FINAL REPORT

COLORADO RIVER SYSTEM CONSERVATION PILOT PROGRAM IN THE UPPER COLORADO RIVER BASIN

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I. Executive Summary

The following report is intended to summarize the outcomes and lessons learned from the three-year Colorado River System Conservation Pilot Program (SCPP) as implemented in the Upper Colorado River Basin (Upper Basin) beginning in 2015.[1] The Upper Basin SCPP is part of a larger, basin-wide program that was funded by four Colorado River municipal water users--the Central Arizona Water Conservation District, the Southern Nevada Water Authority, the Metropolitan Water District of Southern California (MWD), and Denver Water-- partnering with the Bureau of Reclamation (collectively, the Funding Agencies). In 2017, the Walton Family Foundation also contributed to the Upper Basin SCPP through Denver Water.

The overall goals of the SCPP were to, among other things, help explore, learn from and determine whether a voluntary, temporary and compensated reduction in consumptive use in the Upper Basin is a feasible method to partially mitigate the decline of or to raise water levels in Lake Powell and thereby serve as a useful tool for the drought contingency planning processes in the Upper Basin. Thus, the primary objective of the pilot program was not to test whether conserved water actually reaches Lake Powell, but rather to assess the feasibility of system conservation as a future means of increasing storage at the reservoir. From 2015-2017, the Upper Basin SCPP funded 45 projects, for a consumptive use reduction of approximately 22,116 acre-feet at a total cost of $4,555,747. There was significant interest and program participation in the Upper Basin. With assistance from the four Upper Colorado River Division States (Colorado, Utah, Wyoming, and New Mexico) as well as facilitation by key non-governmental organizations (NGOs), the Upper Basin SCPP received 93 applications from 2015 through 2017. Information about the SCPP was collected that will inform the future of the program, or a similar demand management effort, including recommendations for potential improvements.

In addition to demonstrating significant Upper Basin water user interest, the SCPP was also successful in demonstrating and accomplishing the administrative requirements for such a program. These included solicitation of proposals from water users; review, ranking and selection of projects; contracting; field verification of consumptive use savings; payment management and processing; and, management and coordination of activities among multiple funding agencies.

The SCPP successfully demonstrated water user interest, administrative capabilities and requirements, as well as greatly advanced learning – all of which have contributed to a better understanding of whether and how voluntary reductions in consumptive use in the Upper Basin may help protect critical reservoir levels during drought Among the broader-based observations involved in implementing this program, the following have emerged:

1. The Upper Colorado River Commission (UCRC) gained an understanding of the requirements to administer, contract, and pay for conservation activities;
2. It is valuable to have key stakeholders and NGOs participate in program outreach;

[1] In August 2017, the Upper Colorado River Commission agreed to extend the SCPP through 2018 to further study the feasibility of the Program in the Upper Basin. A summary of the fourth year of SCPP in the Upper Basin will be included as an appendix to this Report upon conclusion of the 2018 projects.

3. There can be multiple benefits of conservation, including fuller target reservoirs, in-channel benefits, and benefits to agricultural production through soil "resting";
4. Sufficient resources for program administration must be provided;
5. Additional groups may be interested in providing potential funding – including public water providers, NGOs, and the federal government;
6. Improved methods of estimating conservation, such as remote sensing, may be useful;
7. The desire to generate publicity about program participation varies among selected applicants;
8. Involvement by trusted local and state representatives is critical in attracting agricultural water user participation;
9. The availability of historical crop and water use data and information on a proposed site is beneficial to understanding potential conservation benefits;
10. The SCPP served as a valuable tool for educating local water managers, administrators, and water users about the Colorado River System; and
11. Conservation may be a tool to improve reservoir conditions provided legal, technical and policy issues can be resolved.

The underlying goal of the SCPP was to learn about the logistics and challenges associated with implementing this type of program. The operation of the pilot program showed: 1) there is participation interest within the Upper Basin; 2) it is possible to contract and verify conservation measures; and, 3) competitive pricing can support conservation efforts. Because of the learning successes of the pilot program between 2015 and 2017, the SCPP has been extended into 2018. See footnote 1. Additionally, the information garnered in the first three years of the pilot program has helped clarify remaining questions that need to be answered to support a long-term management program. The following questions should be addressed in conjunction with the lessons learned detailed in this Report:

1. What is the role and objective of a more permanent System Conservation Program? For example, is it an intermittent tool used only when Lake Powell hits critical elevations for large-scale demand management; or, is it vehicle to implement more local water banking options to benefit Upper Basin water users?
2. What can be done to ensure that conserved water gets to Lake Powell?
3. What can be done to improve the ability to measure conserved water volumes?
4. Can projects generate the amount of conserved water that modeling conducted by the Upper Basin suggests may be required to have measurable impacts; and,
5. What are the direct and indirect benefits and impacts to local areas from a significant level of conservation?
6. What would be the source of financial support for measurable demand management volumes, recognizing current unit costs? For example, is it feasible to secure roughly $40 million to conserve approximately 200,000 acre-feet based on the 2017 SCPP unit costs?
7. How do we manage risk and determine an appropriate level of conservation given hydrologic variability? For example, how do we minimize large investments in conservation rendered unnecessary by a wet year—are there opportunities for using surplus conserved water in the Upper Basin (e.g., water banking)?

8. How do we preserve the widespread interest, support, and momentum that the SCPP has generated; will a short-term break in implementation have long-term impacts in interest?
9. What are the possible options and the best vehicle to administer a system conservation program? For example, some of the options being considered by a UCRC/Upper Basin workgroup include administration by Reclamation or other government agencies, continued administration by the UCRC, or administration by an NGO.
10. How does a future system conservation program respond to the goals, objectives, timing, mandates, and priorities of the Upper Basin states and the UCRC?

II. Background

The Colorado River, often considered the lifeline of the American Southwest, supplies water to between 35 and 40 million people in the seven U.S. Basin States of Arizona, California, Nevada, Colorado, Wyoming, Utah, and New Mexico, and approximately 4.5 million acres of land in the Basin and adjacent areas.[2] Prolonged drought conditions over the course of more than 17 years, coupled with increasing demands, have stressed this valuable water system. In 2016, water levels in Lake Mead reached a historic low, dropping below 1,072 feet.[3] Moreover, two of the last 17 years of inflows into Lake Powell were less than five million acre-feet[4] with above-average inflows into Lake Powell occurring only four years since 2000.[5] Should such patterns continue over time, both Lake Powell and Lake Mead could reach critical elevations that would threaten hydroelectric power generation and could eventually lead to a conflict over the 1922 Colorado River Compact.

To help explore drought contingency options that could help increase water elevation levels in Lake Mead and Lake Powell, four Colorado River municipal water users—the Central Arizona Water Conservation District, the Southern Nevada Water Authority, The Metropolitan Water District of Southern California, and Denver Water, partnering with the Bureau of Reclamation (collectively, the Funding Agencies)—funded the SCPP in both the Upper and Lower Colorado River basins. The overarching goal was to assess whether surface water elevations in Lake Mead and Lake Powell could be increased through participation in the program. The SCPP provided over $11 million in funding to develop, test, and collect data for a *temporary, voluntary and compensated* water-savings program to provide a learning opportunity and assess long-term feasibility. The Funding Agencies originally committed at least $2.75 million to implement a two-year SCPP for projects located in the Upper Basin. The UCRC entered into a Facilitation Agreement with the Funding Agencies in May of 2015 to implement the SCPP in the Upper Basin beginning that same year.

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[2] "Colorado River Basin Stakeholders Moving Forward to Address Challenges Identified in the Colorado River Basin Water Supply and Demand Study Phase 1 Report". U.S. Bureau of Reclamation. Available at: https://www.usbr.gov/lc/region/programs/crbstudy/MovingForward/Phase1Report.html.

[3] "Lake Mead Historical Reservoir Levels." U.S. Bureau of Reclamation. Available at: https://www.usbr.gov/lc/region/g4000/hourly/mead-elv.html

[4] "Lake Powell Unregulated Inflow." U.S. Bureau of Reclamation. Available at: https://www.usbr.gov/uc/water/crsp/studies/images/PowellForecast.png.

[5] The Average inflow into Lake Powell was 10.83 MAF from 1981-2010. "Lake Powell Unregulated Inflow." U.S. Bureau of Reclamation. Available at: https://www.usbr.gov/uc/water/crsp/studies/images/PowellForecast.png.

Although the SCPP was originally intended to be a two-year project, greater interest in participation and availability of additional funds motivated the UCRC and Funding Agencies to extend the project through 2017, and again into 2018. Preliminary results of the SCPP and lessons learned from the implementation of the 2015, 2016, and 2017 projects in the Upper Basin are provided below.

III. System Conservation Pilot Program Approach

A. Evaluation Criteria and Project Selection

Evaluation criteria was developed to select projects that would provide learning opportunities to understand how a larger-scale project could be implemented and would most benefit the Colorado River by intentionally leaving water in the system. The UCRC, the four Upper Division States and the Funding Agencies participated in the evaluation process. Evaluation criteria included:

- ability to demonstrate the efficacy of a new conservation method,
- schedule for implementing the conservation project,
- complexity or level of administration involved in project implementation and verification,
- cost per acre-foot of conserved water,
- identified environmental benefits,
- demonstrated commitment to project success,
- diversity in geographic locations,
- diversity in the types of water conservation methods,
- funding availability in conjunction with consideration of other proposed projects,
- demonstrable water savings, and
- potential for any conserved water to benefit storage in the Colorado River system.

B. Project Verification

The SCPP Team worked with the selected project participants or their representatives to establish project-specific verification plans that were included in the final contracts between the participants and the UCRC. The primary focus of each plan outlined procedures to *verify and document* that the applicant performed the conservation measures and complied with the schedule indicated in their contract.

Each verification plan was tailored to take advantage of existing measuring devices, primarily flumes or other diversion measurement devices at river or farm headgates. The primary component for verifying full or partial fallowing was field site visits to visually assess that water was not being applied. Each verification plan included scheduled site visits during project implementation and a standard approach was taken to photograph and document the site visits. The final component of each verification plan was to assess the estimated consumptive use savings compared to the proposed savings. While the consumptive use savings was important, the primary focus of the SCPP was to explore, learn from and determine whether a voluntary, compensated reduction in consumptive use is a feasible method to partially mitigate the decline of Lake Powell reservoir elevations.

IV. System Conservation Pilot Program Results

A. Summary of Selected Projects

The SCPP demonstrated that there is significant interest from Upper Basin water users in participation in this type of program. In the three years of the SCPP, there were more applications received than projects selected due to funding limitations. Figure 1 summarizes the total number of applications received, the total projects selected each year, and the total cost. Notably, in 2017, 5 fewer projects were selected relative to 2016. However, the overall size of the 2017 projects increased while the unit cost decreased relative to the previous year.

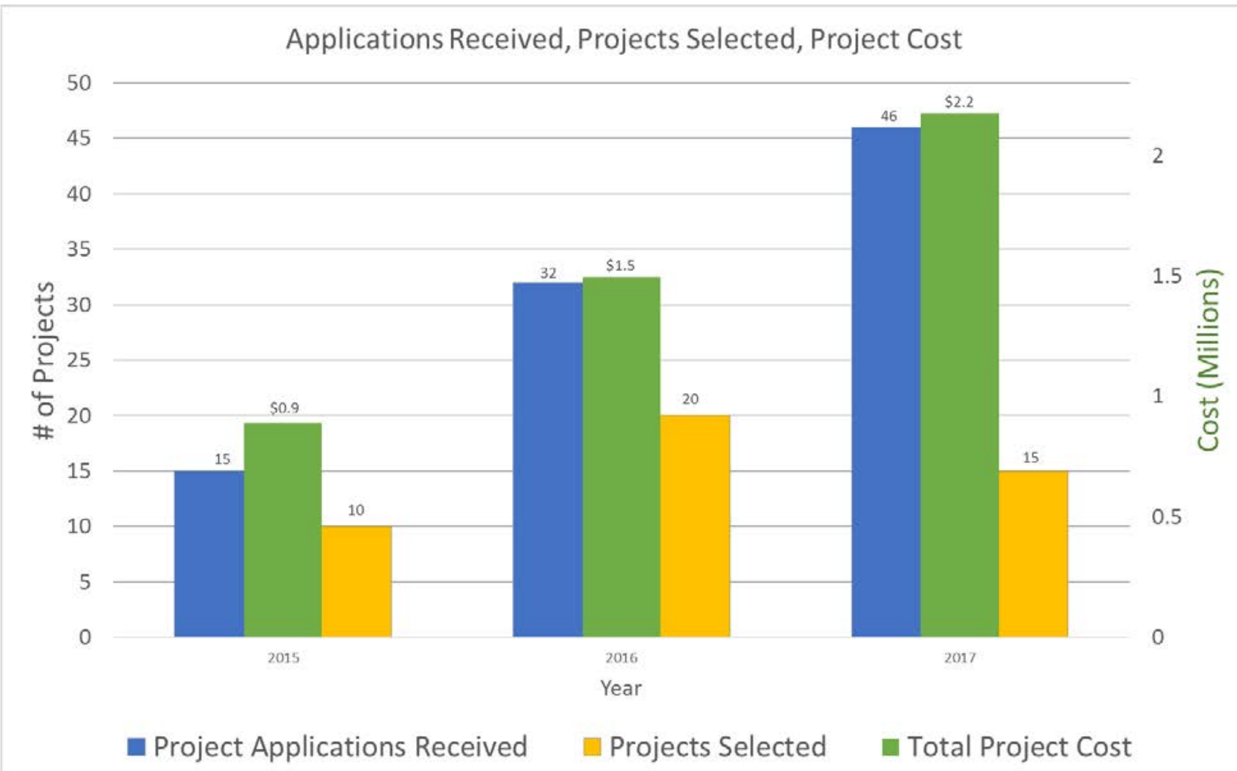

Figure 1 – Number of Applications Received, Projects Selected, and Total Project Cost

Tables 1 and 2 provide an overview of the number of applications received relative to the number of projects implemented in each state.

Table 1 – Total Number of Applications Received in Each Year by State

Year	Colorado	New Mexico	Utah	Wyoming	Total
2015	6	0	1	8	15
2016	17	3	2	10	32
2017	12	4	8	22	46
Total	**35**	**7**	**11**	**40**	**93**

Table 2 – Total Number of Projects Implemented in Each Year by State

Year	Colorado	New Mexico	Utah	Wyoming	Total
2015	5	0	0	5	10
2016	8	2	1	9	20
2017	2	3	6	4	15
Total	**15**	**5**	**7**	**18**	**45**

As the SCPP progressed, the number of applications increased. Colorado and Wyoming saw the most applications throughout the duration of the SCPP. The success in these two states, coupled with the increased number of applications in Utah and New Mexico, is attributed to focused outreach (see "Lessons Learned: Community Outreach and Education").

In 2016, 25 projects were selected; however, only 20 were contracted and implemented. See Table 2. The reasons the five applicants chose not to participate varied and included complexities involving multiple owners and pending property sales.

Table 3 highlights the different project categories implemented in each year. For the fallowing projects, no irrigation water was applied to the enrolled fields for the duration of the irrigation season, and for the split season deficit irrigation projects, no irrigation water was applied during a specified period of the irrigation season (e.g., June 1 through September 30). Some of the projects were a combination in which some fields were fallowed and others were split season deficit irrigated. The municipal projects include both outdoor and indoor municipal water use.

Table 3 – Types of Projects Implemented in Each Year

Project Type	2015	2016	2017	Total
Fallow	1	1	6	8
Split Season Deficit Irrigation	6	14	5	25
Alternative Cropping & Deficit Irrigation	1	4	1	6
Combination of Fallow & Split Season Deficit Irrigation	1	0	3	4
Municipal	1	1	0	2

Figures 2, 3 and 4, below represent the locations of the projects selected and implemented by project type in 2015, 2016 and 2017, respectively. Note that six of the projects were multi-year projects (for example, contracted for both 2016 and 2017) and seven of the projects applied and were selected in multiple years of the SCPP, often enrolling different fields within the same farm or ranch. Focused outreach from representatives of Trout Unlimited and The Nature Conservancy helped enroll several agricultural applicants that may not have otherwise applied (see "Lessons Learned: Community Outreach and Education").

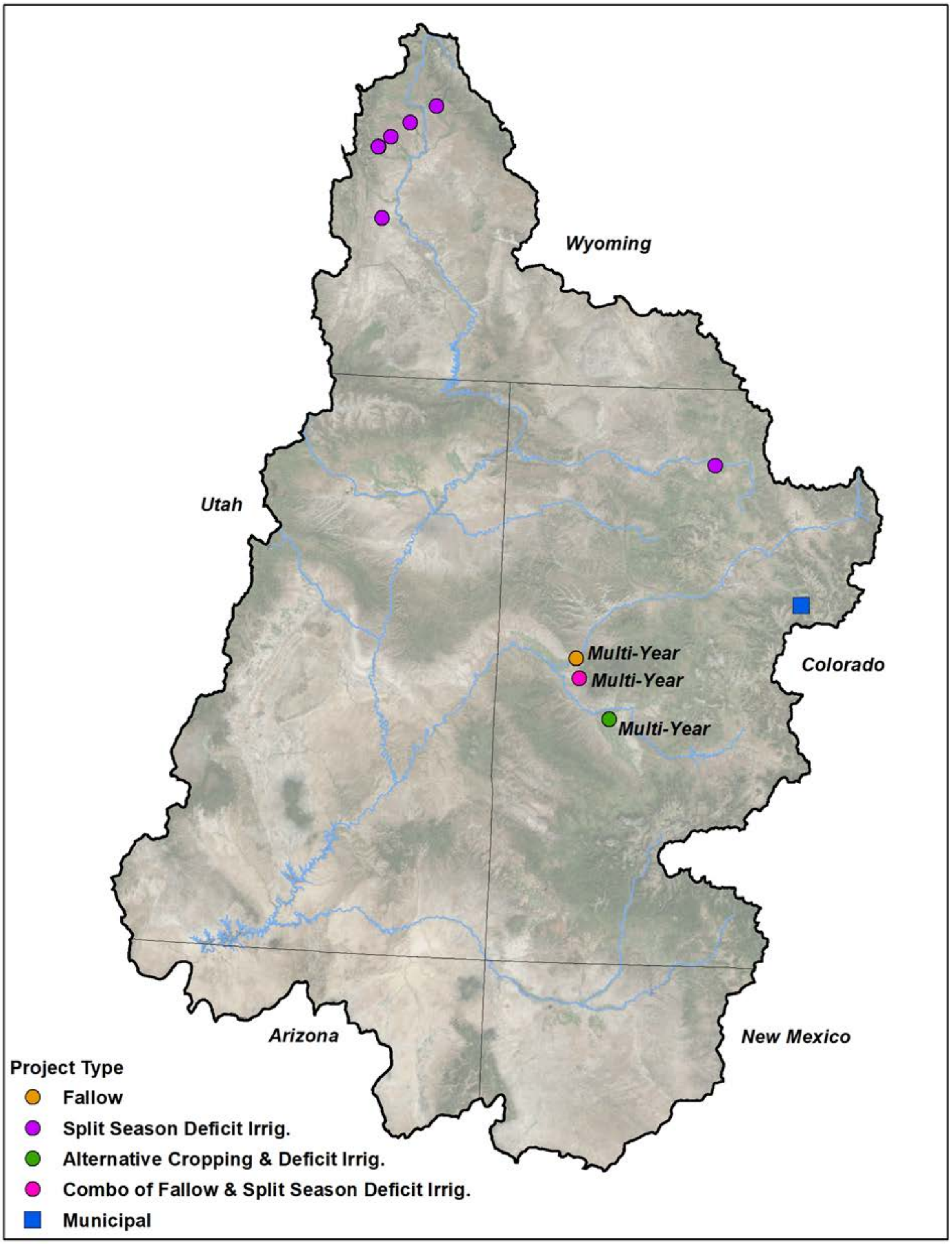

Figure 2 – Location of the Projects Selected & Implemented in 2015

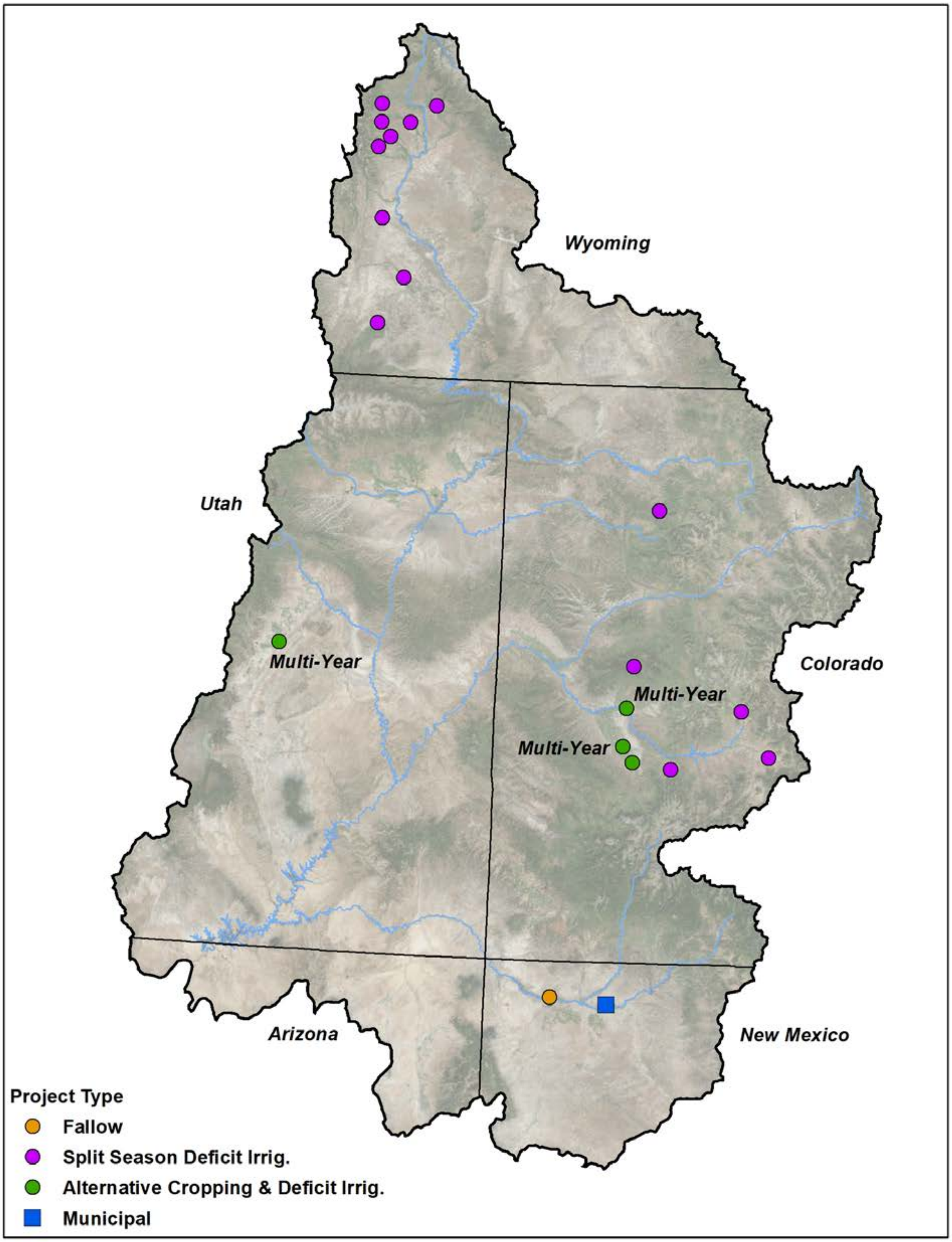

Figure 3 – Location of the Projects Selected & Implemented in 2016

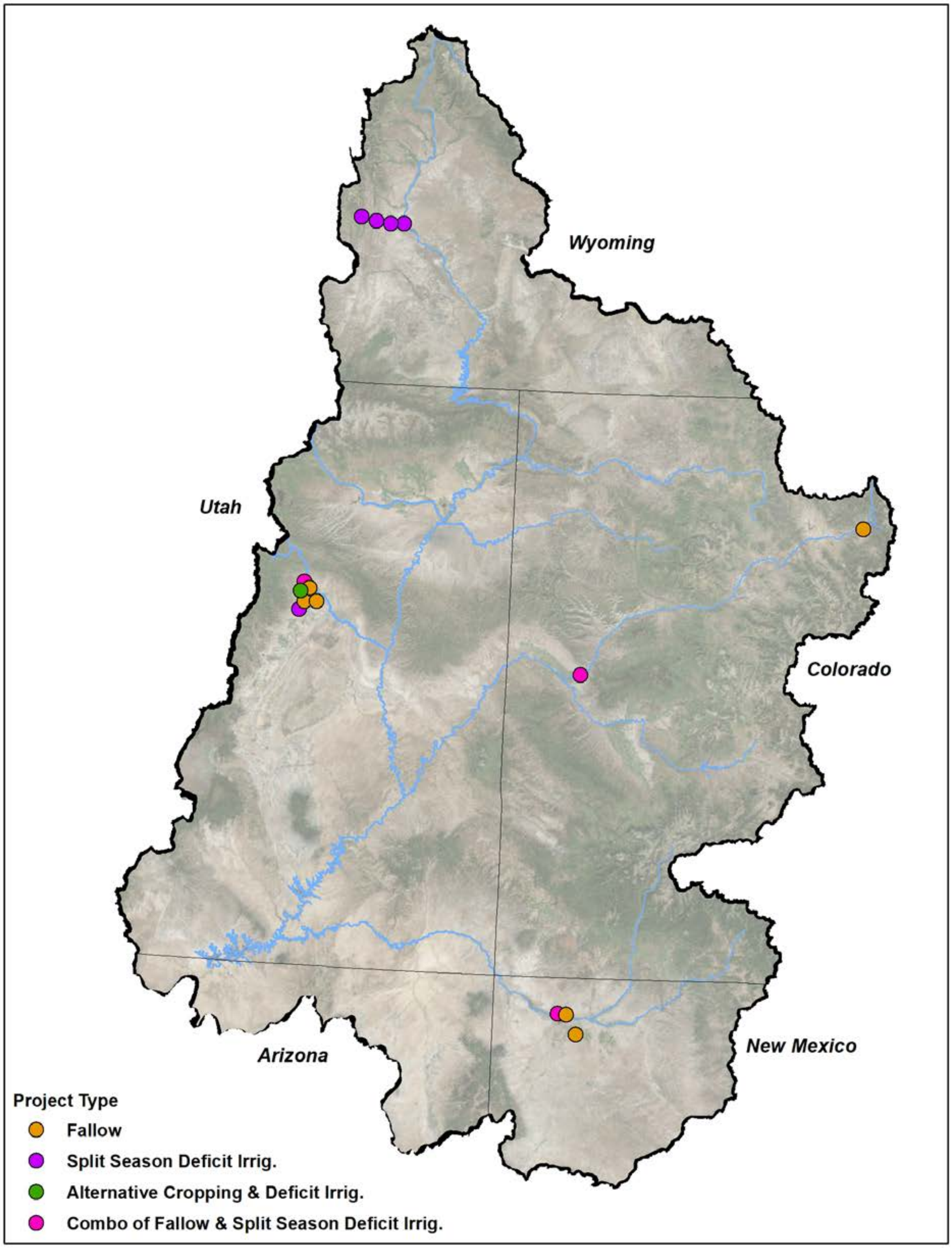

Figure 4 – Location of the Projects Selected & Implemented in 2017

B. Summary of the Contracted Conserved Water and Associated Cost

The participants in the SCPP were compensated based on an estimated average historical conserved consumptive use value associated with each project. These estimates were provided in the application and were reviewed, verified, and adjusted if necessary by Wilson Water Group (WWG) during the project selection process. The estimates were generally based on historical averages that accounted for water supply limitations; however, some of the estimates were negotiated based on pending water right court cases or documented reports.

The method for calculating the potential conserved consumptive use varied by state depending on data availability. In general, the applicants in Colorado, New Mexico, and Utah calculated historical potential consumptive use based on Modified Blaney-Criddle with an elevation adjustment, while the applicants in Wyoming used remote sensed data (Landsat satellite imagery) with the energy balance model METRIC (Mapping EvapoTranspiration with High Resolution and Internalized Calibration). Wyoming relied exclusively on 2011 data for this analysis as it was the most comprehensive METRIC dataset available for SCPP project use. Therefore, Wyoming estimates did not represent average historical consumptive use, but rather a snapshot of a relatively wet water supply year.

The consumptive use estimates were adjusted, if necessary, to account for historical water supply limitations. This is important because the ability for Upper Basin water users to divert water is dependent upon the physical supply associated with the hydrologic year type. Because of this, Upper Basin water users often experience late season water supply shortages. To account for water supply limitations, different methods were used to adjust the potential consumptive use estimates based on the available data in each state:

- **Colorado**: Average water supply limitations were applied based on historical diversions and associated shortages calculated using the state's consumptive use model (StateCU). In Colorado, diversions are measured, recorded, and publicly available in the state's database (HydroBase); therefore, water supply limitations can be readily quantified.
- **New Mexico**: Average water supply limitations were applied based on discussions with the State Engineer's Office. Not all diversions are measured or recorded; therefore, State Engineer's Office staff provided supply limitation estimates.
- **Utah:** Average water supply limitations were applied based on discussions with the State Engineer's Office. Similar to New Mexico, not all diversions are measured or recorded; therefore, State Engineer's Office staff provided supply limitation estimates.
- **Wyoming:** Average water supply limitations were applied based on regulation dates and discussions with the State Engineer's Office, as the METRIC estimates are based upon 2011 data which was a relatively wet supply year. In Wyoming, diversions are generally not recorded except on tributaries that require frequent regulation.

Tables 5 through 7 show the contracted consumptive use estimates by tributary and associated compensation for each program year. Based on the contracted historical conserved consumptive use estimates, the Funding Agencies, including NGOs, provided $4,555,747 to conserve 22,116 acre-feet of water during 2015, 2016, and 2017.

Table 4 – Total Conserved Consumptive Use (CCU) and Associated Compensation for the 2015 Projects[6]

Tributary Name	State	Total Acreage	Crop	Project Type	Total Estimated CCU (acre-feet)	Cost per acre-foot	Total Cost
Fontenelle Creek	WY	221	Grass pasture	Split Season Deficit Irrigation	248	$ 200	$ 49,600
Cottonwood Creek	WY	1,736	Grass pasture	Split Season Deficit Irrigation	1,202	$ 200	$ 240,492
Middle Piney Creek	WY	40	Grass pasture	Split Season Deficit Irrigation	32	$ 200	$ 6,313
Middle Piney Creek	WY	101	Grass pasture	Split Season Deficit Irrigation	88	$ 200	$ 17,563
Pine Creek	WY	81	Grass pasture	Split Season Deficit Irrigation	74	$ 200	$ 14,832
Uncompahgre River	CO	23	Corn	Fallow	46 (2015)	$ 300	$ 21,000
			Winter wheat	Alternative Cropping & Deficit Irrigation	29 (2016)	$ 250	
Yampa River	CO	193	Grass pasture	Split Season Deficit Irrigation	188	$ 200	$ 37,600
Colorado River – Grand Valley	CO	200	Corn & alfalfa	Fallow	334 (2015) 334 (2016) 334 (2017)	$ 330	$ 330,660
Various tributaries on Colorado's West Slope	CO	51	Grass pasture & alfalfa	Combination of Fallow & Split Season Deficit Irrigation	56 (2015) 62 (2016)	$ 300	$ 36,501
South Fork Eagle River*	CO	-	-	Municipal	200	$ 670	$ 134,132
Total	-	**2,646**	-	-	**3,227**	-	**$ $888,693**

**Project was selected in 2015 and implemented in 2016. This was a pilot program and, due to considerations specific to this project, it was funded at a higher rate than others. This is not a rate that was or typically will be considered for other SCPP projects.*

[6] Table also includes multi-year projects that were first implemented in 2015

Table 5 – Total Conserved Consumptive Use (CCU) and Associated Compensation for the 2016 Projects

Tributary Name	State	Total Acreage	Crop	Project Type	Total Estimated CCU (acre-feet)	Cost per acre-foot	Total Cost
San Juan River	NM	-	-	Municipal (outdoor)	39[A)]	$ 190	$ 7,391
Animas & San Juan Rivers	NM	58	Grass Pasture	Fallow	152	$ 200	$ 30,366
Ferron Creek	UT	240	Alfalfa & Grass Pasture	Fallow	517 (2016)	$ 200	$ 255,876
				Alternative Cropping & Deficit Irrigation	381 (2017)		
					381 (2018)		
Fontenelle Creek	WY	381	Grass Pasture	Split Season Deficit Irrigation	466	$ 200	$ 93,200
Cottonwood Creek	WY	726	Grass Pasture	Split Season Deficit Irrigation	482	$ 200	$ 96,400
Middle Piney Creek	WY	1,240	Grass Pasture	Split Season Deficit Irrigation	1,135	$ 200	$ 227,000
Middle Piney Creek	WY	184	Grass Pasture	Split Season Deficit Irrigation	178	$ 200	$ 35,600
South Fork Horse Creek	WY	1,103	Grass Pasture	Split Season Deficit Irrigation	1,226	$ 200	$ 245,200
South Cottonwood Creek	WY	1,631	Grass Pasture	Split Season Deficit Irrigation	1,143	$ 200	$ 228,600
Pine Creek	WY	82	Grass Pasture	Split Season Deficit Irrigation	70	$ 200	$ 14,000
Ham's Fork River	WY	292	Grass Pasture	Split Season Deficit Irrigation	395	$ 200	$ 79,000
Black's Fork River	WY	40	Grass Pasture	Split Season Deficit Irrigation	105	$ 200	$ 21,000
Uncompahgre River	CO	44	Alfalfa, Corn, Beans, Clover	Alt. Cropping & Deficit Irrigation	96[B)]	$ 200	$ 19,250
Uncompahgre River	CO	10	Alfalfa, Corn & Clover	Alternative Cropping & Deficit Irrigation	20 (2016)	$ 200	$ 12,000
					20 (2017)		
					20 (2018)		
Uncompahgre River	CO	12	Alfalfa & Triticale	Alternative Cropping & Deficit Irrigation	24 (2016)	$ 200	$ 14,400
					24 (2017)		
					24 (2018)		
Surface Creek	CO	67	Alfalfa & Grass Pasture	Split Season Deficit Irrigation	125	$ 250	$ 31,250
East River	CO	106	Grass Pasture	Split Season Deficit Irrigation	98	$ 200	$ 19,674
Tomichi Creek	CO	165	Grass Pasture	Split Season Deficit Irrigation	100	$ 200	$ 20,000
Little Cimarron River	CO	195	Grass Pasture	Split Season Deficit Irrigation	170	$ 161	$ 27,375
Milk Creek	CO	94	Alfalfa & Grass Pasture	Split Season Deficit Irrigation	84	$ 200	$ 16,760
Total	**-**	**6,670**	-	-	**7,475**	-	**$ 1,494,342**

A) The estimated CU is for the lifetime of the project (approximately 20 years)

B) Compensated on actual practice and associated CU

Table 6 – Total Conserved Consumptive Use (CCU) and Associated Compensation for the 2017 Projects

Tributary Name	State	Total Acreage	Crop	Project Type	Total Estimated CCU (acre-feet)	Cost per acre-foot	Total Cost
San Juan & Animas River	NM	125	Alfalfa & Corn	Combination of Fallow & Split Season Deficit Irrigation	298	$ 190	$ 56,679
San Juan & Animas River	NM	40	Grass Pasture	Fallow	95	$ 190	$ 18,103
San Juan River	NM	1,286	Alfalfa, Corn & Pinto Bean	Fallow	2,901	$ 219	$ 635,242
Price River	UT	28	Alfalfa & Oat	Alternative Cropping & Deficit Irrigation	58	$ 190	$ 10,992
Price River	UT	371	Alfalfa & Small Grain	Fallow	923	$ 190	$ 175,332
Price River	UT	152	Alfalfa & Grass Pasture	Combination of Fallow & Split Season Deficit Irrigation	311	$ 190	$ 59,157
Price River	UT	186	Grass Pasture	Fallow	372	$ 190	$ 70,674
Price River	UT	159	Alfalfa	Split Season Deficit Irrigation	228	$ 190	$ 43,341
Price River	UT	27	Alfalfa & Grass Pasture	Fallow	67	$ 190	$ 12,675
Fontenelle Creek	WY	275	Grass Pasture	Split Season Deficit Irrigation	407	$ 190	$ 77,330
Fontenelle Creek	WY	492	Grass Pasture	Split Season Deficit Irrigation	540	$ 190	$ 102,600
Fontenelle Creek	WY	717	Grass Pasture	Split Season Deficit Irrigation	714	$ 190	$ 135,660
Fontenelle Creek	WY	878	Grass Pasture	Split Season Deficit Irrigation	1,083	$ 190	$ 205,770
Colorado River	CO	1,252	Alfalfa & Corn	Combination of Fallow & Split Season Deficit Irrigation	3,178	$ 165	$ 525,000*
Colorado River & Fraser River	CO	348	Grass pasture	Fallow	233	$ 190	$ 44,300
Total	**-**	**6,336**	-	-	**11,408**	-	**$ 2,172,855**

**Additional funding for this project came from non-SCPP sources.*

C. Summary of the SCPP Conserved Consumptive Use Analyses

As part of the SCPP, individual project performance was evaluated through project-specific verification plans. Each plan included an analysis of potential consumptive use during the conservation activity using climate data from a nearby climate station, reduced as necessary by water supply limitations. The purpose of the consumptive use analysis was to quantify the amount of water each project conserved by participating in the SCPP. These analyses were for study purposes only, and did not impact participant compensation. Based on these analyses, an estimated 2,645 acre-feet of water was conserved in 2015 and an estimated 8,068 acre-feet of water was conserved in 2016. The individual results from these analyses and a discussion of the methodology are presented in Appendices A and B. Differences between the applicants' estimated conserved consumptive use savings and the final conserved consumptive use calculation are due to climate and water availability for the SCPP year. The same general procedure will be used to provide results for the 2017 projects when they are completed.

V. System Conservation Pilot Program Project Monitoring

As part of the project selection criteria, the SCPP included a qualitative monitoring component separate from verification. The terms "monitoring" and "verification" hold distinct meanings within the context of the SCPP, as defined below:

> **Verification** refers to project compliance – verifying the applicants are doing what they said they would do per their signed contracts.
>
> **Monitoring** is an assessment of the likelihood that the conserved water remained in the system as "system water." The basis for assessing this was to evaluate whether the conserved water was likely to flow to one of the larger main stem tributaries. Each of the projects was qualitatively evaluated based on the ease of monitoring and the ability to track the water savings to Lake Powell or another Colorado River Storage Project (CRSP) reservoir. However, because there is no legal mechanism to ensure that the conserved water is not consumed by downstream users, the basis for assessing the ease of monitoring assumed that if the conserved water was likely to flow to the main stem or one of the larger main stem tributaries, it was more likely to flow to Lake Powell. Main stem tributaries include the Yampa River, White River, Green River, Gunnison River, and the San Juan River. The number of intervening water users between the project and Lake Powell was also considered.

Projects were assessed, in part, based on ease of monitoring. For example, projects for which it was determined that conserved water was likely to flow to Lake Powell or another CRSP reservoir were ranked "high." Alternatively, projects ranked "low" had less probability that conserved water would flow to Lake Powell. Those projects for which water could flow to Powell, but not without some impediment (e.g. the need to shepherd water past downstream diversions) were ranked "medium."

Of the implemented projects in 2015 and 2016, and projects selected for 2017, approximately 71 percent of the projects ranked "medium" to" high" in terms of ease of monitoring. The inability to legally protect the conserved water from downstream diversion significantly impacts the likelihood the water will enhance storage levels in Lake Powell and the effectiveness of these types of programs, as discussed below in the Lessons Learned section.

Regardless of the inability to legally protect the conserved water, quantitatively tracking this water was not possible because it was very small relative to flows on the main stem rivers and storage levels in Lake Powell. For example, in 2015, an estimated 2,645 acre-feet of water was conserved in the Upper Basin. This is equivalent to 0.01 percent of the active storage in Lake Powell and 0.03 percent of the annual 2015 inflow to Lake Powell.

VI. Lessons Learned

Program implementation has generated both broad-based policy information, as well as specific feedback on the administration and operation of the SCPP. Five main themes emerged regarding the administrative and operational lessons learned, and are grouped below accordingly. These lessons were documented throughout the process.

A. Program Administration and Project Implementation

The following lessons fall under the category of program administration and project implementation. This aspect of the SCPP was the most time-intensive and required significant resources from the SCPP Team.

a. **Integrate more detail-oriented questions in the application.** The SCPP application was a simple, fill-in-the-boxes, three-page application that asked for basic project-related information including proposed project description, project location, type of water use, water right, and description of current water use. While this information is crucial, the level of detail requested in the application proved to be too basic, resulting in extensive program administration outreach to understand simple project operations. For example, if a project diverts water under a large ditch company, knowing the water right information is not enough. The application needs to require information relating to the number of shares owned by the applicant and the quantity of water associated with each share. Additional helpful information should include the applicant's total irrigated acreage (not just the acreage proposed for the SCPP), how often the applicant has historically irrigated the proposed fields (irrigation schedule), and the approximate cutting dates for each proposed field. This would significantly streamline the process and save administrative costs by reducing the amount of additional outreach for coordination.

b. **Advertise and provide technical support to potential applicants.** The SCPP application required technical information such as a conserved consumptive use estimate, detailed water right information, and a location map. In most cases, it was difficult for applicants to provide this information without external support. While support was available in each of the Upper Basin states, it was not readily known and advertised in all areas. For example, it was widely known that the State Engineer's Office in Wyoming provided technical support to potential applicants, which resulted in both an increased interest in the program and number of submitted applications. For the other states, assistance was offered to potential applicants during the outreach process; however it was not noted on the application. Moving forward, it will be helpful to indicate other resources, such as NGOs and state and federal entities that may be available to provide technical support on the applications. This would help assure that the application process is not a deterrent or barrier to participation.

c. **Refine selection criteria**. The SCPP Team developed diverse evaluation criteria to select projects that would provide learning opportunities while potentially providing the most benefit to the Colorado River system. However, the selection process, particularly in the first two years of the pilot program, took significantly longer than anticipated. Moving forward, the selection process may benefit from refinement to the evaluation criteria.

d. **Streamline project contracting and funding.** It is critical to streamline and simplify project contracting and funding as much as possible. At the beginning of this program, the UCRC had concerns about potential exposure in its contracts with the Funders and the project participants alike. Moreover, the multi-state nature of the SCPP also gave rise to legal questions with respect to choice of law provisions and possible constraints in state or local laws. To address these concerns, the contracts for each pilot project were more than twenty pages in length and the contracting process took months to complete. Each contract was tailored to the needs of each participant, thus necessitating an iterative review process between the applicant, the funders, and legal counsel.

   Potential improvements in the contracting process may include the development of a shorter standardized contract that requires less intensive review, coupled with a more detailed verification plan tailored to the specific needs and nuances of each project. The standard contract could be included with the application so the participants understand that if they cannot agree to the standard contract, they should not apply.

   In addition to streamlining the contracting process, the funding process could also be improved. Currently, twice a year, the UCRC must track when a payment is needed and then invoice up to five funding agencies for their share of the payment. Once the money is received from each agency, the UCRC writes a check to the participant. This proved to be a time-intensive process, not the least because the UCRC must maintain separate accounting for the SCPP. For example, in 2016, 230 individual invoices had to be sent from the UCRC to pay 23 project participants twice—once within 60 days of the executed contract and again within 60 days of project completion. While this sequence was developed to accommodate both the needs of the funding agencies and the applicants, the funding process itself resulted in delays.

   Moving forward, the funding process should be simplified to work for all the Funding agencies and applicants. Ideally, funders could provide project money up-front and rely on audit reports to track funds.

e. **Understand the impacts associated with sources of funding**. The SCPP was funded by the Bureau of Reclamation, the Central Arizona Water Conservation District, the Southern Nevada Water Authority, The Metropolitan Water District of Southern California, and Denver Water. Through the process, the SCPP Team was surprised to hear that the source of funding may have influenced people's interest and willingness to participate in a program. For example, some applicants indicated they were interested in participating in the SCPP because four municipalities—including three Lower Basin municipalities—were helping fund the program. They felt this represented an enhanced level of cooperation and collaboration between the Upper and Lower Basin states as well as municipal and agricultural water users. By contrast, several potential applicants indicated that they were not interested in participating in the SCPP because it was partially funded by the federal government. While it is impossible to create a program to accommodate everyone, it is important to know and understand that the source of funding may influence participation.

f. **Administrative agency**. The UCRC was ultimately responsible for all contracting and funding distribution. Although this was a new role for the UCRC, it does have authority to administer contract work and has done so in the past. The UCRC agreed to facilitate the program in the Upper Basin to help the Upper Basin states learn about water conservation as a drought contingency management tool, and because the UCRC was best situated to perform the program's administration due to its authorities and connections within the basin. The UCRC had to rely on volunteered assistance from the states and Reclamation due to its limited staffing. The nature of the SCPP was such that it required collaboration from the Funding Agencies, Reclamation staff, technical and legal representatives from each of the Upper Basin states, the Compact Commissioners and the UCRC staff.

   Program administration was a challenge because of the small, 3-person UCRC staff. The funders provided money for verification and some project evaluation. To address the large administrative workload, the state of Colorado provided legal/contracting assistance and program coordination with the funders. Reclamation provided part of a staff person's time to assist with verification, tracking, payment processing, coordination and other administrative functions. UCRC staff was heavily involved in program coordination, tracking, funding, account management and overall program management. Each of the states provided assistance in project development, contract review, project selection and general direction through the UCRC.

B. Operational Lessons

The following lessons fall into the category of project operations. Early on, the Funding Agencies agreed that the available funding would be used to pay participants to reduce consumptive use; not to fund research or cost-intensive methods to verify savings. Therefore, standard approaches, using readily available data and information, were adopted to estimate consumptive use savings. A larger-scale program should consider a means of improving data available for consumptive use estimates. .

a. **Site verification visits.** Verification of project compliance for a majority of the projects was completed via multiple site verification visits. The site verification visits were tailored to meet the needs of each project and consisted primarily of verifying that the river headgates were closed if applicable, the on-farm delivery headgates were closed if applicable, and no irrigation water was being applied to the project fields during the contracted dates. Photos of most headgates and fields were taken and documented in a formal verification report. This method proved adequate to verify the participants were complying with the contracted project activity; however, it is recommended additional verification measures be explored in order to estimate water savings.

b. **Estimating conserved consumptive use**. Compensation for SCPP participants had to be determined in advance of the actual conservation activity. To accomplish this, an original estimated conserved consumptive use volume was calculated based upon historical consumptive use data and availability of water supply at each participant site. This information was then used to establish the compensation amount for each participant. In 2016 and 2017, WWG worked closely with the selected participants in Colorado, Utah, and New Mexico to verify that the conserved consumptive use estimates provided in the applications were reasonable and included water supply limitations. Similarly, the Wyoming State Engineer's Office completed the conserved consumptive use estimates for the Wyoming participants for the three program years (2015, 2016 and 2017) and adjusted the estimates, as needed, to account for water supply limitations. This process was a fundamental component of the SCPP and broadened the conversation surrounding the following concepts:

   - **Methods are constrained by data.** The availability of data—including irrigated acreage, crop type, and diversion records—is inconsistent throughout the Upper Basin states. Because of this, different methods were used in each state to estimate the conserved consumptive use provided for in the applications:

     New Mexico – Monthly modified Blaney-Criddle method with an elevation adjustment was used to estimate the potential consumptive use. Water supply limitations were estimated based on conversations with the State Engineer's Office and ditch companies.

     Utah – The Division of Water Resources estimates consumptive use at climate stations throughout the state using a monthly calibrated Soil Conservation Service Blaney-Criddle method; however, these analyses have not been updated since 1994.[7] Water supply limitations were estimated based on conversations with the Division of Water Resources and ditch companies.

     Colorado – Monthly modified Blaney-Criddle method with an elevation adjustment and historical diversion records were used to estimate water supply limited consumptive use.

     Wyoming – The State Engineer's Office used a METRIC-based analysis using Landsat imagery from 2011 to estimate the conserved consumptive use. Because 2011 was a hydrologically wet year, average water supply limitations were estimated based on regulation dates and conversations with the State Engineer's Office.

[7] Utah Division of Water Right: Consumptive Use Information Table. Available at: http://waterrights.utah.gov/techinfo/consumpt/default.asp

Based on the available data and resources in each state, implementing one method for estimating consumptive use was not practical. Future direct-measurement options could include on-farm instrumentation to measure irrigated and non-irrigated field water use, or a remote sensing method, such as METRIC. In lieu of direct-measurement options, it is important for future program administrators to understand the data constraints in each state, the differences between each method, and the assumptions used to estimate water supply limitations.

- **Defining "historical."** Because water availability in the Upper Basin is highly dependent on hydrologic year type, it is necessary to consider an "average" or "likely" consumptive use for estimating funding requirements for application review. The number of years of data included in a historical consumptive use analysis to estimate average consumptive use for the application varied. Therefore, the consumptive use estimates for some projects were based on 5 years of data while others were based on 25 years of data. When applications were being accepted, it was not possible to predict the upcoming hydrologic year type. There was some comfort with using average consumptive use as the basis of payment with the understanding that there was shared risk between the funders and the applicant, as discussed in more detail below. Another option would be to have the applicant provide historical consumptive use representing a range of hydrologic year types where that information is available, and tie it to different payment options. A clearer definition of what is acceptable for the application should be considered, while keeping in mind that it would require flexibility to account for crop changes and ownership over time.
- **Verifying historical crop type.** Part of the reason the SCPP was based on historical consumptive use was because the SCPP Team did not want to incentivize applicants to, for instance, plant high consumptive use crops for one year and then be compensated the following year based on that high consumptive use, or to irrigate for a single year when they had not been consistently irrigating in the past. To this end, the SCPP compensated participants based on original estimated conserved consumptive use. During the project selection process, the applicants were specifically asked to verbally confirm that they historically grew the same crops upon which their consumptive use estimates were based; for most applications, the SCPP Team was unable to independently confirm historical crop types. After contracts were signed, there were some instances in which it became known that the applicants' historical crop types were not accurate (e.g., planted corn and alfalfa rather than just planting alfalfa).
- **Accounting for soil moisture in the consumptive use estimates.** During the first year of the SCPP, it was acknowledged that it would be difficult to account for consumptive use from soil storage during the "fallowing" period because diversion records were generally not available. It is understood that the consumptive use from soil moisture occurs when fields are partially irrigated or fallowed; however, either diversion records are required to estimate soil reservoir contents or soil moisture sensors must be installed on

participating fields. Given the economic constraints of the SCPP and the cost associated with installing the necessary diversion meters or soil moisture sensors, quantifying consumptive use from soil moisture was not feasible. Therefore, it is possible that applicants that partially fallowed fields in 2015 were over-compensated and the actual conserved consumptive use was less than the contracted amount.

During the second and third years of the SCPP, the consumptive use from soil moisture was estimated using two different approaches for two projects in which the fields were intermittently irrigated (for example, irrigated one day per month or irrigated one time during the middle of the summer for 5 consecutive days). One of the approaches assumed one day of irrigation would fill the soil zone enough to meet the crop irrigation requirement for one week. The other approach assumed the soil zone was filled from irrigation and fully consumed thereafter. For both approaches, the conserved consumptive use estimates were adjusted accordingly.

It is fully understood that these methods provide rough estimates of consumptive use from soil moisture; however, they are the most practical approaches given instrumentation and data limitations. It is recommended that future programs explore different options to more realistically account for consumptive use from soil moisture.

c. **Understanding the impacts of land management strategies.** The SCPP did not specify land management standards for fallowed fields (for example, implementing wind erosion control measures, or managing/controlling weed and plant growth). Three of the projects, however, voluntarily implemented these measures, providing the following benefits:

- The consumptive use from the soil zone was close to zero because there were no weed/plant roots—resulting in completely barren fields.
- The fields were mechanically tilled to control wind erosion and minimize dust
- The fields appeared well-maintained and were not eyesores for the community.

The full extent of these land management strategies likely can only be implemented on fields that grow annual crops (i.e., corn) rather than perennial crops (i.e., alfalfa and grass pasture). However, a scaled version of these measures could be considered as a requirement on fields that grow both annual and perennial crops to reduce wind erosion and dust.

d. **Project types**. Learning about the nuances associated with different types of projects was an important element of the SCPP. Lessons associated with each type of project are summarized below:

- ***Agricultural projects on ditches with multiple water users.*** The size of the ditch greatly influences how conserved water can be accounted for in this type of program. For projects diverting water on ditches with multiple water users, the following approaches were explored in the SCPP:
  - **Large ditch managed by a ditch company that was not involved in SCPP activities.** For the majority of the projects involving large ditches managed by

ditch companies, the ditch company entity was not involved in SCPP project activities. Therefore, all diversions—including those associated with program participants—were diverted as normal at the river headgate, and on-farm delivery headgates were closed to ensure no water could be applied to the participating fields. In theory, the conserved water associated with the program returned to the river via natural drainages or tailed back with ditch return flows. Verifying and quantifying whether the conserved water returned to the system was not feasible given the lack of measurement devices on the large ditch systems and ditch company bylaws.

While this approach may not be ideal, it is the most realistic because many ditch companies do not have the capacity and wherewithal to accommodate these types of programs (i.e., they are personnel and funding limited, constrained by ditch company bylaws, etc.). Ten agricultural projects (23 percent) fell into this category in 2015 through 2017.

Small to medium size ditches with multiple water users. Some of the projects involve smaller ditches that have a handful of water users that divert water from the same river headgate; however, the ditch is not managed by a ditch company. For these projects, two options were explored:

- The water associated with the project fields was diverted at the river headgate and returned to the system through natural drainages, spillways or the ditch tailback. Although the conserved water bypassed the enrolled fields, it ran the risk of being diverted by other ditch users before being returned to the river. Two agricultural projects (5 percent) fell into this category in 2015 through 2017.
- The diversions were reduced at the river headgates by a quantity equivalent to the participant's interest in the associated water rights. For verification, these participants closed their on-farm delivery headgates or pumps to ensure water was not applied to the Project fields. Reducing diversions at the river headgate is preferred because the water associated with the Project fields remains in the river—thus eliminating the risk that it will be consumed by other users on the ditch before returning to the system. Five agricultural projects (12 percent) fell into this category in 2015 through 2017.

o ***Agricultural projects on ditches with single water users.*** Verification of projects located on small ditches in which the participants were the sole diverters allowed the river headgates to be closed so the foregone diversions remained in the river. Note, even though the conserved water remained in the system, it was not guaranteed to flow to Lake Powell because it could be diverted downstream, as discussed below. Single water user ditch projects accounted for 18 (42 percent) of the agricultural projects selected in 2015 through 2017.

- *Storage projects.* Two of the agricultural projects involved a storage component. A brief description of each project and the associated lessons learned are provided below:

  - For one of the projects, the enrolled fields were typically irrigated from a combination of direct streamflow water diverted on a large ditch and storage water released from a private reservoir operated by an association. The diversions at the river headgate continued as normal; however, the applicant's shares were not applied to the project fields and remained in the ditch for use on other fields. An equivalent quantity of water equal to the consumptive use from the shares (125 acre-feet) in a private reservoir was not released for irrigation during Water Year 2016. Because the reservoir historically fills and empties each year, any carryover storage from 2016 should result in an equivalent reduction of water stored in 2017.

    Project verification included visually inspecting that the project fields were dry through monthly site visits and a storage analysis. The storage analysis included a site verification visit at the end of the irrigation season to verify an equivalent amount equal to the conserved consumptive use associated with the project fields was retained in the reservoir at the end of the irrigation season. Additionally, for study purposes only, WWG will perform an analysis in 2017 to determine if the reservoir would have filled without the carryover storage. The results of this analysis will not affect compensation to the applicant.

    This project, located in Colorado, took significant coordination with the State Engineer's Office to develop a plan that worked within the constraints of Colorado water law. Initially, the project was developed such that the conserved water would remain in storage until the end of the irrigation season and then be released in November to benefit low streamflows and minimize the risk of it being diverted by downstream users. This was not feasible because the water in the reservoir could only be legally released for a decreed beneficial use. Therefore, the water was "carried over" to the next year—decreasing the amount of water diverted to storage in 2017. To continue incorporating projects like this in future programs, program administrators will have to work closely with the applicant, associated reservoir companies, and state water officials to develop creative legal solutions.

    Additionally, the reservoir association that operates this reservoir was wary and hesitant of this project—creating another barrier to project implementation. Because of this, the project verification had to be developed without the association's cooperation. Cultural attitudes and perceptions about the SCPP are discussed below in the Community Outreach and Education section of this report.

  - Similar to the project above, one project in Wyoming included a storage component in which the enrolled fields typically receive irrigation water from direct flow rights and water stored in a private reservoir. Due to water law constraints, the same approach was taken with this project; however, the water stored in the reservoir could not be verified at the end of the irrigation season because there is no gage at the reservoir. While this made verification more difficult, the reservoir could only legally release water to irrigate the fields enrolled in the SCPP; therefore, the conserved consumptive use portion likely remained as carryover storage.

The SCPP selected this project to better understand the challenges associated with storage projects. It is recommended that future program administrators consider the importance of measuring capabilities in conjunction with the associated costs to applicants for installing measuring equipment.

- ***Municipal projects.*** One municipal project that involved both indoor and outdoor municipal water use was selected in the SCPP. For this project, trans-basin diversions for municipal use outside the Colorado River basin were reduced by 200 acre-feet. This project was unique because the foregone diversions were measured. Additional verification included assuring that the foregone diversions would have been taken in priority and that there was a clear use for them outside the Colorado River Basin. A second municipal project involved outdoor irrigation of sports complex fields. The project helped fund automation that reduced the number of days of irrigation and allowed scheduled irrigations to cease based on automated rain sensors.
- ***Federal projects***. One project involving coordination with the Bureau of Reclamation was selected in 2017. The lessons learned from this project will be summarized in the 2017 supplemental report.
- ***Tribal projects***. One Tribal project was selected in 2017. The lessons learned from this project will be summarized in the 2017 supplemental report.

e. **Integrating flexibility for contracted project activities**. The majority of the selected projects had well-defined project guidelines outlined in the contracts, including the fields that would be enrolled, type of irrigation practice that was going to be implemented (i.e., fallow or split season deficit irrigation), the type of cover plant that would be planted if applicable, and clear start and end dates. While this approach is ideal from the perspective of the program administrators, it may discourage people from participating because every detail must be planned—resulting in limited flexibility.

To explore what a more flexible approach looks like, the SCPP selected two projects that incorporate different flexibility opportunities. Each project and the associated lessons learned are described below.

- **Flexible irrigation practice.** The SCPP selected one project in which the applicant agreed to conserve at least one acre-foot per acre and no more than 2.5 acre-feet per acre of water. Compensation was based on a consumptive use analysis performed at the end of the irrigation season that accounted for his observed practice. From the perspective of the participant, this approach was more practical because it allowed flexibility to either fallow the enrolled fields, or plant and partially irrigate a low water use cover crop depending on whether he had the time and capacity to install a drip irrigation system. From an administrative perspective, this approach proved more challenging because it required the funders to budget for the maximum payment; potentially reserving funding that could be used elsewhere. Additionally, this approach required extensive outreach and communication with the applicant.

- **Flexible field rotation**. The SCPP selected one multi-year project in which the enrolled fields could be rotated each year as long as the conserved consumptive use was the same. From an administrative perspective, this approach was feasible because the payment was the same each year; therefore, the contract did not have to be amended. However, a new Verification Plan was developed each year to reflect the enrolled fields. From a participant perspective, this type of flexibility is crucial because the participants reap the known benefits associated with rotational fallowing (e.g., soil health) and do not have to worry about the long-term impacts (e.g., crop yield, crop recovery, reduced return flows) of fallowing and/or split season deficit irrigation. Future programs should explore ways to efficiently integrate this type of flexibility.

C. Project Costs, Benefits, and Risks

The following lessons fall under the category of project costs, benefits, and risks—including lessons regarding risks that projected saved water may not be actual saved water, and risks of setting market value.

a. **Risks associated with historical consumptive use.** The participants were paid based on original estimated conserved consumptive use. Although the methods for estimating the consumptive use vary across the states, the goal was to have the estimates represent the *average* supply limited historical consumptive use. Therefore, the risk is distributed between the participants and the funders. For example, in a wet hydrologic year, the crops are more likely to receive a greater supply and actual consumptive use is closer to potential consumptive use. In this scenario, the participants bear the risk because they are underpaid (i.e., their conserved consumptive use in a wet year would have been greater than the calculated conserved consumptive use for an average year). However, in a hydrologically dry year, supply limitations constrain the actual consumptive use and the funders bear the risk because the participants may be overpaid. This method was accepted by both the funders and the participants. Future programs could explore whether participants would be willing to be paid based on estimated consumptive use in the year the project was implemented—which could be calculated at the end of the irrigation season—rather than an estimated historical average consumptive use. As previously noted, payment based on estimated consumptive use in the year the project was implemented increases program flexibility for the participants; however, it requires a change in how the projects are budgeted because the funders would need to set aside funds for maximum payment, making it more challenging for the participants to financially plan because they do not know their compensation until the end of the irrigation season. This approach would remove the risk from the funders and participants, but add an element of uncertainty for both.

b. **Negotiating cost per acre-foot**. In 2015 and 2016, the cost per acre-foot was consistent for similar projects (i.e., fallowing, municipal, etc.); however, program administrators were concerned that the SCPP might set the market price in the Upper Basin for other future projects. Most of the 2017 projects came in at the same unit cost, likely because the cost for the previous years was well known. To gain a better understanding, and in recognition that there was not funding available for all applications, applicants were approached to see if they would accept a lower unit price. This resulted in the selected participants agreeing to a negotiated, slightly reduced cost per acre-foot.

   The discussion of cost negotiations initiated a broader conversation about the following:

   - Does there need to be price consistency between similar projects in the Upper Basin?
   - How can the applicants develop competitive prices without an established market?
   - How does a program like this refrain from setting market prices?
   - If conserved water at the participant level cannot be protected throughout the stream system, will continuing with similar projects create the perception of payment for participation rather than payment for conserved water?
   - Should future programs be designed such that the funders identify the maximum price they are willing to pay per acre-foot; or should the applicants identify the minimum price they are willing to accept (i.e., a reverse auction)? Who should determine this? What are the pros and cons of each?

   This is an ongoing conversation that needs to be further explored and, potentially, incorporated into the design of future programs.

D. Legal Constraints

The following lessons fall under into the category of legal constraints and, more specifically, the issues associated with assuring that conserved water can provide system benefits, and the protection of participant and non-participant water rights.

a. **Shepherding water.** In the Upper Basin states, water is only legally protected from downstream users if it is decreed for a state-approved beneficial use—such as municipal, agricultural, recreational, etc. Currently, intentionally leaving water in the river to flow to Lake Powell (or across a state line) does not count as beneficial use and, therefore, conserved water can legally be diverted by downstream users. The lack of protection makes it difficult to monitor whether the conserved water is making it to Lake Powell and may bring into question the validity/effectiveness of this type of program and/or discourage participation. To maximize the value of a water-savings program for both funders and participants, conserved water should be accounted for and protected from downstream diversions.

b. **Addressing the impacts of reduced return flows.** Changes in irrigation and diversion practices reduce the availability of late season return flows—which in Upper Basin water-short systems may be critical to preventing injury to downstream users. While the SCPP discussed the impacts of reduced late season return flows during the project selection process, there was no mechanism to account for and/or address these impacts. In a larger-scale program, these impacts will need to be considered to prevent injury to other water right holders and non-program participants.

c. **Protection of water rights from non-use.** In some states, abandonment and forfeiture of a water right due to SCPP participation was a concern for water users. Should a long-term program be developed, it will be important to educate potential participants about the implications, if any, of program participation on the validity of their water rights.

E. Community Outreach and Education

The following lessons fall under the category of community outreach and education. While the SCPP was very successful and significantly raised awareness about water conservation opportunities, more can be done to support future programs.

a. **Understanding the public perception and cultural attitudes about the SCPP.** There were many cited reasons why people considered and then chose not to participate in the SCPP; however, one of the main reasons in the agricultural community stemmed from misconceptions about the program coupled with cultural attitudes towards fallowing. For example, many water users were concerned about protecting their water rights from non-use while others were concerned about economic impacts associated with a long-term program. The prevalence of misconceptions underscores the importance of trust, peer-to-peer networking, education, and community outreach; there was higher participation in areas where trusted water managers, administrators, and water users understood and supported the program. Identifying the trusted water authorities in each basin and working with them is critical to success.

b. **Importance of focused outreach**. The importance of focused outreach has been highlighted in the SCPP. Both Trout Unlimited (TU) and The Nature Conservancy (TNC) conducted focused outreach with targeted agricultural water users to inform them about the program, encourage participation, and help them with the application/contracting process. Because of focused outreach, there were more agricultural project applications than any other water sector. The table below highlights the importance of focused outreach by showing the percent of implemented projects that were associated with TU and TNC outreach.

Table 7. Projects Associated with Focused Outreach.

SCPP Year	% of Projects Associated with TU	% of Projects Associated with TNC
2015	60%	10%
2016	50%	15%
2017	60%	7%

For each year of the SCPP, more than 60 percent of the implemented projects were associated with TU and TNC. It is evident that their on-the-ground, focused outreach resulted directly in an increased number of agricultural project applications and geographic diversity. For example, TU did not have focused outreach in Utah during 2016, but increased their outreach for project year 2017. As a result, the number of applications and selected projects in Utah increased significantly. New Mexico did not benefit from focused outreach from TNC or TU as neither is currently active in the San Juan Basin in New Mexico.

Focused outreach to this extent did not occur in other water sectors (e.g., municipal, industrial, etc.), which could be a reason for limited project diversity. Focused outreach could increase both geographic and project-type diversity.

c. **Importance of local outreach.** In addition to focused outreach, a local community presence proved important for agricultural participation. Both TU and TNC staff worked closely with the agricultural participants to fill out applications and navigate the contracting process. Additionally, many of the TU and TNC staff members live and ranch in the areas where they work. This peer-to-peer networking helped build trust and promote participation. Throughout the program, the ranchers and farmers preferred face-to-face conversations with someone living/working in their community rather than talking on the phone with someone outside their basin.

   Although TU and TNC staff was integral to the success of the SCPP, they did not receive funding from the program for their efforts. Moving forward, future program administrators should consider the importance of local outreach.

Appendix A: System Conservation Pilot Program Consumptive Use Analysis (2015)

Background

The Upper Basin System Conservation Pilot Program, established through the System Conservation Agreement[8], promotes temporary, voluntary, measurable reduction of consumptive use of Colorado River water in order to increase storage levels of Lake Mead and Lake Powell. As part of the SCPP, individual project performance is evaluated through project-specific verification plans, which include a potential consumptive use analysis using the Penman-Monteith method—reduced as necessary by water supply limitations—and climate data from a nearby climate station. The purpose of the consumptive use analysis is to quantify the amount of water each project conserved by participating in the System Conservation Pilot Program during the 2015 irrigation season. An ultimate goal is for the conserved water to increase the storage level in Lake Powell.

The conserved consumptive use estimates calculated by WWG and documented in this Appendix are generally greater than or equal to the applicant's estimate. For the 2016 applications, the conserved consumptive use estimates provided in each application were thoroughly reviewed prior to project selection.

Approach

The following, simplified, approach was used for each consumptive use analysis:

1. **Used climate data from the nearby climate station defined in each Verification Plan.** Each Verification Plan identified an appropriate climate station. Climate data from each station was reviewed and corrected using American Society of Civil Engineers (ASCE) standards. Due to errant data at the Orchard Mesa CoAgMet station, data from the Colorado State University Fruita CoAgMet station was used for the Grand Valley Farm analysis.
2. **Estimated the potential consumptive use using Penman-Monteith**. The potential consumptive use was estimated using a daily Penman-Monteith calculation and was reduced by daily effective precipitation (per Soil Conservation Service (SCS) National Engineering Handbook Section 4 (NEH4) guidelines) to determine the potential consumptive use from irrigation during the project-specific contracted dates of participation. The calculated consumptive use from irrigation water equals the net savings during the fallowing period.
3. **Adjusted results for water supply limitations.** As outlined in each Verification Plan, the potential consumptive use estimate would be adequately adjusted for water supply limitations based on available information. The 2015 diversion records were not available in either Colorado or Wyoming at the time the analysis was completed. Based on discussions with staff from the State Engineer's Office, including water commissioners, 2015 was generally a wet year.

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[8] "Agreement Among the United States of America, through the Department of the Interior, Bureau of Reclamation, the Central Arizona Water Conservation District, The Metropolitan Water District of Southern California, Denver Water, and the Southern Nevada Water Authority, for a Pilot Program for Funding the Creation of Colorado River System Water through Voluntary Water Conservation and Reductions in Use."

However, to be conservative in the analysis, average historical water supply limitations were applied to the Colorado projects. Similarly, water supply limitations were applied to the Wyoming projects by comparing the 2011 potential consumptive use to the estimated consumptive use from 2011 remote sensing. This is important because not all projects receive a full supply even in wet hydrologic years due to supply limitations, especially on smaller tributaries, and a lack of storage.

Results

The results from the daily consumptive use analyses are provided in **Table 8**. In the observations column, “Actual water savings is close to the contracted value” indicates the results from this analysis were within 10 percent of the contracted conserved consumptive use estimate. “Actual water savings is higher/less than the contracted value” indicates the results from this analysis differed from the contracted conserved consumptive use by more than 10 percent. In general, the majority of the conserved consumptive use estimates for the projects implemented in 2015 were more than 10 percent higher than the estimates provided in the application. Differences between the applicant’s estimated historical average consumptive use savings and the estimated consumptive use savings are due to climate and water availability for the SCPP year.

Note, per the Contract and Verification Plan, a consumptive use analysis was not completed by WWG for the Water Bank sites. Additionally, the values presented below are rounded for simplicity.

Table 8. The 2015 Estimated Conserved Consumptive Use (CCU) Results

Tributary Name	State	Total Acreage	Crop	Dates of Fallowing or Deficit Irrigation (2015)	Selected Climate Station	Cost per acre-foot	Total Cost for 2015	Estimated CCU per Application (acre-feet)	Estimated CCU per Analysis (acre-feet)	Observations
Fontenelle Creek	WY	221	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 49,600	248	259	Estimated water savings is close to the contracted value
Cottonwood Creek	WY	1,736	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 240,492	1,202	1,442	Estimated water savings is higher than the contracted value
Middle Piney Creek	WY	40	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 6,313	32	38	Estimated water savings is higher than the contracted value
Middle Piney Creek	WY	101	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 17,563	88	103	Estimated water savings is higher than the contracted value
Pine Creek	WY	81	Grass Pasture	July 15 – October 31	Boulder	$ 200	$ 14,832	74	99	Estimated water savings is higher than the contracted value
Uncompahgre River	CO	23	Corn	All of 2015	Delta	$ 200	$ 13,650	46	33	Estimated water savings is less than the contracted value
Yampa River	CO	193	Grass Pasture	July 1 – November 1	Hayden	$ 200	$ 37,600	188	239	Estimated water savings is higher than the contracted value
Colorado River – Grand Valley	CO	200	Corn & Alfalfa	All of 2015	CSU Fruita	$ 330	$ 110,220	334	376	Estimated water savings is higher than the contracted value
Various Tributaries on Colorado's West Slope	CO	51	Grass pasture & Alfalfa	Various Dates Throughout 2015	-	$ 300	$ 16,860	56	56[A)]	See note below.

A) *Per the contract, Water Bank Working Group will complete a consumptive use analysis that integrates field specific water-balance data. This analysis is not yet complete; therefore, it is assumed the estimated CCU equals the historical average estimated CCU per the application.*

Appendix B: System Conservation Pilot Program Consumptive Use Analysis (2016)

Background

The Upper Basin System Conservation Pilot Program, established through the System Conservation Agreement[9], promotes temporary, voluntary, measurable reduction of consumptive use of Colorado River water in order to increase storage levels of Lake Mead and Lake Powell. As part of the SCPP, individual project performance is evaluated through project-specific verification plans which include a potential consumptive use analysis—reduced as necessary by water supply limitations—with climate data from a nearby climate station. The purpose of the consumptive use analysis is to quantify the amount of water each project conserved by participating in the System Conservation Pilot Program during the 2016 irrigation season.

As part of the 2016 project selection process, the conserved consumptive use estimates provided in the applications were reviewed, verified, and adjusted if needed. The estimates were generally based on historical averages that accounted for water supply limitations. However, some of the estimates were negotiated based on pending water right court cases or based on documented reports.

Approach

The following simplified approach was used for each consumptive use analysis:

1. **Collect climate data from nearby climate stations.** A nearby climate station was selected for each project. Climate data from each station was reviewed and corrected using ASCE standards as outlined in Appendix D ASCE Manual 70.
2. **Estimate potential consumptive use.** The potential consumptive use for the projects in each state was estimated using the following methods. For consistency, the method used in this analysis—either modified Blaney-Criddle or Penman-Monteith—was selected based on the method used in the applications and the availability of meteorological data.
    - **New Mexico –** Modified Blaney-Criddle was used to estimate the conserved consumptive use in the application and, subsequently, for this analysis.
    - **Utah –** Modified Blaney-Criddle was used to estimate the conserved consumptive use in the application and, subsequently, for this analysis.
    - **Wyoming –** Mapping EvapoTranspiration with High Resolution and Internalized Calibration (METRIC) was used to estimate the conserved consumptive use in the applications. Because this method was only used to develop estimates for 2011, a daily Penman-Monteith calculation was used for this analysis.
    - **Colorado –** Modified Blaney-Criddle was used to estimate the conserved consumptive use in the applications and, subsequently, for this analysis.

[9] "Agreement Among the United States of America, through the Department of the Interior, Bureau of Reclamation, the Central Arizona Water Conservation District, The Metropolitan Water District of Southern California, Denver Water, and the Southern Nevada Water Authority, for a Pilot Program for Funding the Creation of Colorado River System Water through Voluntary Water Conservation and Reductions in Use."

The potential consumptive use estimates were reduced by daily effective precipitation (per SCS NEH4 guidelines for the Penman-Monteith calculations and the SCS Technical Release-21 method for the Modified Blaney-Criddle calculations) to determine the potential consumptive use from irrigation during the project-specific contracted dates of participation. The calculated consumptive use from irrigation water equals the maximum net savings during the fallowing or deficit irrigation period.

3. **Adjust results for water supply limitations.** In general, 2016 represented an average water supply year with warmer temperatures—allowing for a longer growing season. To account for water supply limitations, the following methods were used to adjust the potential consumptive use estimates based on the available information in each state:
    - **New Mexico** – According to the State Engineer's Office, the ditches associated with Lawrence Stock were not supply limited in 2016; therefore, no water supply limitations were applied to the consumptive use estimate.
    - **Utah –** The State Engineer's Office confirmed 2016 was an average hydrologic year and Rainbow Glass Ranch would not have been supply limited. Therefore, no water supply limitations were applied to the consumptive use estimate.
    - **Wyoming –** Diversion records are not recorded unless a ditch is being administered; however, the State Engineer's Office confirmed it was an average hydrologic year and the consumptive use estimates were adjusted by the average historical shortage.
    - **Colorado –** The 2016 diversion records were not available at the time this analysis was completed. However, the State Engineer's Office confirmed it was an average hydrologic year and the consumptive use estimates were adjusted by the associated average historical shortage.

Results

Results from the consumptive use analyses are provided in **Table 9**. In the observations column, "Actual water savings is close to the contracted value" indicates the results from this analysis were within 10 percent of the contracted conserved consumptive use estimate. "Actual water savings is higher/less than the contracted value" indicates the results from this analysis differed from the contracted conserved consumptive use by more than 10 percent. Differences between the applicant's estimated historical average consumptive use savings and the estimated consumptive use savings are due to climate and water availability for the SCPP year. In general, the majority of the conserved consumptive use estimates for the projects selected in 2016 were within 10 percent of the estimates provided in the application.

Note: The values presented below are rounded for simplicity.

Table 9. The 2016 Estimated Conserved Consumptive Use (CCU) Results

Tributary Name	State	Total Acreage	Crop	Dates of Fallowing or Deficit Irrigation (2016)	Selected Climate Station	Cost per acre-foot	Total Cost for 2016	Estimated CCU per Application (acre-feet)	Estimated CCU per Analysis (acre-feet)	Observations
Animas River & San Juan	NM	58	Grass Pasture	April 1 - October 31	Farmington Agricultural Science Center	$ 200	$ 30,366	152	156	Estimated water savings is close to the contracted value
Ferron Creek	UT	240	Alfalfa & Grass Pasture	April 1 – August 31 October 1 – October 31	Ferron	$ 200	$ 103,380	517	586	Estimated water savings is higher than the contracted value
Fontenelle Creek	WY	381	Grass Pasture	June 20 – October 31	Budd Ranch	$ 200	$ 93,200	466	378	Estimated water savings is less than the contracted value
Cottonwood Creek	WY	726	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 96,400	482	686	Estimated water savings is higher than the contracted value
Middle Piney Creek	WY	1,240	Grass Pasture	May 15 – September 30	Budd Ranch	$ 200	$ 227,000	1,135	1,158	Estimated water savings is close to the contracted value
Middle Piney Creek	WY	184	Grass Pasture	July 20 – September 30	Budd Ranch	$ 200	$ 35,600	178	160	Estimated water savings is close to the contracted value
South Fork Horse Creek	WY	1,103	Grass Pasture	June 5 – September 30	Budd Ranch	$ 200	$ 245,200	1,226	1,213	Estimated water savings is close to the contracted value
South Cottonwood Creek	WY	1,631	Grass Pasture	July 15 – September 30	Budd Ranch	$ 200	$ 228,600	1,143	1,541	Estimated water savings is higher than the contracted value
Pine Creek	WY	82	Grass Pasture	July 20 – October 31	Boulder	$ 200	$ 14,000	70	83	Estimated water savings is higher than the contracted value
Ham's Fork River	WY	292	Grass Pasture	July 1 – September 30	Bridger Valley	$ 200	$ 79,000	395	423	Estimated water savings is close to the contracted value
Black's Fork River	WY	40	Grass Pasture	July 1 – September 30	Bridger Valley	$ 200	$ 21,000	105	108	Estimated water savings is close to the contracted value
Uncompahgre River	CO	44	Alfalfa, Corn, Dry Beans & Clover	January 1 – October 31	Montrose No. 2	$ 200	$ 20,300	Not Applicable	102	Compensated based on actual practice and associated CU
Uncompahgre River	CO	10	Alfalfa, Corn & Clover	January 1 – December 31 Irrigated 1 full day per month May through September	Montrose No. 2	$ 200	$ 4,000	20	21	Estimated water savings is close to the contracted value
Uncompahgre River	CO	12	Alfalfa & Triticale	January 1 – July 14 October 16 – October 31	Montrose No. 2	$ 200	$ 4,800	24	23	Estimated water savings is close to the contracted value
Surface Creek	CO	67	Alfalfa & Grass Pasture	June 10 – September 20	Delta 3 E	$ 250	$ 31,250	125	126	Estimated water savings is close to the contracted value
East River	CO	106	Grass Pasture	July 1 – October 31	Crested Butte Gunnison 3 SW	$ 200	$ 19,674	98	105	Estimated water savings is close to the contracted value
Tomichi Creek	CO	165	Grass Pasture	July 1 – October 31	Cochetopa Creek Gunnison 3 SW	$ 200	$ 20,000	100	185	Estimated water savings is higher than the contracted value
Little Cimarron River	CO	195	Grass Pasture	July 7 - October 31	Gunnison	$ 161	$ 27,375	170	[A)]	Estimated water savings is higher than the contracted value
Milk Creek	CO	94	Alfalfa & Grass Pasture	July 1 – August 31	Meeker 3W	$ 200	$ 16,760	84	82	Estimated water savings is close to the contracted value
Uncompahgre River	CO	23	Winter Wheat	June 1 – October 15	Montrose No. 2	$ 250	$ 7,350	29	35	Estimated water savings is higher than the contracted value
Colorado River – Grand Valley [B)]	CO	200	Corn & Alfalfa	January 1 – December 31	Grand Junction 6 ESE	$ 330	$ 110,220	334	465	Estimated water savings is higher than the contracted value
South Fork Eagle River	CO	-	-	January 1 – December 31	Not Applicable	$ 670	$ 134,132	200	200	Same as contracted value
Various Tributaries on Colorado's West Slope	CO	51	Grass pasture & Alfalfa	Various Dates Throughout 2016	-	$ 300	$ 18,450	62	62[C)]	See note below.

A) Per contract, estimated CU not provided due to pending water court case.

B) Indicates a multi-year project that was selected in 2015 and included different criteria for reviewing the CU estimates provided in the application due to the initial phase of the SCPP.

C) Per the contract, Water Bank Working Group will complete a consumptive use analysis that integrates field specific water-balance data. This analysis is not yet complete; therefore, it is assumed the estimated CCU equals the estimated CCU per the application.