 858 ac-ft is not available for Lake Henry Shareholders accounts.

HydroBase Data: Similar to Lake Meredith, the historical storage contents data are mostly complete in HydroBase starting in water year 1988 (see red line in Figure 4). The Colorado Canal Company provided a complete record of end-of-month storage contents for the January 1980 to present period (blue line). The Canal Company data are generally consistent with the HydroBase data, with differences likely due to different days when the staff gage was read, minor differences in capacity estimates based on staff gage elevation readings, etc.

The change in storage contents for Lake Meredith and Lake Henry was used with the Lake Meredith release data to estimate Lake Henry direct releases to irrigation. Some of the river headgate diversion data (total diversions and diversions to storage) and the storage contents and release data for Lake Meredith and Lake Henry are not consistent. Therefore, some of the colors of water at the river headgate (i.e., to irrigation and to storage) were revised to develop a "best fit" to make the various model input data consistent.

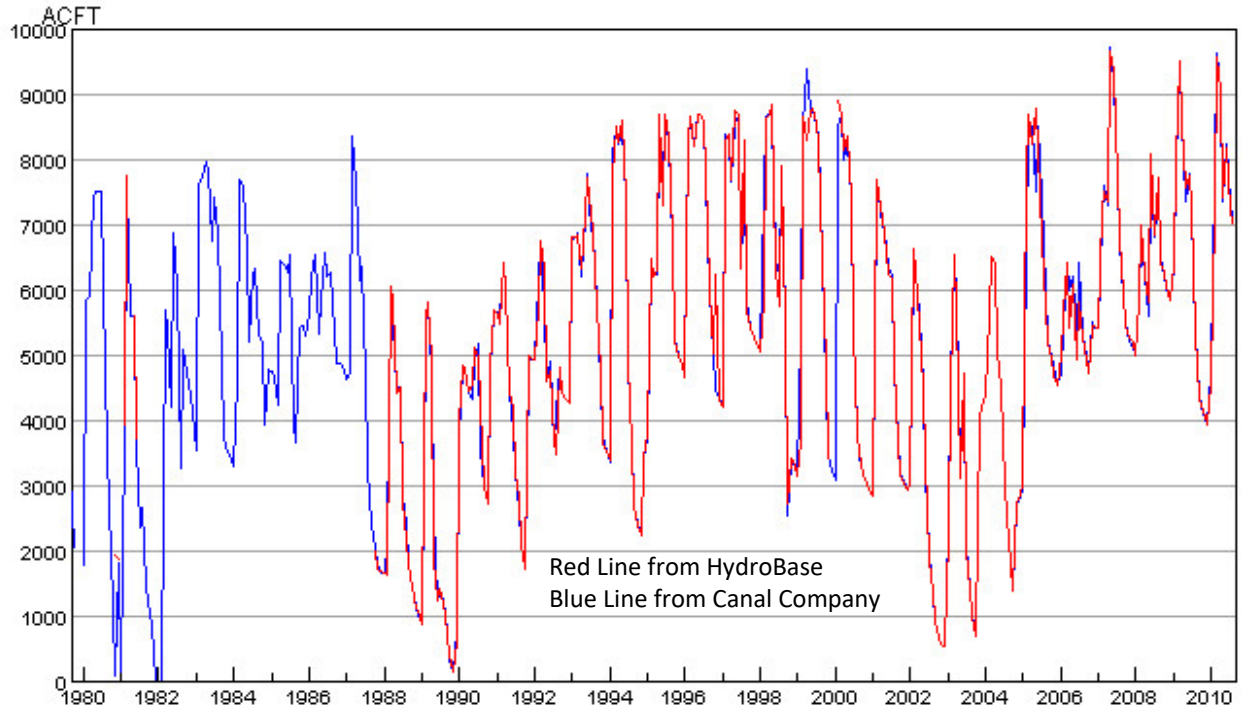

Figure 4: Lake Henry Storage Contents

Storage in Lake Henry is allocated to the shareholders pro-rata based on share ownership. Per Company by-laws, in addition to company water, each shareholder can store other water types in their account. Storage in Lake Henry may include in-priority Lake Henry storage, consumptive use credits from converted Colorado Canal direct flow irrigation rights, and other sources, including Twin Lakes Company water (native and Transmountain), and leased reusable water from a wide variety of sources including changed consumptive use credits and reusable return flows.

WATER RIGHTS

Direct Flow Rights

The Colorado Canal Diversion System has a total decreed flow rate of 756.28 cfs from the Arkansas River for multiple uses, as summarized in Table 6. The water right was originally decreed for irrigation use only. The same rate was also included as a maximum filling rate in the storage decrees for Lake Meredith and Lake Henry and as the diversion rate for the 1898 agricultural exchange. The original irrigation water right was changed in Consolidated Case Nos. 84CW62, 84CW63 and 84CW64 (Change Decree) to include the other uses listed in Table 6. The Change Decree also provided for the exchange of storage releases from Lake Meredith at the confluence of the Lake Meredith Outlet Canal and the Arkansas River up to the Colorado Canal river headgate, Pueblo Reservoir, and upper Arkansas Reservoirs (Turquoise, Twin Lakes and Clear Creek). This exchange provides Lake Meredith shareholders with the mechanism to receive supplemental storage releases from Lake Meredith.

Table 6: Direct Flow Rights

Structure	Appropriation Date	Adjudication Date	Admin. No.	Decreed Amount (cfs)	Case No.	Notes
Colorado Canal	6/9/1890	2/23/1896	14770.0	756.28	CA2535	Irrigation Use
					84CW64	Storage in Meredith Lake and Lake Henry
						Muni, Comm, Dom, Ind Uses
	3/9/1898	11/25/1916	17600.0	756.28	CA13693	Lake Meredith Exchange to Colorado Canal

Source: Colorado Water Rights Tabulation

Storage Rights

The storage rights associated with Lake Meredith and Lake Henry are summarized in Table 7. Lake Meredith has undergone one decreed storage enlargement from its initial decreed capacity of 20,599.6 ac-ft; an increase of 5,068.8 ac-ft to its current decreed capacity of 26,028.4 ac-ft. Lake Henry has not been enlarged.

Table 7: Storage Rights

Storage Unit	Appropriation Date	Adjudication Date	Admin. No.	Decreed Amount (ac-ft)	Case No.	Notes
Lake Meredith	12/31/1891	11/25/1916	19465.15340	6,355	84CW64	Lake Henry Alt Pt
	3/9/1898		19465.17600	20,959.6	CA13693	Absolute (Irrig)
				5068.8		Enl Absolute (Irrig)
				26,028.4	84CW64	Muni, Comm, Dom, Ind Uses
	6/15/1909		21715.0	3,561		Lake Henry Alt Pt
	9/10/1900	10/13/1932	24435.18515	2,000		
		Totals	26,028.4 (Storage)		11,916 (Alternate Point)	
Lake Henry	12/31/1981	11/25/1916	19465.15340	6,355	CA13693	Absolute (Irrig)
	6/15/1909		21715.0	3,561		Enl Absolute (Irrig)
	9/10/1900	10/13/1932	24435.18515	2,000	CA19693	Non-Irrig Uses
		Total	11,916		84CW64	Irrig, Muni, Comm, Dom, Ind Uses for all three Lake Henry storage rights

Source: Colorado Water Rights Tabulation

Administration

Administration of the water rights associated with the Colorado Canal Company and Lake Henry Company involves interaction with the Water District 17 Water Commissioner and the Division 2 Engineer. The Superintendent of the canal company is more often in contact with these individuals during periods of storage and during periods when direct flow calls have been placed downstream on the Arkansas River.

OPERATIONAL INFORMATION

The general operating strategy for the Colorado Canal and Reservoir System in a typical year is as follows:

Non-Irrigation Season

The Colorado Canal typically shuts off by November 15, once the Winter Water Storage Program season begins. The companies try to finish the Winter Water season (March 15) with the reservoirs full. Although operations vary depending on the hydrologic year and other factors, a general approach to meeting this objective is to fill the reservoirs at the end of the Winter Water season by estimating the expected rate of diversion available and the number of days it will take to fill unfilled capacity, going backward from March 15 and starting conveyance of water at that time.

Winter Water is stored in multiple locations, which may include Pueblo Reservoir, John Martin Reservoir, Lake Meredith and Lake Henry, Holbrook Reservoir, and Adobe Creek and Horse Creek Reservoirs. Program participants without storage under their systems request their Winter Water in Pueblo Reservoir, John Martin Reservoir, or in off-channel storage reservoirs under the Colorado, Holbrook, and Fort Lyon Canals. Shareholders in the Colorado Canal and Lake Henry and Lake Meredith Reservoir Companies have first priority to water stored during the Winter Water

storage season in the Colorado Canal system reservoirs. Additional water in storage is allocated to other Winter Water participants. The other entities generally take delivery of their Winter Water early in the irrigation season since their water will be booked out if the Lake Henry or Lake Meredith storage rights come into priority during the spring runoff.

The amount of water available to the Winter Water program participants is dependent on river flows, as outlined in the 84CW179 decree that officially recognized the Winter Water Storage Program. The Colorado Canal company is entitled to 10.69 percent of the first 100,000 ac-ft yield and 12.8025 percent of any waters stored beyond 103,106 ac-ft. Total yields for the Winter Water Program have ranged from about 75,000 ac-ft in 2003 to almost 180,000 ac-ft in 2000. The Colorado Canal Company's portion of the 2000 yield was about 20,500 ac-ft. The Winter Water storage amounts in the Colorado Canal system reservoirs are based on gage height rather than river diversions. Therefore, the Winter Water storage amounts are accounted after conveyance losses down the Colorado Canal.

Irrigation Season

The Colorado Canal has a relatively junior direct flow right that is typically in priority to divert during spring runoff, during significant storm events, and later in the summer in above average and wet years.

In wet years, CS-U and Aurora may lease their share water back to irrigators under the canal or lease reusable return flows from upstream releases. During dry and average years, the cities try to exchange their supplies up to Pueblo Reservoir. The municipalities divert their share water into storage under the Colorado Canal system. Often there is not sufficient river exchange potential to move the water or sufficient space in upstream storage to receive the exchange water, so the stored water is exchanged up the river system later in the season or the following water year when exchange potential may become available. Such stored water may be carried over multiple years until exchange potential, upstream storage space, and need for the water exists.

Historically, irrigators under the ditch benefitted from Winter Water stored in Lake Meredith and Lake Henry, releases of Fry Ark Project water from Pueblo Reservoir, and supplemental deliveries attributable to shares in the Twin Lakes Reservoir & Canal Company (TLCCo).

TLCCo deliveries to the Colorado Canal for the last 20 to 30 years have been limited. CS-U, Aurora, Pueblo Water, and Pueblo West typically take delivery of their ditch and reservoir company shares and TLCCo share water higher up in the Arkansas River basin. Therefore, since municipalities took over the majority of the share ownership in the canal and reservoir companies (post ~1985), typically less than 5 percent of TLCCo water owned by irrigators makes it past Pueblo Reservoir and down the Colorado Canal.

Fryingpan-Arkansas Project (Fry-Ark) water has generally been delivered from Pueblo Reservoir in the July to August period. Annual deliveries averaged about 1,700 acre-feet from the mid-1980s through mid-1990s. Deliveries during the 2000s have been more sporadic and have averaged closer to 500 acre-feet per year, which is consistent with the reduced irrigation use under the Colorado Canal.

Other deliveries through the canal and/or into the reservoirs include delivery of reusable return flows, first use transmountain water rights from systems other than Twin Lakes, or deliveries of leased water from a wide variety of sources for direct irrigation use, storage, or augmentation.

Although the sequence of delivery each year varies widely based on hydrologic conditions, ditch operational issues, shareholder needs, and other conditions, a general order of operations for water supplies into the Colorado Canal is as follows:

- Direct Flow Water
- Winter Water and water diverted under its storage from Lake Meredith (by exchange) and Lake Henry (direct)
- Other sources, including reusable return flows, leased water, Twin Lakes Canal Company, and Fry-Ark Project Water from Pueblo Reservoir or other upstream locations

Where to find more information:

- Additional information on Colorado Springs Utilities' use of its Colorado Canal water is presented in the ArkDSS Colorado Springs Utilities memorandum.
- Additional information on the City of Aurora's use of its Colorado Canal water is presented in the ArkDSS Aurora Water memorandum.
- Additional information on Holbrook Canal Company operations is presented in the ArkDSS Holbrook Canal Operations memorandum.
- Additional information on Fort Lyon Canal Company operations is presented in the ArkDSS Fort Lyon Canal Operations memorandum.
- Additional information on Pueblo Reservoir and the Winter Water Storage Program is presented in the ArkDSS Fryingpan-Arkansas Facilities and Related Operations memorandum.
- Additional information on ditch and reservoir operations in and around the Colorado Canal is presented in the ArkDSS Water District 17 memorandum.
- Additional information on John Martin Reservoir is presented in the ArkDSS Water District 67 memorandum.

REFERENCES

- Meeting with Water Division 2, Water District 17 Commissioner Lonnie Spady (lonnie.spady@state.co.us).
- Meeting with Scott Campbell, General Manager. Twin Lakes Reservoir and Canal Company and Colorado Canal Company (retired).
- Bruce Hughes, General Manager. Twin Lakes Reservoir and Canal Company and Colorado Canal Company (bhughes@ccanal.net).
- Kevin Lusk, President of the Twin Lakes Reservoir and Canal Company, the Colorado Canal Company, the Lake Meredith Reservoir Company, and the Lake Henry Reservoir Company, and Principal Engineer for Colorado Springs Utilities (klusk@csu.org).

- Abbott, P.O., Description of Water-Systems Operations in the Arkansas River Basin, Colorado. USGS Water Resources Investigations Report 85-4092. Lakewood, Colorado. 1985.
- MWH Americas, Inc. Hydrologic Model Documentation Report Southern Delivery System Environmental Impact Statement, Prepared for Bureau of Reclamation Eastern Colorado Area Office. Loveland, Colorado. November 2007.
- Pueblo County District Court decrees in Civil Actions 13693 and 19693.
- W.W. Wheeler & Associates, Inc. Final Report Colorado Canal, Lake Henry and Lake Henry Change of Water Rights. Englewood, Colorado. October 1985 (Revised).
- Decrees, engineering reports, and associated water court material available at http://dwrweblink.state.co.us/
- State of Colorado, Division of Water Resources, HydroBase database.
- State Engineer's Office. Straightline Diagrams and Maps and Filing Statements.