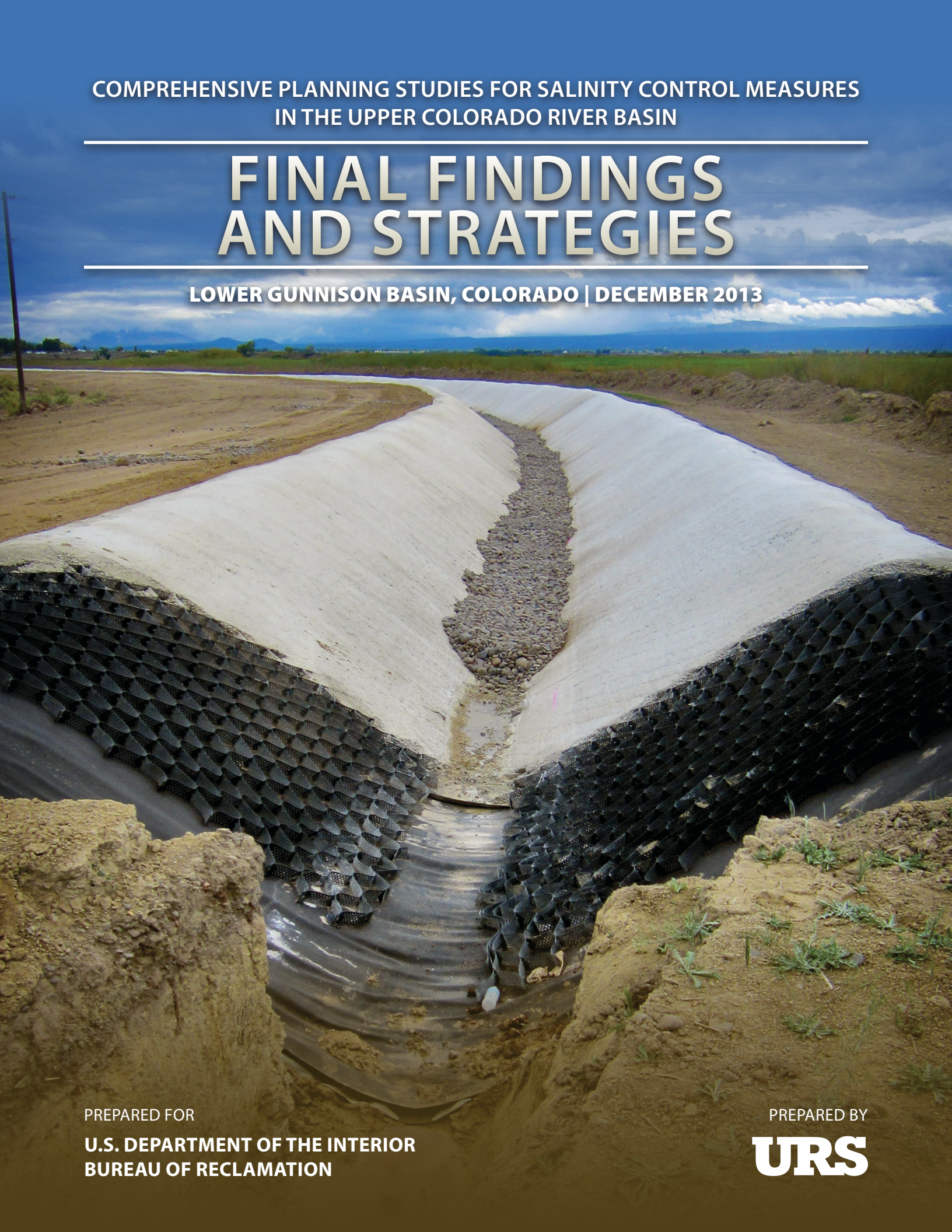
COMPREHENSIVE PLANNING STUDIES FOR SALINITY CONTROL MEASURES IN THE UPPER COLORADO RIVER BASIN

FINAL FINDINGS AND STRATEGIES

LOWER GUNNISON BASIN, COLORADO | DECEMBER 2013



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List of Abbreviations/Acronyms

ac	acre
ac-ft	acre feet(foot)
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
BSP	Basin States Program
CD	Conservation District
CDSS	Colorado Decision Support System
cfs	cubic feet per second
Co.	Company
Cr	creek
CRBSCF	Colorado River Basin Salinity Control Forum
CRSP-MOA	Colorado River Storage Project – Memorandum of Agreement
CWCB	Colorado Water Conservation Board
DCD	Delta Conservation District
DMEA	Delta-Montrose Electric Association
DWR	Department of Water Resources
EIS	Environmental Impact Statement
EQIP	Environmental Quality Incentives Program
FOA	Funding Opportunity Announcement
FMC	Fire Mountain Canal
ft	feet
GIS	Geographic Information System
ha	hectare
HUC	Hydrologic Unit Codes
IWM	Integrated Water Management
kW	KiloWatt
LEPA	Lower Energy Precision Application
LESA	Lower Elevation Spray Application
LG	Lower Gunnison
LGBU	Lower Gunnison Basin Unit

M&E	Monitoring and Evaluation
mi	mile
Misc.	Miscellaneous
Mtn.	Mountain
MWh	Megawatt hour
NA or N/A	Not Applicable
NAIP	National Agriculture Imagery Program
NFWCD	North Fork Water Conservancy District
NRCS	Natural Resources Conservation Service
NPS	Non-Point Source
Reclamation	United States Department of Agriculture, Bureau of Reclamation
RLG	Remainder of the Lower Gunnison
SCS	Soil Conservation Service
SDI	Surface Drip Irrigation
SMP	Selenium Management Program
SSDI	Sub-Service Drip Irrigation
tons/yr	tons per year
UCDSM –Model	Upper Colorado Detailed Salinity
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USDA-ARS	United States Depart of Agriculture, Agricultural Research Service
USGS	United States Geological Survey
UVWUA	Uncomphagre Valley Water Users Association
WCD	Water Conservancy District

Executive Summary

The United States Bureau of Reclamation (Reclamation) has authorized a comprehensive planning study for salinity control measures within the Lower Gunnison Basin. The views, conclusions, and recommendations are those of the author(s) and are not intended to represent the views of the US Government, Reclamation or the Salinity Control Program. Publication does not imply endorsement of the report's finding or recommendations. This report is published to share with the public the information and ideas gathered.

Both an advisory council and a study team have been selected to oversee and direct the study. The Lower Gunnison Basin Salinity Study Team consists of staff members from federal and state agencies, water resource managers, and local stakeholders involved with the salinity program in the Lower Gunnison Basin.

For this study, the Salinity Control Program refers to the efforts of the Reclamation, Natural Resource Conservation Service (NRCS), and Basin States Program (BSP) to control salinity. The Study Team developed the study purpose and objectives and provided guidance to URS during the study.

The purpose of this study is to identify and prioritize cost effective salinity control opportunities, identify impediments to these opportunities, and to describe how a variety of control measures might be best implemented in a coordinated manner to maximize local and basin-wide benefits in cooperation with other potential funding partners in the Upper Colorado River Basin.

Study Objectives

The study objectives are:

1. Identify and summarize information regarding sources of salinity in the basin. Much information concerning the sources of salinity in the basin is available through Reclamation, NRCS and CDSS. New technical studies into salinity sources are not an objective of this study.
2. Identify and summarize salinity control accomplishments. Much information is available about accomplishments from Reclamation, NRCS, and Colorado Department of Agriculture. All significant canals have been mapped in the Lower Gunnison Basin. Reclamation can identify the canals that have been piped or lined by its program. NRCS can provide a numerical summary of on-farm improvements accomplished to date by their Environmental Quality Incentive Program (EQIP) by county. NRCS cannot, however, provide site-specific data. Site-specific data was not investigated.
3. Identify and prioritize future salinity control opportunities. Identify ways to optimize off-farm delivery system improvements to enhance on-farm participation by producers.
4. Identify impediments to full implementation of the salinity program, both off-farm and on-farm. Impediments considered are physical, technical, social, cultural, and/or economic in nature. While many impediments are likely common to all irrigation systems, certain impediments are anticipated to be unique to the Lower Gunnison Basin.
5. Identify strategies that move the salinity control program forward in the Lower Gunnison Basin. Salinity control strategies can only be adopted and moved forward by the authorized implementing agencies. Due to limited time and funds this study effort

focuses on implementation of the program and identification of technical and data needs rather than performing additional scientific investigation.

ASSESSMENT

The URS Study Team, consisting of URS water resources engineers, irrigation engineers from Keller-Bliessner, and a social scientist from Colorado State University, was contracted in August 2012 to conduct the above assessment of the salinity control program in the Lower Gunnison Basin and to recommend strategies to improve participation in the program. The Lower Gunnison Basin represents the largest contribution of salinity to the Colorado River system, with a total annual loading of 1,440,000 tons. There had been a concern that participation had fallen off in recent years, and this assessment was an effort to determine what the issues were, and how participation could be improved.

Interviews and meetings were conducted with more than 76 individuals, comprising irrigators, irrigation company board members, conservation district officials, Federal and State agency officials and engineering consultants involved with the program.

As would be found in any large program, be it Federal, State or even local, there were frustrations expressed in working through the bureaucracy to achieve success. However, most of the program limitations were due to funding limitations, at the USBR and NRCS level, and to the requirements placed upon the expenditure of federal funds.

By and large, the program is successful and well received, but there is a desire on all parts to do things better. There are also two very distinct areas in the Lower Gunnison Basin, the Uncompahgre Valley and the remainder of the Lower Gunnison (RLG). The Uncompahgre Valley is the beneficiary of a 100-year-old Reclamation project, serving a very large area, with direct service to shareholders, and a good administrative and operational network. The "Remainder of the Lower Gunnison", consists of small irrigation companies dealing with a myriad of issues. For the program to succeed, the issues of both of these disparate areas need to be addressed.

One common theme that cropped up across the spectrum was the need for a more comprehensive planning effort and the desire to have an individual in the basin who could serve as a coordinator among the responsible entities and as a coach to the companies and individuals trying to participate in the program. There was a strong desire to "do right" in terms of environmental responsiveness, but also a need to maintain an economical approach to agriculture and not increase long-term obligations. Many of the small companies were also limited by the time constraints placed upon volunteer board members and even operational staff. A coordinator could help in navigating the way through the different programs.

The need for more comprehensive planning is made even more complex by consideration of hydropower in small systems, a way to both help fund the project and to provide some local power resources. With power costs continuing to rise, irrigators are reluctant to convert to a pressurized sprinkler system in the absence of a gravity pressure delivery system. However, in the RLG, there is potential for systems to combine, gain additional head in the process, and possibly recover some portion of the costs by installing small hydropower generating facilities. This has been made more feasible by the recent passage of federal legislation (**HR 113-678 The Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act**) that

eases the licensing of these types of projects. Additionally, the Lower Gunnison Basin is currently a "hot-bed" of small hydropower interest. At the recent Colorado Small Hydropower Association conference in Denver in July 2013, the majority of the projects were from Western Colorado. Reclamation recently completed a study compiling the hydropower potential on Reclamation canals (**Site Inventory and Hydropower Energy Assessment of Reclamation Owned Conduits (Final Report - March 2012**). This study identified 14 structures on USBR facilities in the Lower Gunnison Basin where sufficient head and flow exists to at least consider the installation of hydropower. An additional study by Reclamation is currently underway, **Feasibility of Integrating Low-Head Hydropower with Effective Canal Management,** to further evaluate operational impacts. This interest should be capitalized upon with new projects.

The issues in the area and for the Program break down into two improvement categories and two and distinct perspectives:

Improvement Categories

1. On Farm (principally NRCS programs),
2. Off-Farm (principally Reclamation Programs)

Perspective

1. The perspective of the applicant
2. The perspective of the agency

It is imperative that all sides understand and accept where the other sides are coming from, so that common ground can be reached.

RECOMMENDATIONS

The four most important recommendations which came from this assessment are:

BASIN COORDINATOR: Either through State or Federal funding, a full time, locally based Salinity Coordinator is needed to provide the many small companies and private individuals with the support necessary to move forward with the best implementation for the area. This requires identifying an individual who can relate to the irrigation entities and yet have a encompassing view of the programs, rules and regulations which drive the Salinity Control effort

COMPREHENSIVE PLANNING: In particular, with the many small ditch and reservoir companies that exist outside of the UVWUA service area, there is obviously a great potential to combine and improve groups of canals and laterals. However, there can be a natural resistance to change which needs the development of a "community vision" to overcome. .

HYDROPOWER INTEGRATION: With the new legislation and proposed legislation to increase the use of renewable energy, hydropower can be used to assist with project funding. The Colorado Agriculture Department is very interested in assisting in this area.

IMPROVED IRRIGATION WATER MANAGEMENT SUPPORT: Much of what can be accomplished can be accomplished with existing systems, operated more efficiently on a continuous basis. We can't always just go in, make the necessary capital improvements, and leave, hoping that all will be well in the future. We have heard also that the pay scale for good IWM personnel does not really support their long-term retention. A way should be found to

maintain (or continue) the federal and national benefits that continuation of effective Irrigation Water Management provides.

1.1 INTRODUCTION

The United States Bureau of Reclamation (Reclamation) has authorized a comprehensive planning study for salinity control measures within the Lower Gunnison Basin. Both an advisory council and a study team have been selected to oversee and direct the study. The Lower Gunnison Basin Salinity Study Team consists of staff members from federal and state agencies, water resource managers, and local stakeholders involved with the salinity program in the Lower Gunnison Basin. The Study Team members represent:

1. Reclamation
2. United States Department of Agriculture—Natural Resource Conservation Service (NRCS)
3. United States Geological Survey (USGS)
4. Colorado Water Conservation Board
5. Colorado Department of Agriculture
6. Colorado River Water Conservation District
7. Shavano Conservation District
8. Delta Conservation District
9. Colorado River Basin Salinity Control Forum (CRBSCF)

The purpose of this study is to identify and prioritize cost effective salinity control opportunities, identify impediments to these opportunities, and to describe how a variety of control measures might be best implemented in a coordinated manner to maximize local and basin-wide benefits in cooperation with other potential funding partners in the Upper Colorado River Basin.

The URS Study Team, consisting of URS water resources engineers, irrigation engineers from Keller-Bliessner and a social scientist from Colorado State University, made numerous visits to the study area and interviewed or conducted meetings with 76 individuals, ranging from local irrigators to the Assistant State Conservation for NRCS – Colorado. From these interviews and site visits, the team was able to discern not only the existing system, and the potential improvements which could be accomplished, but also begin to understand the impediments to full implementation of the program in the Lower Gunnison Basin.

1.2 STUDY OBJECTIVES

The study objectives are:

1. Identify and summarize information regarding sources of salinity in the basin. Much information concerning the sources of salinity in the basin is available through Reclamation, NRCS and CDSS. New technical studies into salinity sources are not an objective of this study.
2. Identify and summarize salinity control accomplishments. Much information is available about accomplishments from Reclamation, NRCS, and Colorado Department of Agriculture. The vast majority of significant canals have been mapped in the Lower Gunnison Basin. The mapping of the remainder of the canals, which are located south of Colona, is scheduled to be completed by April 2014. Reclamation can identify the canals

that have been piped or lined by its program. NRCS can provide a numerical summary of on-farm improvements accomplished to date by their Environmental Quality Incentive Program (EQIP) by county. NRCS cannot, however, provide site-specific data. Site-specific data was not investigated.

3. Identify and prioritize future salinity control opportunities. Identify ways to optimize off-farm delivery system improvements to enhance on-farm participation by producers.
4. Identify impediments to full implementation of the salinity program, both off-farm and on-farm. Impediments considered are physical, technical, social, cultural, and/or economic in nature. While many impediments are likely common to all irrigation systems, certain impediments are anticipated to be unique to the Lower Gunnison Basin.
5. Identify strategies that move the salinity control program forward in the Lower Gunnison Basin. Salinity control strategies can only be adopted and moved forward by the authorized implementing agencies. Due to limited time and funds this study effort focuses on implementation of the program and identification of technical and data needs rather than performing additional scientific investigation.

1.3 HISTORY OF SALINITY CONTROL PROGRAM IN LOWER GUNNISON/COLORADO RIVER BASIN

The Colorado River and its tributaries provide municipal and industrial water to about 36 million people and irrigation water to nearly 5.5 million acres of land in the United States. The river also serves about 3.3 million people and 500,000 acres in Mexico. Historically the Colorado River carried an average salt load of about 9 million tons per year at Hoover Dam. The effect of salinity is a major concern in both the United States and Mexico and quantified economic damages resulting from salinity are estimated to be $295 million per year. The Salinity Control Act (Public Law 93-320) and amendments (Public Law 98-569, 104-20, 106-459, 104-127, 107-171, and 110-246) authorize the Secretaries of the U.S. Department of the Interior (Interior) and USDA to enhance and protect the quality of water available in the Colorado River for use in the United States and the Republic of Mexico by implementing salinity control projects throughout the Basin.

Salinity control projects are implemented by Reclamation, the Bureau of Land Management (BLM), and the NRCS. Projects implemented to date by these agencies prevent an estimated 1.30 million tons of salt from reaching the Colorado River system. Reclamation, BLM, and NRCS have a combined control target of 1.85 million tons by the year 2030.

Irrigation induced salt loading is estimated to contribute 37% of the salinity at Imperial Dam and is the primary target for salinity control projects by Reclamation and NRCS. Salinity control project areas for reducing irrigation related salt loading have been established throughout the Upper Basin States of Colorado, New Mexico, Utah, and Wyoming. **Figure 1-1** shows the location of the Lower Gunnison Basin Unit within the Upper Colorado River Basin. Monitoring and studies have been conducted in each of these areas to provide estimates of salt loading including irrigation related, or agricultural, sources.

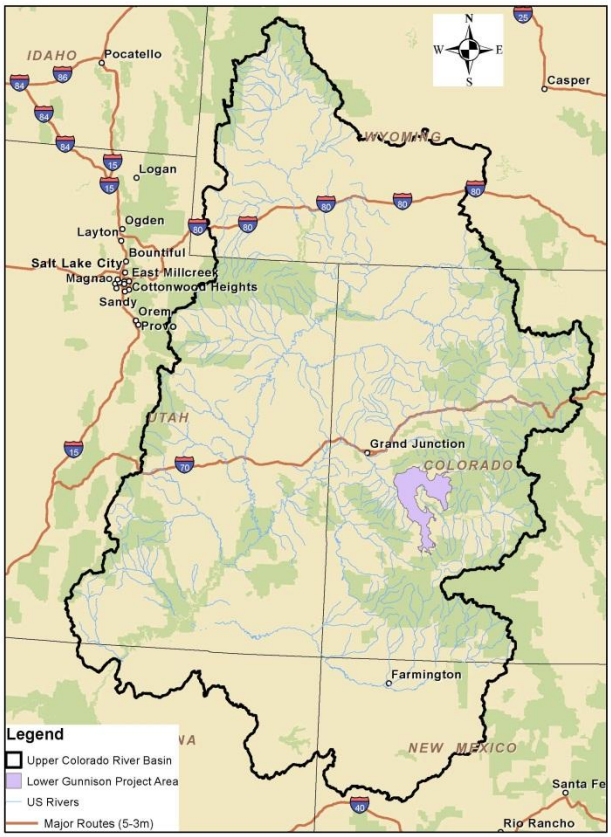

Figure 1-1: Colorado River Basin -Lower Gunnison Basin Program Area

Off-farm salt loading is targeted by Reclamation in the Basinwide Salinity Control Program. The Basinwide Salinity Control Program seeks to control salt loading through a grant program whereby applications are accepted throughout the Colorado River Basin that propose methods for reducing salt loading to the Colorado River system. Applications to the Basinwide Program are primarily proposals for piping or lining irrigation delivery systems that reduce seepage and, consequentially, off-farm salt loading.

On-farm salt loading is targeted by the NRCS through its EQIP. Individual landowners and producers participate in the EQIP program through an application sign-up process. Qualifying applicants typically receive 75% cost share towards on-farm irrigation improvements. Improvements such as sprinklers or improved flood irrigation increase efficiency which reduces deep percolation and, consequentially, on-farm salt loading.

1.4 LOWER GUNNISON BASIN, HISTORY & BACKGROUND

The Lower Gunnison Basin is located in west central Colorado, in Delta, Montrose and Ouray Counties. The area feeds primarily to the Gunnison and Uncompaghre Rivers and their tributaries. The basin includes approximately 166,000 irrigated acres. The Mancos formation underlies the central and southern part of the basin and is the principle source of salt loading.

Elevations in the area range from 4,910 feet at Delta, Colorado on the Gunnison River to 14,321 feet at Uncompaghre Peak. **Figure 1-2** identifies the study area boundary and some major geographical features.

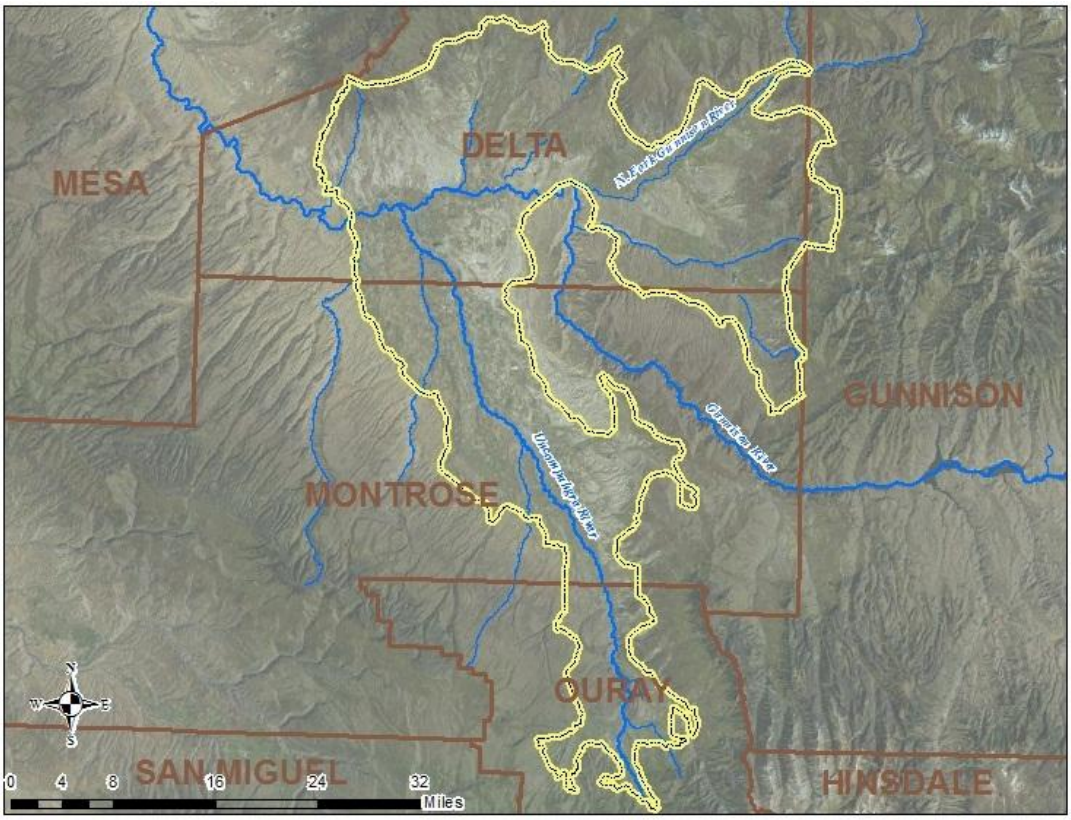

Figure 1-2: Lower Gunnison Basin-Salinity Project Area

Hydrosalinity studies of the Lower Gunnison Basin estimate the salinity load to be 1,440,000 tons annually of which 840,000 tons is attributed to agricultural practices. On-farm practices, which include field irrigation and supply delivery ditches (or near-farm ditches), are estimated to contribute 440,000 tons annually. Off-farm practices, which include larger irrigation delivery systems such as canals and laterals, are estimated to contribute 400,000 tons annually. **Figure 1-3** shows the conceptual baseline salt load sources, in tons per year, of the Lower Gunnison Basin according to different studies done by the NRCS and Reclamation and how they are allocated throughout the study area.

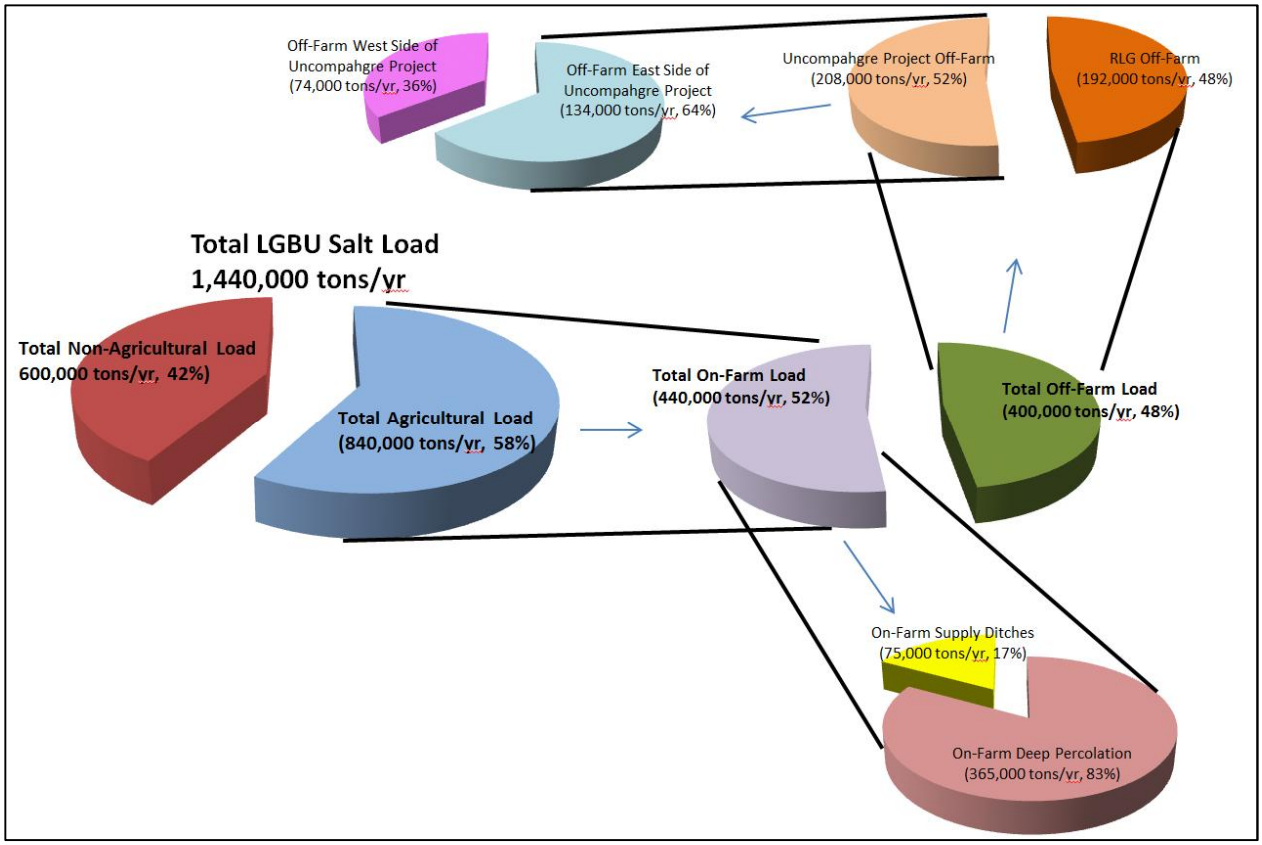

Figure 1-3: Lower Gunnison Basin Salt Load Allocation

Salinity control projects were first implemented in the Lower Gunnison Basin beginning in 1986. Salt loading to the Colorado River in the Lower Gunnison Basin has now been reduced by approximately 227,100 tons per year by both on-farm and off- farm measures through combined efforts from Reclamation, USDA/NRCS, and the BLM [8]. Salinity Control Program projects implemented to date by cooperating agencies prevent an estimated 1.30 million tons of salt annually from reaching the Colorado River System [8]. Reclamation, BLM and NRCS have a combined control target of 1.85 million tons by 2030.

1.5 ACCOMPLISHMENTS REPORT SUMMARY

There have been significant accomplishments by the Salinity Control Program within the Lower Gunnison Basin since its inception in 1986. An early key accomplishment of the program was the removal of "winter water" deliveries from approximately 552 miles of canals within the Uncompaghre Valley WUA distribution system. Subsequent program accomplishments of the program in the Lower Gunnison Basin have included the piping or lining of an additional 117 miles of canal or laterals out of approximately 1,345 miles and improved irrigation methods on approximately 62,306 acres [9] out of 171,000 total irrigable acres. However, there is still approximately 1,228 miles of canals or laterals that remain unlined or un-piped and over 100,000 acres of flood irrigated acres that could have improved irrigation practices. The current mapping and inventorying that has been conducted by the USBR-Grand Junction Projects office is still considered to be a " work in process and has only includes ditches with a decreed capacity of greater than 4 cfs which serve two or more users. (Reference 1)

There is a question with the total amount of acres reported as irrigated in the Lower Gunnison area. As in all areas, there has been a consistent conversion from agricultural to urban uses, a trend which is expected to continue into the future. Partially in response to this trend, the NRCS has recently reduced their goal of acres to be treated from 135,000 acres to 115,000 acres.

The State of Colorado has not yet released the 2010 GIS data set for use, so it is not possible at this time to provide more accurate estimates of the irrigated acreage – however, this does impact the computation of the residual or "flood" irrigation lands.

It is still uncertain what the long term salinity implications of the conversion of agricultural land to urban development will be, but studies conducted by the USGS in the Grand Valley have generally shown a decrease in salt loading from deep percolation when agricultural land is urbanized, as long as unlined ponds are not a component of that conversion.

Data used for the evaluation of the Salinity Program was provided from Reclamation GIS, NRCS Reports, and Colorado's Decision Support System (CDSS) GIS. Additionally, the USGS has just (January 2014) released preliminary data from a remote sensing project of agriculture in the Upper Colorado River Basin (Figure 1-4), and Table 1.3 (below) This data was developed using remote sensing information from 2007 to 2010, and "supplemented" by the use of 2005 CDSS data. This provides yet another set of numbers for total irrigated acreage in the Lower Gunnison Basin, as well as the type of irrigation being utilized.

The Reclamation, NRCS and CDSS data sources are represented in the following maps and figures which are found in Appendix A in the Accomplishments Report [1]:

1. Figures 8 & 9: Reclamation Surveyed Ditch Data (ongoing)
2. Figure 6: CDSS GIS Data, Total Irrigated Acreage (dated 2005)
3. Figures 2 & 3: NRCS Monitoring and Evaluation Reports [10]

1.6 TREATMENT STATUS

1.6.1 Off-farm Improvements

The total length of treated canals and laterals within the Lower Gunnison Basin (off-farm improvements) is summarized in **Table 1-1**.

Table 1-1: Summary of Treated Canals and Laterals

Off-Farm Delivery Systems	Miles	Percent Total
Total Canal and Laterals	1,345	100%
Lined or Piped Canals and Laterals	117	9%
Remaining Untreated Canals and Laterals	1,228	91%

Values are based on preliminary Reclamation canal and lateral GIS data. Only canals and laterals that have a decreed right greater than 4 cfs and serve two or more users were surveyed. Upper headwater canals and laterals are still being surveyed at the time of this report.

1.6.2 On-farm Improvements

Table 1-2 summarizes the irrigated acreage and treatments within the Lower Gunnison Basin [9]. **Table 1-3** summarizes preliminary work the USGS performed to characterize multiple irrigation types from aerials from 2007-2010 and supplemented with CDSS 2005 irrigated acreage data.

Table 1-2: Irrigation in Lower Gunnison Basin-NRCS CONTRACTS APPLIED

Irrigation Category	Acres	Percent Total
Total Irrigated Acreage	171,000	100%
Sprinkler Irrigated Acreage	7,121	4%
Drip System	1,285	1%
Flood	108,694	64%
Improved Flood Irrigation	53,900	32%

Table 1-3: Irrigated Acreage by Type from USGS (2014)

2007-2010 (Supplemented by 2005 CDSS)		
Irrigation Type	**Area (ac)**	**% of Total**
Other	74	0.05%
Unknown - not irrigated	893	1%
Sprinkler	11,361	7%
Misc. Flood	140,886	92%
Grand Total	153,214	100%

2.1 IRRIGATION TECHNOLOGY AND THE LOWER GUNNISON BASIN

As water supply and water quality concerns are addressed by policy makers, the conversation can quickly turn to irrigated agriculture and irrigation efficiency. In this section irrigation efficiency and technology are briefly discussed; as is their impact on both water supply and water quality.

2.1.1 Irrigation Efficiency

From a seasonal perspective, a common definition of irrigation efficiency is:

$$E_i = (V_b/V_f) * 100$$

Where V_b is the water beneficially used by the crop, and V_f is the water delivered to the farm or field. The water beneficially used by the crop includes crop evapotranspiration (ET_c) and the water required for leaching to maintain the soil salt balance. ET_c includes water transpired by the crop and evaporation from the plant foliage and soil surface (**Figure 2-1**). Water not beneficially used includes the percolation to the water table in excess of the leaching requirement and surface runoff. Irrigation efficiency can be increased by reducing surface runoff (tail water) and deep percolation, and can be accomplished by improved irrigation water management, system improvements or a combination of both.

Irrigation uniformity is also very important. There are various ways of defining uniformity but conceptually you want to infiltrate the same depth of water across the entire field. This can be a challenge with surface irrigation because the opportunity time at the head end of the field is greater than at the tail end of the field. It is easy to over-irrigate the head end and under irrigate the tail end. Sprinklers reduce this problem. It is not uncommon for people to correlate increased irrigation efficiency with water savings (reduced basin depletions). The main driver for farmers to invest in new or updated irrigation technology is increased yields. Crop yields should increase with system improvements because of improved irrigation efficiency and uniformity. Higher yields result in more water being depleted from the basin.

There is some degradation in surface water quality as water runs across the field and potentially picks up fertilizer, surface salts and pesticide residue. Deep percolation is of more concern and a focus of the salinity program. As irrigation water percolates below the crop root zone and to the water table, it picks up naturally occurring salts and minerals and eventually transports them to the streams and rivers of the basin. The deep percolation component must be reduced to impact the salt outflow of the basin. If a system has poor irrigation efficiency because of high surface return flow (tail water) and relatively low deep percolation, system improvements that primarily reduce tail water and dramatically increase the irrigation efficiency will have little benefit for salinity control. In such situations the salinity reduction claimed for on-farm system improvements can be vastly overstated. In areas of the Lower Gunnison Basin surface runoff is reused multiple times, making the basin irrigation efficiency much higher than a particular farm or field irrigation efficiency. When looking at irrigation system improvements for salinity loading reduction, it is important to focus on reducing deep percolation.

Table 2-1 has been adapted from work by Terry Howell of the USDA-ARS [3]. It shows the range of expected irrigation efficiencies based on system type. Management of the irrigation system can be as important as the system type. A well-managed furrow system on good soils

may obtain efficiencies as high as a center pivot that is marginally managed. However, on average a center pivot will produce higher efficiencies (80%) than a furrow irrigation system (65%). The NRCS salt loading calculations use considerably lower surface irrigation efficiencies than presented in **Table 2-1**. NRCS assumes from 32% for unimproved flood to 55% for well managed improved flood irrigation. In this context flood and surface irrigation are synonymous.

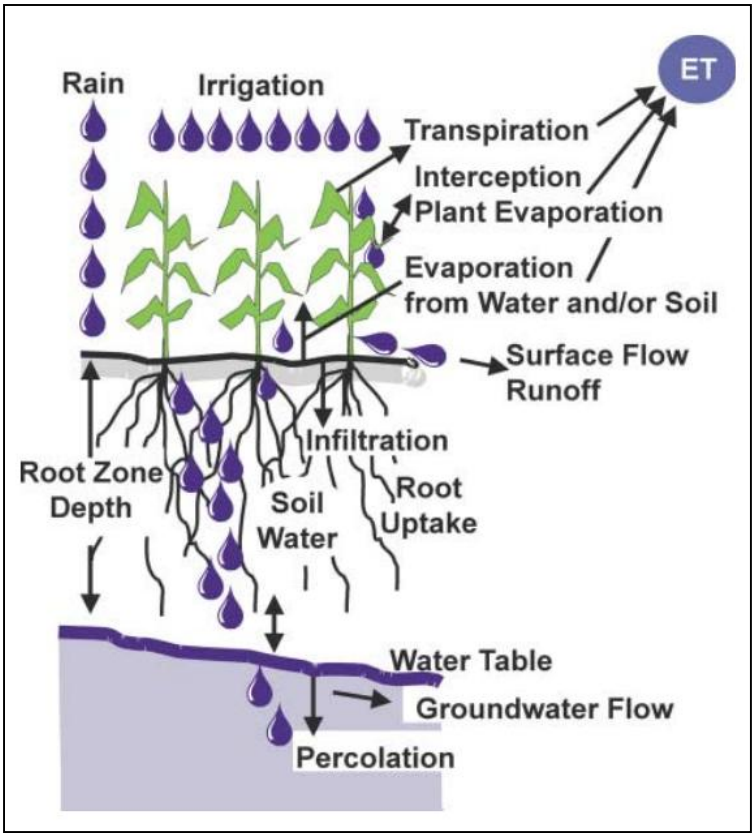

Figure 2-1: Illustration of the various transport components needed to characterize irrigation efficiency (From Irrigation Efficiency by Terry A. Howell [3])

Table 2-1: Examples of Farm and Field Irrigation Application Efficiency and Attainable Efficiencies*

Irrigation Method	Field Efficiency (%)		
	Attainable	Range	Average
Surface			
Graded Furrow	75	50–80	65
w/tail water reuse	85	60–90	75
Level Furrow	85	65–95	80
Graded Border	80	50–80	65
Level Basins	90	80–95	85
Sprinkler			
Periodic Move	80	60–85	75
Side Roll	80	60–85	75
Moving Big Gun	75	55–75	65
Center Pivot			
Impact Heads w/End Gun	85	75–90	80
Spray Heads wo/End Gun	95	75–95	90
LEPA[a] wo/End Gun	98	80–98	95
Lateral Move			
Spray heads w/Hose Feed	95	75–95	90
Spray Heads w/Canal feed	90	70–95	85
Microirrigation			
Trickle	95	70–95	85
Subsurface Drip	95	75–95	90
Micro Spray	95	70–95	85
Water Table Control			
Surface Ditch	80	50–80	80
Subsurface Drain Lines	85	60–80	85

[a] LEPA is low energy precision application

*Table adapted from Irrigation Efficiency by Terry A. Howell, USDA, Bushland Texas. Published in Encyclopedia of Water Science, 2003 by Marcel Dekker, Inc. [3].

2.1.2 Irrigation Technology

In the Lower Gunnison Basin, historic improvement practices have been the conversion of unimproved flood irrigation to the installation of gated pipe. To qualify for salinity program cost sharing funds there has to be a reduction in salt loading from a treated field. While high efficiencies and good uniformity can be accomplished with surface irrigation practices, it typically involves more time and effort on the part of the farmer than switching to a different technology such as sprinklers. Well managed wheel lines or center pivots will typically improve both irrigation efficiency and uniformity as well as crop yields over a typical gated pipe surface irrigation system. Wheel lines are not practical for the entire season on tall crops such as corn but center pivots work well.

The NRCS assumes 65% efficiency for new wheel lines, 75% for Center Pivot/Linear Move Systems and 85% for "High Tech Systems" in the salinity cost effectiveness calculations. The definition of "High tech" is somewhat unclear but likely includes technology such as drip and potentially Low Energy Precision Application LEPA systems (See **Table 2-1**). Most farmers desiring to switch from surface irrigation to sprinklers should be competitive in the salinity program. In our discussion with water users in the basin there appears to be a general reluctance to switch to any type of pressurized system if there is an associated pumping costs. Sprinklers appear to be much more attractive to local farmers if pressurized water is provided and no pumping is required.

2.1.3 Periodic Move Systems

Wheel-lines are extensively used throughout the western United States but present their own challenges. One of the biggest drawbacks is the labor requirement to move the lines once or twice a day. For small farmers, particularly those with outside employment, it can be difficult to have equal day and night-time sets. For example, if the lines are moved at 7:00 am and 5:00 pm each day, this results in 10 hour day sets and 13.5 hour night sets assuming a half-hour down time. Assuming no deficit irrigation, these varying set times reduce uniformity and irrigation efficiency. A continuous move system such as a center pivot, eliminates differences in set times and reduces the labor requirements. Pivots can also be used with tall crops such as mature corn.

For small areas of irrigated pastures other types of sprinklers such as pod or K-Line systems can be used. These systems typically have impact sprinklers mounted in short pods spaced along a flexible line that can be moved (while operating) by dragging with a 4-wheeler. Such system may provide an increase in irrigation efficiency over uncontrolled flooding. However, the likely haphazard movement between sets can decrease uniformity.

2.1.4 Continuous Move Systems

In the Lower Gunnison Basin there are many small fields that provide design challenges for typical continuous move systems such as quarter section center pivots. There are manufactures that make low profile mini-pivots that can be configured for a variety of field sizes. One such manufacture is Lindsay Corporation with their Greenfield MP400 Mini-Pivot Product line. **Figure 2-2a** shows how the pivot can be configured for fields ranging in size from 1 to 73 acres. **Figure 2-2b** shows a photo example of the pivot. Other manufacturers, such as Valmont with their Valley line of pivots, can build shorter length pivots but do not have a mini-pivot.

The study team contacted a Zimmatic Dealer (Lindsay Corporation) and a Valley Dealer from Northern Utah to get their opinion of mini-pivots. Both dealers referred to them as toy pivots because of their lighter gauge steel construction, which makes them less likely to hold up under commercial farming operations. Many dealers do not routinely stock parts for mini-pivots, making them more difficult to service and repair. Both dealers commented that with smaller fields you can use standard pivot towers with smaller pipe and longer spans that makes them economically competitive with mini-pivots. For small systems, mini-pivots do have an advantage in that they come with single-phase motors instead of 3-phase motors, which reduce the cost of providing power to the field where 3-phase power is not readily available. Another advantage to mini-pivots is that they typically have shorter span lengths and more towers, resulting in less problematic wheel rutting. This advantage, however, can be replicated with standard pivots by

decreasing the span pipe diameter so that the water weight per wheel is similar to the mini-pivots.

Linear move systems are also feasible on smaller acreages. They are not used as much as center pivots because of their increased complexity. They are well suited for rectangular fields. Lindsay makes a line of Mini-Lateral systems designated ML400. These systems can be configured to pivot at the end of the field resulting in doubling of the area of coverage, and preventing the need to run them back dry for new irrigation events (**Figure 2-3a** and **Figure 2-3b**).

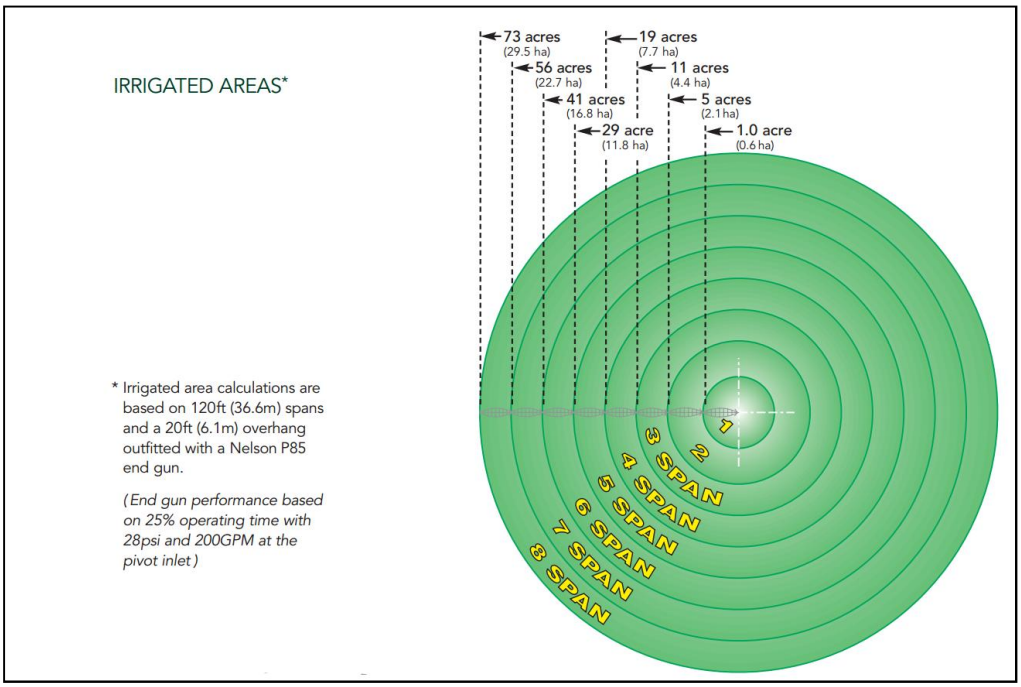

Figure 2-2a: Irrigated areas for various configurations of the Lindsay Greenfield MP400 Mini-Pivot Pivot (Figure adapted from Lindsay Greenfield MP400 Brochure)

Figure 2-2b: Photo example of a Lindsay Greenfield MP400 Mini-Pivot Pivot (Photo from the Lindsay Greenfield MP400 Brochure).

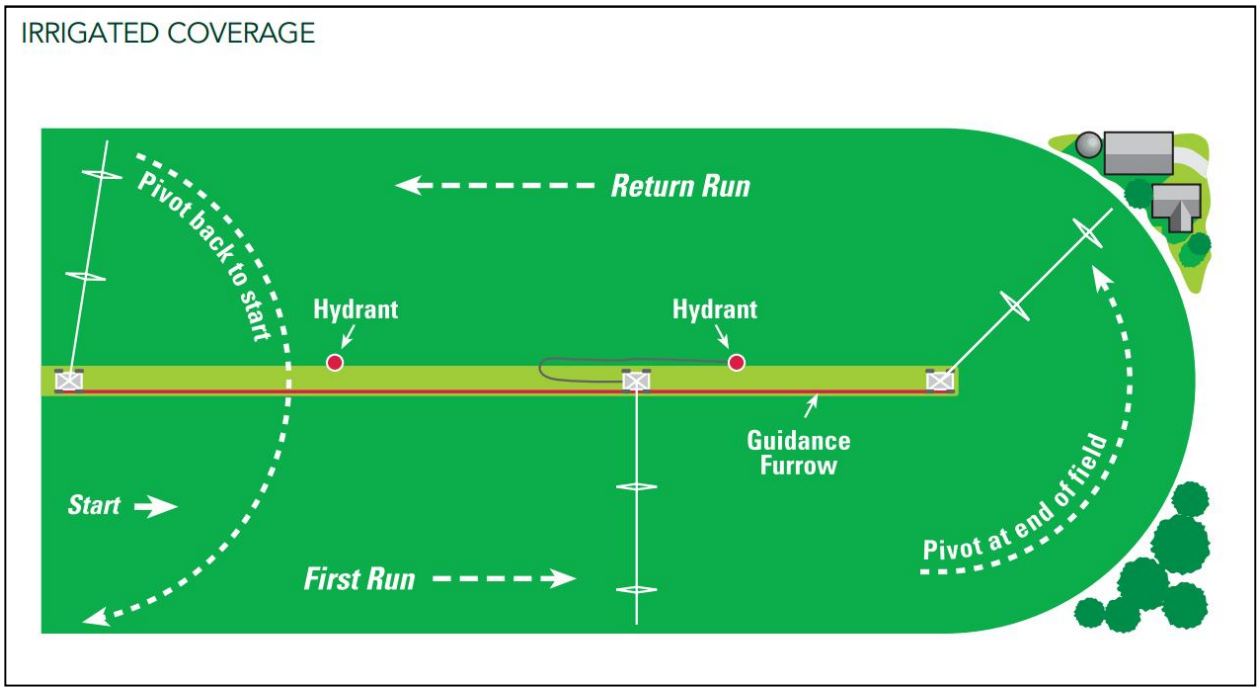

Figure 2-3a: Irrigated area for a Lindsay Lateral move system showing pivoting at the ends of the field (Figure adapted from Lindsay Greenfield ML400 Brochure)

Figure 2-3b: Photo of a Lindsay Lateral move system (Photo from the Lindsay Greenfield ML400 Brochure)

2.1.5 High Tech Systems

The top tier of the NRCS system efficiencies is termed High Tech. High efficiencies can be obtained with center pivots combined with soil monitoring and an irrigation scheduling program. The goal of irrigation scheduling is to match the crop water requirements with the water applied by estimating crop water use with weather based ET calculations. Soil moisture monitoring helps calibrate the scheduling program by providing a check between field soil moisture and what is calculated. Pivots equipped with Low Elevation Spray Application (LESA) or Low Energy Precision Application (LEPA) equipment can obtain very high efficiencies and improved crop yields, and would likely be considered a "High Tech" system for NRCS funding.

Sub-Surface Drip Irrigation (SSDI) and Surface Drip Irrigation (SDI) would also be considered high tech. These systems are used in areas with high cost water and typically high value crops. In the Central Valley of California, drainage problems and selenium loading to Kesterson National Wildlife Refuge has led to dramatic changes in irrigation practices since the 1980's. Westland's Water District lost their drainage service, which resulted in more than 200,000 acres having saline groundwater within 10 feet of the surface. This has led to many farmers changing cropping patterns and going to high tech irrigation systems such as drip. It has been reported in the Central Valley of California that drip can use one third of the water and one half of the nitrogen of surface irrigation systems. In California, SSDI and SDI are commonly used on vegetables, melons, trees and vines. Water costs can range from $100 to $150/ac-ft providing great incentive for efficient use of water.

There are specialty crops in the Lower Gunnison Basin such as onions, hops and vines where SSDI or SDI systems may make economic sense. With the cost of water being relatively low, such systems need to be carefully analyzed against current irrigation systems in terms of potential water savings and yield increases to see if they are economically justified.

2.2 SALINITY CONTROL PROGRAM INTERVIEWS

Interviews were conducted throughout the Lower Gunnison Basin with many Salinity Program stakeholders by the URS team. The purpose of the interviews was to identify impediments to full implementation of the salinity program, both off-farm and on-farm. Focus within these discussions was placed on physical, technical, social, cultural and economic impediments. Individuals representing various private and public entities were interviewed. **Table 2-2** shows the affiliations of individuals interviewed.

Table 2-2: Interviewee Affiliations

Bonafide Ditch Company	Needle Rock
Cedar Mesa Ditch	NFWCD FMC and Reservoir Co.
Cimarron Ditch and Canal	North Delta
Colorado Department of Agriculture	North Fork Farmers
Colorado Trout Unlimited	North Fork WCD
Colorado Water Conservation Board	NRCS
Colorado River Water Conservation District	NRCS Colorado
Consultants	NRCS Montrose
Delta Conservation District	NRCS –Delta
DMEA	Orchard City Irrigation District
Duke Ditch	Orchard Ranch Ditch
Fire Mtn. Canal & Res.	Paonia Ditch
Fruitland Irrigation Co.	Reclamation
Grandview Ditch Co.	Relief Ditch
Hart's Basin	Rodgers Mesa Water District
Irrigator in Delta and Montrose	Shavano Conservation District
Jesse Ditch/Fire Mountain Ditch	Stewart Ditch
Lone Cabin Ditch, & Reservoir Co.	The Nature Conservancy
Minnesota Ditch	Turner Ditch
Uncompaghre Valley Water Users Association	

2.2.1 Findings from Interviews and Group Meetings

Group meetings and individual interviews with agricultural producers and those who manage agricultural water throughout the Lower Gunnison Basin yielded a sense that the salinity programs have been well-received and appreciated. Representative of the sentiments the study team heard was a comment from the president of a ditch company that received funds early in

the program and is now applying for more. After detailing some concerns and making suggestions for improvements, he said,

> *"But all said and done, we appreciate everything we got. We have water in years when we wouldn't have had it, and without the leakage the water goes a lot further."*

Another said he is *"an absolutely satisfied customer of the process,"*— that the program makes sense and he wants to help promote it.

2.2.1.1 Motivation

What motivates participation in the programs? Reduced ditch maintenance and reduced loss of water to seepage appear to be the top motivators for off-farm improvements, while labor savings and increased productivity were often mentioned as motivation for on-farm improvements. One participant said that because of the center pivot he purchased through the program:

> *"my alfalfa production was substantially greater this drought year than it would have been."*

Another pointed out that increased productivity does not happen automatically, that there is an ongoing learning curve associated with the new systems, which might discourage some at first.

> *"Sprinklers are only as good as the operator. It depends on how well you manage your system."*

One participant said he can now irrigate more ground than he could get water to before[1]. Another pointed out that piping allowed him to cover over the entire old ditch, yielding more land to plant. One ditch company whose application was not funded said they wanted to make one ditch out of two in order to even out deliveries.

> *"Water slows down, giving us more maintenance on the lower end than the upper. If we pipe the whole thing, it will even things out—our maintenance headaches will go away."*

"What is our motivation for applying? We leak!" Many cited reducing seepage as their primary motivation. One person said, *"We aren't interested in salt savings. What we want to do is to stretch our water further. Where else are you going to get millions of dollars to improve your 100-year-old ditch system?"*

Others did mention reduction of salt load as a motivator. One person said,

> *"it will get rid of the salt load—most of it—and it will also help the selenium problem—a double dipper."*

He said being a good citizen, *"helping everybody out"* is his attitude. Another mentioned that flash floods filled their ditches with silt this year, whereas if it had been in pipe that would not have happened. Some are interested in a more localized benefit of reducing salt.

[1] No discussion of whether additional acreage is within approved water right.

"We have five miles of the ditch with no head gates, so it would be helpful to have it piped—that's where the salinity is. The water runs through alkali and salt and causes harm to the soil."

Another said that their ditch runs down a canyon causing wash outs where it is narrow and hard to fix. Stretching water supplies and extending the irrigation season was a motivator for many.

Some of the "de-motivators" are reflected in these statements:

- *People in this area see benefit of deep seepage because trees have grown up in the seep. Piping extensively could change the look of things considerably.*
- *If you put a ditch in pipe, people who were getting water gratis from someone else's runoff are unhappy.*
- *Because of the size of a pivot, you should have lots of acres in one crop. That's a lot of acres to have in just one crop.*
- *There is a management spike as you go from flood irrigation to gated pipe or sprinklers. It requires someone to put in the effort to learn a new way.*
- *At first, some didn't like the idea of losing the "babbling brook" effect they got from open ditches running through their property.*
- *Loss of habitat is an unfortunate side effect, though mitigation is supposed to help.*
- *It's too expensive for fuel to power the system, where gravity doesn't do the trick.*
- *With piping you can't take advantage of early "free" water.*

Why sprinklers have been slow to catch on in the Lower Gunnison Basin was the subject of some discussion at one of the group meetings. It was said that the experts early in the program advised against sprinklers. Others said the older sprinklers did not work well and gave sprinklers a bad reputation.

2.2.1.2 Changes in Farming

Changes in farm size and farm ownership were brought up many times. One interviewee said that a lot of larger farms have been split up into smaller farms and there is not much interest in improving irrigation.

"They put their house right in the middle of the acreage so that doesn't work well for sprinklers."

Another said these small acreage "farmers" do not know how to deal with their water situation.

"A lot of 20-acre farmers who don't understand water have their lawyers on 'speed dial.'"

One individual said that now, on their ditch, only five of the 39 property owners are full-time agricultural producers. The others are in it for hobby farming. *"Those who work other jobs don't have time to take care of managing their water. They are causing the biggest problems,"* one participant said. The person sitting next to him laughed and retorted, *"If our boss would let us go home at noon to change our water it would work!"*

Another problem is absentee ownership where land is being leased or rented.

> *"Labor savings of improved irrigation doesn't matter to them because they aren't doing the labor, their renters are. Only 30% want to fix up their farms. The others just want their rent check."*

2.2.1.3 Water Rights

There evidently remains a concern among some farmers that if they install sprinklers and design for the lower required flows they will have their original water rights reduced.

> *"If they think their water rights are going to be jeopardized in any way, they think they better stay away from it."*

One person even cited a case where a water commissioner told him that participating in the project could undermine his water rights. On the other hand, someone pointed out that piping a ditch on a system that is water short improves the ability of everyone to get their full water right. Another said *"the big need is helping the landowners understand that they have a right to the consumptive use and not to all the water they are diverting."*

"What happens to the water we conserve?" one person asked. One participant suggested that water not lost to ditch seepage should be put into a water bank to give incentives to farmers to conserve. Another person said *"in Idaho, they can lease that water. I wish we could do that here."*

2.2.1.4 The "Government"

Some individuals said they know those who will not participate in the programs because of a fear and dislike of interacting with the government. Some even referred to vague conspiracy theories. One farmer said his water conservancy district was set back from participating for 20 years because of a bias against the government on the part of their manager. There is a perception on the part of some that *"if I participate in the program, they will make me do things I don't want to do."* Another said he has heard of irrigators opting out of ditch mapping projects done for salinity project applications *"because they think it's a ploy from the feds to take their water away."*

How proceeds from the programs are taxed was an issue that came up. *"Will we get a 1099 and have to come up with cash at tax time?"* one individual asked. *"If I get a million bucks for a pipeline will I have to pay taxes on that million dollars?"* another asked.

2.2.1.5 Issues associated with Reclamation

Much of the discussion in both the individual interviews and the group meetings centered around what was often considered to be excessive time and effort required to complete the paperwork required for program participation. Here are some of the comments:

- *We have done a number of projects and they have all come to a good conclusion. But there was always a frustration factor. If you figure out how to cope, it's okay, but to a lot*

of people it's all Greek. They are busy farming, they are not academics. Filling out stacks of paperwork is onerous.
- *The paperwork and time is worse than going to the dentist!*
- *Once you figure out the system they change it.*
- *The application process seems complicated and very bureaucratic—it should be streamlined.*
- *Grant writing is tedious. If you miss a couple of boxes, forget it. You used to be able to call the Reclamation office in Grand Junction and get someone user friendly to help you, but now it has been moved to Salt Lake City. Calling Salt Lake City is like calling the moon.*

Other discussion revolving around improvements needed in the application process were more specific:
- *The length of the salinity program application process makes planning difficult. Construction and material costs often end up being higher than originally estimated because it can often take years to receive funding.*
- *My experience is that the Reclamation and the NRCS are not communicating. Each says I have to get information from the other.*
- *Piping our lateral will save a lot of salt, but we were told it might take 4-5 years to get the salt numbers for our area because Reclamation was understaffed.*
- *A lot of the easier projects have already been done. These harder applications need more lead time and funding for preparation.*
- *Reduce the time frame from start to finish. Shorten the window.*
- *Extra points should be given to ditch companies who can show a high percentage of those willing to go into the on-farm program.*

2.2.1.6 Issues associated with the NRCS

Several comments were directed specifically toward the NRCS and there definitely were conflicting viewpoints, which were difficult to parse to a cause, whether it was the individual, the servicing office or the type of system. One person said *"the NRCS application is easy to do and they are good to help you."* One person who would like to see red tape reduced said nevertheless the NRCS office does a good job of helping farmers through the process. Others were concerned that NRCS may be understaffed for the number of salinity applications that need to be processed and that takes away from them having time to help the farmers think through what would work best on their property. Several indicated they believe NRCS should go out to the field instead of waiting for folks to come into their office. Said bluntly by another person, *"Get NRCS out to the farms!"* One person said that NRCS did not assign an engineer to help him figure out the best way to make his on-farm improvements, which was frustrating. He did not feel there was much help until he signed a contract.

Other issues had to do with quality of assistance. Here are some summaries of those comments:
- Locals think that the NRCS specifications are over-kill, resulting in very expensive systems farmers can do cheaper themselves without cost share and without dealing with the government.

- Some don't agree with how the NRCS designs systems s. Some systems haven't worked quite right. News travels about those.
- Some who have participated in the program have found NRCS designs to be somewhat inadequate and have had to make modifications to make it work right. NRCS has never really operated the systems, they have just designed them. They lack experience out in the field.

- NRCS funding and the cost sharing schedules should be available early in the calendar year, or even better, early in the fiscal year.
- *"On-farm" applications should get preference when their ditch has a project already.*

2.2.1.7 Ditch Company Capabilities

The issue of it being hard for ditch companies to come up with the skills and experience necessary to undertake a big piping project came up several times. One person said,

> *"for a ditch company with a $20,000 annual operating budget to undertake a $2 million project causes some fear. That's a big scary contract to run."*

The time required is a major difficulty as evidenced by several who said things such as "*if our board secretary hadn't volunteered his time to be project manager, we couldn't have done it"* and *"as president of our ditch company I ended up putting in 600—700 hours for free"* and *"we are beginning to have a hard time getting board members because of all the time it takes to run these projects."* One person said ditch companies are notoriously impoverished, and assessments high enough to hire managers are hard to come by since agriculture operates on such thin margins.

Another issue complicating program participation by ditch companies is that of maintenance once the system goes in. Some are concerned about the unknowns of pipe maintenance. *"If a valve goes out, that's 15% of our whole annual ditch budget"* one person said. Another put it this way: *"The minute this breaks, we are screwed."* Lack of experience creates a hardship. One person said *"it's not that simple to operate the system once it's installed. It's more technical and requires a different kind of management and maintenance than farmers are used to. You need a different skill set—someone who understands pressurized pipe and how to work with it."*

On one ditch system where a project recently was completed, shareholders are upset because the system went in without measuring devices so as to ascertain everyone is getting the appropriate amount of water. Some say it is because ditch leadership did not have the background to ask the right questions of the engineers who designed the system.

Another concern of ditch companies is that they may get a certain amount of funding, but by the time the project gets built, costs have gone up. One individual said,

> *"our ditch company signed a contract in 2005 but it took us a long time to come up with our cost share. We finished in 2009 but got paid in 2005 dollars. So we had to come up with the difference on our own. That was a BIG problem."*

A suggestion made at one of the group meetings was for the Reclamation to add contingency costs when a project is approved to account for inflation.

On the other side, when entities getting funding for projects are large enough to have management, in one case even big enough to have a construction crew of their own and plenty of expertise, they can run into the problem of the total obligation cap of $8 million. One such entity said that they have the demonstrated capability to handle a larger backlog of salinity projects, the administrative controls to assure that projects do not get out of control, and a large annual operating budget so that maintenance costs do not overwhelm their capabilities, but they cannot do as many projects because of the cap.

One person we interviewed had managed an early salinity control project for his ditch company and now is managing another. He compared the two experiences. Here is what he said:

> *"Earlier, the Bureau funded us as a turnkey project, but now they don't allow that. So we have to do all the coordinating ourselves. And all on donated time. We have to hire someone to do the environmental assessment work, we have to get easements, we have to hire a design engineer, we have to buy our own pipe, we have to deal with bonding and insurance. We would prefer to have one company to hire instead of having to coordinate all these pieces. There is no finger pointing when one entity is the overseer. If pipe shows up that's bad, the turnkey engineering company takes care of it.*
> *I think it's a pendulum swing thing. Ditch companies weren't applying because they couldn't handle all the coordination, so the Bureau went to turnkey. Now they have swung to no turnkey and ditch companies are again complaining they don't have time to do all the project management themselves. Maybe the pendulum will swing back to turnkey—I think it's better."*

2.2.1.8 Engineering Firms

A subject of considerable discussion, especially at the group meetings, was that of ditch companies relying on engineering companies to do the applications for them. Many times engineering companies are putting together the applications on a contingency basis for ditch companies. If the ditch company gets the funding, the engineering company gets the design work. If they do not, the work filling out the application is considered a cost of getting business.

> *"If they don't feel you have a good chance of getting funding, they won't help you" said one person. The sentiment is that engineering firms may be cherry picking potential projects with big salt loads. "Salt load is the magic number."*

Many feel that the engineering companies do not have time to come up with good estimates for the applications. *"The company we worked with had ten ditches they were helping at one time. If they had more time during an application process, they could do better."* Others suggested that trying to work on so many applications at one time makes it hard for the engineering companies to give each estimate the time it takes, so *"they*

may say $1.2M to cover the risk when if they had a longer time to plan they might drill it down to $1M—or even $800K."

One person said he believes the engineering companies are motivated to make the application fit the parameters they think are more likely to be funded than parameters they think are best for the ditch company.

Although Reclamation recommends that ditch companies hire an engineering company up front to avoid these problems, these small companies frequently do not have the funds to pay for up-front engineering costs. The point was made that sometimes grant money from the CWCB has been (tied to selenium rich areas) made available to assist with that pre-planning, but ditch companies do not have the time or expertise to find that funding. While most had good things to say about the performance of the engineering companies after the grants were funded, some concerns were raised. One person said,

> *"we ditch companies need some support to evaluate what these engineering companies are telling us. We don't know if it's good advice."*

2.2.1.9 Salt Numbers

The question of salt numbers and how they are derived came up a lot. Many would like more consistent salt research and numbers—and more explanation about why the salt numbers have changed. One ditch company is frustrated because improvements they made earlier at their own expense reduced their salt numbers such that now they cannot qualify for funding to take care of leaks in their system elsewhere that contribute to salt. One person referred to the Fire Mountain Canal, which is a Reclamation project.

> *"Fire Mountain has been excluded because of low salt but one of their laterals got funded. That's putting the cart before the horse. Wouldn't it make more sense to pipe the big canal first? Why would the laterals have more salt than the main canal?"*

Suggestions made to improve the situation include:

- Transparency in the process to help folks understand how salt load is calculated.
- Need a color coded map to show who has the higher salt loading to see if certain ditch companies should even bother to apply for funding
- As more salt loading research is done, don't change so often—maybe only every five years
- The Bureau needs to do a better job of explaining where the numbers are coming from
- The Bureau should expand the salt studies to other areas where ditch companies keep applying but don't show enough salt figures to compete.

2.2.1.10 Holistic versus Piecemeal

Perhaps the most prevalent theme in both the interviews and the group meetings was that the salinity programs promotes looking at things piecemeal instead of holistically,

causing not only inefficiencies, but less effective solutions in the long run. One aspect of the problem is related to the NRCS handling on-farm projects and the Reclamation handling off-farm projects. These comments are representative:

- If we could treat all the delivery systems and then go to the field, we would be better off.
- Do we need to do a better plan with landowner groups to get them into EQIP in conjunction with the Reclamation side—the conveyance system piping—instead of piecemeal? Would more participate in the on-farm program if pressurized conveyance came first?
- The division of NRCS and Reclamation is unnatural. If you don't improve the delivery system, you won't have opportunity to improve the on-farm. It's important to improve the delivery first.
- The NRCS and the Bureau need to communicate for the overall good of the area, and the program. They need to come up with a master plan for an area that includes both off-farm and on-farm.
- You really need the on-farm to make significant impact with off-farm improvements.
- We started with on-farm first. We should have concentrated on the conduit first.
- My on-farm system cost was higher because Reclamation has twice denied my ditch company cost sharing funds for piping the system which would have provided pressurized water.
- One option would be to conduct a demonstration project on a smaller system where Reclamation and NRCS can work jointly to provide pressurized water to the farmers and the on-farm improvements to go along with it.

Another aspect has to do with the programs not being geared to or even allow for good long-range planning. These comments are representative:

- Large scale planning is not encouraged. Since no money is available for studies, you can't do it.
- The USBR $6M project limit is an impediment to thinking holistically instead of piecemeal.
- Many of the systems on the Gunnison rely on the water being reused several times. So when irrigation efficiencies are increased in one area of the system it can cause problems elsewhere. That's why a holistic approach to the Gunnison systems is important.
- People at the bottom are getting flooded from the efficiencies of those up above.
- It's not just piping that's needed, there's also a need for system optimization. We need to focus more energy on modernizing systems to be more efficient.
- As I drive around I see a lack of organization, a lack of cohesiveness. There have been unexpected consequences to some of the piping projects, like tail water ending up in a completely different area. Someone needs to sit down with a map and figure out how to coordinate the improvements and study what happens when you have a piping project—look at the thing whole, not just piecemeal.
- The one with the most salt loading got approved, but it didn't make sense because they are at the bottom of the system.

- When you're breaking a project into components everything is more expensive.
- There is not enough incentive in the Bureau's bidding process for upfront planning.
- We need to figure out a way to get groups of irrigation companies together to work on a master plan. Require any company wanting to apply for salinity money to have a water master plan—to prevent helter-skelter projects.
- You need to have a master plan for each farm and the district conservationists could help with that—and take some load off the NRCS.
- Having a conservation plan leads to engineering which could lead to ranking high for funding.
- We could only pipe about half the canal. The rest didn't qualify for salinity money.
- There is a huge potential for combining ditches in new ways to reduce redundancy, but it's a human issue instead of a design issue. For example, you often have to deal with road crossings and right of ways—and you butt up against a lot of people you have to explain it to.
- We have the salt numbers at the west end of our system but not at the upper end. The size of the canal makes it cost prohibitive for us to do the upper end by ourselves.
- We wanted to do it all as one project, so that it would be less expensive for everyone. But their end of the project didn't get funded even though dollars per ton of salt saved was good. Now we are working on a master plan to see what our best route is to get funding.
- Somehow we need to get the rural electric folks on board too. We are still waiting for power to run our pivots even though the canal piping is done.

Some interest has been shown in getting two or more ditch companies to prepare a joint application for piping. In one case, two ditch companies considering such a move said they could eliminate six miles of pipe by working together. One of the problems is that each of the ditches has different decrees and shareholders are concerned that by combining systems they might lose some of the value of their water rights.

2.2.1.11 Coordinator Needed

By far, the most prevalent recommendation in the group meetings was the need for the salinity programs to invest in a local coordinator to help ditch companies and agricultural producers work through the issues and come up with the best solutions. Here are some comments made:

- We didn't know what we were doing for sure—we planned it out as we filled in the application. The whole process could be way more efficient if someone came in and widened our perspective about the best way to do this—in a situation that's unhurried, where we are not paying an engineer by the hour. Someone to help us look at the bigger management situation before we even start applying.
- It would be really helpful to have someone who had "people" skills along with technical skills. Almost like a counselor to help a ditch company explain to its shareholders how things could be better. The technical side isn't that complex but

it takes someone creative—not just a cookie cutter approach. NRCS has great people with good skills, but they aren't able to spend time with folks to help them figure out the best way to do what they think they want to do.

- There needs to be someone in a position to coordinate between the ditch company and the agencies, and even between agencies (NRCS and Reclamation.)
- A coordinator could help develop an "area master plan." They could be on the ground continuously helping ditch companies prioritize projects within the master plan.
- The NRCS doesn't have staff for outreach. You need someone you can take out in the field and show them what you are trying to do.
- There needs to be some way to get administrative and engineering support—especially for small ditch companies.
- A local coordinator could help you know up front what your changes are from the salt standpoint—and help you find funding for cost-sharing if you needed that to make the numbers work.
- We need a coordinator who has time to really get to know the situation "on the ground." They could go to individual ditch companies and see their unique situations -- connect with the few people on the ditch who really know how things run. Someone you can take out and show what you are trying to accomplish—they might even have a better idea.
- The program needs a strong local dedicated presence to assist entities working through a long and complex process.
- Funds for a coordinator could come from earmarking some of the funds now going to projects. The Bureau would get a huge return on this investment in better quality projects all around, and better opportunity to reach its salinity control goals.

2.2.1.12 Education

One of the group meetings we held attracted a good many people who were interested in implementing salinity control projects on their land and came to find out how to do it. That brought up the question of education and how best to get out the word. If we want to get more ditch companies and agricultural producers aware of the benefits of the program and the methodologies available to them, how can we best reach them? Several suggestions were made. Some suggested that the agencies should put together a brochure explaining the three programs and how they work—stepping you through which program would be best for their situation. It could also address the irrigation water management services available. *"You could piggyback on the mailings ditch companies send their shareholders,"* one person suggested as a good way to distribute such a brochure. Having them available at annual ditch company meetings was another suggestion.

One idea brought forth was having tours of ditches and farms where improvements had been made under the programs, to make those improvements more visible. *"Showcase the successful projects,"* said one person, *"seeing is believing!"*

Others thought the programs should arrange for ditch companies who have already done projects to share their experience with ditch companies considering applying for funds. They could share their experience with maintenance costs and pass on other lessons learned. This would provide an opportunity for those who have already piped to share with those considering it, what they would do differently. A list of "lessons learned" might help others feel more willing to take a risk with the investment of time and money. Perhaps the agencies could even arrange a workshop to cover these topics.

2.2.2 Overall Satisfaction

Again, it needs to be expressed that overall, people are pleased with what the salinity program has done for the Lower Gunnison Basin. Summing it up is this quote from a farmer at our first group meeting:

> *"My experience so far is that I don't have a problem. I recognize that I am competing, so I might not get anything. I may go through this learning curve and all this work and not get a grant. But if I do get a grant, all this work will have paid off. That's just how the game is played."*

Discussions and interviews held with the many agricultural producers, canal operators and owners, agency representatives, and other interested stakeholders have led to significant positive feedback for many different aspects of the Salinity Program. Some of the most frequently identified benefits of the Salinity Program include effective and localized technical assistance, increased yields, and operating cost savings. A continued stream of applicants to the program also adds ample evidence of the Program's continued benefits. The following benefits of the Salinity Program have been found to be particularly significant.

2.2.2.1 Local Assistance

Multiple farmers highlighted the ease of completing on-farm treatments and attributed this to the strong support of the NRCS field offices. The more localized the administrative and technical interaction, the better the response by farmers. The farmers acknowledged that many of the staff members are very helpful because of their first-hand experience with farming.

2.2.2.2 Increased Yields

Crop production has increased and operating costs decreased as a result of Salinity Control Program projects. This has been an economic benefit to the individual farmers and the overall Lower Gunnison Basin economy. These benefits are in addition to the benefits associated with direct funding of project construction by Reclamation, Basin States and NRCS.

2.2.2.3 Application Process Fairness

There is a general understanding that the technical challenges associated with fairness between applicants for funding have not always been met. However, many acknowledged that these challenges are very difficult and express their appreciation for the efforts made by Reclamation and NRCS to make the program as fair as possible.

2.2.2.4 Basin States Funding Success

Those who have participated in Basin States funding found the process more flexible and easier to implement than either NRCS or Reclamation funding processes. However, these comments were for the former Basin States Parallel program that no longer exists.

2.2.2.5 Drought Resilience

With the implementation of irrigation efficiency measures, drought resiliency has increased. The "back to back" droughts of 2012 and 2013 have sparked an increased interest in the program, as irrigators see the benefits to extending a limited water supply.

3.1 OPPORTUNITIES AND STRATEGIES FOR IMPROVED PROGRAM PARTICIPATION

By and large, the Lower Gunnison Basin has "turned the corner" with respect to being competitive and involved in the Salinity Control program. There is an adequate level of benefit that can be achieved by many projects, a lot of salt yet to be removed, and interest in the program. Probably the most significant impediment is the limited amount of Federal funding (both Reclamation and NRCS). Another important impediment is agency capacity to administer any additional funding in a timely fashion. While education and improved operational efficiency is important in both areas, the discussion in Section 2 on irrigation systems has shown that relatively high efficiencies can be achieved even on flood irrigation fields, if attention is given to land leveling and intensive operation. Many of the fields in the Uncompaghre Valley are well suited to these types of improvements, which are further aided by improvements in off farm delivery systems through piping and lining. The Rest of the Lower Gunnison typically has more elevation drop across the delivery systems, making the use of pressurized systems more practical. They additionally benefit from a finer resolution in sub-basin salt loading, providing the ability to target high salt areas in planning operations.

UNCOMPAGHRE VALLEY: The Uncompaghre Valley area is dominated by the Uncompaghre Valley Water Users Association (UVWUA), a Reclamation project which is making significant progress in lining and piping canals and laterals. The UVWUA has completed five phases of a multi-phase program, has two more under construction, and are planning to continue as long as funding is available.

Additionally, there is a major optimization study being funded by a consortium of agencies and being conducted by Dr. Charles Burt, at the Irrigation Training and Research Center, Cal Poly – San Luis Obispo. This project is likely to be eligible for funding from the new Reclamation funding that is being made available from CRSP power revenues. The ultimate goal of the study to identify opportunities to implement on-farm projects in association with improved delivery systems. However, more detailed information on this is not available at this time.

A significant difference between the Uncompaghre Valley and the RLG is the fact that the UVWUA has more than 70,000 acres under management from a single, "mature" organization (23) , and has developed a vision for how they would like to implement their improvements. They are able to "self-perform" the majority of the projects, and will continue to improve the overall system. They also control all of the water rights, draw from both storage and direct flow, and are able to "internalize" the benefits of "saved" water by extending their storage reliability. The rate of implementation by the UVWUA is typically limited by local interest, capacity, and available resources.

REST OF THE LOWER GUNNISON (RLG): The RLG, in contrast to the Uncompaghre Valley, is dominated by smaller ditch and reservoir companies. The majority of the ditch and reservoir companies serve 1,000 to 3,000 acres, and have 100 or more shareholders within the company, but are often dominated by three to five majority shareholders. They have mostly volunteer boards, and with limited assessments for operations. Projects performed by these entities require a strong sponsor on the Board, willing to put in the time necessary to apply for and manage the grant.

There are five federal projects which are operated by either a water conservancy district or an irrigation district, (**Table 3-1**) and they then deliver the water from the federal projects to the private companies. Federal Projects within the RLG consist of Bostwick Park, Dallas Creek, Fruitgrower's Project, Paonia Project and the Smith Fork Project. As such, canal and ditch companies affiliated with these projects may be eligible for "MOA Funds" the CRSP surcharge.

Table 3-1 Participating Projects in the RLG

Federal Project	Operating Entity	Acres Served
Bostwick Park	Bostwick Park Water Conservancy District	5,200
Dallas Creek Project	Tri-County Water Conservancy District	12,000
Fruitgrowers Project	Orchard City Irrigation District	2,700
Paonia Project	North Fork Water Conservancy District	15,300
Smith Fork Project	Crawford Water Conservancy District	6,400

OPPORTUNITIES:

The significant innovative opportunities which could exist in the Lower Gunnison Basin, beyond the existing on-farm and off-farm improvements, are in the installation of new hydropower on the canals in the area, and in the combination of ditch and canal systems, reducing many miles of conveyance structure, eliminating the associated seepage, with the intent of improving the cost effectiveness of the proposed projects. The possibility of the use hydropower revenues and MOA monies to expand the benefits associated with these irrigation improvement projects has the potential of significantly improving their competitiveness and increasing the Federal benefit.

STRATEGIES:

INSTALLATION OF HYDROPOWER WHERE FINANCIALLY VIABLE TO PROVIDE ADDITIONAL PROJECT REVENUE

HYDROPOWER: Reclamation has recently completed an exhaustive assessment of hydropower potential on federal facilities, and has an additional study underway on assessing the potential impact to system operation when hydropower is installed. The majority of these projects are within the UVWUA, with three potential projects in the RLG. What is significant is the total amount of power that could be produced, over 60,000 MWh annually with a value of over $3,000,000 (at $50/MWh). There are many more potential projects on the private distribution systems owned and operated by the ditch and reservoir companies.

Many of the impediments to hydropower production either have been removed in the past few years, or are under review. Legislation recently enacted by Congress (2013) streamlined the process for hydropower on federal conduits, and legislation under consideration by the Colorado legislature will provide state assistance in permitting and financing new, small hydropower. The major remaining impediment is the market, in particular for the larger (1,000 kW and greater) projects. The local electrical market is dominated by two wholesalers, Tri-State Generation and Transmission (TSG&T), and Municipal Energy Agency of Nebraska (MEAN). Both of these entities have long term contracts with the municipal power utilities and REA's which limit the amount of "self-supplied" power that the direct suppliers can feed into the system. This has necessitated such arrangements as TriCounty WCD entering into a contract with the City of Aspen to purchase the production from Ridgway Dam, as there was no local utility that could purchase the power. With a continued push for local renewables, some of these contracts may ultimately be modified, but it does represent a near time issue for larger projects. **Table 3-2** summarizes the potential hydropower projects.

Table 3-2 Potential Hydropower Projects

Structure	Owner	Head	Flow	Capacity	Annual Energy
		(ft)	(cfs)	kW	MWh
Smith Fork Drop to Reservoir	CWCD	58	9	32	102
Smith Fork Feeder Drop	CWCD	12	9	7	21
Fire Mountain "The Drop"	NFWCD	11.5	115	81	348
Chuet 3 Loutzenhizer	UVWUA	28	10	202	865
Chute 1 Loutzenhizer	UVWUA	30	101	217	927
Chute 2 Loutzenhizer	UVWUA	57	101	416	1,763
CP Check	UVWUA	8	572	327	1,363
Double E Chute	UVWUA	42	226	687	2,840
East Canal Pipeline	UVWUA	6	172	75	276
GH Lateral	UVWUA	34	25	52	224
Holly Rd Check	UVWUA	6	229	98	392
Junction Ironstone & M&D	UVWUA	18	20	22	103
Loutzenhizer	UVWUA	6	229	98	392
Shavano Falls	UVWUA	125	572	5,168	20,550
South Canal Drop 4	UVWUA	73	813	4,242	18,654
South Canal Drop 5	UVWUA	5	813	291	1,278
South Canal Drop 6	UVWUA	29	813	1,685	7,410
South Terminus	UVWUA	16	813	930	4,089
Total					**61,597**

CONSOLIDATE EXISTING, DUPLICATIVE CANAL AND DITCH STRUCTURES TO REDUCE SYSTEM MILES AND IMPROVE COST EFFECTIVENESS

DITCH CONSOLIDATIONS: The ditch consolidations which are presented are primarily in the "Rest of the Lower Gunnison" (RLG), and contain a mixture of Federal projects and non-Federal projects. The following potential ditch and canal consolidation and piped proposals were identified at a large scale only to open conversations among ditch managers, users, and agency personnel as a means to decrease salinity loading within the LGBU. Each of the following proposals would require a more in-depth feasibility study to address local institutional and engineering impediments as well as possible micro-hydroelectric generation. Each proposed area has an associated estimated length of canals/laterals that could potentially be improved and an estimated amount of irrigated acreage that could be improved due to potentially pressurized pipe feeds (**Table 3-3**). Estimated potential canal/lateral length improvements were based on preliminary Reclamation ditch GIS data and irrigated acreage improvements were based on CDSS 2005 irrigated acreage data (the most recent publically available irrigated acreage GIS data at the time of this report). Only canal/laterals and irrigated acreage areas within the LGBU Salinity Program boundary were considered in this estimation. **Figure 3-1** shows these nine potential ditch consolidation projects that were identified relative to each other within the LGBU. These potential projects are provided only for illustrative purposes and should not be construed as an exhaustive or inclusive list.

Table 3-3: Summary of Estimated Potential Canal/Lateral and Irrigated Acreage Improvements

Report Section	Proposed Combination Name	Estimated Potential Length of Canal/Lateral Improvements (miles)	Estimated Potential Irrigated Acreage Improvements (acres)
3.1.1	**Crawford Clipper & Grandview Ditches**	52.8	7,192
3.1.2	Lone Cabin & Turner Ditches	25.0	911
3.1.3	**Fire Mountain, North Fork Farmers**, Shepard Wilmont, & **Monitor Ditches**	63.7	6,695
3.1.4	**Cimarron Canal**	42.3	4,241
3.1.5	Cedar Mesa & Lone Pine Ditches	27.9	683
3.1.6	Settle, Trickle, Omega, & Old Reliable Ditches	17.8	925
3.1.7	Forest, Weir, Johnson, Buttes, & Fogg Ditches	31.4	2,201
3.1.8	**Saddle Mountain & Daisy Ditches**	14.6	1,437
3.1.9	Fruitland Highline, Dyer Fork Cattlemans Ditches	53.2	4,238
3.1.10	Pinion, Roswell Hotchkiss, & McDonald Ditches	12.3	1,035
3.1.11	Homestretch, Old Agency, & Upper Uncompahgre Ditches	11.3	1,178

Bolded project may be CRSP affiliated

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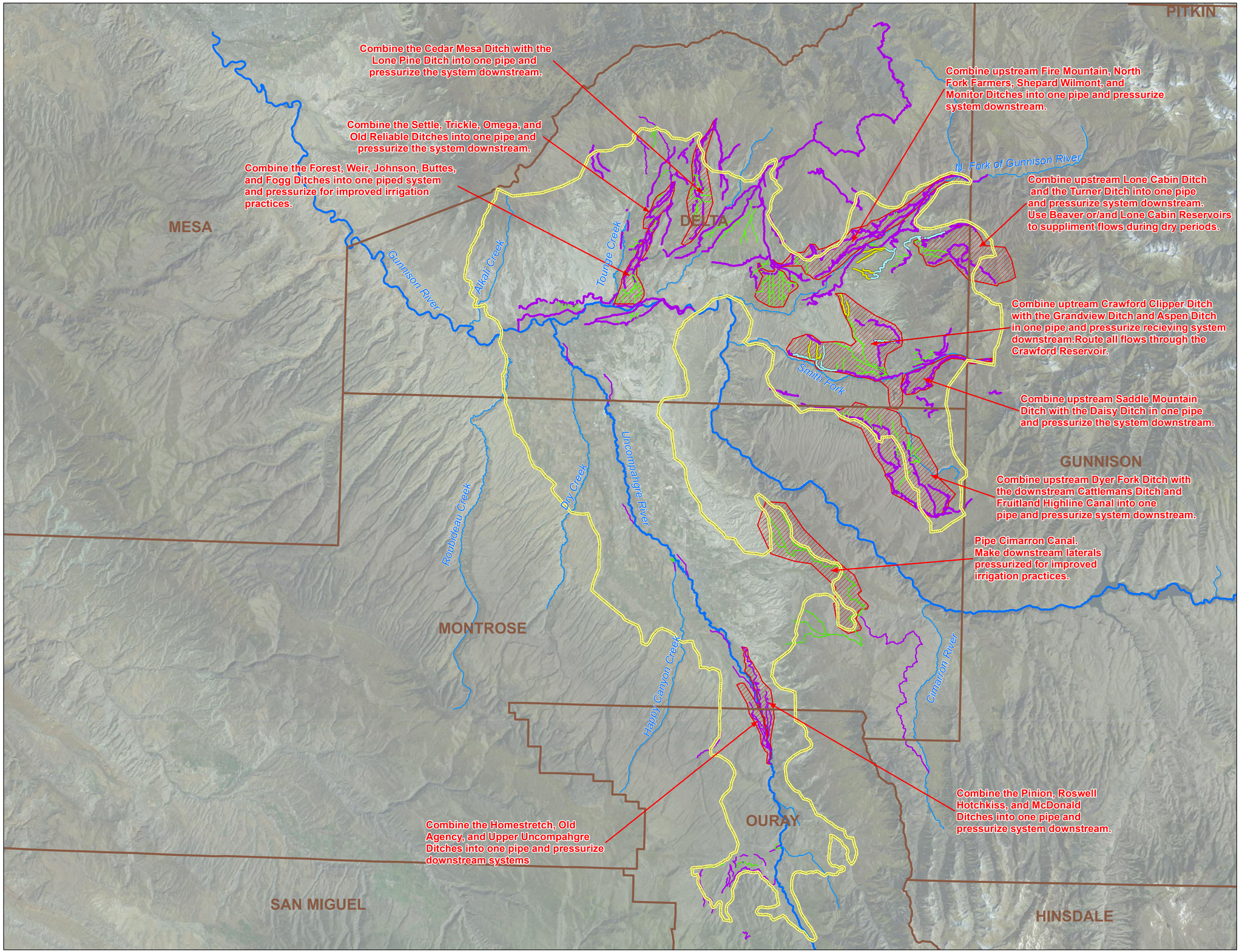

Legend

- Salinity Project Area
- Counties
- Improved Piped Canals
- Improved Piped Laterals
- Unimproved Canals
- Unimproved Laterals
- Potential Canal Improvments
- Streams
- Rivers

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*Canal & Laterall Data: Bureau of Reclamation (PRELIMINARY)
Aerial Source: ESRI online GIS server

Miles
0 1.753.5 7 10.5 14
1 in = 3.5 miles

Figure 3-1

Potential Lower Gunnison Basin Canal Improvements

Lower Gunnison River Basin Salinity Study

Date: October 2013 By: JWM

3.1.1 Combine Crawford Clipper Ditch and Grandview Ditch using Crawford Reservoir.

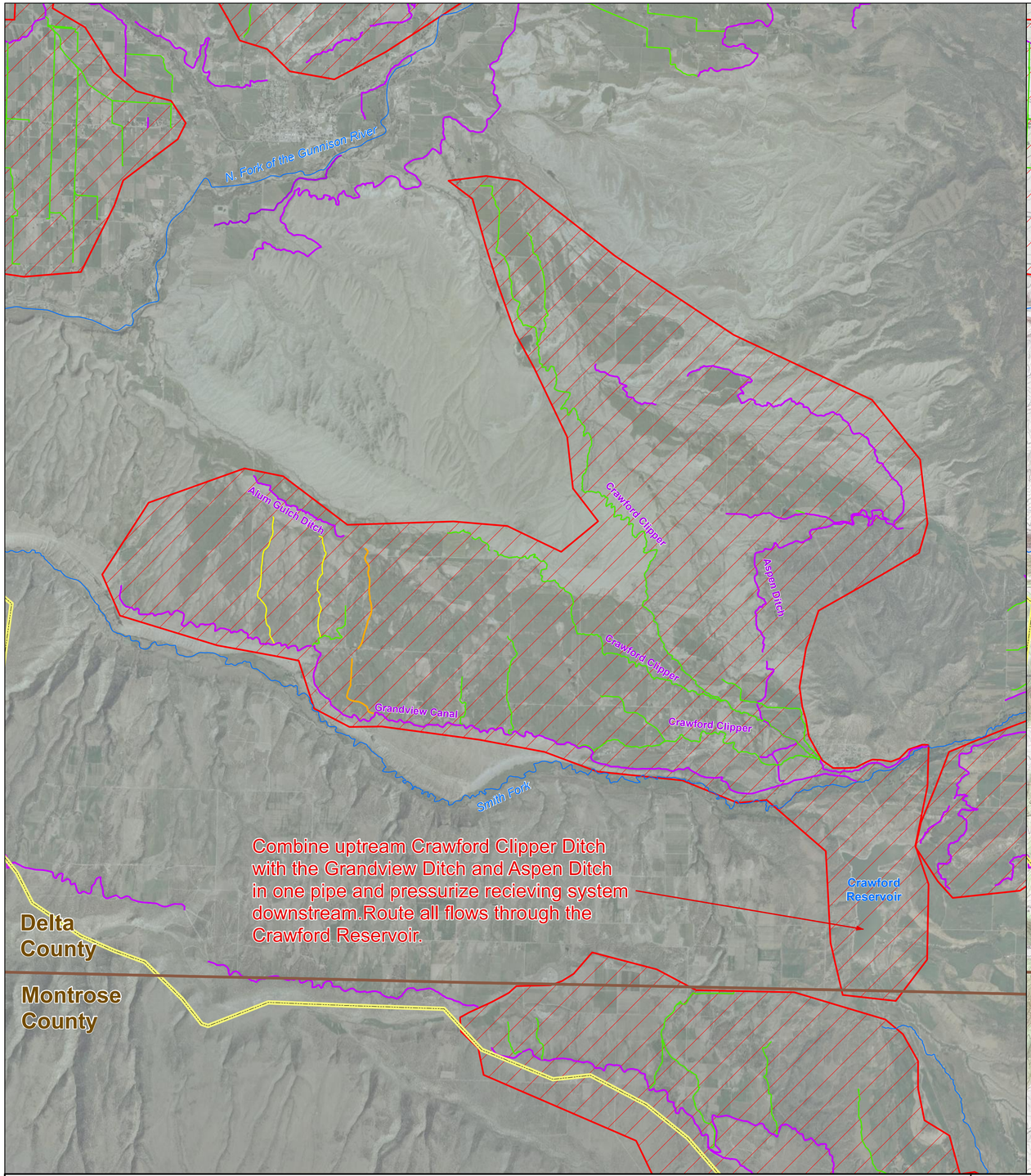
This potential improvement would route water diverted out of the Smith Fork through the Daisy Feeder Canal and the Crawford Reservoir to the Crawford Clipper Ditch and the Grandview Ditches through a single piped outlet for both systems out of the reservoir. The system could potentially be pressurized to serve users from both ditches and associated laterals. The delivery system would give the end users the opportunity to improve on-farm irrigation practices that require pressurized systems, such as sprinkler or micro drip irrigation systems. The delivery system would minimize conveyance losses (seepage and evaporation) as well as utilize the Crawford Reservoir as an auxiliary source during times of drought (See **Figure 3-2**). It is expected that this would result in a reduced diversion rate, due to the current conveyance losses, and would thereby give more junior right water holders along the Smith Fork drainage greater opportunities to fulfill their current water right during drought years. Referring to **Table 3-3**, this proposed improvement could potentially treat an estimated 52.8 miles of canals/laterals while potentially delivering piped pressurized water to help improve irrigation practices to approximately 7,192 irrigated acres downstream.

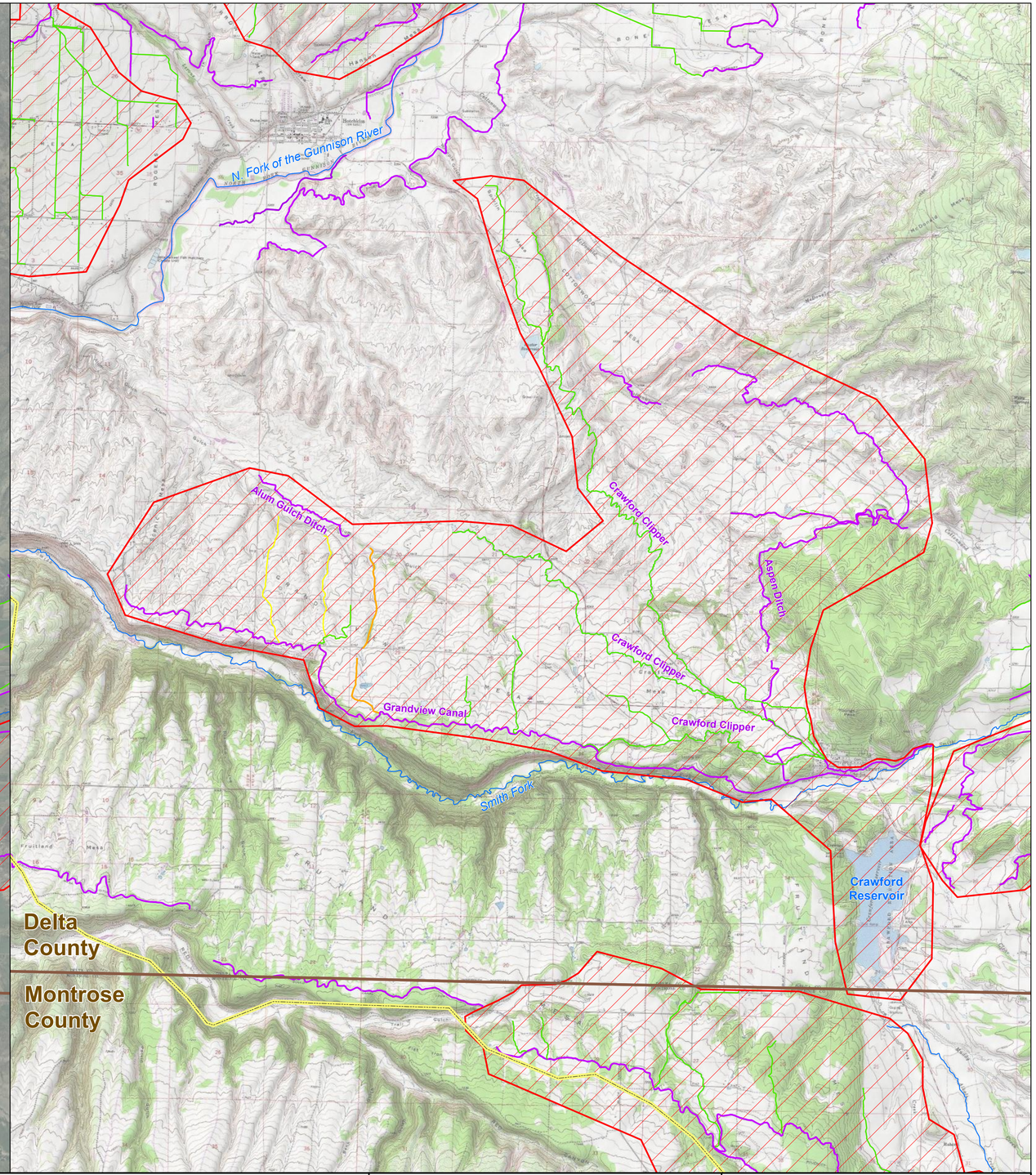
3.1.2 Combine Lone Cabin Ditch and Turner Ditch

This potential project would modify the diversion for both the Lone Cabin Ditch and Turner Ditch to be from a single diversion point along Minnesota Creek. The diversion would be conveyed in a new, single pipeline with an alignment following the Minnesota Creek drainage. The system would be gravity fed and potentially pressurized to service downstream users from both ditches on pressurized laterals from the main piped alignment. The delivery system would minimize conveyance losses (seepage and evaporation) as well as allowing users to utilize the potentially pressurized delivery system to improve on-farm irrigation practices to sprinkler or micro drip irrigation (See **Figure 3-3**). The potential Lone Cabin and Turner Ditch combination could potentially treat an estimated 25 miles of canals/laterals while giving approximately 911 of irrigated acres downstream the potential to upgrade their on-farm application process with a potentially pressurized pipe delivery system (**Table 3-3**).

3.1.3 Combine Fire Mountain Canals with North Fork Farmers, Shepard Wilmont, and Monitor Ditches

This potential project would modify the diversion points for the Fire Mountain Canal, the North Fork Farmers Ditch, the Monitor Ditch, and the Shepard Wilmont Ditch by consolidating all extracted flow from a single diversion point from the North Fork of the Gunnison River. A pipeline from this single diversion point would convey water in an alignment following the North Fork of the Gunnison River drainage which would serve all users from all four canals. The combined effort of piping a single alignment is estimated to improve approximately 63.7 miles of canals/laterals and, if the gravity pipe reaches pressurized status, could allow an estimated 6,695 acres of irrigated land to upgrade their on-farm application practices (**Table 3-3**). The delivery system would minimize conveyance losses (seepage and evaporation) as well as give more junior right water holders further downstream along the North Fork of the Gunnison River better odds of fulfilling their current water right during drought years (See **Figure 3-4**).





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1 in = 3,500 ft

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Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Rivers
- Creeks
- Counties

Disclaimer

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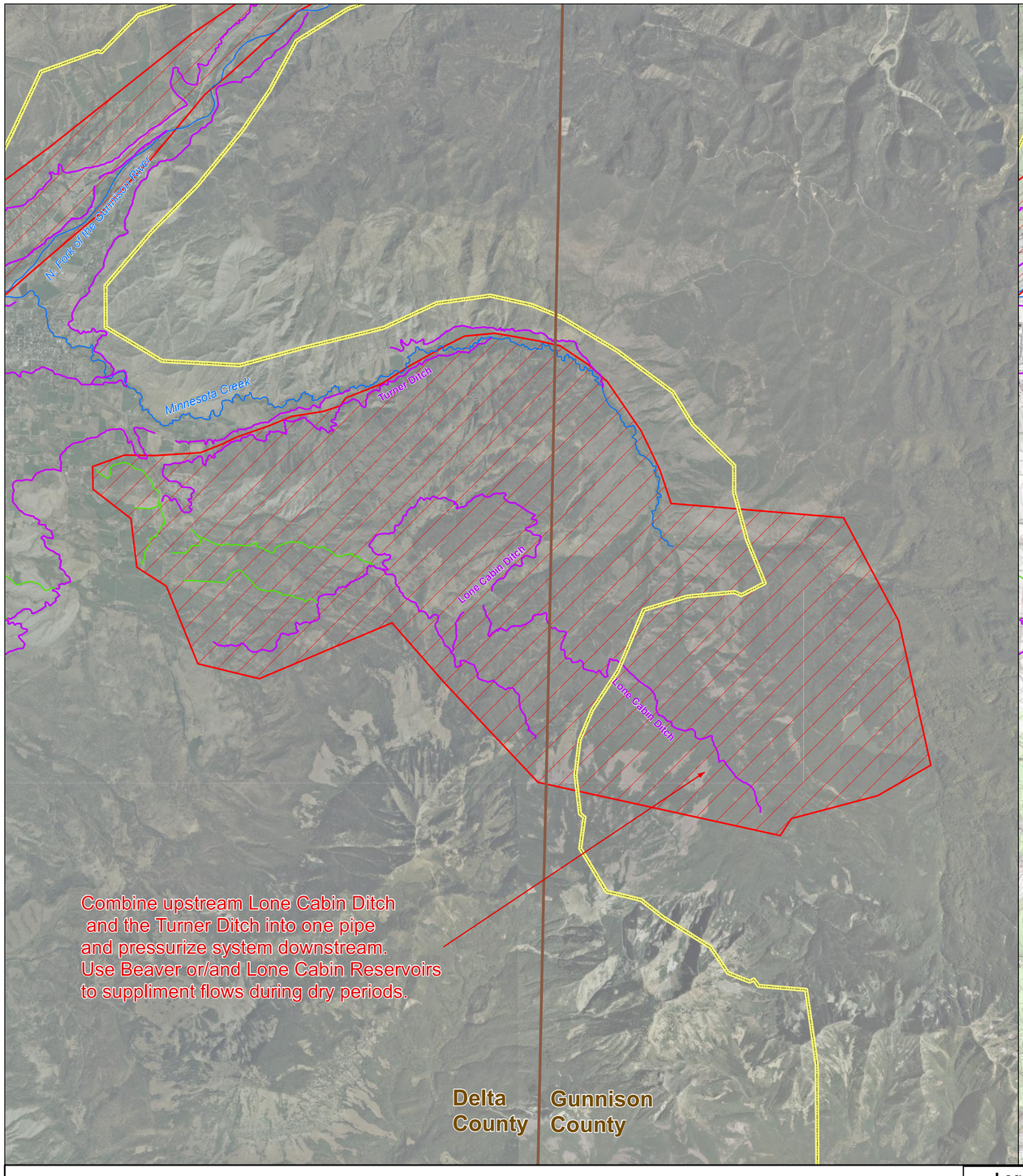
*Aerial & USGS Quadrangle Source: ESRI online GIS server
*Potential canal combinations are conceptual and will require in depth anlyses to determine if feasible and cost effective.

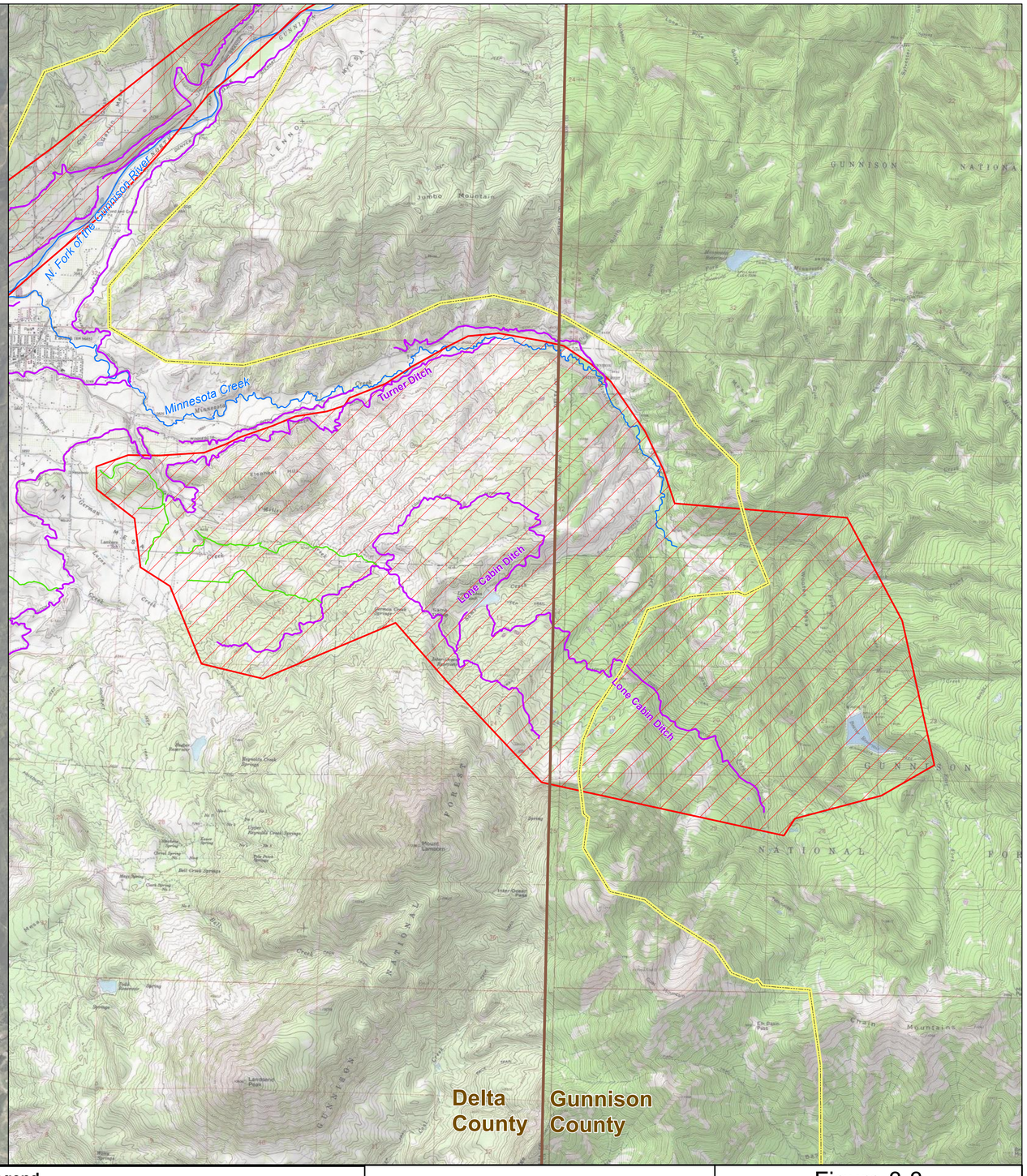
Date: September 2013 By: JWM

Figure 3-2

Potential Crawford Clipper & Grandview Ditch Combination with Crawford Reservoir

Lower Gunnison River Basin Salinity Study





N

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1 in = 3,000 ft

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Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Creeks
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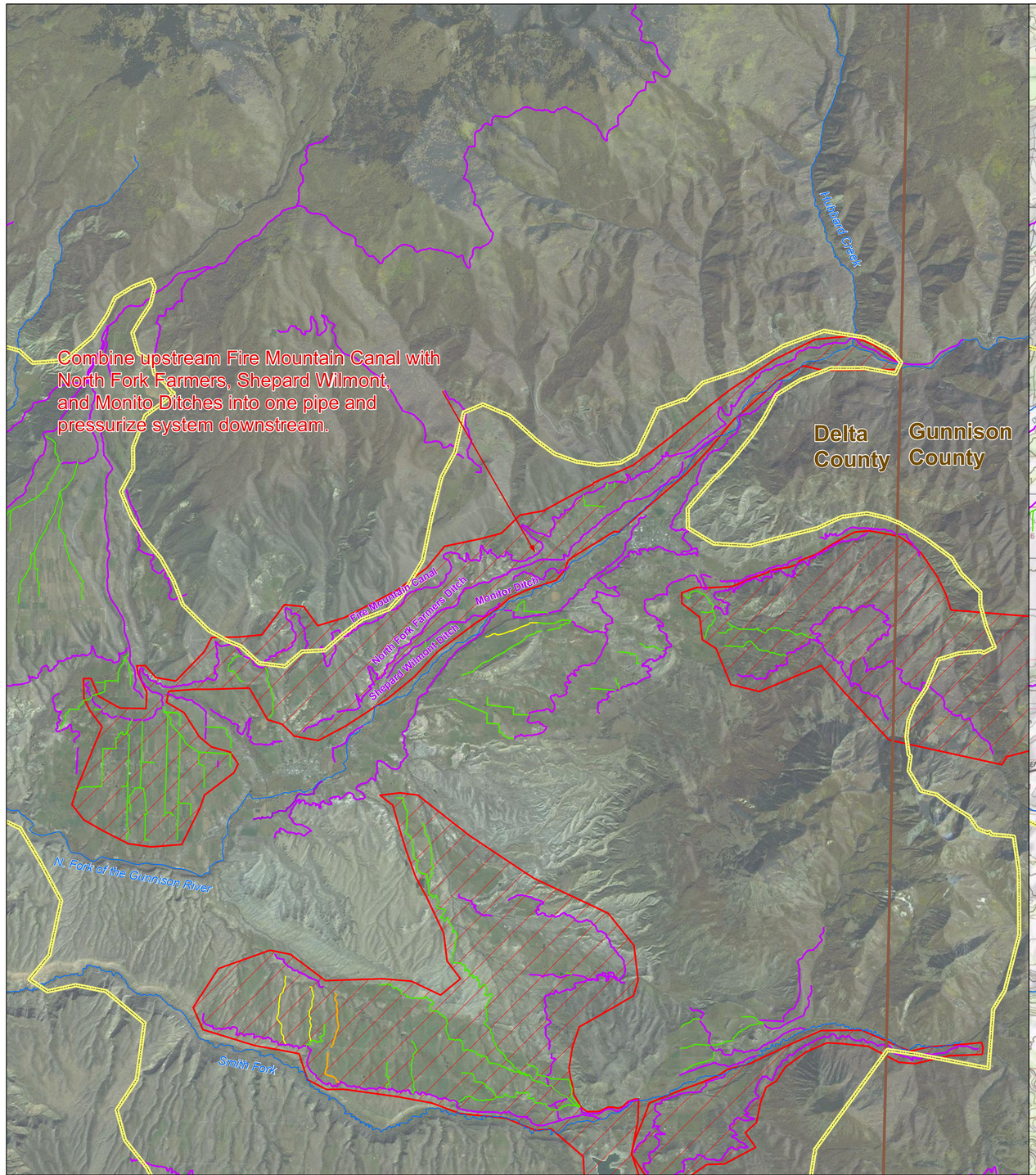
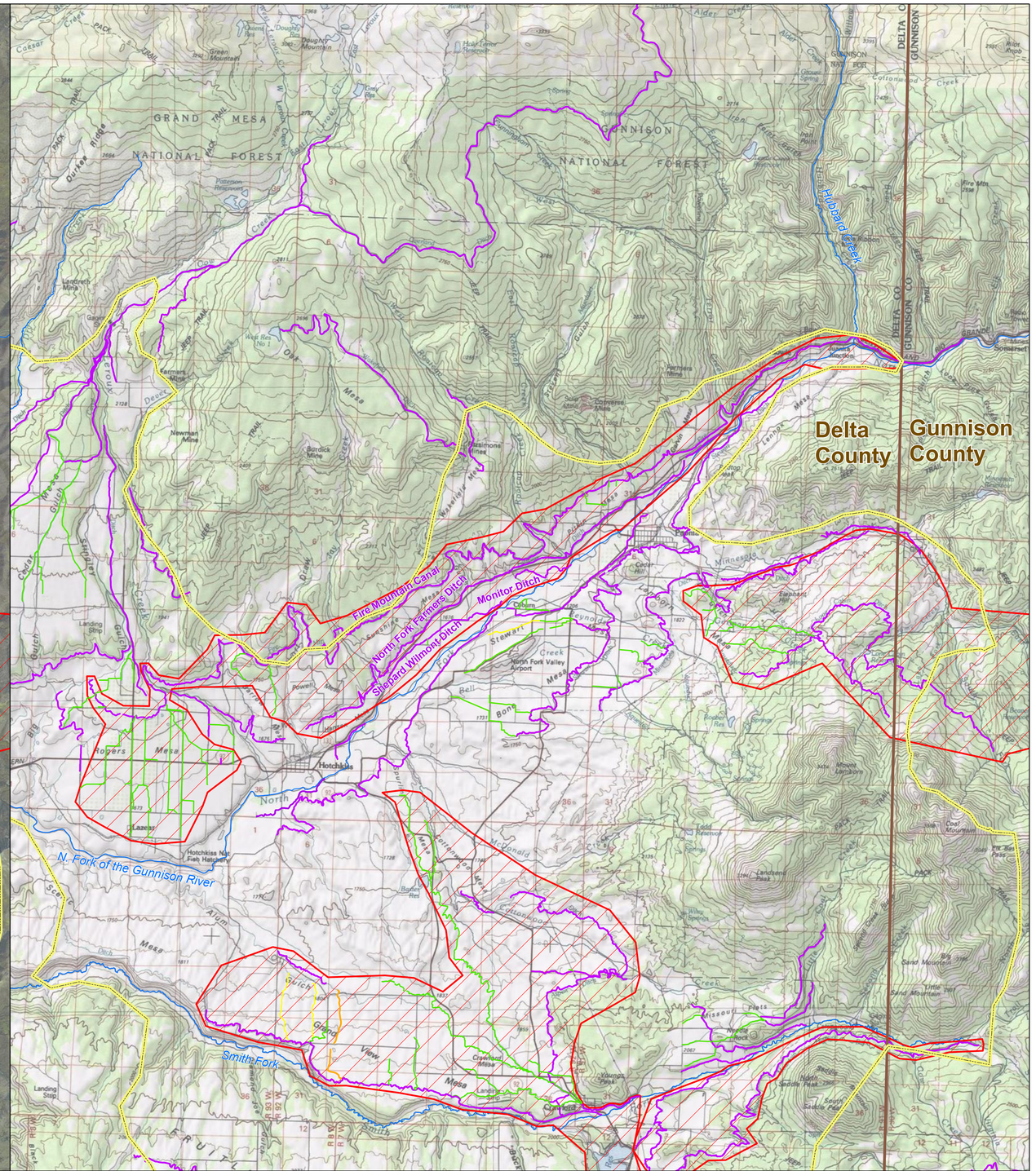
Date: September 2013 By: JWM

Figure 3-3

Potential Lone Cabin & Turner Ditch Combination

Lower Gunnison River Basin Salinity Study





N

0 3,250 6,500 13,000 19,500 26,000 Feet

1 in = 6,500 ft

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Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Rivers
- Creeks
- Counties

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Date: September 2013 By: JWM

Figure 3-4

Potential Fire Mountain Canal, North Fork Farmers, Shepard Wilmont, & Monitor Ditch Combination

Lower Gunnison River Basin Salinity Study

3.1.4 Pipe Cimarron Canal.

The entire Cimarron Canal has the potential to be piped from its diversion point along the Cimarron River to its downstream users. All users would potentially be serviced with pressurized laterals from the pressurized, gravity-fed Cimarron piped alignment as it skirts the west side of the Cimarron River drainage. The delivery system would minimize conveyance losses (seepage and evaporation) as well as allow users to utilize the potentially pressurized delivery system to improve on-farm irrigation practices, such a sprinkler or micro drip irrigation (See **Figure 3-5**). The proposed piping of the Cimarron Canal could potentially improve an estimated 42.3 miles of canals/laterals and enable approximately 4,241 irrigated acres to be able to utilize pressurized pipe to upgrade their on-farm application if a new proposed gravity-fed pipe alignment could achieve enough pressure for downstream users (**Table 3-3**).

3.1.5 Combine Cedar Mesa Ditch and Lone Pine Ditch

This potential project would modify the diversions for both the Cedar Mesa Ditch and Lone Pine Ditch and extract flow from a single diversion point along Surface Creek. The diversion would be conveyed in a new, single pipe alignment that skirts the east side of the Surface Creek drainage. The system would be gravity fed and potentially pressurized to service downstream users from both ditches on pressurized laterals from the main pipe alignment. The gravity fed pipeline could potentially treat an estimated 27.9 miles of downstream canals/laterals and enable approximately 683 acres of irrigated land to utilize the potentially pressurized delivery system to improve on-farm irrigation practices, such as sprinkler or micro drip irrigation (See **Figure 3-6** and **Table 3-3**). The decreased diversion rate would decrease present day conveyance losses to seepage and evaporation and give more junior right water holders downstream, along Surface Creek, better odds of fulfilling their current water right during drought years.

3.1.6 Combine Settle, Trickle, Omega, and Old Reliable Ditches

This potential project would modify the diversion points for the Trickle Ditch, the Settle Ditch, the Omega Ditch, and Old Reliable Ditch by consolidating all extracted flow from a single diversion point from Surface Creek. This single diversion point would be conveyed in a new, single pipe alignment following the west side of the Surface Creek drainage which would serve all previous users from all four canals with piped, and potentially gravity pressurized, laterals. A consolidated single piped system could potentially improve an estimated 17.8 miles of canal/lateral delivery ditches while minimizing conveyance losses (seepage and evaporation) as well as allow users to utilize the potentially pressurized delivery system to upgrade an estimated 925 irrigated acres of downstream on-farm irrigation practices (See **Figure 3-7** and **Table 3-3**).

3.1.7 Combine Forest, Weir, Johnson, Buttes, and Fogg Ditches

This potential project would modify the diversion points for the Forrest Ditch, the Weir & Johnson Ditch, the Buttes Ditch, and the Fogg Ditch by consolidating all extracted flow from a single diversion point along Surface Creek. This single diversion point would be conveyed in a new, single pipe alignment following the east side of the Surface Creek drainage which would serve all previous users from all five canals with piped, and potentially pressurized, laterals, improving an estimated 31.4 miles of canals/laterals (**Table 3-3**). The delivery system would

Pipe Cimarron Canal.
Make downstream laterals
pressurized for improved
irrigation practices.

Gunnison River

Uncompahgre River

Cimarron Ditch

Ouray County

Montrose County

Gunnison County

N

0 3,250 6,500 13,000 19,500 26,000 Feet

1 in = 6,500 ft

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Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Rivers
- Creeks
- Counties

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*Potential canal combinations are conceptual and will require in depth anlyses to determine if feasible and cost effective.

Date: September 2013 By: JWM

Figure 3-5

Potential Piped Cimarron Canal

Lower Gunnison River Basin Salinity Study

Combine the Cedar Mesa Dtich and the Lone Pine Ditch into one pipe and pressurize the system downstream.

Delta County

Delta County

Scoonie Ditch

Van Tuyl Ditch

Dry Creek

Cedar Mesa Canal

Lone Pine Canal

N

0 1,500 3,000 6,000 9,000 12,000 Feet

1 in = 3,000 ft

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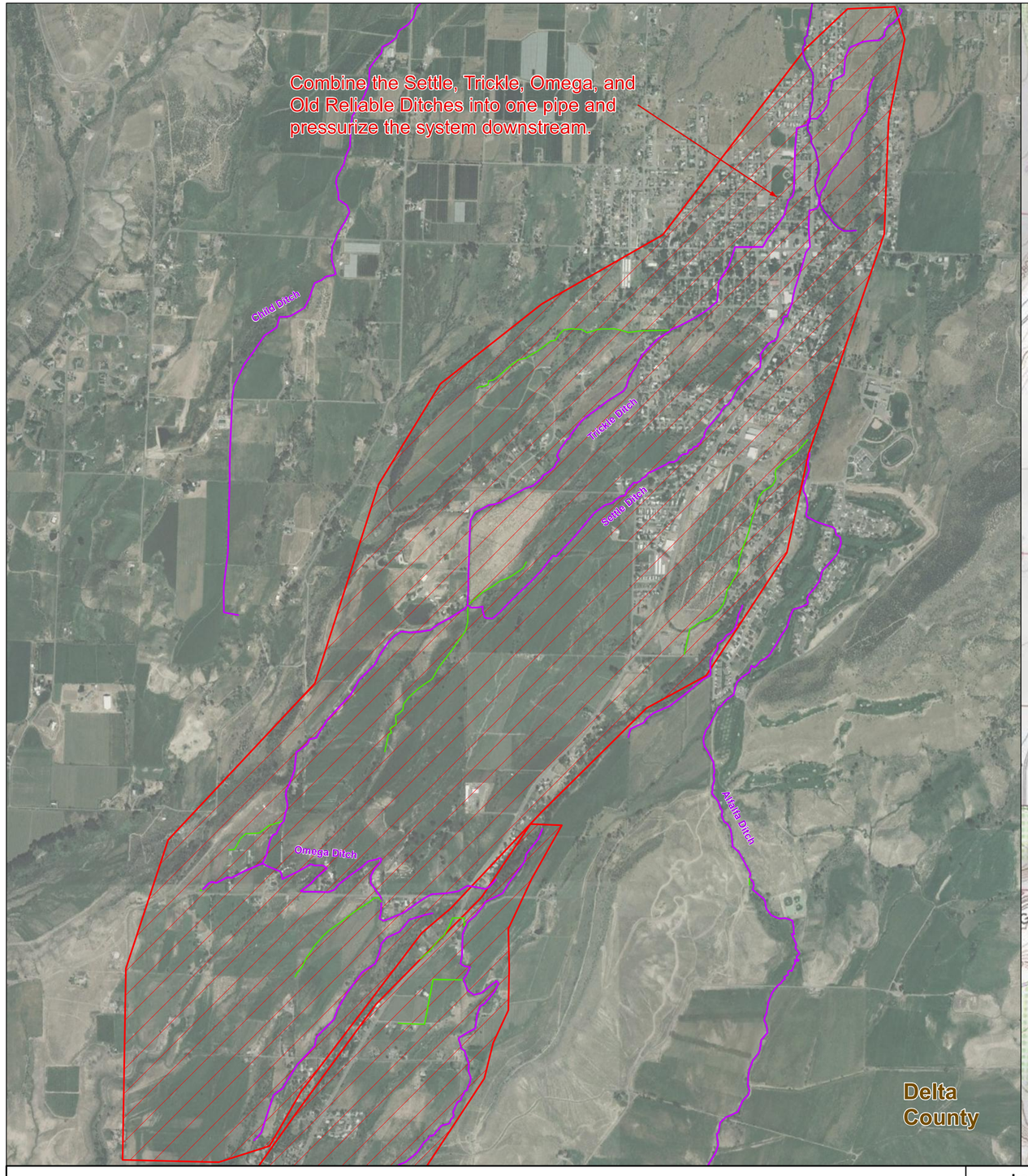
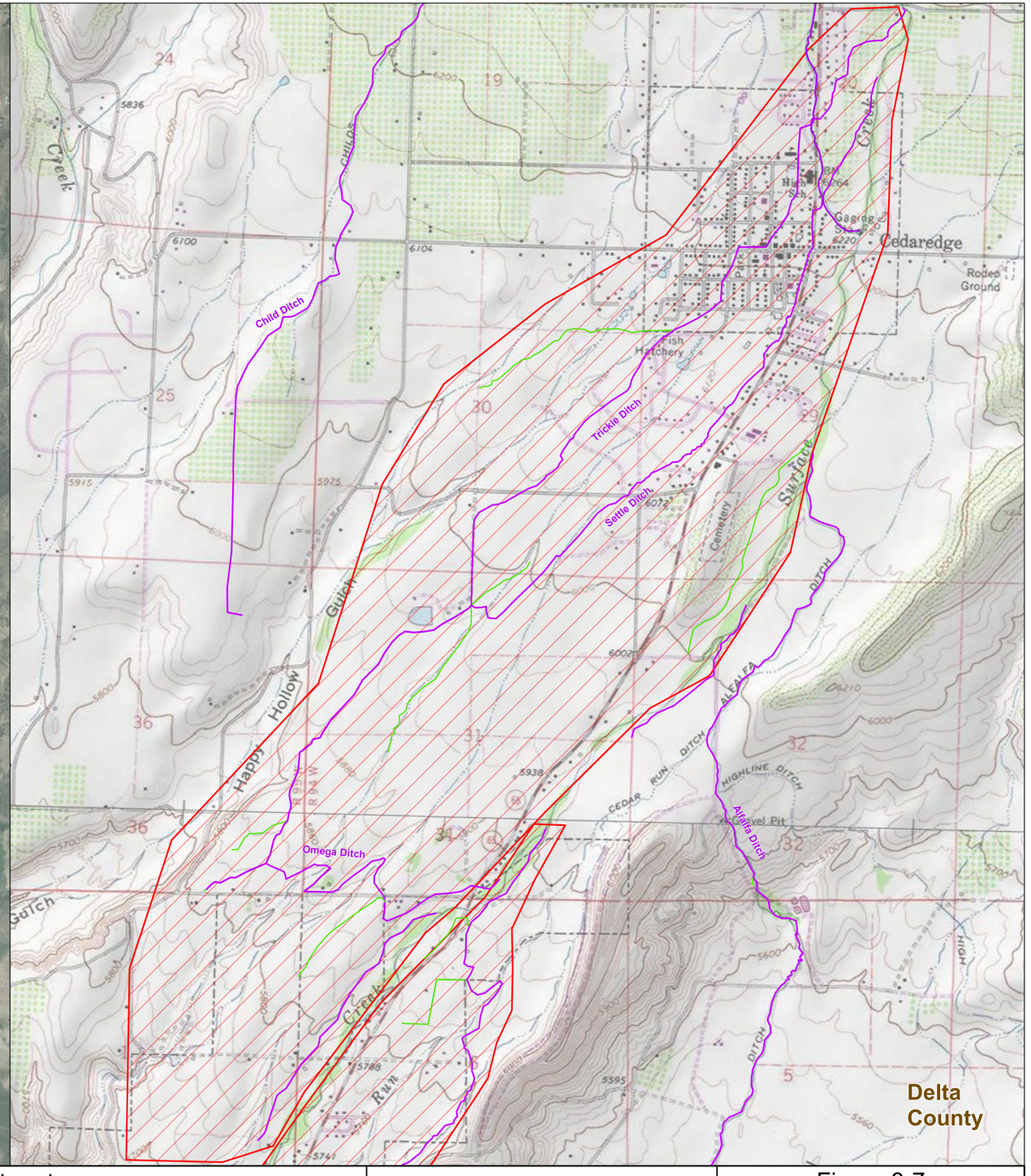
Date: September 2013 By: JWM

Figure 3-6

Potential Lone Pine & Cedar Mesa Canal Combination

Lower Gunnison River Basin Salinity Study





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0 500 1,000 2,000 3,000 4,000 Feet

1 in = 1,000 ft

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Date: September 2013 By: JWM

Figure 3-7

Potential Settle, Trickle, Omega, & Old Reliable Ditch Combination

Lower Gunnison River Basin Salinity Study

minimize conveyance losses (seepage and evaporation) as well as allowing users to utilize the potentially pressurized delivery system to potentially upgrade an estimated 2,201 on-farm irrigated acres to sprinkler or micro drip irrigation (See **Figure 3-8**). The decreased diversion rate would decrease present day conveyance losses and give more junior right water holders along Surface Creek better odds of fulfilling their current water right during drought years.

3.1.8 Combine Saddle Mountain Ditch and Daisy Ditch

The potential Saddle Mountain and Daisy Ditch combination would modify the diversion for both the Saddle Mountain Ditch and Daisy Ditch to extract flow from a single diversion point along the Smith Fork. The diversion would be conveyed in a new, single pipe alignment that skirts the east side of the Smith Fork drainage and improve an estimated 14.6 miles of canals/laterals. The system would be gravity fed and potentially pressurized to service downstream users from both ditches on pressurized laterals from the main piped alignment. The delivery system would minimize conveyance losses (seepage and evaporation) as well as allow users to utilize the a pressurized delivery system to upgrade an estimated 1,437 on-farm irrigated acres to sprinkler or micro drip irrigation (See **Figure 3-9** and **Table 3-3**).

3.1.9 Combine Dyer Fork, Fruitland Highland, and Cattlemans Ditch.

This potential project would modify the diversion points from both Dyer Fork and Cattlemans Ditches by consolidating all extracted flow from a single diversion point from Dyer Creek or further downstream on Crystal Creek. This single diversion point would be conveyed in a single pipe alignment following the west side of the Dyer and Crystal Creek drainages which would serve all previous users from both canals with piped, and potentially gravity pressurized, laterals. The delivery system could treat an estimated 53.2 miles of canals/laterals as well as allowing users to utilize the potentially pressurized delivery system to improve an estimated 4,238 acres of on-farm irrigation area to sprinkler systems, micro drip irrigation, or other high efficiency irrigation practices (See **Figure 3-10** and **Table 3-3**). Further analysis could potentially include combining the piped alignment with the Gould Reservoir to act as more of an active auxiliary flow to downstream users to secure steady water feeds and better secure water rights during drought years.

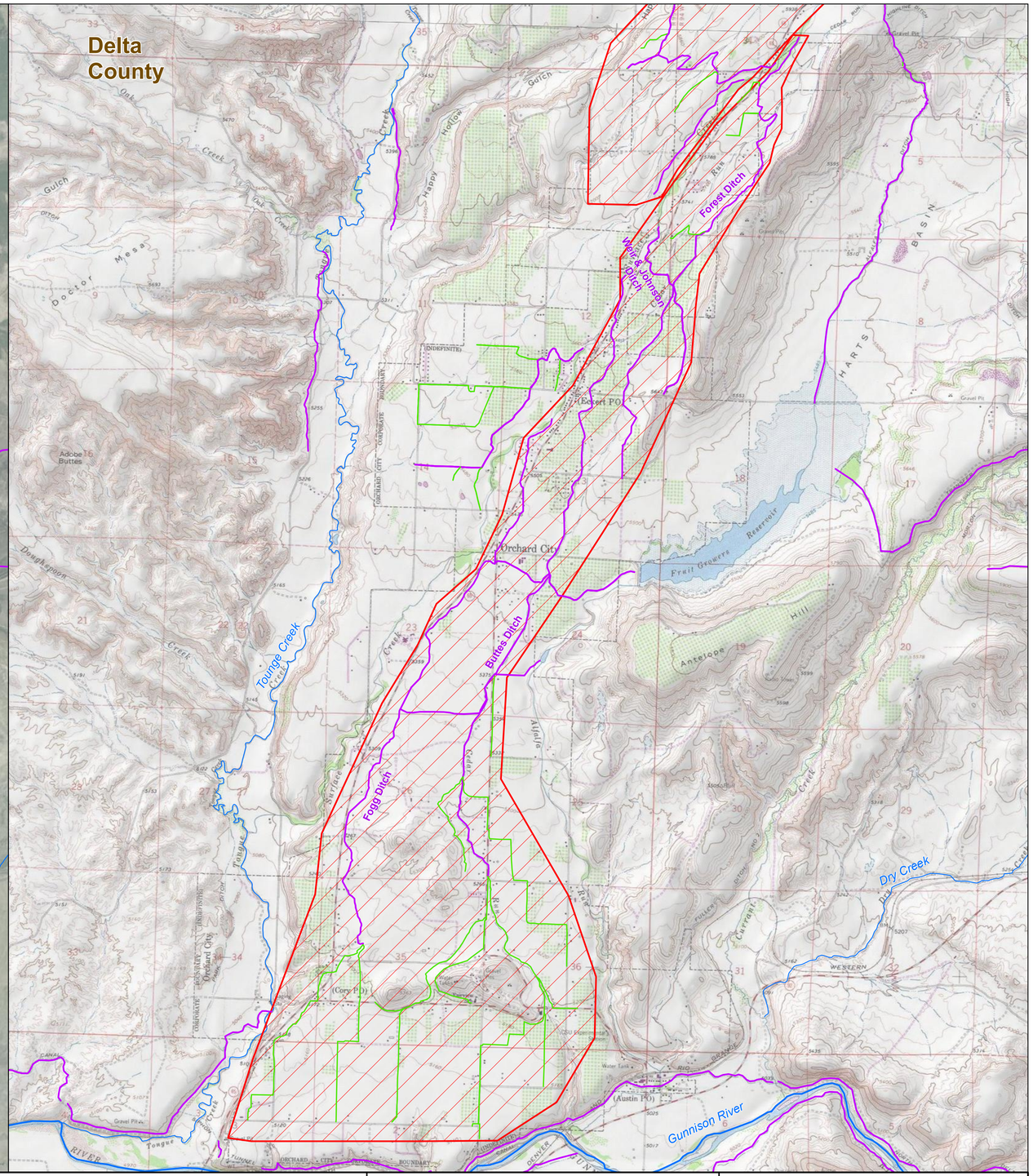
3.1.10 Combine Pinion, Roswell Hotchkiss, and McDonald Ditches.

The potential Pinion, Roswell Hotchkiss, and McDonald Ditches would be consolidated in one pressurized pipe alignment with a modified diversion point from the east side of the Uncompahgre River. This proposed system could potentially improve an estimated 12.3 miles of earthen canal/laterals (**Table 3-3**) while minimizing conveyance losses (seepage and evaporation) and potentially allowing downstream users to utilize a pressurized gravity fed system. A pressurized system would give downstream receiving users the potential to improve their irrigation application system, potentially upgrading approximately 1,035 on-farm irrigated acres (See **Figure 3-11**). The decreased diversion rate would decrease the present day conveyance losses and give more junior right water holders along the Uncompahgre River better odds of fulfilling their current water right during drought years.

Delta County

Combine the Forest, Weir, Johnson, Buttes, and Fogg Ditches into one piped system and pressurize for improved irrigation practices.

Forest Ditch
Weir & Johnson Ditch
Buttes Ditch
Fogg Ditch
Tounge Creek
Dry Creek
Gunnison River



N

0 1,000 2,000 4,000 6,000 8,000 Feet

1 in = 2,000 ft

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

URS

Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Rivers
- Creeks
- Counties

Disclaimer

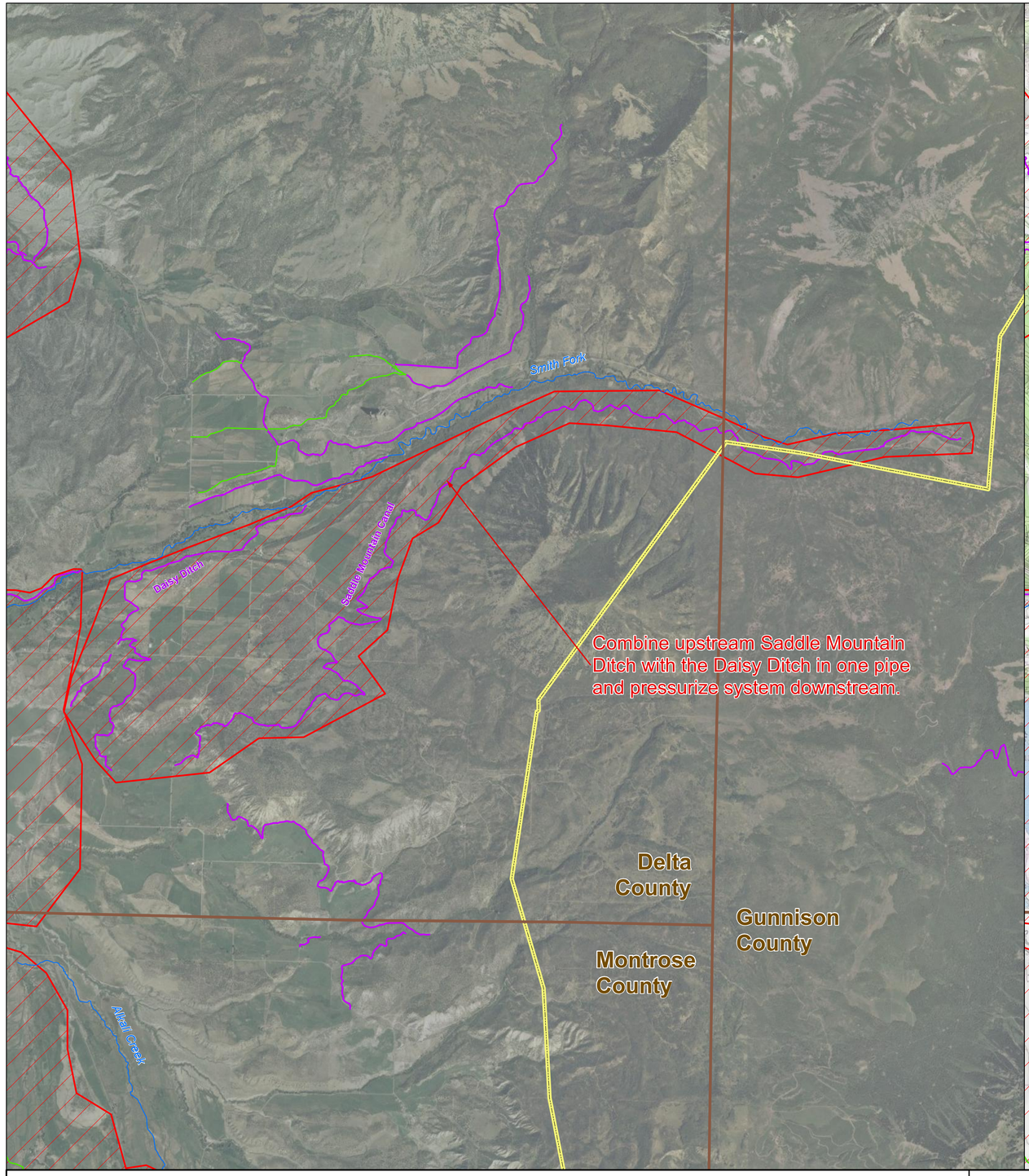
*Canal & Lateral Data was obtain from Bureau of Reclamation as PRELIMINARY data for conceptual analyses.
*Aerial & USGS Quadrangle Source: ESRI online GIS server
*Potential canal combinations are conceptual and will require in depth anlyses to determine if feasible and cost effective.

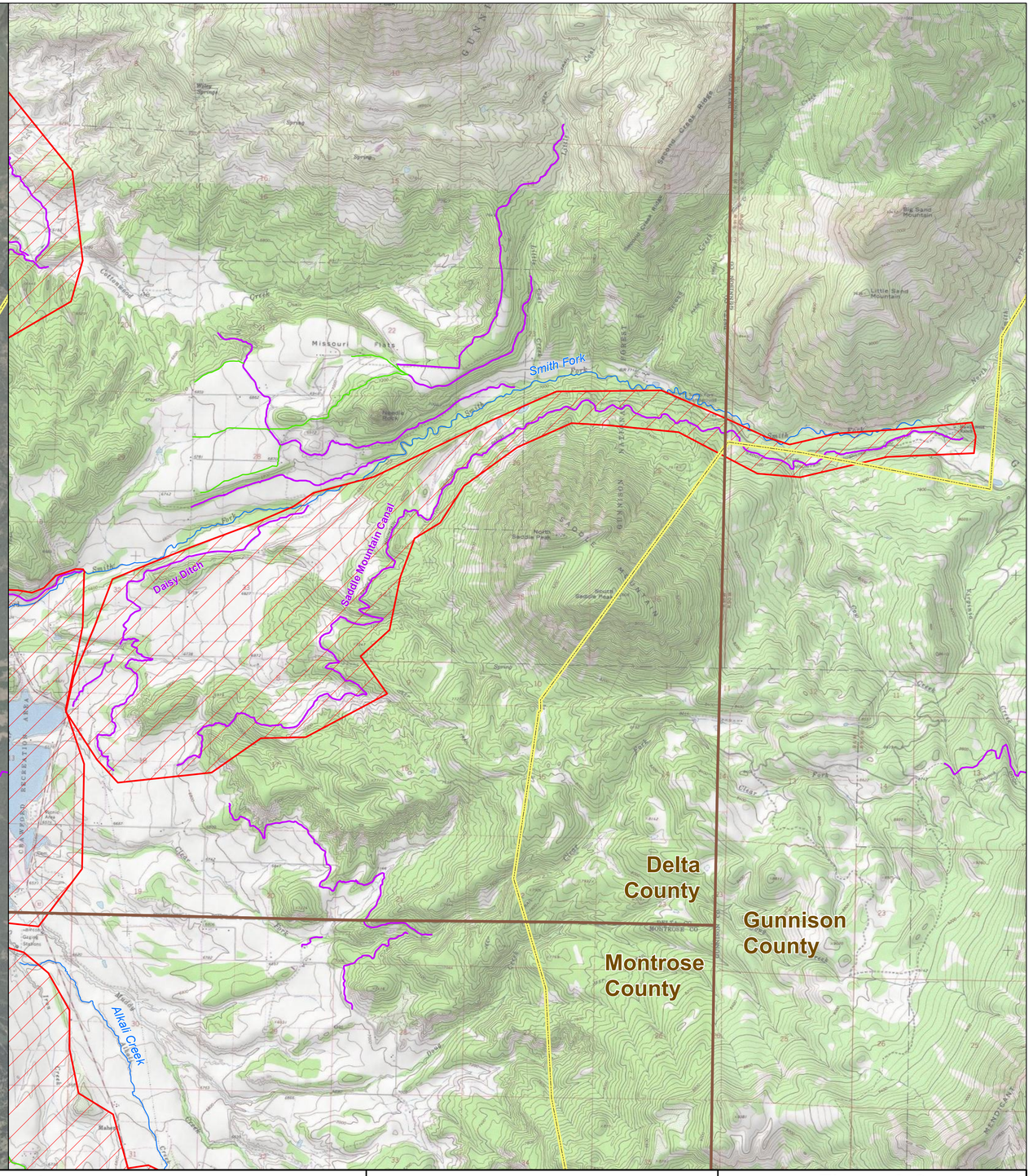
Date: September 2013 By: JWM

Figure 3-8

Potential Forest, Weir, Johnson, Buttes, & Fogg Ditches Combination

Lower Gunnison River Basin Salinity Study





N

0 5,000 10,000 Feet

1 in = 2,500 ft

U. S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

URS

Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
- Potential Canal Improvements
- Rivers
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Date: September 2013 By: JWM

Figure 3-9

Potential Daisy Ditch & Saddle Mtn. Canal Combination

Lower Gunnison River Basin Salinity Study

Delta County

Montrose County

Alkali Creek

Dyer Fork Ditch

Cattlemans Ditch

Fruitland Highline Canal

Combine upstream Dyer Fork Ditch with the downstream Cattlemans Ditch and Fruitland Highline Canal into one pipe and pressurize system downstream.

Gunnison River

N

0 1,000 2,000 4,000 6,000 8,000 10,000 12,000 Feet

1 in = 3,000 ft

U. S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

URS

Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
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- Rivers
- Creeks
- Counties

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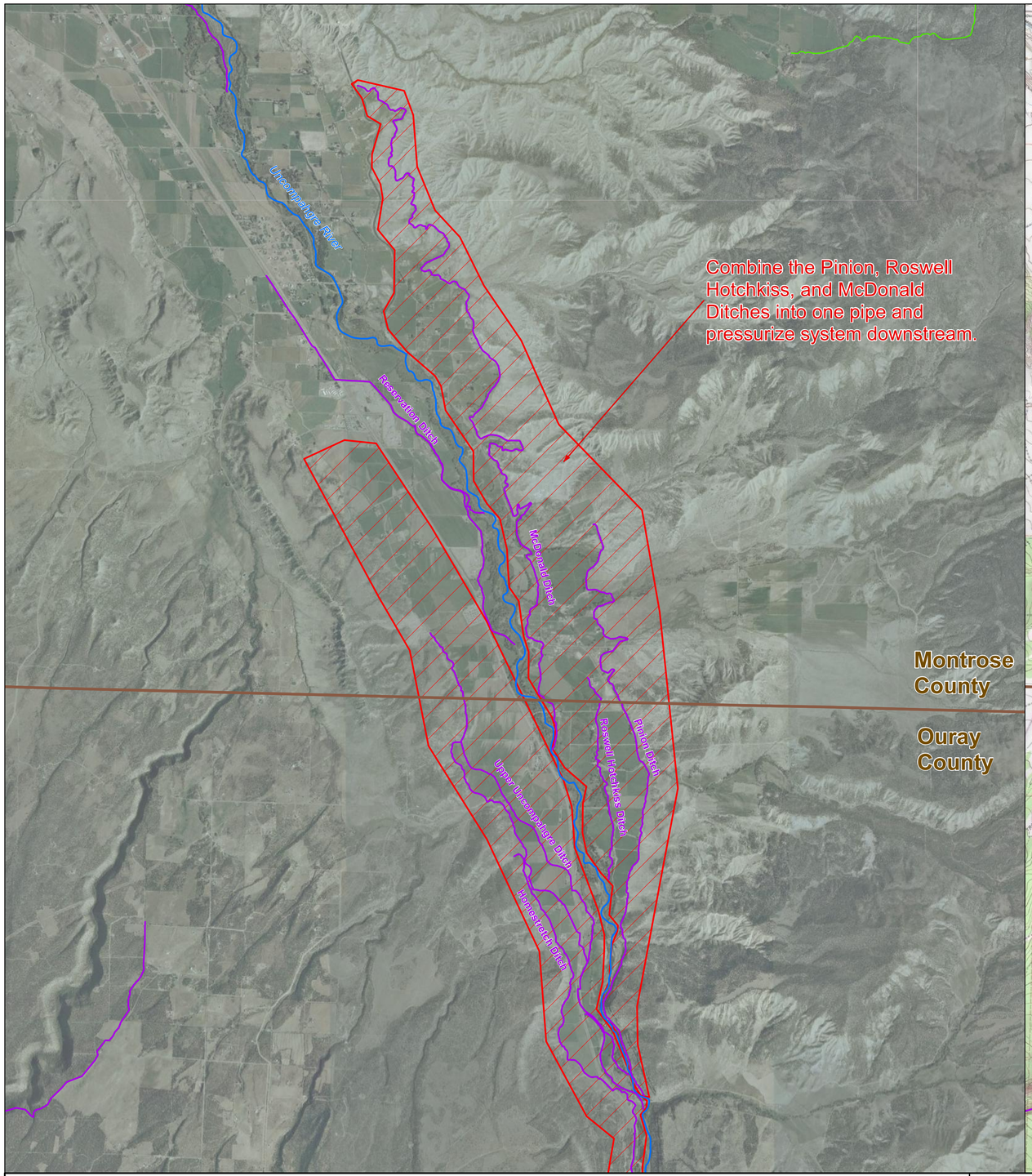
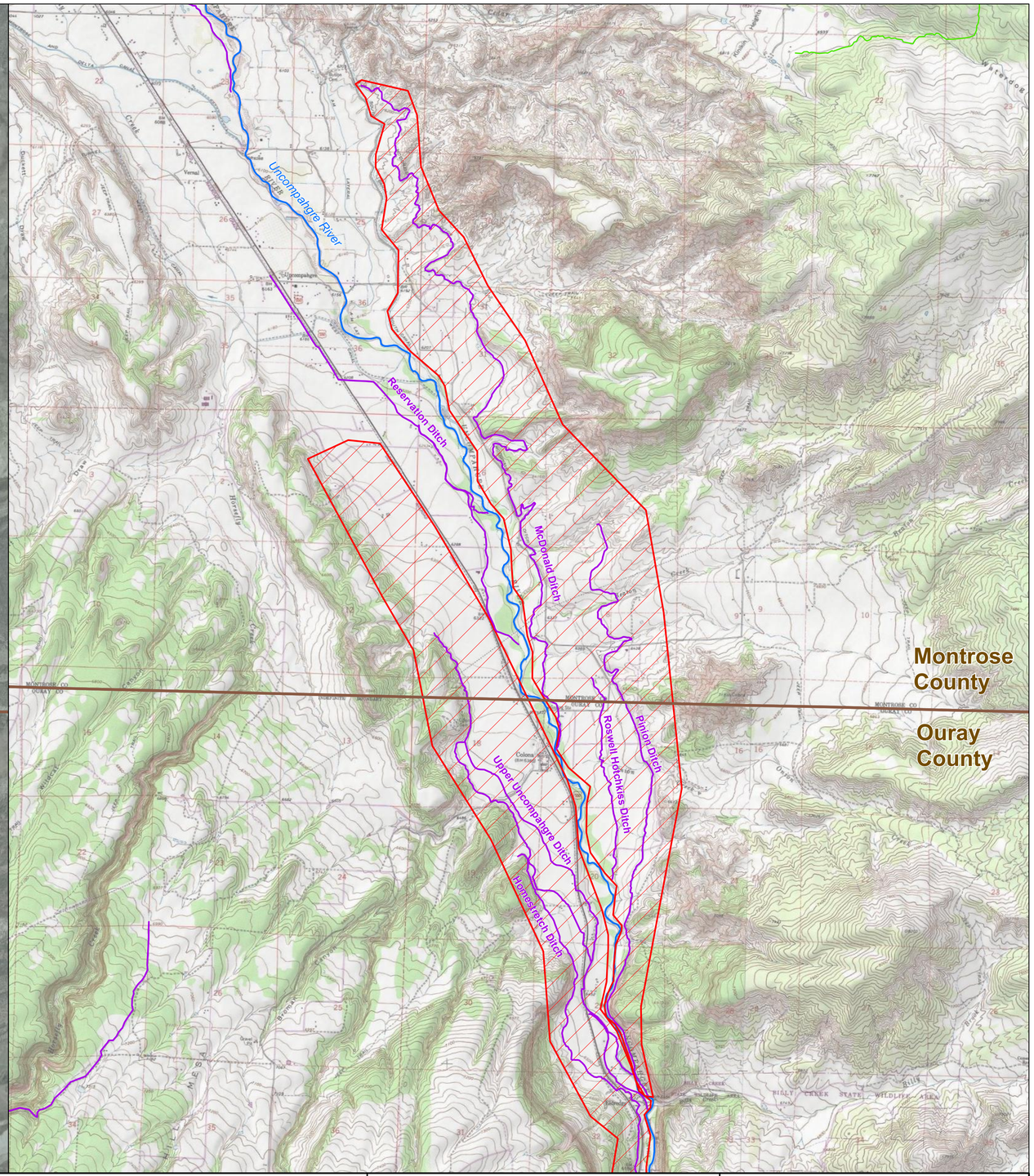
Date: Setember 2013 By: JWM

Figure 3-10

Potential Dyer Fork, Cattlemans Ditch, & Fruitland Highline Canal Combination

Lower Gunnison River Basin Salinity Study





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1 in = 2,500 ft

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

URS

Legend

- Salinity Project Area
- Unimproved Canals
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- Improved Piped Laterals
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Date: Octoberr 2013 By: JWM

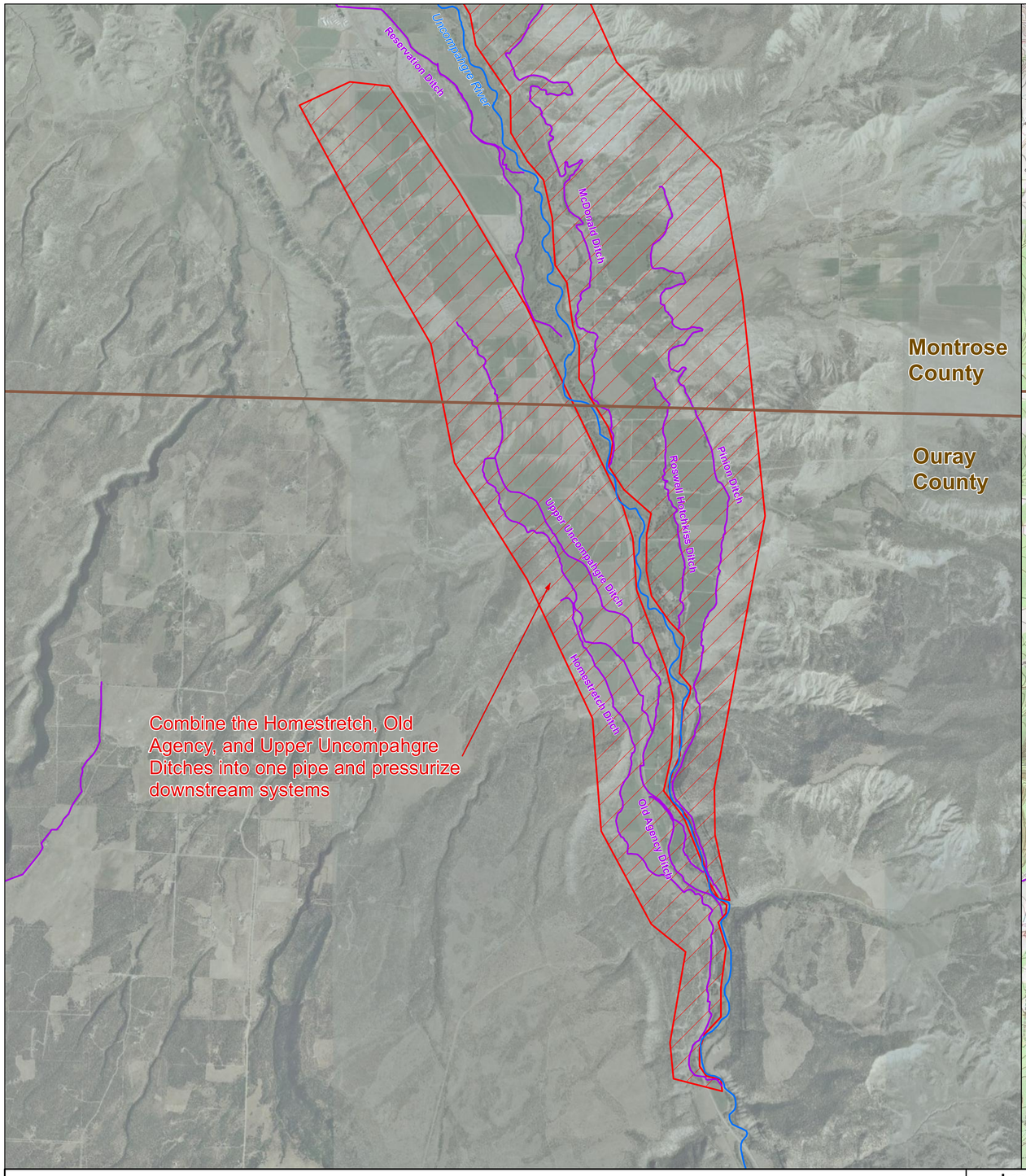
Figure 3-11

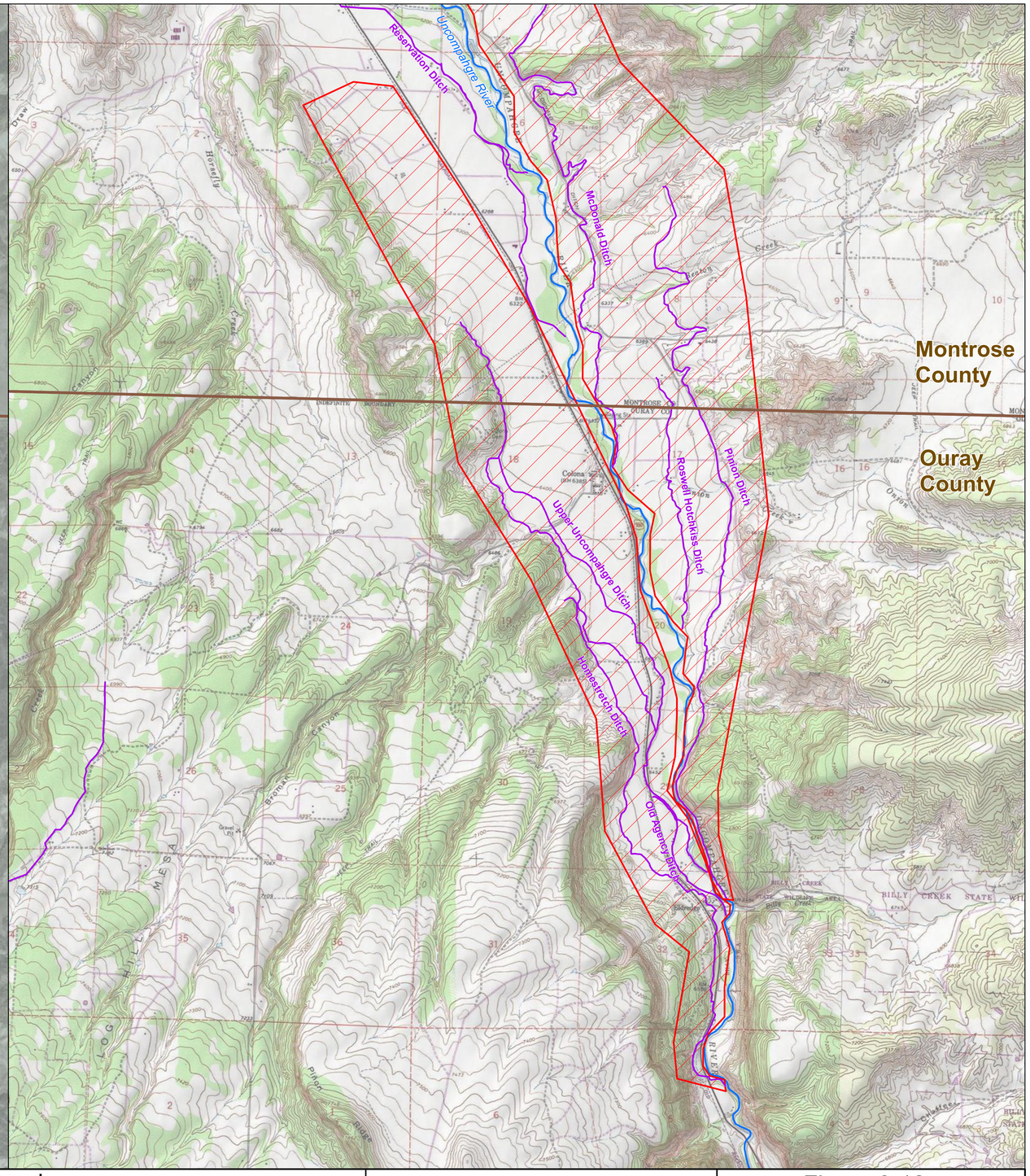
Potential Pinion, Roswell Hotchkiss, & McDonald Canal Combination

Lower Gunnison River Basin Salinity Study

3.1.11 Combine Homestretch, Old Agency, and Upper Uncompahgre Ditches

This potential project would modify the diversion points for the Homestretch, Old Agency, and Upper Uncompahgre Ditches by consolidating all extracted flow from a single diversion point along the west side of the Uncompahgre River. This single diversion point would be conveyed in a new, single pipe alignment following the east side of the western edge of the drainage which would serve all previous users with potentially pressurized, piped, laterals, improving an estimated 11.3 miles of earthen canals/laterals (**Table 3-3**). The delivery system would minimize conveyance losses (seepage and evaporation) as well as allow users to utilize the pressurized delivery system to upgrade an estimated 1,178 on-farm irrigated acres to sprinkler or micro drip irrigation (See **Figure 3-12**).





N

0 1,500 3,000 6,000 Feet

1 in = 2,000 ft

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

URS

Legend

- Salinity Project Area
- Unimproved Canals
- Unimproved Laterals
- Improved Piped Canals
- Improved Piped Laterals
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Date: October 2013 By: JWM

Figure 3-12

Potential Homestretch, Old Agency, & Upper Uncompahgre Canal Combination

Lower Gunnison River Basin Salinity Study

4.1 IMPEDIMENTS

This section summarizes impediments and their impacts to "full implementation of the Salinity Control Program" (Study Objective 4).

These impediments and responses were presented to a governmental and agency focus group to be discussed and to understand their limitations. **Table 4.1** summarizes perceived impediments and potential program responses associated with the USBR off-farm program and **Table 4.2** summarizes perceived impediments and potential program responses associated with the NRCS on-farm program. Following these tables are descriptions of the impediments.

Table 4-1: Off-Farm Program Impediments and Potential Program Responses

Impediment Number	Perceived Off-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
1.0	Lack of understanding of programs	Less participation and fewer applications	1. Provide additional training beyond existing workshops. 2. Public information campaign to correct the untruths; discuss perceived contradictions	N/A
2.0	No comprehensive planning of modernization opportunities to guide proposals	1. Low quality FOA applications 2. Higher ultimate Program costs from non-integrated projects.	Advance comprehensive planning	N/A
3.0	Lengthy, complicated FOA application and award process	1. Discourages participation 2. Equipment and installation costs escalation liabilities for companies	1. Streamline process and decrease the time to receive funding 2. nts	N/A
4.0	Short competitive proposal process limits planning/ quality of proposals	Does not provide the "best" proposals and ultimately most cost-effective installed systems	1. Extend FOA application process 2. Increased planning effort would improve quality of applications and diminish need for longer FOA application period. 3. Focus company's efforts on highest value projects	N/A

Table 4-1: Off-Farm Program Impediments and Potential Program Responses (continued)

Impediment Number	Perceived Off-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
5.0	$6M Limit on project size	Causes some proposals to be broken into less efficient parts	Re-examine reasons for limit; weigh benefits of policy vs. loss of opportunity	N/A
6.0	Lack of competent preliminary design	1. Potential disqualification from FOA process 2. Final design process difficulties 3. Low quality cost estimates	Comprehensive planning to establish easier transition to FOA-level design	Program currently encourages retention of engineer for application process
7.0	Changing nature of salt load reduction estimates is not well understood	1) Credibility of process is questioned 2) Creates difficulty in project planning	1. Increase efforts to explain changing values related to improved information 2. Adopt values and retain them for a prescribed number of FOA cycles 3. Identify areas with highest salt loading	Program has reached out to areas where loading values changed
8.0	Potential fundable off-farm improvement are limited to certain high salt loading sub-basins	Some areas cannot compete for off-farm improvements & thus provide pressure for high efficiency on-farm improvements	1. Increase local funding	N/A
9.0	Water rights – risk of losing rights if pipelines are not diverting full right; may need water in future	Less likely to participate in FOA process	1. Help those concerned with water rights to examine overall project benefits 2. Discuss with DWR issue of water rights losses 3. Demonstrate how expanded use of storage in existing reservoirs can store water available due to reduced diversions	Program and State are attempting to address this water rights issue
10.0	Cultural aspects -- Splitter box mentality; reuse of return flows	1. Less likely to participate in FOA process 2. All users settle for lower level of irrigation technology	1. Examine how to provide more low tech options 2. Provide additional inducements	N/A

Table 4-1: Off-Farm Program Impediments and Potential Program Responses (continued)

Impediment Number	Perceived Off-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
11.0	Desire to maintain existing system to avoid loss of riparian habitat and return flows/sub-irrigation	Less likely to participate in FOA process	Identify opportunities for improvements that retain riparian habitat.	Program is working on habitat replacement
12.0	Value of system improvements is not recognized by some producers	1. Less likely to participate in FOA process 2. Other users forced to settle on lower level of irrigation technology	1. Invite participating farmers to talk to new or non-program participants. 2. Provide advance planning to allow period of adjustment/acceptance 3. Demonstration projects showcased	Outreach and Education are being attempted by Reclamation and NRCS
13.0	Lack of motivation due to water abundant area	1. Less likely to participate in FOA process 2. More inefficiencies resulting in greater salt loading	1. Focus on areas with later season shortages or have high interest in efficient on-farm systems. 2. Educate non-participants on Colorado water banking regulations/opportunities.	N/A
14.0	Ability to manage large projects and risk of cost overruns	1. Less likely to participate in FOA process 2. Discourage other participants	1. Training for irrigation companies 2. Streamline FOA funding process	Program currently provides guidance on large projects and fund some management activity
15.0	Difficulty in securing rights-of-way or in combining delivery systems	1. Limits efficient system layout 2. Increases costs	1. Advance comprehensive planning 2. Better educated stakeholders	N/A
16.0	Learning water management for new pipelines	Less likely to participate in FOA process	Provide training for irrigation companies	N/A
17.0	Low Quality FOA applications	1. Difficult to evaluate 2. Bad publicity for program	Provide "coaching" to applicants	Post application debrief

Table 4-1: Off-Farm Program Impediments and Potential Program Responses (continued)

Impediment Number	Perceived Off-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
18.0	Contractors provide low quality projects	1. Bad program publicity 2. May reduce desire of companies to participate	Increase oversight by Reclamation	N/A
19.0	Piecemeal approach to implementation	1. Leaves more expensive remaining portions of facilities 2. Fewer opportunities to maximize salt load reduction	Comprehensive area/sub-basin planning including identifying opportunities for close coordination of on- and off-farm projects	N/A

Table 4-2: On-Farm Program Impediments and Potential Program Responses

Impediment Number	Perceived On-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
20.0	Lack of in-place off-farm delivery system or inadequate topography to provide pressure for on-farm high efficiency systems	1. Fewer high efficiency projects 2. Fewer on-farm participants because of pumping costs	1. Improve NRCS /BOR coordination of group projects 2. Look at off-setting pumping costs with hydropower revenues 3. Educate on reality of pumping costs vs increased crop production 4. Concurrent completion of on- and off-farm projects	Not currently being coordinated or prioritized
21.0	Lack of coordination between on- and off-farm improvements	Less than optimum systems	1. Provide "liaison" to facilitate on-and off-farm planning and construction. 2.Single on- and off-farm administrator.	N/A
22.0	Lack of motivation to change; includes desire to: - Stay with existing, convenient systems -Avoid expensive investments and increased operating costs	Less on-farm improvements and less support for off-farm improvements. Fewer participants in group projects that are potentially more efficient and more cost effective.	1. Educate water users on the production and operating benefits of on-farm improvements. 2. Institute programs to help local water users make sound decisions when significant free funding is being provided.	Annual Soil Health workshops to provide information and "cross - fertilization"

Table 4-2: On-Farm Program Impediments and Potential Program Responses (continued)

Impediment Number	Perceived Off-farm Impediment	Impacts of Impediment	Potential Program Responses	Current Program Response
23.0	Lack of timely designs and coverage of small acreage opportunities due to insufficient NRCS staff	1. Extended project development process may deter some 2.Processing applications for many small parcels limits the effectiveness of the program	1.Increase NRCS resources 2. Incorporate small parcels into group projects 3. Increase staffing during critical approval periods or extend periods of review/approval.	N/A
24.0	Lack of assistance in navigating lengthy and complicated application process	1. Discourages participation 2. More time required to implement	1. More assistance-- Increase NRCS staffing to improve applicants' experience. 2. Reduce application requirements.	N/A
25.0	Inconsistency of NRCS cost dockets from year to year	Equipment and installation costs increases are owner's responsibility. Risk deters participation	Could other programs provide supplemental funding to cover shortages	N/A
26.0	Increased crop production not valued as benefit	Less program participation	1. More IWM 2. Social marketing program	Annual Delta Soil Health conference
27.0	Efficiency improvements going from gated pipe to sprinklers too small to be cost effective & EQIP fundable	Results in lost opportunity when pressurized system becomes available	Continue NRCS upgrade assistance	N/A

4.1.1 Impediment No. 1 – Lack of Understanding of Programs

Many of the interviewees misunderstood many of the details of the salinity control program, and more particularly the FOA application process and selection criteria. Reclamation provides information in written form and also conducts a pre-FOA workshop. The misunderstandings have been described in this report. Reclamation could focus on correcting the public's incorrect understandings by focusing on those issues.

4.1.2 Impediment No. 2 – No Comprehensive Planning

It is perceived by many of the interviewees that the there are many opportunities being overlooked because of the lack of comprehensive planning of projects. This small view approach is resulting is less effective allocation of financial resources and results in lower quality projects.

4.1.3 Impediment No. 3 – Lengthy, Complicated FOA, Award and Budgeting Process

The FOA process requires considerable time and effort by applicants and results in increase cost risk for the successful applicants because any cost escalation is born solely by the applicant.

4.1.4 Impediment No. 4 – Short Competitive Proposal Process

Even though the overall process is lengthy and complicated (see above), the time available to put together the formal FOA application is relatively short. This impediment relates to the need for advanced planning prior to commencement of the FOA process so that the application preparation is not as burdensome.

4.1.5 Impediment No. 5 – Size of Project Allowed Under current FOA

The current FOA will only consider projects of $6 million dollars or less. This project limitation has resulted in some projects not being applied for, with some potential combined projects ineligible for consideration. The limitation does not consider that two or three companies are sharing the project and the limitation should be accordingly increased. Otherwise, two smaller, less efficient projects would be funded under two $6M limits. When these projects are broken into smaller pieces, there are usually costly, redundancies required, and the most efficient pipeline layout cannot be attained.

4.1.6 Impediment No. 6 – Lack of Competent Preliminary Design

This is related to Impediment 4 in that advanced planning would improve the quality of the applications. This impediment also relates to the need for high quality cost estimates to ensure both the competitiveness of the application and also to reduce risk of cost escalation that becomes the sole responsibility of the successful applicant.

4.1.7 Impediment No. 7 – Calculation of the Salt Load Reductions

There is a lack of understanding pertaining to the calculation methods used for salt load reductions for projects in the Lower Gunnison Basin. This lack of understanding creates barriers to trust in the program and inhibits participation.

4.1.8 Impediment No. 8 – Funding Limited to High Salt Loading Areas

It is perceived by many that Program funding is not available to low salt loading areas and discourages participation by those with this perception. This impediment is derived from Impediment 1, lack of understanding of the programs. There is limited understanding that Program funding is available but may have to be at a lower percentage of project cost.

Additionally, where off-farm projects cannot be funded there are fewer opportunities for on-farm sprinklers.

4.1.9 Impediment No. 9 – Risk of Loss of water Rights

There is a real concern by many interviewees that with increased water use efficiency, the participant will lose water rights. This is a particular concern when the capacity of the new water conveyance facility is significantly less than the historical facility on which the water right was based. This concern causes reluctance in participating in the Program.

4.1.10 Impediment No. 10 – Cultural Aspects - Splitter Box Mentality or Reuse of Return Flows

Local practices such as how users split excess flows from a ditch in a splitter box and the historical reuse of return flows can limit users' willingness to consider new pipeline delivery systems. This insistence on maintaining some of those practices can mean saying no to pressure pipelines and opportunities for higher efficiency on-farm irrigation systems. An historical dependence on return flows by some influential users creates additional reluctance.

4.1.11 Impediment No. 11 – Loss of Riparian Habitat and Return Flows/Sub-Irrigation.

In many of the systems, the waste or return flows are utilized by lands located down-gradient from the lands which received the first irrigation water supplied. When the flows are reduced to the amounts need by the crops, this water is no longer available, or an additional delivery system would have to be installed. Also, some previous projects have introduced unforeseen, minor challenges which discourage new projects. Others value the riparian habitat resulting from seepage from canals that would be lost with construction of pipelines or canal lining projects.

4.1.12 Impediment No. 12 – Delayed Acceptance of Better Irrigation Practices

Delay by some in accepting improved irrigation technology, such as sprinkler irrigation, results in an impediment to those wanting to upgrade to the more efficient systems. This results in conflicts between those wanting to participate in the Program and those wanting to retain their status-quo irrigation systems. It also results in projects providing "special consideration" to provide system capacity to deliver flood irrigation flow rates to a minority of system shareholders.

4.1.13 Impediment No. 13 – Lack of Motivation in Water Rich Area

Increased irrigation efficiencies have a great value for those with limited water resources. Conversely, those with abundant water supplies are less motivated to invest in more efficient irrigation projects. However, water abundant areas with extremely low efficiencies have potentially the greatest impact on salt loading because of the ability to apply excessive amounts of water.

4.1.14 Impediment No. 14 – Large Projects Management Capabilities

There are those irrigation companies that do not have the in-house skills to manage a large construction project. This discourages them from taking on this responsibility. Hiring professional management increases their costs and lowers their competitiveness for FOA funding.

There was a distinct difference between the Uncompaghre Valley, dominated by the Uncompaghre Valley Water Users Association (UVWUA) and the "Rest of the Lower Gunnison". The UVWUA was a "mature" entity, with corporate governance which had been well established over the past 100 years, and which provided service to over 60,000 acres of irrigated lands. They have significant professional administrative, operational and construction/maintenance staff, and have benefited from years of support by the Reclamation as a Bureau project. They have been able to leverage this structure and staff to their benefit, and are well underway with a long term vision and improvement program. They have the ability to levy assessments against the land holdings of their water users, assessments which carry a "senior lien" position and they hold the water rights.

The majority of the ditch and reservoir companies which comprise the entities in the "Remainder of the Lower Gunnison" are in the 1,000 acre range, have volunteer Boards and either volunteer or extremely part time staff. Incurring a new obligation which may require an increase in assessments in the future is a large undertaking, and it is more difficult to gain acceptance of a majority of the shareholders. An exception to this is when a majority of the shares are in the hands of one or two primary operators, with the balance being smaller operators.

4.1.15 Impediment No. 15 – Difficulty with ROW and Combining System.

This impediment relates to the challenges associated with developing conceptual plans and the difficulty in identifying and acquiring rights-of-way without condemnation authority. Combining two or more canals compounds the challenges with right-of-way.

4.1.16 Impediment No. 16 – Learning Management for Pipelines

Operators are familiar with their existing open channel systems. Operating a pipeline system brings a need for a different skill set for its management and maintenance. This causes some to be reluctant to participate knowing that a different management scheme will be required.

4.1.17 Impediment No. 17 – Low Quality FOA Applications Affect the Selection Process

Historically, the Basinwide Program has received many poor quality FOA applications mostly as the result of some consultants attempting to file multiple applications in an effort to prospect for competitive projects that could best bring them funding. These applications are difficult for Reclamation to evaluate; some are rejected outright. The owners of the facilities are often times very upset with their consultant.

4.1.18 Impediment No. 18 – Low Quality Projects

In order to be competitive and to keep local cost share as low as possible, projects are sometimes constructed to meet minimum requirements without consideration of operational constraints or

long-term maintenance needs. Low quality projects result in frustration once under operation. These negative reports have to potential of reflecting negatively on the Program and discourage others from participating.

4.1.19 Impediment No. 19 – Piecemeal Approach

The approach currently used is to let the private sector bring forward proposals for projects. This has the potential for "cherry picking" the easiest, most cost competitive projects to accomplish, leaving the more difficult or more costly projects unfunded. This approach has historically worked well in accomplishing significant salt reduction. However, the negative aspect is that this piecemeal approach has the potential to forever preclude the "orphan" components from every being treated. It also has the potential to overlook significant opportunities that could provide greater benefits at lower cost than if piecemealed.

4.1.20 Impediment No. 20 – Lack of Off-Farm Improvements Inhibiting Implementation of On-Farm Improvement

In many cases, the lack of upstream improvement can impede down-stream, on-farm improvement. Many farmers share a perspective that in order for sprinklers to be cost effective gravity pressure systems, which eliminate pumping costs, are needed. In some cases topography for near farm or on-farm improvements is insufficient to provide sufficient pressure for sprinkler irrigation. In other cases the off-farm improvements are limited because of difficulty in securing right-of-way. There are greater incentives for on-farm improvements when off-farm improvements provide the needed pressures for sprinkler irrigation.

4.1.21 Impediment No. 21 – Lack of Coordination Between On- and Off-Farm Projects

It was reported by interviewees that the lack of coordination between development and construction of off-farm projects with on-farm projects has created an increased burden for participants. A reduced capacity off-farm conveyance facility may not deliver flood irrigation flow rates and if the on-farm projects are not ready, the farmer cannot adequately irrigate. Conversely, if the on-farm project is complete without the off-farm, the farmer has to "temporarily" pump. If the on-farm funding by NRCS is contingent on the off-farm completion, then NRCS will not reimburse the farmer for his on-farm expenses until completion of off-farm facilities. This results in a very high level of risk for the farmer that includes loss of crops, reduced crop production or large unreimbursed capital expenses. This risk creates reluctance to participate in the Program.

4.1.22 Impediment No. 22 – Lack of Motivation to Change Irrigation Practices

Some irrigators have expressed their desire to stay with existing flood irrigation for convenience and to avoid capital expenses. They may object to the frequent moving of wheel lines when their flood irrigation is relatively easy.

4.1.23 Impediment No. 23 – Limited NRCS Staffing to Support Small Acreage Projects

There is a perception among some non-participants that NRCS staff are too busy to facilitate their small acreage projects. This may be a reality but may also be that individuals approached NRCS for assistance at inopportune times.

4.1.24 Impediment No. 24 – Lack of NRCS Assistance with Application Process

Besides small acreage applicants, there is a perception that NRCS has not provided the resources to adequately facilitate those wanting to make application for EQIP funding. The application process is perceived as being lengthy and complicated.

4.1.25 Impediment No. 25 – Inconsistency of NRCS Cost Dockets

It was reported by interviewees that NRCS approved cost dockets are not consistent. This is likely because of necessary adjustments for changes in material and labor costs. The concern is that this inconsistency impacts participants through higher direct costs to the applicant.

4.1.26 Impediment No. 26 – Increased Crop Production not Valued as Benefit

Some "hobby" farmers do not value the small incremental increase in crop production associated with a small farm. The small incremental crop production increase is not sufficient to warrant the capital costs associated with conversion to sprinkler irrigation.

4.1.27 Impediment No. 27 – The Efficiency Improvement Going from Gated Pipe to Sprinklers is too Small to be Cost Effective & EQIP Fundable.

When gated piped has been previously installed on a field, and the landowner wishes to move to a higher efficiency system such as sprinklers, the EQIP worksheet does not yield a sufficient benefit to cover the cost of the new system. This prevents landowners from upgrading their infrastructure and reducing more salt.

4.1.28 Impediment No. 28 – Opportunities for NRCS to Install the High Efficiency Irrigation Systems are not Well Defined or Envisioned.

The benefits of agency efforts & expenditures are minimized because of a lack of planning for the best systems on an area-wide basis and with landowners not fully aware of their possibilities.

A preliminary list of strategies has been developed with a primary focus on the extensive **opportunities** to **maximize salinity control in the Lower Gunnison River basin**. Additionally, the strategies attempt to address many of the impediments identified in Section 4.

As described in an assessment of Salinity Program accomplishments in the basin, continuing the program as is, without changes, will likely result in a moderate level of salinity control. Piecemeal off-farm projects will continue to be implemented in scattered locations resulting in the loss of the opportunity to maximize on-farm improvement. However, adopting all or some of the strategies described in this section could result in a maximization of salinity control in this very promising area.

The following six strategies are designed to help maximize the level of salinity control attainable in the Lower Gunnison basin. We develop these strategies by asking the following questions:

How do we obtain:

1. The **most effective off & on-farm infrastructure**? – Allowing Federal agencies to maximize salt reduction from this area and providing stakeholders with the best, well-thought out irrigation systems
2. The **best local decisions**? – Allowing local interests to fully consider their options with adequate information and make the best long-term choices.
3. Beneficial **partnerships and funding synergies**? – Allowing the Federal agencies to maximize the results of their projects by working together with like-minded entities instead of separately.
4. The **most effective agency processes**? – Removing or minimizing any impediments to maximizing salinity reduction
5. The **most effective implementation of off & on-farm projects**? – Allowing the entities and individuals implementing the projects on behalf of the Federal agencies additional support and ease of implementation
6. **Maximization of the overall effects of large Federal expenditures in this area**? -- Assuring that the large influx of Federal monies in the Lower Gunnison accomplishes as much direct and indirect salinity reduction as possible in the best interest of the taxpayer.

The six strategies which have evolved are explained below.

5.1 STRATEGY NO. 1 -- FACILITATE THE IMPLEMENTATION OF THE MOST EFFECTIVE OFF & ON-FARM INFRASTRUCTURE TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.1.1 ACTION 1. Begin "Master" Planning of Off & On-Farm Facilities in Selected "High Potential" Areas

5.1.1.1 Background & Description of Action:

Presently, a lack of planning typically leads to undesirable consequences – in the case of the Basinwide Program, piping projects are being implemented on a piecemeal basis throughout the lower Gunnison Basin. This means individual ditches may be improved without consideration of the most cost effective design for adjacent pipeline systems and other ways to maximize the use of existing infrastructure. On-farm projects are sometimes implemented without the long-term thinking on what systems might be used where pressure is provided by an off-farm pipeline. Opportunities are being missed. By undertaking or supporting master planning, more opportunities to maximize salinity control could be realized.

This action would explore ditch combinations and optimum layout of pipe delivery systems to reduce overall costs, improve functionality, improve on-farm irrigation efficiency and crop yields and improve the chances of success for local FOA applicants. Fuller utilization of other infrastructure including existing reservoirs would be analyzed. Concurrent promotion and implementation of on-farm improvements would be included. Demonstration projects should be considered to model the "way it should be done". Typically, many individual irrigators become much more interested in upgrading their systems when they see how well improvements have worked out for others.

This is not a new concept, master planning is already being embraced by the UVWUA (currently conducting a study in cooperation with the CWCB and River District) and the Crawford WCD. An example of a "master planning" opportunity that exists for the Program is demonstrated by the high level of interest in the Crawford area (see next page). This is just an example, out of the 11 potential system combinations which were identified in Chapter 3. This has the advantage of having local leadership with a vision for what can be done, a potential for cooperation, would be eligible for additional Reclamation funding through the CRSP MOA funds. If successful, it could serve as an inducement for other entities to implement similar improvements

A CRAWFORD AREA OPPORTUNITY

Many opportunities exist in North Delta County for "Master" planning to maximize salinity reduction, but one of the most promising lies in the Crawford vicinity. Clipper and Grandview ditch companies, in cooperation with the Crawford Water Conservancy District, have been moving forward with evaluation of ditch combination and re-alignment ideas utilizing the "business development" related services of their engineering consultant.

One of the seemingly better ideas involves the potential elimination of the upper 3 miles of the Grandview Ditch, sending a portion of their water through an enlarged Clipper diversion and canal originating from the Smith Fork. Grandview's remaining water right entitlement, including some high runoff, might then be routed through an upgraded Smith Fork Feeder Canal and stored in Reclamation's Crawford Reservoir. Water savings from reduced seepage in completely piped Clipper and Grandview delivery systems could also be stored in the reservoir. It is believed that 90% or more of the water users could convert to sprinkler systems on their farms.

The additional water stored in the reservoir could have multiple benefits including providing water for late season application in a majority of the Smith Fork Project service area; thus improving crop yields and viability of farming operations. The recreation season could be extended at the reservoir.

Hydropower opportunities involving the irrigation water delivery system could be investigated to supplement funding resources, possibly enhancing the financial viability of the project.

This project is also slated to be a beneficiary of CRSP-MOA funding. Initial studies are underway considering upgrades of existing project facilities to assure their continued performance and to possibly enhance Smith Fork Project outputs that may occur as a result of Salinity Control Program funded improvements.

Refer to Figure 3-2 for map of Crawford area.

5.1.1.2 Potential Steps for Master Planning:

The following represents a generic outline of master planning steps which might be employed in the Lower Gunnison Basin.

1. Develop a funding process
2. Dedicate or hire staff and/or consultants
3. Identify candidate areas for maximizing salinity control
   a. Use a screening/rating system
   b. Conduct a brief appraisal study of candidate areas
      i. Review local water user ideas/concepts
      ii. Hold meetings to discuss options
      iii. Identify potential impacts/red flags
      iv. Develop salt load reduction estimates
      v. Use parametric cost estimating to appraise promising areas
   c. Select most promising area(s) for the first detailed study effort(s)
   d. Conduct detailed studies working through issues with stakeholders
   e. Document findings and recommendations

5.1.1.3 Benefits/Advantages of Taking Action (Including How Section 4 Impediments are Addressed):

1. Could provide well thought-out planning basis including advance local coordination along with improved preliminary designs leading to better FOA applications
2. Allows local water users and agencies to develop an overall vision for each delivery system and serviced on-farm systems
3. Lower ultimate costs for Salinity Control Program and applications
4. Easier transition to FOA application for project sponsors
5. Better planning, coordination and concurrent completion of off- and on-farm improvements
6. Longer planning periods allows irrigation companies and individual water users more time to contemplate and possibly become more comfortable with significant changes in water delivery systems.
7. Higher chance of maximizing salt load reductions from simultaneous off- and on-farm improvements and fewer missed opportunities.

5.1.2 ACTION 2. Identify the Best Delivery System Design, Construction Strategies and Develop a Vision to Maximize Concurrent On-Farm Salinity Control

5.1.2.1 Background & Description

Presently, in some cases, there is limited coordination between off-farm delivery system designers (consultants or Reclamation staff) and their on-farm (NRCS) counterparts. Better

coordination would hopefully lead to more efficiently planned improvements, more flexibility for the landowners and fewer future problems or conflicts.

This action would likely require the formation of interagency team to better define design practices and determine how best to schedule construction of the off- and on-farm improvements. A standard process could be developed to be utilized when each Basinwide FOA selection is made. By undertaking this type of coordination, all could have a better vision of the possibilities and more opportunities to maximize salinity control might be realized.

5.1.2.2 Benefits/Advantages of Action (Including How Section 4 Impediments are Addressed):

1. Allows local water users and agencies to develop an overall vision for each delivery system and serviced on-farm systems
2. Lower ultimate costs for Salinity Control Program and applicants
3. Better planning and coordination of off and on-farm improvements could improve applications and stakeholder confidence
4. By defining standard practices, the competency of preliminary designs could be improved
5. Improved chances of maximizing salt load reductions from simultaneous off-and on-farm improvements and fewer missed opportunities

5.1.3 ACTION 3. Identify the Best, Most Efficient, Improvement Options for Small Acreage Properties with the Least Landowner Effort

5.1.3.1 Background & Description

The lack of good water management on small acreage properties has been discussed frequently over the years. Many new landowners lack the knowledge and motivation to pursue higher efficiency irrigation systems for their properties. However, NRCS recently reported many of their new EQIP applications are coming from such properties. Are the most efficient systems available to them at reasonable cost and minimizing the effort needed to implement and maintain them?

This action would investigate all options for such landowners and provide them with better information to maximize their own vision for their properties and hopefully benefit salinity control.

5.1.3.2 Benefits/Advantages of Action (Including How Section 4 Impediments are Addressed):

1. Provides better options for the small-acreage property owner allowing them better choices.
2. Hopefully, increases interest and participation in EQIP

5.1.4 ACTION 4. Identify Other Infrastructure Related Planning Possibilities:

Other actions that might address infrastructure improvements might include:

1. Evaluating hydroelectric generation opportunities within the irrigation water delivery systems to generate additional revenues and enhance project feasibility
2. Strongly consider implementing a complete, well-planned, off & on-farm "demonstration" project in a high salt loading area to demonstrate to local interests the advantages of such a project. Increase the likelihood of their participation and willingness to forego concerns over some of the impediments listed in **Tables 4.1** and **4.2**.

5.1.5 Impediments Addressed by Strategy No. 1

- Item 2: No comprehensive planning of modernization opportunities to guide proposals
- Item 4: Short competitive proposal process limits
- Item 6: Lack of competent preliminary design
- Item12: The thinking and behavior of some irrigators often evolves slowly
- Item 17: Poor FOA applications
- Item 18: Poor performance by contractors
- Item 19: Piecemeal approach to implementation
- Item 20: Lack of in-place delivery system to provide pressure for on-farm high efficiency systems.
- Item 22: Lack of motivation to change
- Item 27: Size and shape of fields not conducive to sprinklers
- Item 28: Opportunities for NRCS to install the high efficiency irrigation systems are not well defined or envisioned.

5.1.5.1 Obstacles & Potential Response/Mitigation – Strategy 1

If these above actions are pursued under Strategy No. 1, the following obstacles (shown in **Table 5-1**) may have to be addressed. Potential responses or mitigation are suggested.

Table 5-1: Potential Responses to Obstacles of Strategy 1

	Potential Strategy 1 Obstacles	Potential Response/Mitigation
1.	Agency procurement policies may prevent providing assistance directly to potential applicants for Master planning or for demonstration projects	a. Hold competition for funding assistance b. Facilitate direct assistance from Program partners (CWCB, SMP, etc.) c. Award grants to local partner agencies who would hire consultants
2.	Selection of most promising Master planning study areas must be transparent	a. Implement criteria-based, screening/ ranking process and include local team members
3.	Staff available to participate on Item b. interagency team may be limited	a. Hire outside assistance

5.2 STRATEGY NO. 2 -- FACILITATE THE MOST EFFECTIVE LOCAL DECISION MAKING TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.2.1 ACTION 1. Establish In-Basin Coordinator or "Liaison" Position

5.2.1.1 Background & Description

The complexity of Federal programs and agency policies is daunting to many landowners and irrigation companies. Additionally the vast array of options and choices to be made when planning irrigation system improvements can slow or deter action.

This action would install a LG Basin salinity coordinator/liaison to help improve local decision making by providing information, explaining the options to companies and individuals, answering or pursuing answers to questions, coordinating education programs, helping stakeholders through the agency processes, etc. This person would help stakeholders establish their own vision for their properties and irrigation water delivery facilities and thus, benefit salinity control.

The funding for this position would have to be coordinated among the State of Colorado (CWCB & Conservation Districts), Reclamation and NRCS. The position must be independent from the existing agency structure, to have credibility with the local producers. The person should be someone already familiar with the area ("of the basin"), familiar with agricultural issues in the Basin and familiar with the structure of the agencies involved. The lack of such an individual in the past has resulted in the un-coordinated applications which have been seen, but at the

Reclamation FOA level and the NRCS annual EQIP funding. While there is a risk to funding this position, there is also a risk to not funding it – the continuation of fundable, but non optimal projects. If it is funded by "soft money" it would not have to be a perpetual obligation, but would only last as long as the person was successful.

5.2.1.2 Benefits/Advantages of Action (Including How Section 4 Impediments are Addressed):

1. Unlike agency staff, a dedicated individual could have time to work with many stakeholders to:
   a. More thoroughly promote salinity program objectives
   b. Meet and coordinate off/on-farm planning and implementation
   c. Act as an "honest" broker to help facilitate understanding and resolution of issues between stakeholders and agency staff
   d. Assist in evaluating farm economics and justifications for undertaking improvements
2. Increase the quality of available information and provide better options for the landowners allowing them to make the best choices.

5.2.2 ACTION 2. Establish Comprehensive Education Effort and Target Mitigating "Reluctance to Participate" Impediments (Cultural Practices, Water Right Concerns, etc.)

5.2.2.1 Background & Description

Interviews and discussions conducted during this study have revealed the various levels of knowledge and understanding of the Salinity Control Program. Some stakeholders have a fairly intricate knowledge and understanding, while others, mostly those who have been less involved, may not understand some of the basics. The complexities and divisions between the three primary sub-programs – Basinwide, EQIP and Basin States, help create this problem. Other local issues which may impede the implementation of salinity control projects may need better explanation, local discussion and weighing of their importance.

This action would seek to implement a comprehensive educational effort to bridge these gaps. An initiative could be designed to give the stakeholders a much better understanding of the Program and its benefits, including the following facets:

1. The Salinity Control Act, its requirements and basis for the Program
2. A comprehensive review of the program structure, accomplishments and future goals
3. Differences between the agency programs and where to find assistance
4. Where local opportunities exist to improve irrigation systems and what such improvements can mean to irrigation companies and water users.
5. How water rights are affected and how local hydrology and existing water use practices affect planning for new systems
6. Contradictions and untruths could be discussed and corrected.

7. Farmers using improved systems could be provide testimonials or examples for others.

5.2.2.2 Benefits/Advantages of Action (Including How Section 4 Impediments are Addressed):

1. Discussions of local issues could assist stakeholders in examining:
   a. trade-offs when considering modernizing their systems
   b. improved use of facilities to stretch irrigation seasons and increase farm output
2. Helping potential applicants understand how to maximize the results of their efforts
3. Stakeholders may be more likely to participate in the Program

5.2.3 ACTION 3. Improve Salt Load Reduction Estimating Processes and Make Estimates Static While Educating Stakeholders on Estimation Processes

5.2.3.1 Background & Description

Salt load reduction estimates for off-farm projects in the RLG have changed during each subsequent FOA since about 2008 (3 revisions going on number 4 at the time of this report). This has caused irrigation companies difficulties in planning projects and some dissatisfaction with the Basinwide Program. The frequent changes have been the result of Reclamation's continuing "improvements" to the salt load estimating data and methodologies. Some do not recognize how Reclamation's efforts have been beneficial in the RLG, as many projects have been selected for implementation. Formerly rejected FOA applicants, who are making valiant efforts to reformulate competitive projects, have become frustrated. Due to the technical nature of salt load estimating, explanations of Reclamation's process are not necessarily well understood by the stakeholders.

This action would seek to establish the "best" values given the existing data and level of salinity model development and keep those values in place for an extended period (possibly 5 years or the next 2-3 FOAs) , allowing those planning new projects to have a firm basis for their evaluations. Sessions would be held in several locations/times, or on request, to explain in detail the derivation and use of those values. The most promising locations for projects could be discussed. Ideas for maximizing the extent of those promising areas could be evaluated.

5.2.3.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Improved credibility for the estimating process
2. Easier for applicants to plan the best projects

5.2.4 ACTION 4. Identify & Assist Areas Likely to be Less Successful in the FOA Due to Less Salt and Lower Potential for Off-Farm Improvements that also have a Need for Cost Sharing

5.2.4.1 Background & Description

Reclamation uses a methodology to identify the high loading sub-basins or sub-areas of the lower Gunnison basin, such as Cottonwood Creek or the east side of the Uncompahgre Valley. As some portions (sub-basins) of the basin are high in salinity loading, some are also relatively low. The lower loading areas are not likely to be able to compete in the FOA without cost sharing or significant changes in their irrigation water delivery systems.

This action would identify those areas and assist those water users to identify sources of additional funding or cost sharing. If other benefits are identified which bring their own funds (i.e. in-stream flow or other environmental values), the Salinity Program would meet its goals of $/ton saved and the project could move forward.

Are the benefits worth the users incurring some additional costs? Efforts would be made to maximize interest in on-farm improvements in those areas including the installation of higher efficiency systems.

5.2.4.2 Benefits/Advantages of action (Including how Section 4 Impediments are Addressed):

1. The realities of competing in the Basinwide FOA would be made known sooner rather than later so entities could proceed with other plans or accept their condition. Most stakeholders don't have time to fool around with ideas that will not likely to be fruitful.
2. Local concepts for joint cooperation and maximizing their remaining opportunities could be developed, hopefully, maximizing salinity control in those areas.

5.2.5 Impediments Addressed by Strategy No. 2

- Item 1: Lack of understanding of programs
- Item 7: Changing nature of salt load reduction estimates is not well understood
- Item 8: Potential fundable off-farm improvements are limited to certain high salt loading sub-basins
- Item 9: Water rights – risk of losing rights…
- Item 10: Cultural aspects – splitter box mentality; reuse of return flows
- Item 11: Desire to maintain existing system – avoid environmental losses of open ditches and sub-irrigation from ditch seepage
- Item12: The thinking and behavior of some irrigators often evolves slowly
- Item 13: Lack of motivation due to water rich area
- Item 17: Poor FOA applications
- Item 21: Inability to adequately coordinate (on-farm) with off-farm improvements
- Item 22: Lack of motivation to change; includes desires to: 1) stay with existing convenient systems, and 2) Avoid expensive investments & operating costs
- Item 24: Lack of assistance in navigating lengthy and complicated application process
- Item 26: Lack of motivation to get max benefits from existing improvements (particularly with small acreages)

5.2.6 Obstacles & Potential Response/Mitigation – Strategy 2

If these actions are pursued under Strategy no. 2, the following obstacles (shown in **Table 5-2**) may have to be addressed. Potential responses or mitigation are suggested.

Table 5-2: Potential Responses to Obstacles of Strategy 2

	Potential Strategy 2 Obstacle	Potential Response/Mitigation
1.	Difficulty in locating candidates for liaison position fully versed in all facets of the salinity program	Use a team approach - a lead liaison person with several subject matter experts/team members available when needed

5.3 STRATEGIES NO. 3 -- FACILITATE AND ENHANCE PARTNERSHIPS AND FUNDING SYNERGY TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.3.1 ACTION 1. Expand Cooperative Relations and Strategize with the Selenium Management Plan/Selenium Task Force, CWCB, River District, Conservation Districts and Other Appropriate Entities

5.3.1.1 Background & Description

Several other entities work in the Lower Gunnison Basin to improve water use and irrigation efficiency for economic and pollution control reasons. These entities' objectives have benefited by the strong financial role of the Salinity Control Program in this area. They have worked to promote the Salinity Program in the past, and will most likely continue into the future. Some have brought forth funding to support salinity control projects, in some cases, buying down the cost effectiveness values for FOA applicants. A wide variety of activities have been undertaken to help accomplish salinity and selenium reduction goals.

This action would recognize this strong synergy with these partners and develop continuing strategies and cooperative efforts to further the complimentary goals. A coordination team could be developed and meet on a regular basis. Work could also be done with local conservation districts, irrigation entities, etc. to facilitate local funding and cost sharing. Effective incentives for improved water management could be developed among these partners.

5.3.1.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. These entities have desires and capabilities to investigate options for controlling salinity that have not traditionally been pursued by the Salinity Control Program.
2. Some partners are interested in addressing other non-agricultural salinity loading sources including golf courses and ponds.
3. These partners provide staff resources and funding for projects and activities that may be aimed at other issues such as selenium, but also reduce salinity, including
   a. Direct funding from the CWCB to study and potentially pursue various selenium control options
   b. Staff previously successful in obtaining grants for studies and projects, including cost sharing for salinity projects.

5.3.2 ACTION 2. Coordinate Planning Activities and Projects with Reclamation's CRSP-MOA) and Upper Basin States or Upper Colorado River Commission

5.3.2.1 Background & Description:

Several of the Reclamation projects in the lower Gunnison basin are scheduled or eligible to be the beneficiaries of CRSP-MOA funding. This funding is administered by Reclamation, but close coordination with the Upper Basin States is required. These projects include the Smith Fork Project (Crawford Reservoir), Paonia Project, and Uncompahgre Project. To be eligible to use these monies, projects must be directly tied to existing CRSP projects, and improve water availability, water quality or have other environmental values. Some early allocations of funding have been made available. Reclamation currently has underway a priority-setting study to help allocate the remaining funding which will become available in future years. Although this funding cannot be used to directly buy down the cost effectiveness of projects proposed in the FOA application process, it can potentially accomplish salinity control on its own (lining or piping ditches not presently cost competitive under the FOA) or "enable" projects funded through the FOA. "Enabling," for example, could include constructing a re-regulating reservoir that then allows a canal to be downsized with lower piping or lining costs.

This action might have Master planners coordinating directly with MOA planners to maximize project outputs while reducing salinity loading. This is already occurring to some degree with the previously mentioned Crawford area studies.

5.3.2.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Synergy between the Salinity Program and CRSP-MOA could produce greater overall benefits for the both programs and local water users.

5.3.3 Impediments Addressed by Strategy No. 3

- Item 2: No comprehensive planning of modernization opportunities to guide proposals
- Item 28: Missing high efficiency opportunities
- Item 28: Opportunities for NRCS to install the high efficiency irrigation systems are not well defined or envisioned.

5.4 STRATEGY NO. 4 -- FACILITATE THE MOST EFFECTIVE FOA/EQIP/BSP PROCESSES TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.4.1 ACTION 1. Provide Assistance to Potential FOA/EQIP/BSP Applicants to Improve the Quality of their Applications

5.4.1.1 Background & Description

Interviews and discussion with potential applicants have indicated a need exists to help small irrigation companies and individuals assemble better, more complete applications and to work through the complicated and sometimes lengthy agency selection processes.

This action would provide "coaching" for anyone desiring help to submit an application. Capabilities of agency staff could be enhanced to provide this service. "Master plan" output could be used to help applicants select the best projects and construction sequence. That output could possibly provide improved preliminary designs for FOA applications

5.4.1.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Increased quality of applications making the job of evaluating and selecting projects for funding much easier
2. Improve Program credibility, work relationships and stakeholder confidence in the Program

5.4.2 ACTION 2. Re-Consider Existing Program Policies and Procedures that may be Limiting Accomplishment of the Most Cost Effective Project Components

5.4.2.1 Background & Description

Some agency policies developed for their selection and implementation processes may actually be limiting what can be accomplished in terms of maximizing salinity control. For example, it is expected that several projects undergoing Master planning will require some redundant facilities and have extra costs if required to have separate stand-alone projects not exceeding a set dollar amount. This has already encumbered several applicants in past FOAs. The ultimate cost of accomplishing salinity control is higher.

Staff availability, funding sequence, reimbursement methods, etc. can all be limiting salinity control accomplishment. Delays in funding for selected projects can results in higher costs and overruns and other difficulties for irrigation companies and individuals.

This action would encourage the agencies to re-examine the objectives of some policies and procedures and consider the trade-offs and lost opportunities. While still being responsive to the original reasoning for the policy/procedure, can it be modified to allow the realization of projects which will maximize salinity control in the Lower Gunnison Basin? Would it be feasible to give "special" consideration to areas where Master Plans are in place? Is any stream-lining possible? The reasoning behind agency procedures and policies could be made available to stakeholders to increase transparency.

5.4.2.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Increased participation and more salinity control
2. Increased credibility for the agencies

5.4.3 ACTION 3. Target or "Fast-Track" On-Farm Work in Areas Selected for Pipeline Projects

5.4.3.1 Background & Description

The concurrent installation of on-farm improvements at the same time as pipeline construction is believed to provide the best circumstances for optimizing projects. With known information on the type and size on the on-farm irrigation system, pipelines can be sized and designed to give flexibility while minimizing costs, and increase the potential for selection in the FOA process.

This action would install a policy that prioritizes on-farm improvement design and installation for areas with funded off-farm projects to encourage the best overall outcome.

5.4.3.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Fewer missed opportunities to obtain the biggest bang for the salinity control buck.
2. Good demonstration to other irrigators of what is possible in a well-coordinated effort.

5.4.4 Impediments Addressed by Strategy No. 4

- Item 3: Lengthy and complicated FOA application and award process
- Item 6: Lack of competent preliminary design
- Item 23: Lack of timely designs and coverage of small acreage opportunities due to insufficient NRCS staff
- Item 25: Inconsistency of NRCS cost dockets from year to year

5.4.5 Obstacles & Potential Response/Mitigation- Strategy 4

If these actions are pursued under Strategy No. 4, the following obstacles (shown in **Table 5-3**) may have to be addressed. Potential responses or mitigation are suggested.

Table 5-3: Potential Responses to Obstacles of Strategy 4

	Potential Strategy 4 Obstacle	Potential Response/Mitigation
1.	Federal agency staff limitations	Hire more outside help

5.5 STRATEGY NO. 5 -- FACILITATE THE MOST COST EFFECTIVE OFF & ON-FARM IMPLEMENTATION TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.5.1 ACTION 1. Educate and Provide Additional Assistance Concerning Project Management for Small Irrigation Companies and Individual Water Users

5.5.1.1 Background & Description

The implementation of multi-million dollar projects by small irrigation companies is extremely difficult and time consuming. Luckily for the Salinity Program, some board members have been willing to dig in, donate the time, and undertake the risks. Others are likely deterred by the immenseness of it all. Salinity control is limited when no one is willing to do the work or is not trained in or familiar with the processes.

This action could provide training on various topics involved in installation and operation of improved systems, including:

- how to manage small and large construction projects & contracts
- Federal procurement processes and policies
- Right-of-way procurement
- Pipeline water management

This is another place where coaching could enhance the ability of small companies to undertake large projects.

5.5.1.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. If board members are better trained in managing projects, they may be more willing to undertake the risks and submit applications
2. Potential for reduced costs
3. Could make life easier for agency staff overseeing the implementation of these projects that have their own well trained staff/board members.

5.5.2 ACTION 2. To Improve Efficiency, Consider Centralizing Some Work Through the Conservation Districts or Another Entity

5.5.2.1 Background & Description

Some implementation tasks might be more efficiently performed by one entity. Development of habitat replacement plans and some construction tasks may be worth considering in order to trim costs.

This action would examine implementation processes and attempt to isolate activities that might be better performed by some central, area-wide entity. Those entities with an interest should be involved from the beginning in looking at the possibilities.

5.5.2.2 Benefits/Advantages of Action (Including how Section 4 Impediments are Addressed):

1. Potential for reduced costs and better overall implementation

5.5.3 Impediments Addressed by Strategy No. 5

- Item 14: Ability to manage large projects and risk of cost overruns
- Item 15: Difficulty in securing rights-of-way or in combining delivery systems
- Item 16: Learning water management for new pipelines

5.6 STRATEGY NO. 6 -- FACILITATE INDIVIDUAL WATER USERS TO MAXIMIZE THE EFFECTS OF FEDERAL EXPENDITURES TO MAXIMIZE SALINITY CONTROL

Actions to be considered:

5.6.1 ACTION 1. Greater Promotion of Irrigation Water Management

5.6.1.1 Background & Description

Extensive on-farm improvements have occurred on approximately 8,406 sprinkler/drip irrigated acres in the Lower Gunnison Basin [9]. Initially, these improvements may have met the efficiency expectations of the designers. However, some losses in efficiency have been reported, and it is critical to maintain those original performance levels. This action would seek to maintain and expand existing Irrigation Water Management activities. Would additional staff or continuing education activities help maintain performance and/or create additional salt savings?

5.6.1.2 Benefits/Advantages of Action (How Section 4 Impediments are Addressed):

1. The benefits of current and future salinity control projects would be maximized.

5.6.2 ACTION 2. Implementing a Social Marketing Program to Help Facilitate Better Water Use Decisions by Individuals

5.6.2.1 Background & Description

This action would seek to use social marketing principles to improve the outcome of those decisions. Doug McKenzie-Mohr (an innovator of this strategy) has developed such a program

and says -- "Community-based social marketing is based upon research in the social sciences that demonstrates that behavior change is most effectively achieved through initiatives delivered at the community level which focus on removing barriers to an activity while simultaneously enhancing the activities' benefits. Community-based social marketing involves four steps: 1) Identifying the barriers and benefits to an activity, 2) Developing a strategy that utilizes 'tools' that have been shown to be effective in changing behavior, 3) Piloting the strategy, and 4) Evaluating the strategy once it has been implemented across a community."

5.6.2.2 Benefits/Advantages of Action (How Section 4 Impediments are Addressed):

a. This could work to address lack of motivation to get obtain maximum benefits from existing and future agency improvements, particularly for small-acreage properties.
b. It could help establish a set of community norms which call for widespread installation of efficient irrigation systems and their long-term maintenance to maximize benefits.

5.6.3 Impediments addressed by Strategy No. 6

- Item 10: Cultural aspects – Splitter box mentality; reuse of return flows
- Item 12: The thinking and behavior of some irrigators often evolves slowly
- Item 26: Lack of motivation to get max benefits from existing improvements (particularly with small acreages)

5.6.4 Obstacles & Potential Response/Mitigation – Strategy 6

If these actions are pursued under Strategy No. 6, the following obstacles may have to be addressed. Potential responses or mitigation are suggested.

Table 5-4: Potential Responses to Obstacles of Strategy 6

	Potential Strategy 6 Obstacles	Potential Response/Mitigation
1	Keeping good IWM staff on board is problematic given existing low salaries.	Provide additional funding to conservation districts for this vital service.
2.	Being a non-traditional measure, social marketing may be difficult for the Program to undertake	a. Work with interested partners to implement this effort b. Provide grants for others to pursue this action

6.1 RECOMMENDATIONS

Reclamation and the NRCS have had a very successful salinity control program in the Lower Gunnison Basin for nearly three decades. During this time, their efforts have resulted in a reduction in salt loading of over 185,000 tons annually. However, there is still a great potential in the basin to do more, limited only by funding availability, vision and leadership. This assessment has shown that there is very good acceptance in the basin for the program, but many of the potential participants have significant other, personal priorities that would limit their ability to participate as fully as possible. The four most important recommendations which came from this assessment are:

BASIN COORDINATOR: Through a combination of Federal, State and local funding, a full time, locally based Salinity Coordinator is needed to provide the many small companies and private individuals with the support necessary to move forward with the best implementation for the area. This requires an individual who understand the basin, the people, the hydrology and the agencies. It may not be easy to find such an individual, but the stakes in terms of long term Federal investments are high The individual needs to be outside of the existing bureaucracy to have local credibility.

COMPREHENSIVE PLANNING: In particular with the many small ditch and reservoir companies that exist outside of the UVWUA service area, there is obviously a great potential to combine and improve groups of canals and laterals. There is also a large social inertia which must be overcome and can only be overcome by a common development of a grand vision for how things could be. This doesn't come easy, but the payoffs can be enormous, as the potential salt (and selenium) savings are almost limitless.

HYDROPOWER INTEGRATION: With the new legislation and proposed legislation to increase the use of renewable energy, hydropower can be used to assist with project funding. The Colorado Agriculture Department is very interested in assisting in this area.

IMPROVED IRRIGATION WATER MANAGEMENT SUPPORT: Much of what can be accomplished can be accomplished with existing systems being operated more efficiently on a continuous basis. We can't always just go in, make the necessary capital improvements, and leave, hoping that all will be well in the future. We have heard also that the pay scale for good IWM personnel does not really support their long term retention, and a way should be found to recognize the federal and national benefit that can be achieved through continuous, effective Irrigation Water Management.

The area has great potential and great people – let's find a way to maximize what is done in the future in this basin.

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Appendix A

Salinity Control Accomplishments Report, Lower Gunnison Basin, Colorado, January 2013

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1.1 BRIEF SALINITY PROGRAM HISTORY IN THE LOWER GUNNISON BASIN

The Colorado River Basin Salinity Control Program (Salinity Control Program), under the Colorado River Basin Salinity Control Act, was established in 1974 to reduce and maintain salinity concentrations within the Colorado River Basin to a level compliant with the Colorado River Basin Water Quality Standards. To meet these standards, continued investment has been placed in more efficient agricultural irrigation systems, irrigation conveyance systems and, other projects (ex. deep well injection, gas well plugging, ect.) in order to reduce salinity laden return flows to the Colorado River and its tributaries.

The Lower Gunnison Basin Unit (LGBU) is located in the west-central Colorado in the Upper Colorado River Basin. It primarily is delineated within the counties of Delta and Montrose known for areas of high saline soils and the underlying Mancos Shale Formation. Percolation of water due to natural infiltration and irrigation conveyance system and irrigation application seepage come in contact with these high saline formations and ultimately return to the Colorado River with high salt loading. For the Bureau of Reclamation's (Reclamation) study purposes, the LGBU was broken into two separate study areas: The Uncompahgre Project Area and the Remaining Lower Gunnison (RLG) Area. The Uncompahgre Project Area includes part of the drainage area to the Uncompahgre River before its confluence with the Gunnison River. The Uncompahgre Project encompasses lands surrounding the town of Montrose, Colorado and extends approximately 34 miles along both sides of the Uncompahgre River to Delta Colorado to serve approximately 76,000 acres of project land [23]. The RLG Area resides mostly in Delta County and encompasses areas on the North Fork of the Gunnison River as well as areas north and south of the city of Delta, Colorado along the Gunnison River including Tongue Creek, Surface Creek, and the Colona area. The project area with delineated 10-digit Hydrologic Unit Codes (HUCs) is illustrated in Figures 4 to 6.

There are three main on-farm and off-farm programs that are currently in place to help assist farms, ditch companies, and the LGBU in general to alleviate salt loading to the Colorado River: the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP), Reclamations Basinwide Program, and the Basin States Program (BSP). The following sections give a brief description of each program.

1.1.1 NRCS - Environmental Quality Incentives Program

Majority of the on-farm salinity control measures can be implemented by the NRCS through EQIP. Qualifying applicants receive a financial incentive set by the cost docket, typically a 75% cost share, (fixed at the time of contracting) to install and maintain conservation practices that provide salinity control benefits. Applications are screened, ranked, and selected based on optimized environmental benefits, including cost effectiveness.

1.1.2 Reclamation Basinwide Program

Reclamation's Basinwide Salinity Control Program was initiated in 1995 to apply a new approach of implementing salinity controls. All programs under Reclamation's Basinwide Program compete for funding through a "Request for Proposal" process [8]. In 2007, projects were then switched to a system that solicited through a process for financial assistance

agreements called Funding Opportunity Announcements (FOAs) and chosen based on ranked on cost effectiveness ($/tons removed) and risk factors. Applications are only in areas above Hoover Dam where salt loading has been derived and adopted. Successful salinity control projects chosen to be funded under the Basinwide Program are funded by a one-time grant that is limited to the sponsor's competitive bid. All facilities implemented under the chosen project are then owned, operated, maintained and replaced by the sponsor's own expense [19]. Majority of the projects chosen have been improved irrigation delivery systems.

1.1.3 Basin States Program

The BSP is a program created to better utilize the funds repaid by the Upper Colorado River Basin Fund and the Lower Colorado River Basin Development Fund (Basin Funds). Basin Funds are financed from the sale of power generated at hydropower facilities along the Colorado River. The Reclamation is authorized to use Basin Funds to reimburse allocated costs of salinity projects or supplement salinity projects by meeting cost-share requirements [7]. Basin Funds used for cost sharing in the Reclamation and NRCS programs are administered through the BSP. The BSP has funded on-farm projects that do not meet EQIP eligibility requirements and off-farm projects that are too small for the Basinwide program.

2.1 SUMMARY OF PRE-PROJECT LOADING ESTIMATES

2.1.1 Salt Allocation Scenarios

The total annual salt loading in the LGBU is composed of on-farm and off-farm loads based on the provided references. The earliest salt loading baseline reported is published in the SCS (now NRCS) 1982 Final Environmental Impact Statement (EIS) [4]. The 1982 EIS indicates a total baseline annual salt loading of 1,440,000 tons/year with a total agricultural (artificial) loading of 840,000 tons/year and residual other loading from non-agricultural sources and sources outside the LGBU basin (the Upper Gunnison Basin) of 600,000 tons/year. An estimated annual salt loading of 440,000 ton/year of the 840,000 tons/year total artificial total is estimated to be from on-farm practices on an estimated 171,000 potentially irrigated acres with the resulting 400,000 ton/year originating from off-farm, conveyance induced loading. Reclamations Grand Junction, Colorado supplied a salt loading diagram that summarizes off-farm and on-farm baseline loading values currently being used for the Uncompahgre Project Area and how they are divided up between the eastern and western areas [23]. The flow diagram also states the on-farm and off-farm baseline salt loading estimates for the RLG area as well as the sub-area baseline estimates for within the off-farm loading from the 2012 USGS LowGunS model described in Section 4.6 [23]. A conceptual flow diagram of how each baseline loading allocation is divided among the basin is shown in Figure 1 and tabulated on Table 2.1.

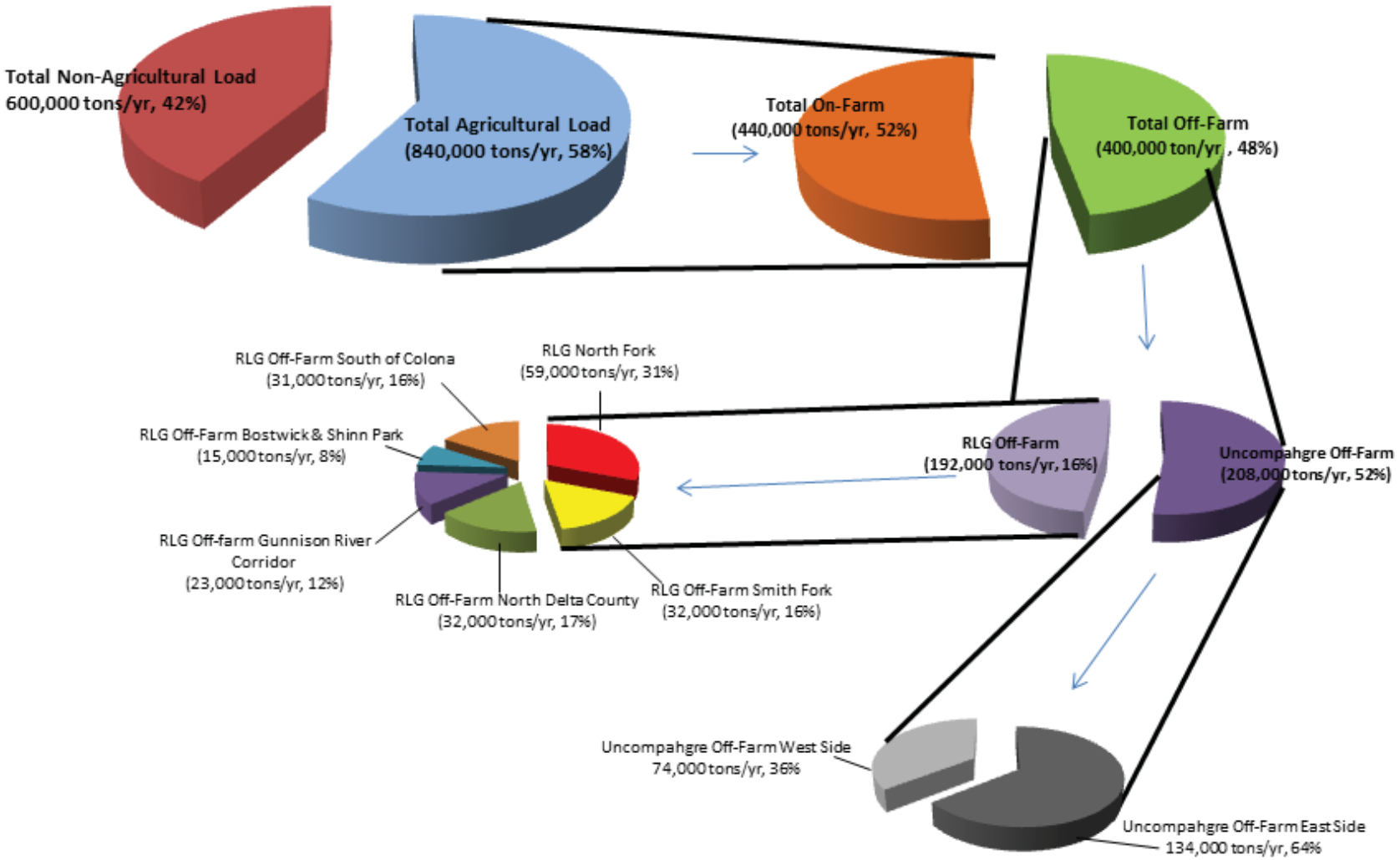


Figure 1. Conceptual Lower Gunnison Basin Unit Baseline Salt Load Allocation

Table 2.1. Tabulated Lower Gunnison Basin Unit Salinity Baseline Loading Values [23].

Major LGBU Entities	Loading Value (ton/yr)	Percentage (%)
Total LGBU Loading	1,440,000	-
Total LGBU Agricultural Loading	840,000	58%
Total Non-Agricultural + Upper Gunnison Loading	600,000	42%

LGBU Agricultural Loading	Loading Value (ton/yr)	Percentage (%)
Total LGBU Agricultural Loading	840,000	-
Total Off-Farm	400,000	48%
Total On-Farm	440,000	52%

Uncompahgre Project Off-Farm Loading	Loading Value (ton/yr)	Percentage (%)
Total Off-Farm	208,000	-
East Side	134,000	64%
West side	74,000	36%

Remaining Gunnison River (RLG) Off-Farm Loading	Loading Value (ton/yr)	Percentage (%)
Total Off-Farm	192,000	-
North Fork Basin	59,000	31%
Smith Fork Basin	32,000	17%
North Delta County	32,000	17%
Gunnison River Corridor Area	23,000	12%
Bostwick & Shinn Park Areas	15,000	8%
Area South of Colona	31,000	16%

3.1 TREATMENT STATUS

Projects implemented to date by cooperating agencies prevent an estimated 1.19 million tons of salt annually from reaching the Colorado River System [8]. Reclamation, BLM and NRCS have a combined control target of 1.85 million tons by the year 2030. Treatments include projects to reduce seepage from canals and from improved on-farm irrigation efficiencies.

3.2 ON-FARM IRRIGATION IMPROVEMENTS

Reporting of accomplishments for on-farm irrigation improvements from the M&E reports for the LGBU are reported as acreage of irrigated land on which improvements in irrigation efficiency have been completed. Reported acreage that has been treated includes fields that have been treated a second time to a higher level of irrigation efficiency and salt savings over the course of the salinity project [3]. This could include improvement from flood to gated pipe flood irrigation; from flood to sprinkler; from gated pipe to sprinkler; or improved flood irrigation efficiency. Figure 2 shows the cumulative on-farm efforts for reducing salinity loading in the LGBU since 1998 from NRCS. The graph indicates approximately 66% of the 166,000 tons/year basin goal has been achieved at the time of the publication of the 2011 Monitoring and Evaluation Report (M&E Report) [3] for the LGBU. The status of treatment has been reported by NRCS in its annual M&E Report [3] and by Reclamation in various interim status reports [7] and [8]. This document does not replicate those documents but consolidates and summarizes accomplishments from those other sources and compares them with GIS data from other sources. Figure 3 shows the cumulative on-farm acreage types of improvements since the projects inception.

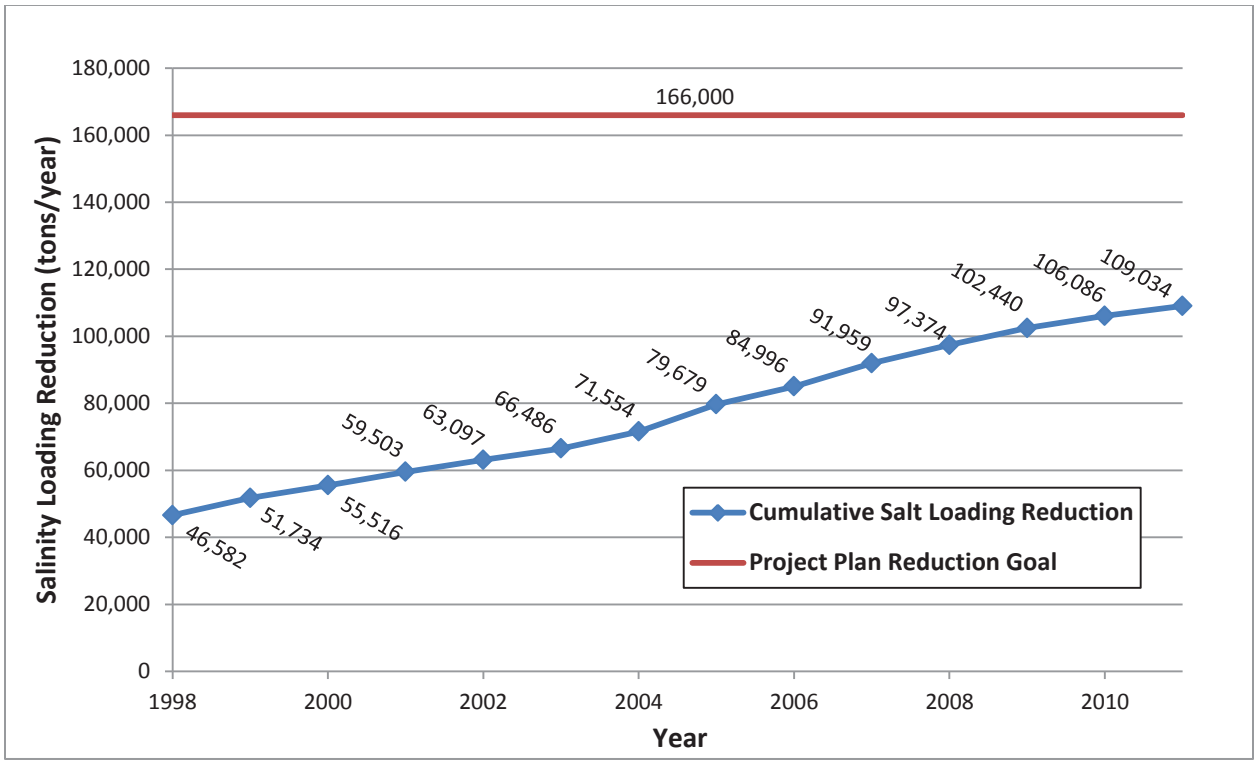


Figure 2. Lower Gunnison Basin Cumulative On-Farm Salinity Load Reduction Trend [3].

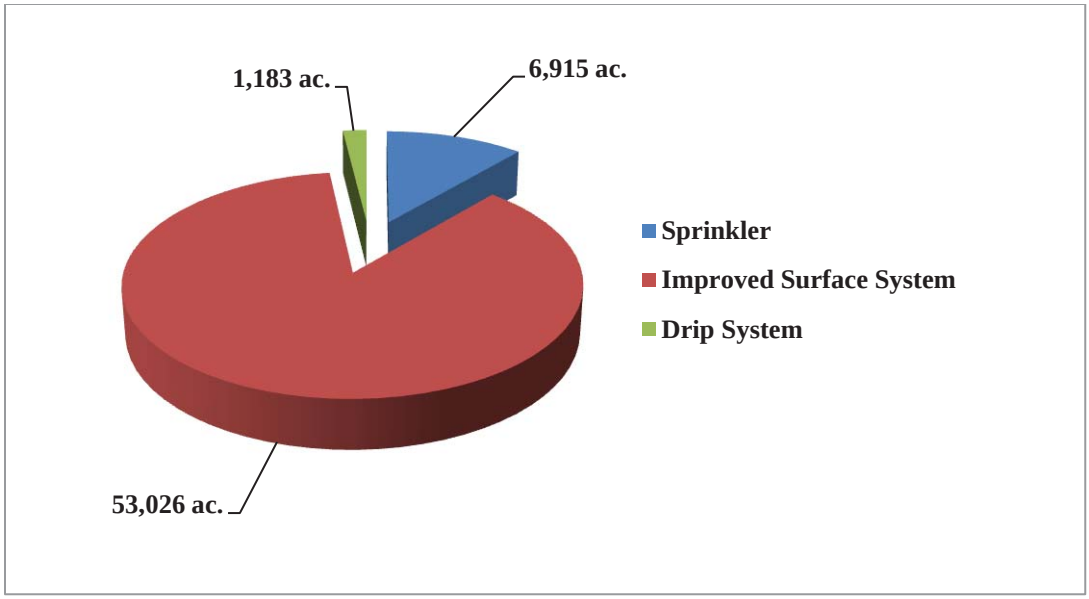
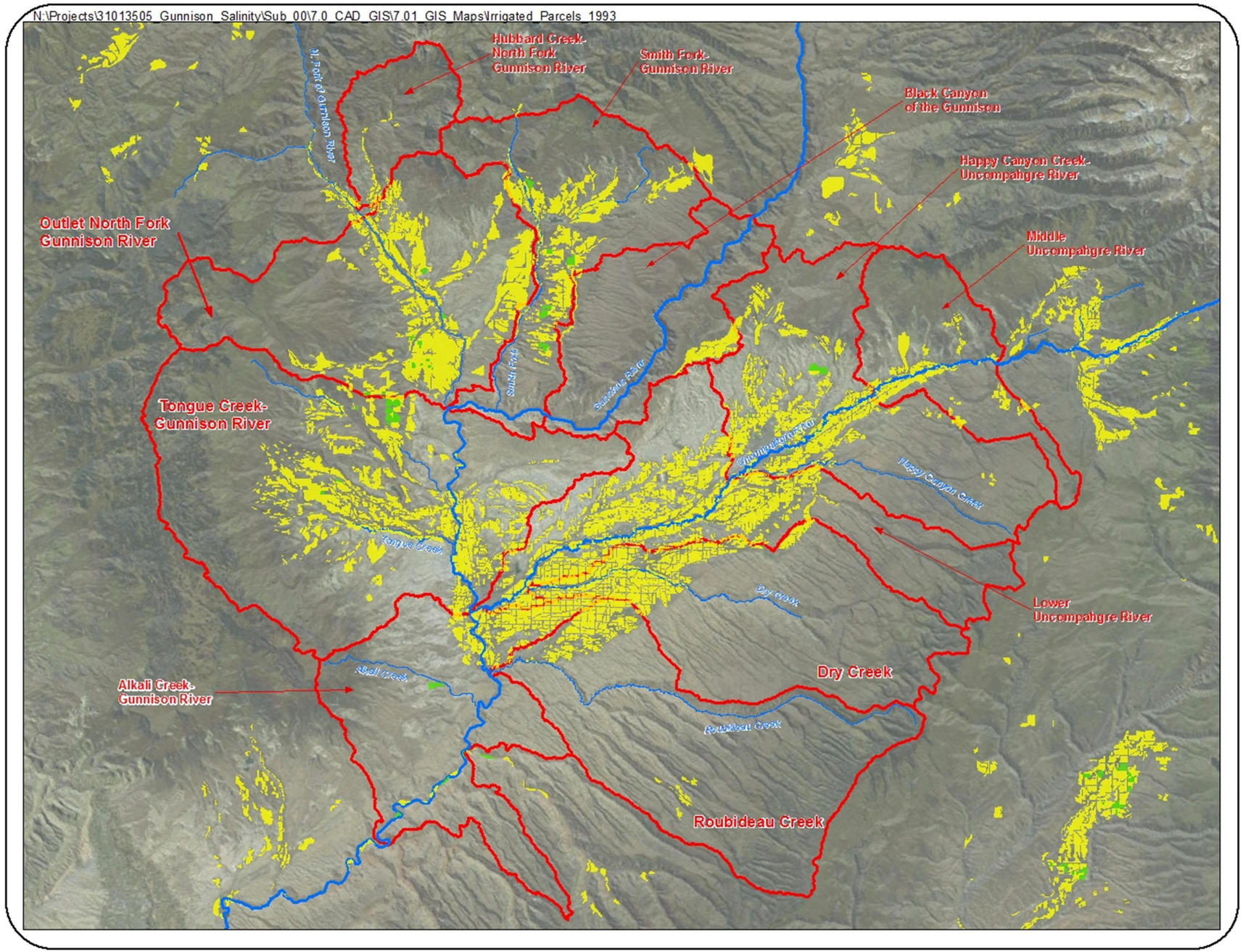


Figure 3. Lower Gunnison Basin Cumulative Irrigation Improvement Types [3].

The M&E 2011 Report goes into more detail on the LGBU's irrigation improvement history and localized irrigation development trends: The earliest mico-spray systems were installed in the late 1980s and have stayed relatively consistent. Sprinkler irrigation is becoming more popular in areas with larger, more uniform field sizes; however, there are many relatively small areas with irregular shapes that make the sprinkler installation problematic. Some areas with little relief and large fields make the installation of gravity pressure delivery systems needed for sprinkler systems extremely difficult and most likely will require pump stations. Regardless, there has been an increase in the installation of sprinkler systems in these larger fields in recent years due to the systems ease of operation and more uniform application. Smaller fields in the upper areas of the basin have been improved to drip and micro-spray systems which are attributed to the increased number of vineyard and orchard operations, but on a relative basin scale, account for little of the overall irrigated acreage in the basin.

The CDSS (Colorado Decision Support System) GIS publically available irrigated acreage data provides snapshots of the irrigated area and irrigation type for years 1993, 2000, and 2005 shown in Figures 4, 5, and 6, respectively. The GIS data sets were initially delineated and categorized using NAIP (National Agriculture Imagery Program) imagery for each respective irrigated year at the snapshot the NAIP imagery was taken. The irrigated parcels can be divided into three types of irrigation practices for each year's snapshot in time: Sprinkler, Drip, and Miscellaneous Flood. The data sets have more irrigation type attributes but were historically estimated based on aerial imagery and not back checked with ground survey. Currently, the data is being validated by local knowledge and ground observations, such as water commissioners input and other local knowledge. Figure 7 and Table 3.1 summarize the CDSS irrigated acreage GIS data sets at the time of this report but it should be noted that these data sets are still a work in progress. However, the total irrigated acreage for the basin as well as the irrigated acreages for the three previously stated irrigated classification types should be correct for these year snapshots in time.

A preliminary 2010 irrigation data set was obtained but is still being quality checked at the time of this report. Actual numbers or the spatial distribution were not tabulated or mapped for this report but conceptual trends, when compared to earlier years, seem to align with historical trends in that sprinkler irrigation continues to grow, miscellaneous flood continues to decrease, and the total irrigated acreage for the basin continues to decrease due to urban sprawl.


N:\Projects\31013505_Gunnison_Salinity\Sub_00\7.0_CAD_GIS\7.01_GIS_Maps\Irrigated_Parcels_1993
Hubbard Creek-North Fork Gunnison River
Smith Fork-Gunnison River
Black Canyon of the Gunnison
Happy Canyon Creek-Uncompahgre River
Middle Uncompahgre River
Outlet North Fork Gunnison River
Tongue Creek-Gunnison River
Lower Uncompahgre River
Dry Creek
Alkali Creek-Gunnison River
Roubideau Creek
Legend
Rivers
Creeks
Project 10 Dig. HUCs
Irrigation Type
Misc. Flood
Sprinkler
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N
E
S
W
* Irrigated Parcel Data: CDSS
Aerial Source: ESRI online GIS server
Miles
0 3 6 12
1 in = 6 miles
Figure 4
Irrigated Parcels - 1993
Lower Gunnison River Basin Salinity Study
Date: 11/26/12 By: JWM

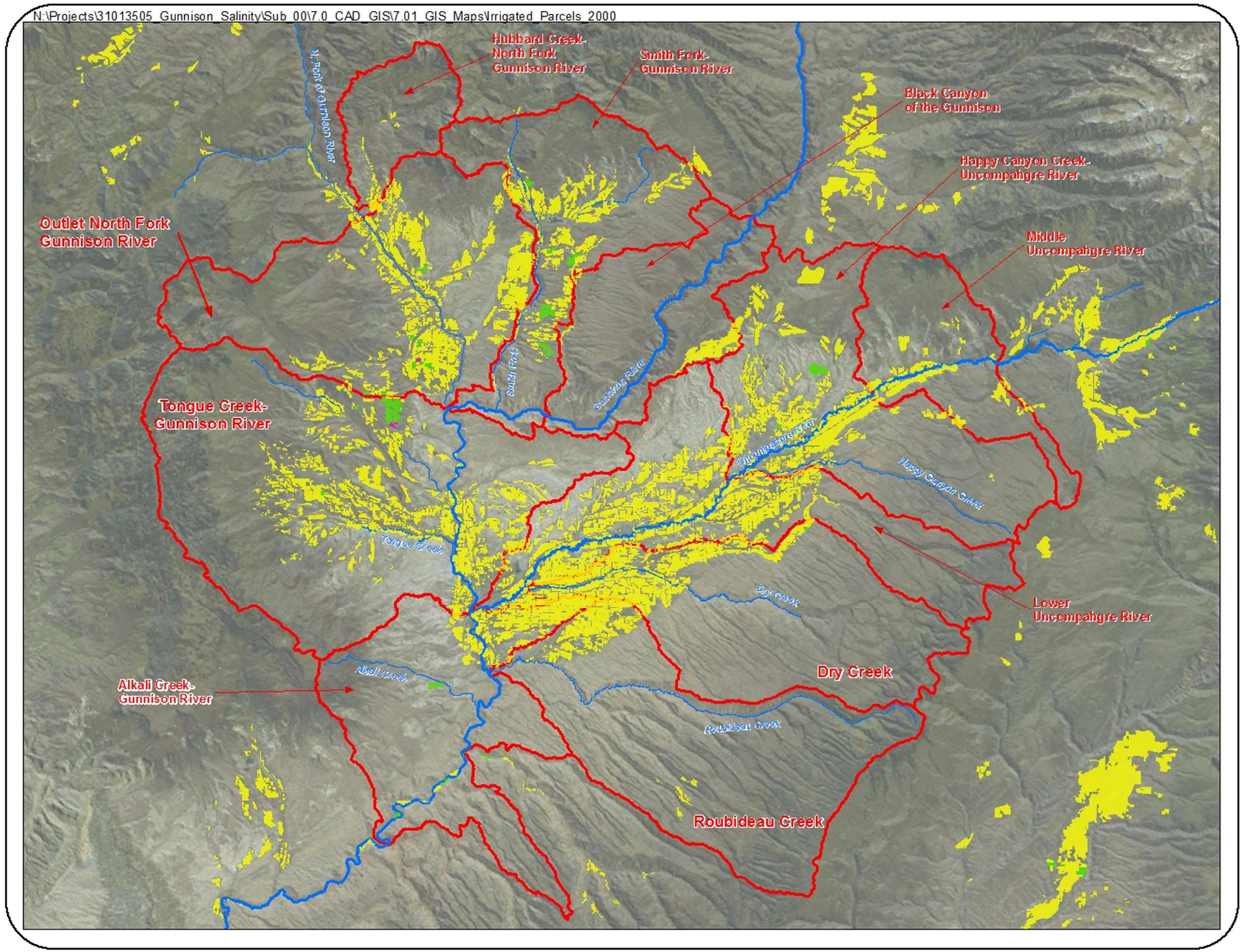
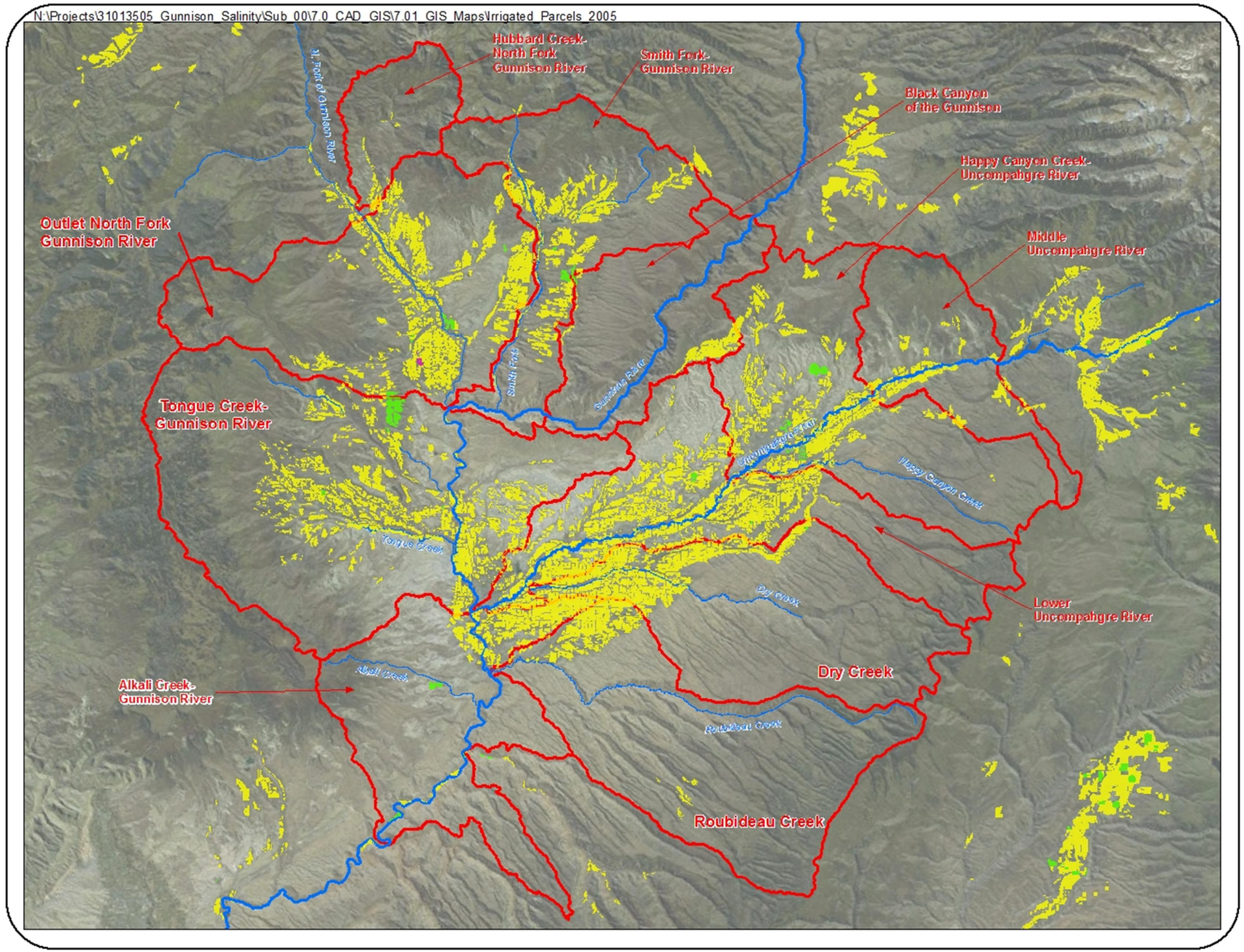


Figure 5

Irrigated Parcels - 2000

Lower Gunnison River Basin Salinity Study

Date: 11/26/12 By: JWM



Legend

- Rivers
- Creeks
- Project 10 Dig. HUCs

Irrigation Type

- Drip
- Misc. Flood
- Sprinkler

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N E S W

* Irrigated Parcel Data: CDSS
Aerial Source: ESRI online GIS server

Miles
0 3 6 12
1 in = 6 miles

Figure 6

Irrigated Parcels - 2005

Lower Gunnison River Basin Salinity Study

Date: 11/26/12 By: JWM

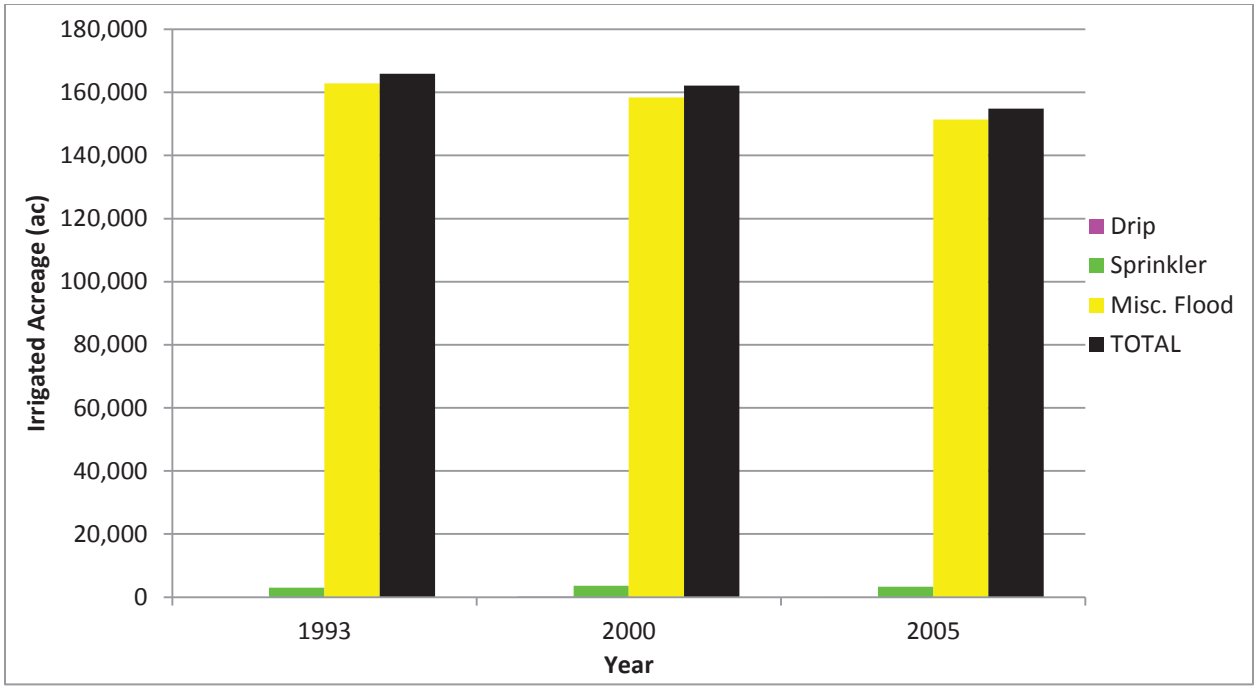


Figure 7. Lower Gunnison Irrigation Type Distribution from CDSS GIS data.

Table 3.1 Tabulated Lower Gunnison Irrigation Type Distribution from CDSS GIS data.

Irrigation Type (ac)	Year					
	1993		2000		2005	
	Area (ac)	% of Total	Area (ac)	% of Total	Area (ac)	% of Total
Drip	0	0.0%	116	0.1%	78	0.1%
Sprinkler	2,975	1.8%	3,635	2.2%	3,298	2.1%
Misc. Flood	162,900	98.2%	158,450	97.7%	151,426	97.8%
TOTAL	165,875	100%	162,200	100%	154,802	100%

According to the NRCS irrigation application efficiency standards, drip and sprinkler irrigation practices provide the highest irrigated efficiency ranging from 70%-95% as opposed to gated pipe and flood irrigation that range in efficiencies of 35%-50% that are part of the miscellaneous flood irrigation category [3].

3.3 DATA SOURCES FOR CANAL AND LATERAL TREATMENT

Data used for reporting canal and lateral improvements was obtained from the Reclamation's GIS department as a work in progress. Canals were supplied in two major drainage areas within the LGBU: the Uncompahgre River area and the RLG area. Only ditches that met two sets of criteria were surveyed: 1) A decreed right of greater than 4 cfs 2) Services two or more users. Some owners, although a relatively small number of them, would not participate in the ditch survey mapping and either did not allow access on their land or did not release their decreed right of the ditch. Ditches were classified as either canals or laterals based on the surveyor's judgment. Canals represented a "main stem" of conveyance whereas laterals represented

branches from the "main stem." The GIS attribute data labeling the line networks is currently being deciphered and filled in from point based survey data. The unlabeled ditch types were manually updated as improved lateral or canal type (a piped or lined ditch) by URS based on point survey data obtained from the Grand Junction Reclamation office and aerial imagery.

The Remaining Gunnison River area canals and laterals GIS file is still a work in progress. The data is tentatively scheduled to be updated in the Spring of 2013 with field verified data as well as the addition of survey data for the upper drainage area south of Colona. Figure 8 provides a map of the current state of the canals and laterals data for the RLG area. A few line ditches were manually updated with either canal and lateral designations by URS based on point survey data and aerial imagery.

The Uncompahgre River GIS data source provided more detailed attributes to analyze between improved and unimproved canals and laterals as well as lateral piped phase improvements from the multiple phases of the East Side Lateral Program. All improvements replaced earthen ditches with underground pipelines [17]. Figure 9 provides the resulting GIS mapped canals and laterals data for the Uncompahgre Project Area section of the Lower Gunnison Basin Unit.

3.4 CANAL AND LATERAL TREATMENTS

The ditch GIS data supplied by Reclamation shown in Figures 8 and 9 is currently a work in progress. This data refers to only off-farm ditches. Reclamation and NRCS have not considered elimination of on-farm ditches (or sometimes referred to as near-farm ditches) in their declared benefits from the salinity control program.

Apart from the GIS data source treatment results, a Winter Water Program within the Uncompahgre Project Area was completed in 1995. The Winter Water Program was designed to eliminate the use of unlined canals and laterals during the winter months for livestock [17]. The program expanded the domestic water system in the area to fill stock water tanks and eliminated seepage during the non-irrigation season which is estimated to reduce the salinity loading from the canal system by approximately 41,380 tons/year [17].

Also within Uncompahgre Project Area, the East Side Lateral Program is planned to replace approximately 195 miles of earthen irrigation laterals and approximately 7 miles of small canals east of the Uncompahgre River with underground pipelines. The Plan is currently competing for funding in Reclamation's Basinwide Salinity Control Program under the authorities of Public law 104-20 [19]. The total estimated salt load reduction, when the East Side Lateral Program project is fully completed, is approximately 98,880 tons/year [17]. According to Reclamation's Grand Junction office, as of March 2013, construction of lateral phases 1-4 and 6A have been completed while phases 5 and 7 have been started (see Tables 3.2 and 3.3).

A 7.5 mile section of existing unlined earthen irrigation laterals was replaced with buried pipe in the South Canal system of the Uncompahgre Project Area in 2000 and was cost-shared under the Departments of Interior's National Irrigation Water Quality Program (NIWQP). NIWQP was interested in assisting in these efforts as cooperative effort in also controlling selenium loads from the area. This cost shared program was estimated to reduce salinity load by approximately 2,300 tons/year [19].

Tables 3.2 and 3.3 summarize the tabulated Basinwide Program off-farm improvements from Reclamation personnel in the Grand Junction office within the LGBU for the Uncompahgre and

RLG areas through March 2013, respectively. Based on these tables, 82.7 miles of earthen laterals have been switched to pipe and 1.6 miles of canal has been lined within the Uncompahgre Project Area, totaling 84.3 miles of improvements. The Winter Water Program could be figured into those improvement length estimates by claiming 552 miles of improvement of canals/laterals that are not in use during the winter months, and thus, are not contributing to salt loading in the winter. These improvements were estimated to reduce annual salt loading from the Uncompahgre Project Area by approximately 65,000 ton/year, which includes the Winter Water Program.

Approximately 32.5 miles of piped canal and lateral improvements are reported within the RLG area were estimated, yielding approximate 11,500 tons/year of salt load reduction. The total estimated salt load reduction under Reclamation's Basinwide Program for off-farm improvements in the LGBU is approximately 76,300 ton/year. These salt loading reduction estimates are preliminary estimates and are subject to change as the USGS LowGunsS salinity model, used to prorate salt loading within the RLG area (See Section 4.6), may become more refined in the future.

Table 3.2 Summary of Basinwide Program Off-Farm Improvements for the Uncompahgre Project Area[1]

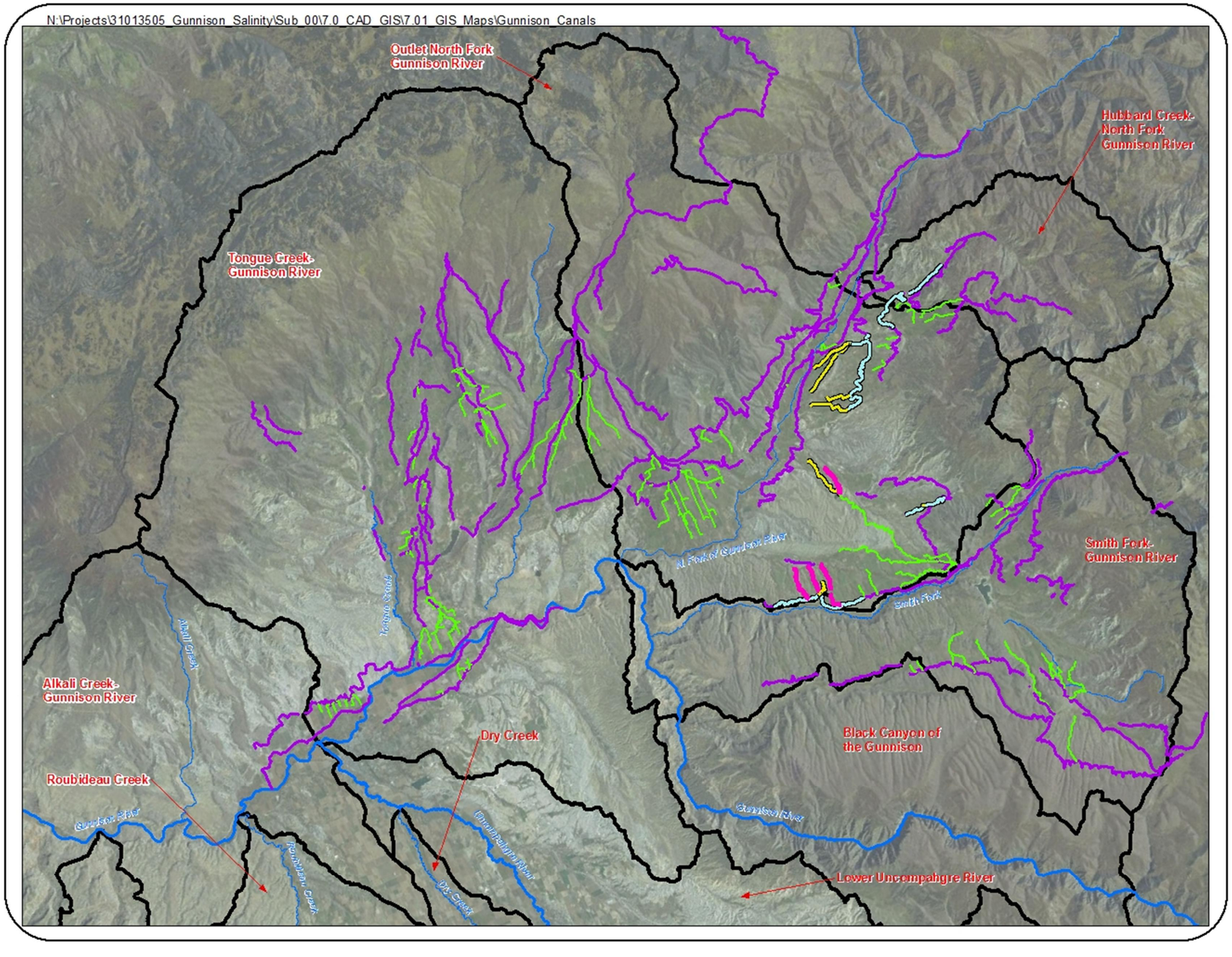
Phase	Location		FOA or funding year	Length to Repl. / Improv (ft)	Length to Repl. / Improv (mi)	Improvement Type	Salinity Program Funding	Selenium Funding	Estimated Salt Load Reduction (tons/yr)*	Work completed thru March 2013	
	Canal system	Drainage(s)								Length (mi)	Percent Completed
N/A	All (Winter Water Program)	Entire project area		-	552.00	Winter Water Elimination	$ 24,000,000	$ -	41,380	552	100%
1	South	Montrose Arroyo		44,880	8.50	Pipe laterals	$ 695,366	$ 550,809	2,295	8.5	100%
2	South	Cedar/Dry Cedar		108,240	20.50	Pipe laterals	$ 2,133,000	$ 1,706,000	6,139	20.5	100%
3	South/Selig	Cedar/Loutzenhizer		55,440	10.50	Pipe laterals	$ 1,262,561	$ -	2,292	10.5	100%
4	Selig/East	Loutzenhizer/unnamed	2008	60,192	11.40	Pipe laterals	$ 2,002,285	$ 800,000	3,651	11.4	100%
5	Selig/East/Loutz. (GHA, GHAA, DG, DFG, EC5.17, GD, GDB, ECE, ECDB & GH)	Loutzenhizer & ?	2010	100,493	19.03	Pipe laterals	$ 4,318,122	$ -	5,034	12.6	66%
6A	Selig	Loutzenhizer/Unc. R.	2009 (est.)	8,448	1.60	Line portion-EC Lateral	$ 1,490,050	$ 539,000	1,073	1.6	100%
7	Selig/East/Loutz. (GH, GHD, GHDA, GHDAE, GH4.36, GHF, ECC, ECB, ECBA, GE, ECA, ECE, EC2.53 & DK)	Loutzenhizer & ?	2010	67,275	12.74	Pipe laterals	$ 3,183,983	$ -	3,029	1.66	13%
TOTALS	**For all Improvements**				**636.27**		**$ 39,085,367**	**$ 3,595,809**	**64,893**	**619**	
TOTALS	**For only the laterals to be piped or lined**			**444,968**	**84.27**		**$ 15,085,367**	**$ 3,595,809**	**23,513**	**66.7**	

*Estimated salt load. Subject to change.

Table 3.3 Summary of Basinwide Program Off-Farm Improvements for the Remaining Lower Gunnison (RLG) Area[1]

Location of Laterals		FOA Year	Length Repl. / Improv. (feet)	Length Repl. / Improv. (miles)	Improvement Type	Salinity Program Funding	Estimated Salt Load Reduction (tons/yr)*	Work complete thru March 2013	
Canal system	Drainage(s)							Length (miles)	Percent Completed
Lower Grandview Canal & selected laterals	Alum Gulch	2008	51,313	9.72	Pipe	$ 5,353,242	2,552	9.72	100%
Lower Stewart Pipeline	Reynolds/Bell	2010	60,953	11.54	Pipe	$ 6,000,000	5,892	10.97	95%
Minnesota Ditch Project 1	Minnesota Cr.	2010	27,489	5.21	Pipe	$ 3,943,272	1,364	5.21	100%
C Ditch - Lower Needle Rock	Cottonwood Cr.	2010	12,985	2.46	Pipe	$ 1,434,885	714	0	0%
Clipper Ditch Project 4	Cottonwood Cr.	2010	18,709	3.54	Pipe	$ 1,214,140	1,427	0	0%
TOTALS				**32.47**		**$ 17,945,539**	**11,494**	**25.90**	

*Estimated salt load. Subject to change.



Legend

- Improved Unclassified
- Improved Canals
- Improved Laterals
- Unimproved Canals
- Unimproved Laterals
- Rivers
- Creeks
- Project 10 Dig HUCs

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N E S W

*Canal & Laterall Data: Bureau of Reclamation
Aerial Source: ESRI online GIS server

Miles
0 1.75 3.5 7
1 in = 3.5 miles

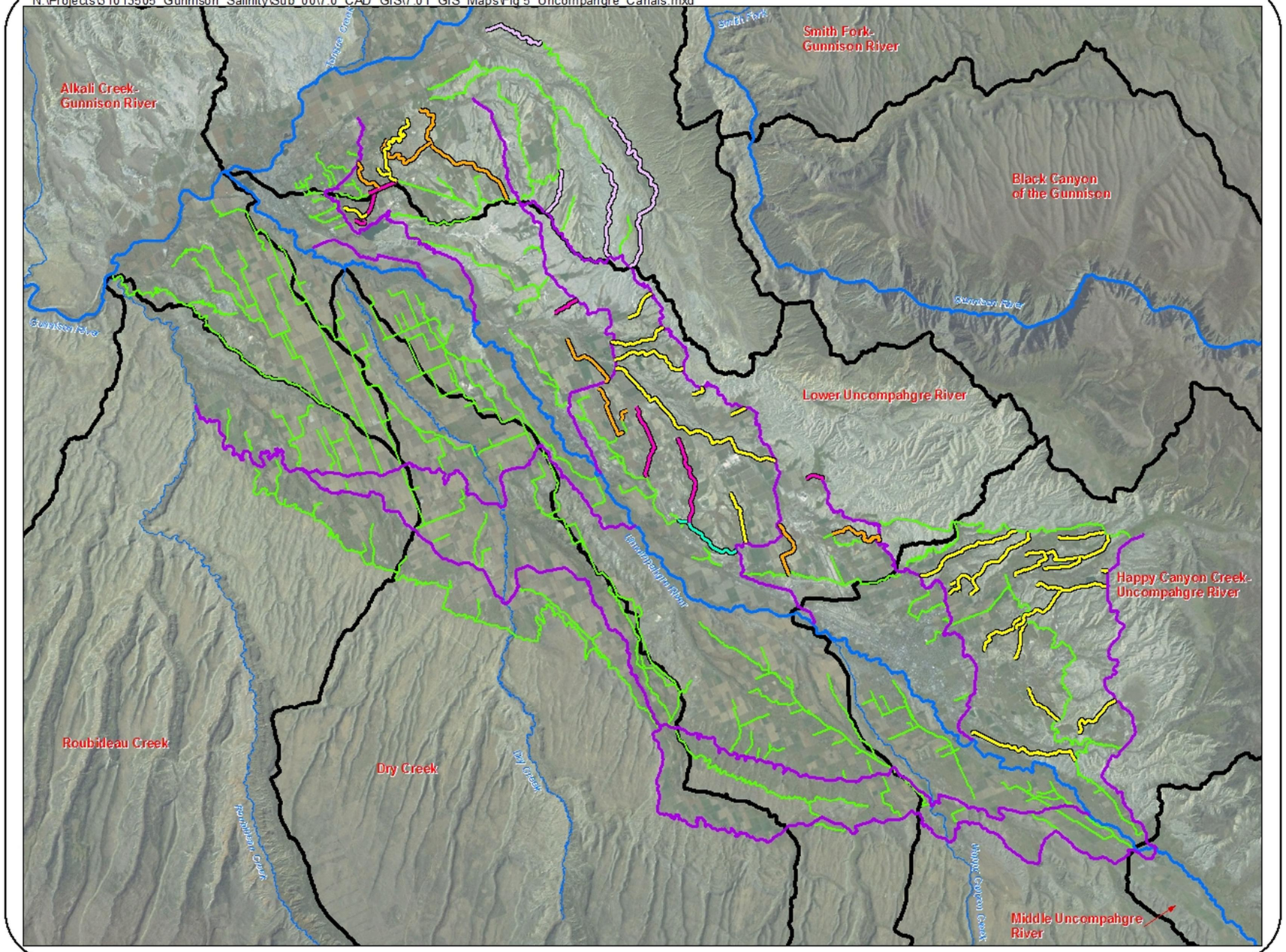
Figure 8

Remaining Gunnison Area Canals & Laterals

Lower Gunnison River Basin Salinity Study

Date: 11/26/12 By: JWM

N:\Projects\31013505_Gunnison_Salinity\Sub_00\7.0_CAD_GIS\7.01_GIS_Maps\Fig 5_Uncompahgre_Canals.mxd



Legend

- Unimproved Canals
- Unimproved Laterals
- Rivers
- Creeks

Lateral Piped Phased Improvements

- 1-4
- 5
- 6A
- 7
- 8
- Project 10 Dig HUCs

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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N
E
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S

*Canal & Laterall Data: Bureau of Reclamation
Aerial Source: ESRI online GIS server

0 1.25 2.5 5 Miles
1 in = 2.5 miles

Figure 9
Uncompahgre River Canals & Laterals
Lower Gunnison River Basin Salinity Study
Date: 11/26/12 By: JWM

4.1 QUANTIFICATION OF SALINITY LOAD REDUCTION

The purpose of this section is to describe the reported salinity reductions by Reclamation and NRCS. The methods used by both agencies have evolved significantly over the decades that each program has operated. Furthermore, the raw data on which those computations of salinity reductions have been based are either too extensive to evaluate by this effort or are no longer available.

4.2 BASELINE HYDROSALINITY STUDY

Currently, Reclamation has adopted the NRCS baseline salt loading values [4] of 440,000 tons/day for on-farm loading and 400,000 tons/day for off-farm loading totaling 840,000 tons/day for the entire LGBU. These baseline salinity loading values provide a measuring point for both Reclamation and NRCS efforts in salinity control applications for on-farm and off-farm sources.

4.3 RECLAMATION OFF-FARM SALINITY REDUCTION

Total annual Basinwide Program off-farm salt loading reduction for the Uncompahgre and RLG areas are approximately 65,000 tons/year and 11,500 ton/year, respectively, totaling approximately 76,300 ton/year for the LGBU. These salt loading reduction estimates are preliminary estimates and are subject to change as the USGS LowGunsS salinity model, used to prorate salt loading within the RLG area (See Section 4.6), may become more refined in the future.

4.4 NRCS ON-FARM SALINITY REDUCTION

Total reduction from on-farm salt loading reported by NRCS in the M&E Report for the 2011 fiscal year is 109,034 tons/year [3]. This is approximately 66% of the total on-farm salinity loading reduction goal of 166,000 tons/year. Based on the numbers at the time of this report's publication, 61,124 irrigated acres have been treated with improved irrigation systems.

4.5 ESTIMATE OF CUMULATIVE SALINITY REDUCTION

Cumulative efforts from the NRCS estimated on-farm salt loading reduction of 109,034 [3] and Reclamation's estimated off-farm salinity reduction of 76,300 ton/year total approximately 185,300 ton/year within the LGBU.

The United States Geological Survey (USGS) completed a salt loading trend analysis report that included a gaging station (USGS station #09152500) below the Lower Gunnison Basin, near Grand Junction, between 1986 and 2003. This trend span covers part of the salinity control implementation period within the LGBU that was initiated in 1988. However, the area studied includes the Upper Gunnison Basin as well which also contributes flow and salinity loading to the gaging station on the Gunnison River, near Grand Junction. The Upper Gunnison Basin includes areas of coal mining and additional agricultural area that contributes part of the "other" 600,000 ton/year baseline salinity loading value stated in Section 2.1.1. The reported measured salinity loading reduction from this expanded study area (including the Upper Gunnison Basin) was measured as 201,600 tons/year [15]. The combined reported salt loading reduction for on-

farm (NRCS) and off-farm (Reclamation) efforts for 2003 was reported as 101,161 tons/year (66,486 and 43,675 tons/year, respectively) [3]. This leaves approximately 91,439 tons/year of salt loading reduction that is unclaimed by any management practices from either agency in 2003 occurring in both the LGBU basin and the Upper Gunnison Basin [3]. This may be attributed to other undocumented management practices or land-use changes over time [3] and/or the cumulative conservative estimation of the effects of multiple salinity control improvements in both the LGBU and the Upper Gunnison Basin since the projects inception. Regardless of quantifying where and how much salinity efforts have affected loading to the gaging station along the Gunnison River, near Grand Junction, the study shows that the program and additional, undocumented efforts are significantly reducing the annual salt loading within the basin.

4.6 USGS REGRESSION MODELING

In 2004, the USGS began developing a water-quality regression model for the upper Colorado River Basin called the Upper Colorado Detailed Salinity Model (UCDSM) that is facilitated by GIS to quantify the effects of remediation efforts in the Lower Gunnison River Basin and the Grand Valley Basin [2]. The efforts were funded by combination of funding from Reclamation's Science and Technology Program and through the Salinity Control Forum process. A sub-section of the model, called LowGunS, was used to help prorate the salinity values across the LGBU that were not within the Uncompahgre Project Area. This area also included areas south of Colona. The model utilizes statistical combinations of independent variables that helps explain the variations in salinity and selenium loading within area being modeled.

5.1 SUMMARY

The accomplishments of the Salinity Control Program within the Lower Gunnison Basin from both Reclamation and NRCS have been significant. Personnel from the Grand Junction Reclamation office have indicated FOA funding secured for off-farm improvements under the Basinwide Program has been secured for 84.27 miles and 32.47 miles of conveyance improvements for the Uncompahgre Project area and Remaining Lower Gunnison (RLG) area, respectively, totaling 116.74 miles of canal/lateral improvements within the Lower Gunnison Basin Unit (LGBU). The Winter Water Program could be figured into those improvement length estimates by claiming 552 miles of improvement of canals/laterals that are not in use during the winter months, and thus, are not contributing to salt loading in the winter. Under the NRCS EQIP program, 61,124 acres of irrigated agricultural lands have been updated with improved irrigation systems which leaves 79,876 acres, or 59%, remaining to be improved irrigation practices from the project plan goal of 135,000 acres. The NRCS EQIP program has reported cumulative salt load reduction of 109,034 tons/year of on-farm loading at the time of the 2011 Monitoring and Evaluation Report [3], approximately 66 percent of the projects salt loading reduction goal of 166,000 ton/year. Reclamations Basinwide program is estimated to have reduced off-farm loading by approximately 76,300 ton/year. These salt loading reduction estimates are preliminary estimates and are subject to change as the USGS LowGunsS salinity model may become more refined in the future. Reclamation does not have a specific off-farm salt loading reduction goal for the LGBU.

The USGS has developed a water-quality regression model for the upper Colorado River Basin called the Upper Colorado Detailed Salinity Model (UCDSM) that is facilitated by GIS to quantify the effects of remediation efforts in the Lower Gunnison River Basin and the Grand Valley Basin [2]. A sub-section of the model, called LowGunS, was used to help prorate the salinity values across the LGBU that were not within the Uncompahgre Project Area. This area also included areas south of Colona. The model utilizes statistical combinations of independent variables that helps explain the variations in salinity and selenium loading within area being modeled. Reclamation has chosen to use the detailed LGBU study data for the Uncompahgre Project area for estimating individual canal and lateral loading.

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[1]Data received from the Grand Junction Reclamation office.