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POWER CANAL CAPACITY REPORT

PREPARED FOR
Grand Valley Water Users Association
Grand Junction, CO

PREPARED BY
Olsson Associates
760 Horizon Drive
Grand Junction, CO 81506
970-263-7800

OLSSON ASSOCIATES®

Project No. 015-2650

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Glossary

Acronym	Definition
GVWUA	Grand Valley Water Users Association
PID	Palisade Irrigation District
OMID	Orchard Mesa Irrigation District
CDWR	Colorado Division of Water Resources
CCU	Conserved Consumptive Use
ac-ft	Acre-Feet
LOPP	Lease of Power Privilege
USBR	United States Bureau of Reclamation

Disclaimer

This report details one potential mechanism through which water associated with Conserved Consumptive Use (CCU) could be protected and returned to the Colorado River under a pilot project water bank administered by the Grand Valley Water Users Association (GVWUA). The investigation of a water bank involving the Grand Valley Project and the preparation of this report have been conducted in connection with the efforts of the Colorado Water Bank Work Group (WBWG) to explore voluntary and compensated strategies to implement temporary demand reduction across all water use sectors diverting from the Colorado River Basin. The GVWUA has cooperated in these efforts at the request of the WBWG.

The cooperation of the GVWUA in investigating a pilot project water bank and in exploring the matters detailed in this report should not be construed as any of the following: (1) a willingness, interest or commitment by the shareholders of GVWUA to decrease their beneficial consumptive use of Colorado River water; (2) a willingness, interest or commitment by GVWUA to make management decisions or system improvements with the goal of decreasing the amount of water put to beneficial use by its shareholders; (3) a willingness, interest or commitment by GVWUA or its shareholders to lease or convey any beneficial use of Grand Valley Project irrigation water to any other person or entity or to otherwise allow any other person or entity to use Grand Valley Project irrigation water; or (4) a recommendation by GVWUA that its shareholders should decrease consumptive use of Grand Valley Project irrigation water in any way.

1.0 INTRODUCTION

1.1 Purpose

During the operation of a pilot project water bank, it may be beneficial for the Grand Valley Waters Users Association (GVWUA) to utilize the unused capacity within the Orchard Mesa Power Canal (power canal) to deliver water to the Grand Valley Power Plant (GVPP). The purpose of this report is to investigate any potential unused capacity within the power canal. For this analysis it is assumed that any unused power canal capacity could be used temporarily as a protective means for Conserved Consumptive Use (CCU) generated through a pilot project water bank. It is further assumed that any additional capacity available within the conveyance system could provide water to generate hydroelectric power.

1.2 Objectives

The objective of this project is to determine how often and to what extent during the irrigation season additional water could be accommodated in the power canal for delivery to the GVPP. This report will investigate available historical flow records in order to determine if an additional amount of water could potentially have been conveyed to the GVPP during years with historical record.

2.0 CURRENT OPERATIONS

The GVPP is jointly operated by the GVWUA and Orchard Mesa Irrigation District (OMID) under a Lease of Power Privilege (LOPP) with the United States Bureau of Reclamation (USBR). OMID oversees the daily operations of the plant. The current maximum generation output at the plant is 2.75 MW. Water for power generation is diverted at the Roller Dam, conveyed through the Highline Canal, siphoned under the Colorado River immediately upstream of the Grand Valley Project Tunnel Number 3, conveyed through the power canal and delivered to the GVPP. The OMID irrigation water pumping plant is immediately downstream of the intake to the GVPP penstocks. See map 2.0 in Appendix A.

The canal section referred to as the power canal is the portion of canal between the Colorado River siphon and the GVPP. This portion of canal carries both irrigation water and power water in differing quantities and proportions throughout the irrigation season. The canal also carries up to 800 cfs of water strictly dedicated to power production during the non-irrigation season.

2.1 Water Rights in the Power Canal

There are currently four water rights conveyed through the Power Canal during the irrigation season. Table 2.1 illustrates these rights.

Table 2.1 Water Rights Associated with the Power Canal

Owner	Appropriation Date	Net Amount (cfs)	Use	Notes
Orchard Mesa Irrigation District	1900-10-01	10.2	Irrigation	
Orchard Mesa Irrigation District	1907-10-25	450	Irrigation	
United States of America	1908-02-27	800	Power*	Limited to 400 cfs During Irrigation Season
GVWUA, OMID, USA	1926-04 01	640	exchange	Orchard Mesa Check Case

*When irrigation diversions are below 1,310 cfs at the Roller Dam, power right may be exercised to maintain 1,310 cfs

The irrigation rights associated with OMID serve irrigated acres in the Vinelands area prior to the GVPP as well as irrigated acres served by the OMID pumping plant.

2.2 Available Irrigation Season Power Canal Capacity

The amount of water conveyed through the power canal during the irrigation season varies depending on a number of factors including irrigation demand, hydrology, canal operations (OMID, GVWUA, and the Grand Valley Irrigation Company), and water rights administration. For this analysis, historical records were obtained from the Colorado Division of Water Resources (CDWR) and OMID. Both entities utilize the same gaging station location downstream of the Stoke's Gulch siphon. However, the entities utilize different measuring devices and apply different rating curves to the reading. Both records have significant gaps in data and certain areas are filled with average data. Appendix B demonstrates the available data for the 2015 irrigation season for OMID and CDWR, and gives an indication of the shift between the records kept by CDWR and OMID. Conversations with CDWR staff suggest that a new gaging station along the power canal should be operable soon, and ongoing coordination between OMID and CDWR suggests that this new gaging station and rating curve will be acceptable to both entities.

Even with incomplete and disagreeing data sets it is still possible to analyze data in a manner that gives an indication of any remaining capacity in the power canal. The analysis has been done in a manner that compares the relative difference between the maximum value for a yearly data set

and the daily value for each day within the same dataset. The analysis allows us to look at the relative amount of space available regardless of the measuring device or rating curve applied. The following sections outline the findings from the data analysis.

2.2.1 ORCHIDCO (CDWR) Stoke's Gulch Data

CDWR maintains a gage within the power canal referred to as ORCHIDCO. Irrigation season data is available for the years of 1996 through 2007, and 2013 through 2015. It should be noted that a significant portion of data obtained from CDWR is listed as "provisional". Appendices C1 and C2 represent the data available from CDWR for the ORCHIDCO station during the irrigation season.

2.2.2 OMID Stoke's Gulch Data

OMID maintains a gage within the power canal referred to as the Stoke's Gulch gage. Irrigation season data is available for the years 2006 through 2008, 2012, 2013 and a portion of 2015. Appendix D represents the data available for the OMID Stoke's Gulch gage during the irrigation season.

2.2.3 Available Power Canal Capacity

A number of assumptions are necessary for this data analysis in order to come to some reasonable conclusions. The assumptions made for this analysis are as follows:

- The portion of the irrigation season that is analyzed in this report is April 1 – October 31 of each year.
- The maximum capacity of the power canal varies by year (capacity being not only physical space available within the infrastructure, but also the operational and managerial time and resources necessary to achieve maximum flows) and is dependent on numerous factors. It has been assumed that the maximum flow measurement recorded during each irrigation season is the maximum capacity of the power canal for that year.
- The difference between the maximum capacity of the power canal in a year and each daily measurement during that year is considered available space within the power canal. For example, during 2005, the maximum recorded flow was 822 cfs on July 3rd. On October 31 the flow measurement was 797 cfs. Therefore, on October 31 there existed 25 cfs (822 – 797) of unused capacity within the power canal.
- The 25 cfs of available capacity from the previous assumption is available for 24 hours. This yields a cumulative volume of available capacity of 1.98 ac-ft per cfs per day.

Using the assumptions listed above, the available historical record can be manipulated to give an indication of the unused capacity of the power canal. Table 2.2.3 in Appendix E illustrates the estimated available capacity within the power canal based on the assumptions outlined. Both data sets have been utilized for this analysis when available.

3.0 CONCLUSIONS AND NEXT STEPS

The data within this report indicates that throughout the historical record analyzed capacity exists within the power canal to convey additional water. The amount of unused power canal capacity varies between years and is dependent on a number of factors. The potential unused capacity varies from a maximum of 49,279 ac-ft during the 2002 irrigation season to a minimum of 9,824 ac-ft during the 2005 irrigation season.

Data from an earlier report prepared for the GVWUA by Olsson Associates suggests that one scenario for a pilot project water bank could generate nearly 5,000 ac-ft of CCU. This amount of CCU could have been conveyed through the power canal during irrigation seasons containing sufficient data to be analyzed within this report.

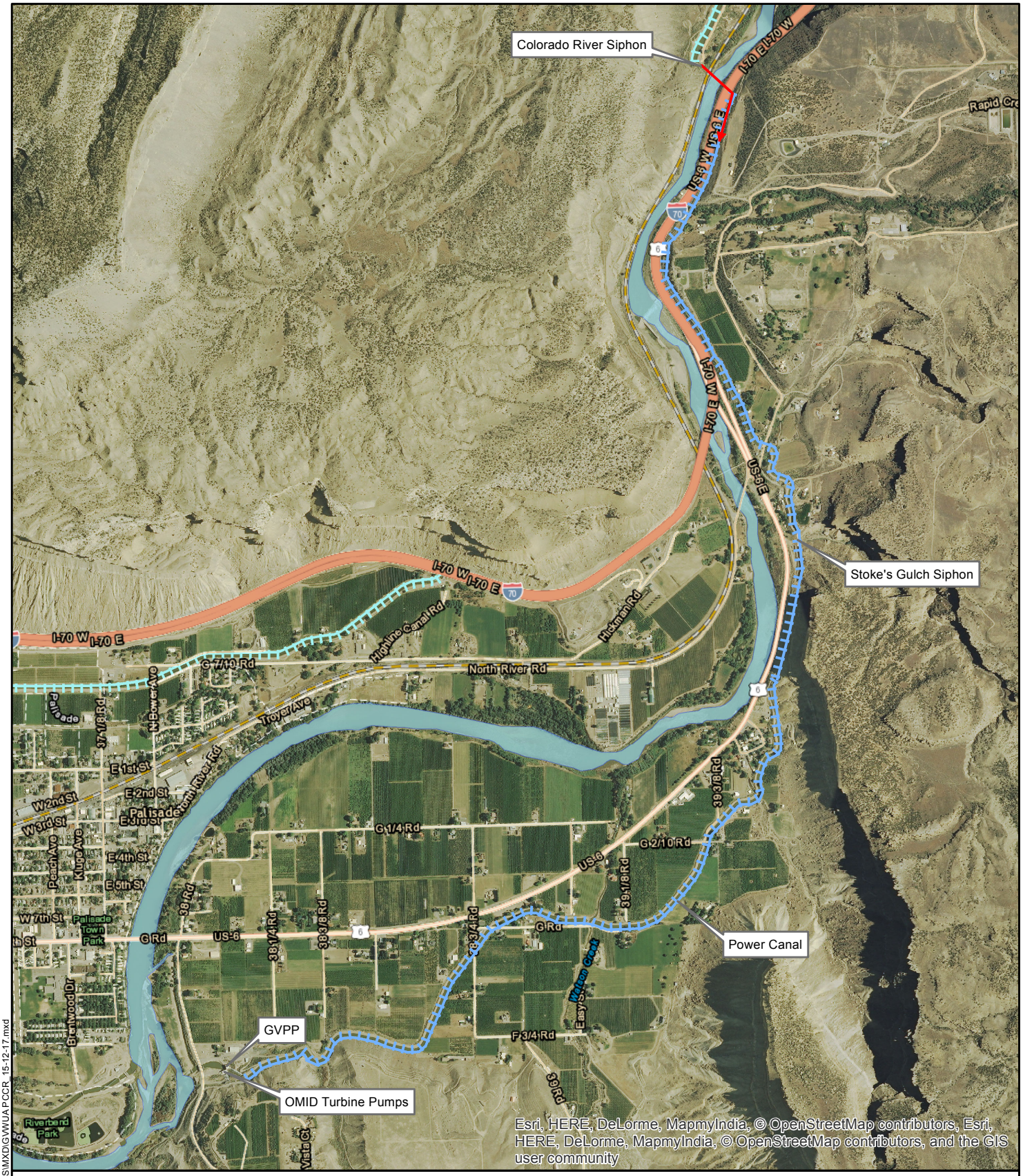
It is important to note that sufficient capacity does not always exist within the power canal to convey CCU at the same rate of CCU accumulation. The pilot project water bank scenario outlined in the earlier Olsson Associates report estimated that nearly 1,200 ac-ft of CCU could be generated during the month of July. During July 2005, there was not sufficient space available within the power canal to convey 1,200 ac-ft of water.

3.1 Next Steps

This report has demonstrated that the power canal has unused capacity during each irrigation season. However, through conversations with staff at both the GVWUA and OMID it has become apparent that there are still a number of unresolved issues related to the utilization of the unused capacity. Some of the issues that may need to be explored further are:

- Who realizes the benefits of any potential increased power production?
- How do the Orchard Mesa Check Case and certain critical river flow points affect the future operations of the power canal?
- Will future operations by the GVWUA and OMID utilize any unused capacity of the power canal without a water banking pilot project?
- How will system improvements by OMID and GVWUA affect the operation and unused capacity of the power canal?
- Is it possible for OMID and GVWUA to come to an agreement prior to each irrigation season that dedicates a certain amount of capacity in the power canal to conveying CCU? How would such an agreement affect existing water rights?

It has become apparent through this report that while the ability to utilize the power canal as a protective mechanism may be convenient for a pilot project it is most likely only available to the GVWUA on a temporary basis. Further protection of CCU may be required for water banking outside of a pilot project.



Legend

- Colorado River
- GVWUA Highline Canal
- Power Canal

DISCLAIMER : This Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended, nor does it replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of locations in this GIS cannot be substituted for actual legal surveys.

0 500 1,000 Feet

N

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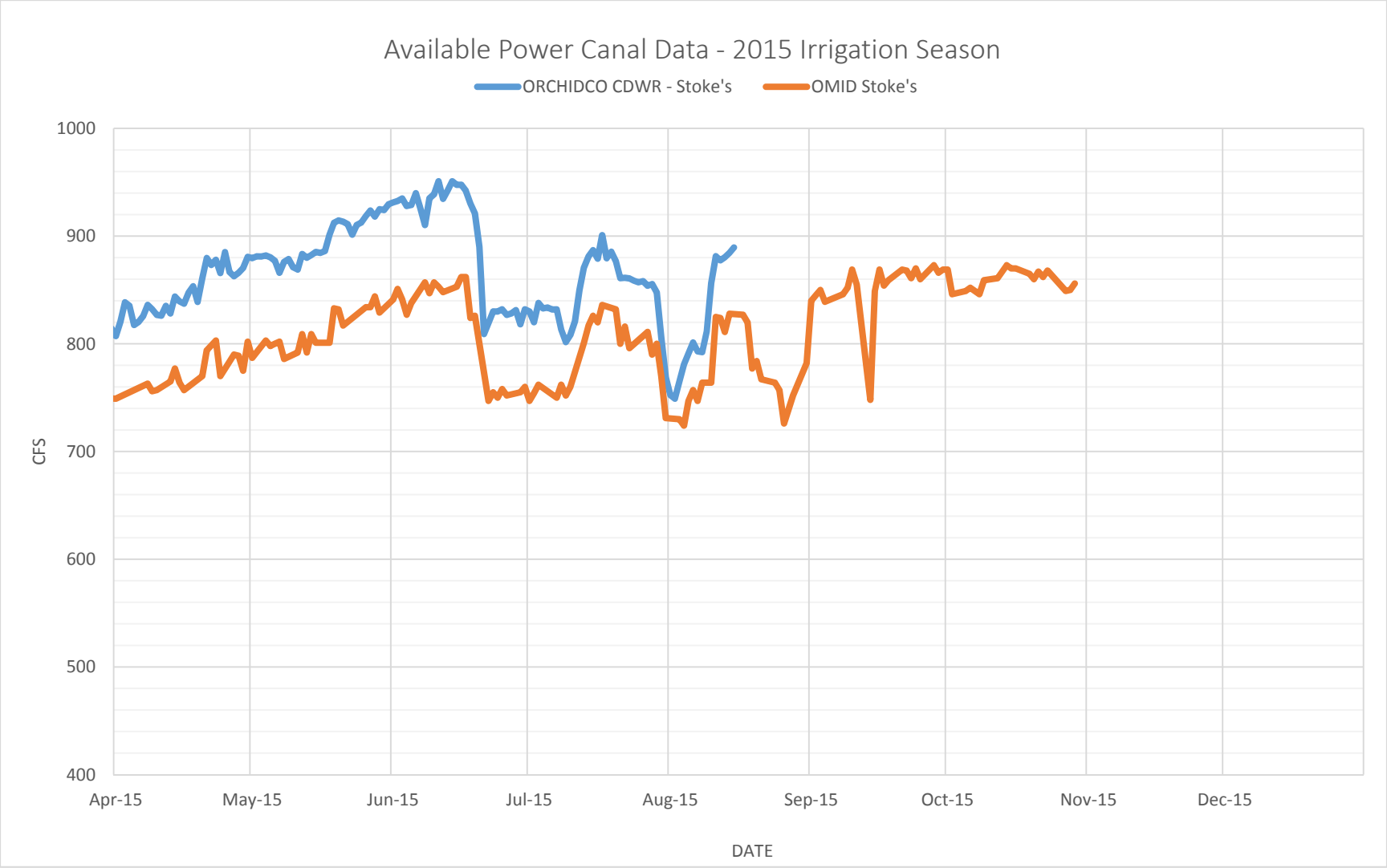
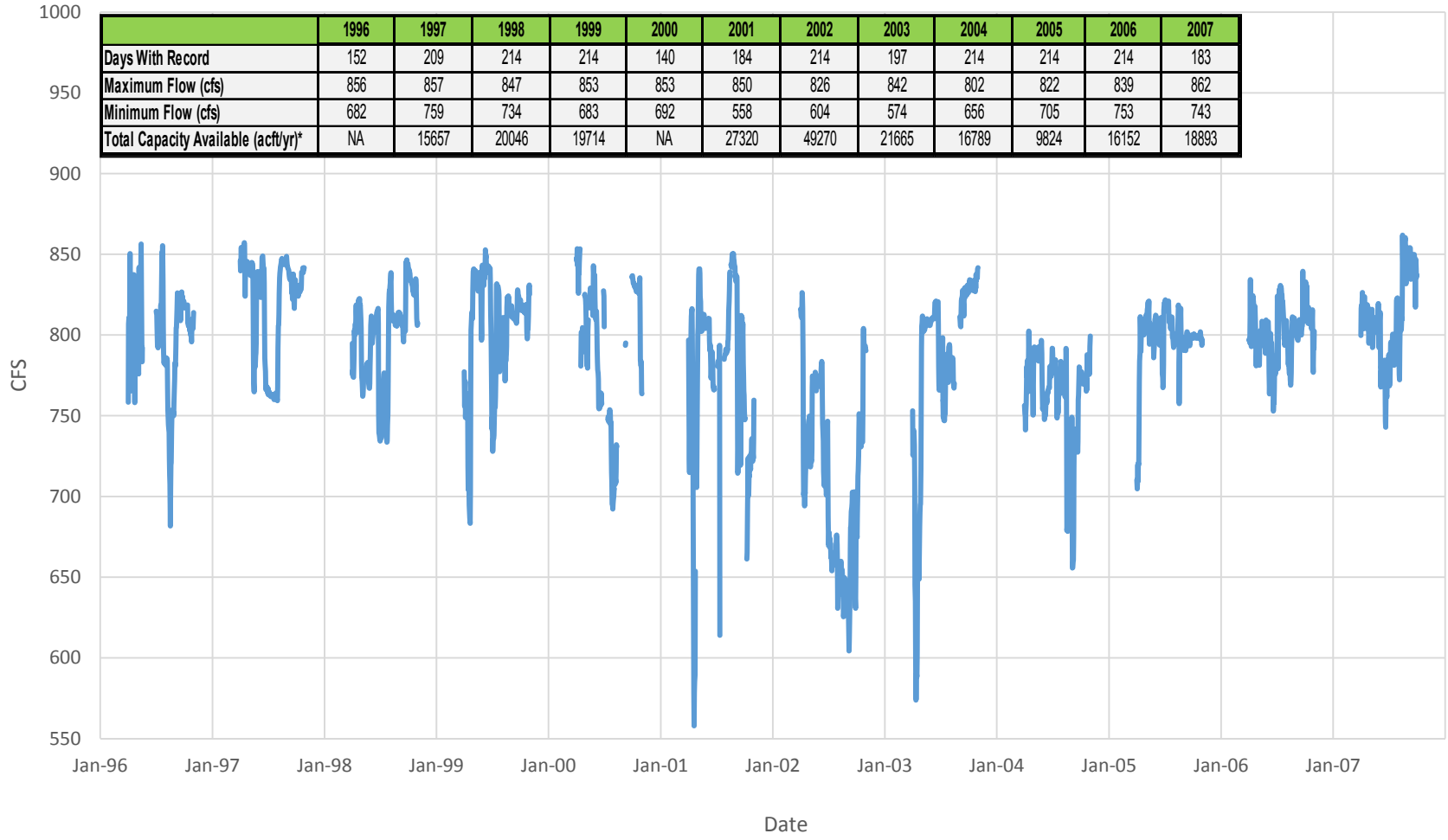
Project Number: 015-2650	GVWUA Power Canal Capacity Report Mesa County, Colorado	OLSSON ASSOCIATES 760 Horizon Drive, Suite 102 Grand Junction, CO 81506 P: 970.263.7800 F: 970.263.7456	Appendix A
Drawn By: SBS			**Map 2.0**
Revision Date: 12/21/2015			


Available Power Canal Data - 2015 Irrigation Season
ORCHIDCO CDWR - Stoke's
OMID Stoke's
1000
900
800
700
600
500
400
CFS
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
DATE

CDWR ORCHIDCO Irrigation Season 1996 - 2007

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Days With Record	152	209	214	214	140	184	214	197	214	214	214	183
Maximum Flow (cfs)	856	857	847	853	853	850	826	842	802	822	839	862
Minimum Flow (cfs)	682	759	734	683	692	558	604	574	656	705	753	743
Total Capacity Available (acft/yr)*	NA	15657	20046	19714	NA	27320	49270	21665	16789	9824	16152	18893



"NA" in Total Capacity Available row indicates less than 85% of record available

*Total Capacity Available represents the sum of (yearly maximum value – daily value) for all days with record multiplied by 1.98 ac-ft/day/cfs

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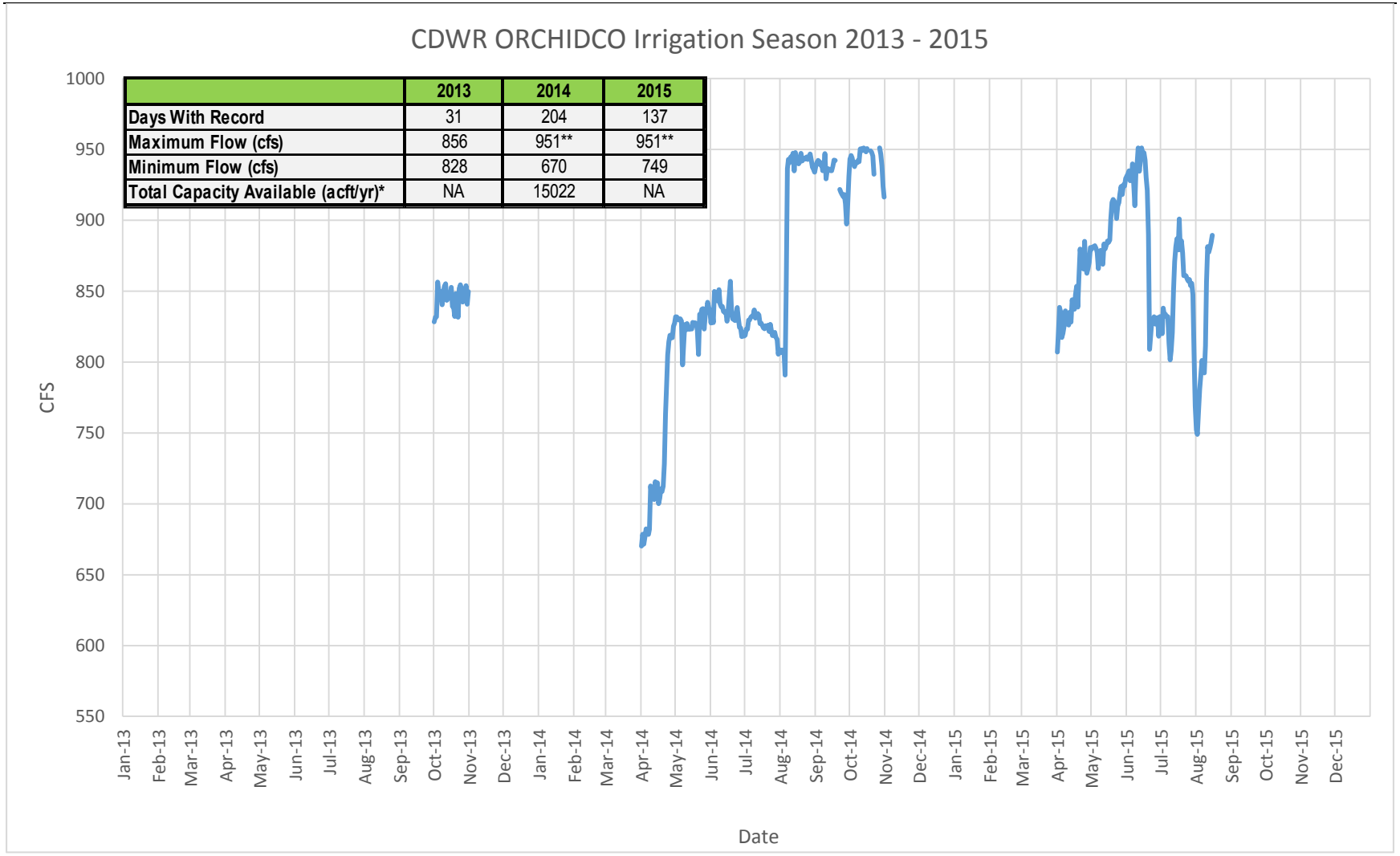


	2013	2014	2015
Days With Record	31	204	137
Maximum Flow (cfs)	856	951**	951**
Minimum Flow (cfs)	828	670	749
Total Capacity Available (acft/yr)*	NA	15022	NA

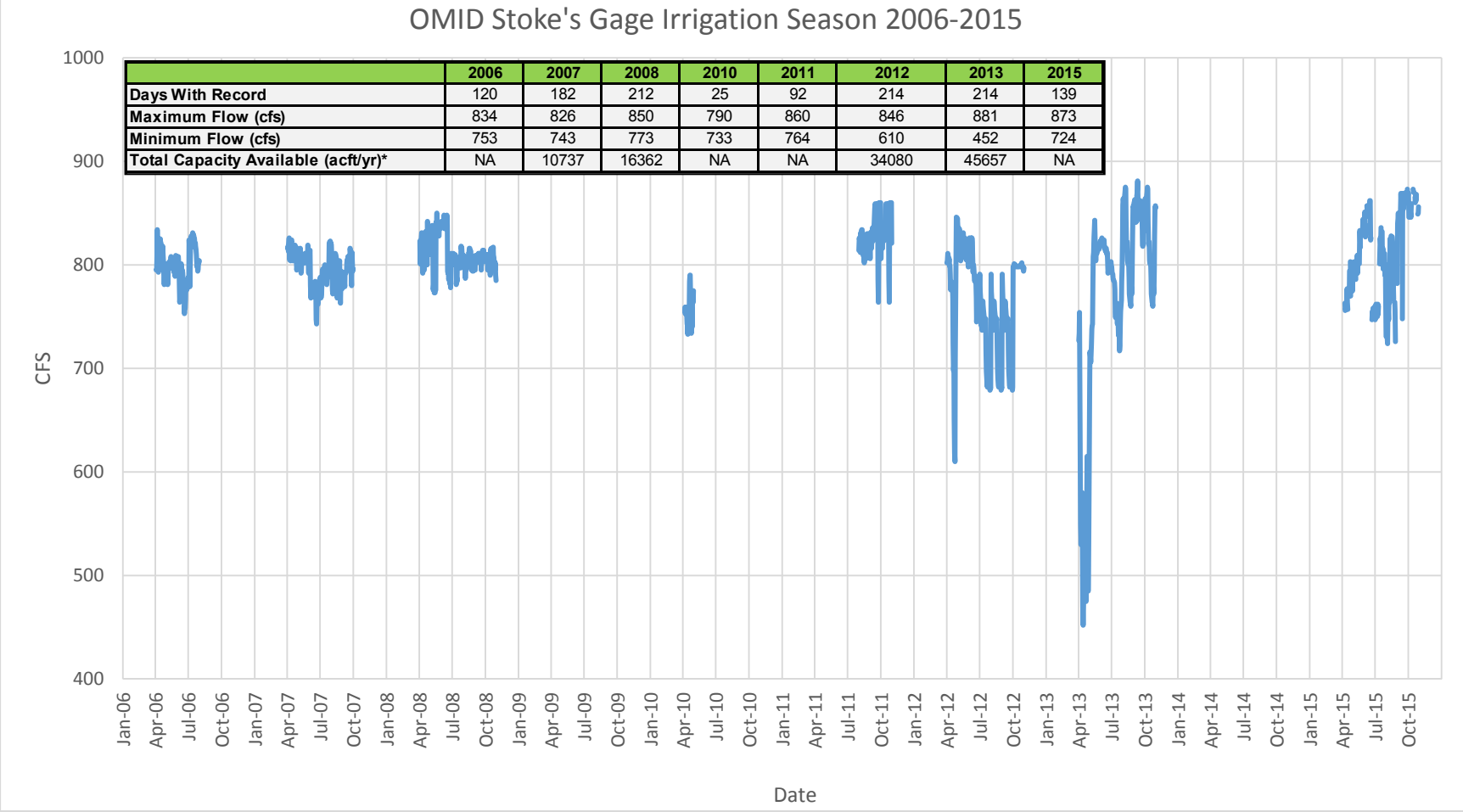
"NA" in Total Capacity Available row indicates less than 85% of record available

*Total Capacity Available represents the sum of (yearly maximum value – daily value) for all days with record multiplied by 1.98 ac-ft/day/cfs

**951 cfs is likely not indicative of actual power canal capacity, apparent rating curve shift in 2014

Total Capacity Available data for 2014 is adjusted for a 94 cfs rating curve shift in data on Aug 7th

APPENDIX D – OMID STOKE'S GULCH DATA



	2006	2007	2008	2010	2011	2012	2013	2015
Days With Record	120	182	212	25	92	214	214	139
Maximum Flow (cfs)	834	826	850	790	860	846	881	873
Minimum Flow (cfs)	753	743	773	733	764	610	452	724
Total Capacity Available (acft/yr)*	NA	10737	16362	NA	NA	34080	45657	NA

"NA" in Total Capacity Available row indicates less than 85% of record available

*Total Capacity Available represents the sum of (yearly maximum value – daily value) for all days with record multiplied by 1.98 ac-ft/day/cfs

Table 2.3.1 Power Canal Historically Available Excess Capacity (acre feet)

Source	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Yearly Total
CDWR	**1997**	774	2,292	2,690	5,831	1,299	1,412	1,359	15,657
CDWR	**1997**	2,482	4,298	3,072	5,323	1,998	1,750	1,122	20,046
CDWR	**1998**	5,651	1,260	1,329	4,170	2,800	2,191	2,312	19,714
CDWR	**1999**	7,417	2,282	2,936	2,237	1,389	6,773	4,287	27,320
CDWR	**2001**	4,355	4,156	5,196	9,917	11,131	9,678	4,837	49,270
CDWR	**2002**	9,693	2,159	2,121	4,091	1,922	1,115	565	21,665
CDWR	**2003**	1,715	1,145	2,150	1,807	4,274	4,120	1,580	16,789
CDWR	**2004**	2,541	1,008	1,238	697	1,402	1,520	1,417	9,824
CDWR	**2005**	1,972	2,518	3,404	1,696	2,733	1,975	1,853	16,152
OMID	**2007**	801	1,337	2,961	1,914	2,055	1,722	NA	10,737
OMID	**2008**	1,836	1,914	1,787	2,809	2,934	2,590	2,701	16,362
OMID	**2012**	4,596	1,662	3,152	7,414	7,414	7,087	2,908	34,080
OMID	**2013**	19,464	5,685	4,163	7,117	3,719	1,853	3,719	45,657
CDWR	**2014**	7,512	1,811	1,293	1,973	967	1,073	392	15,022
							Yearly Min		**9,824**
							Yearly Max		**49,270**
							Yearly Avg		**22,735**

Notes:

Only years with data for greater than 85% of days within irrigation season represented, missing data not represented in Totals

"NA" represents a month with no data

Months with "NA" not reflected in Yearly Total column

CDWR and OMID gages located at same site, measuring device and rating curves differ

2007 CDWR data has been omitted from this table due to an inconsistency in the data