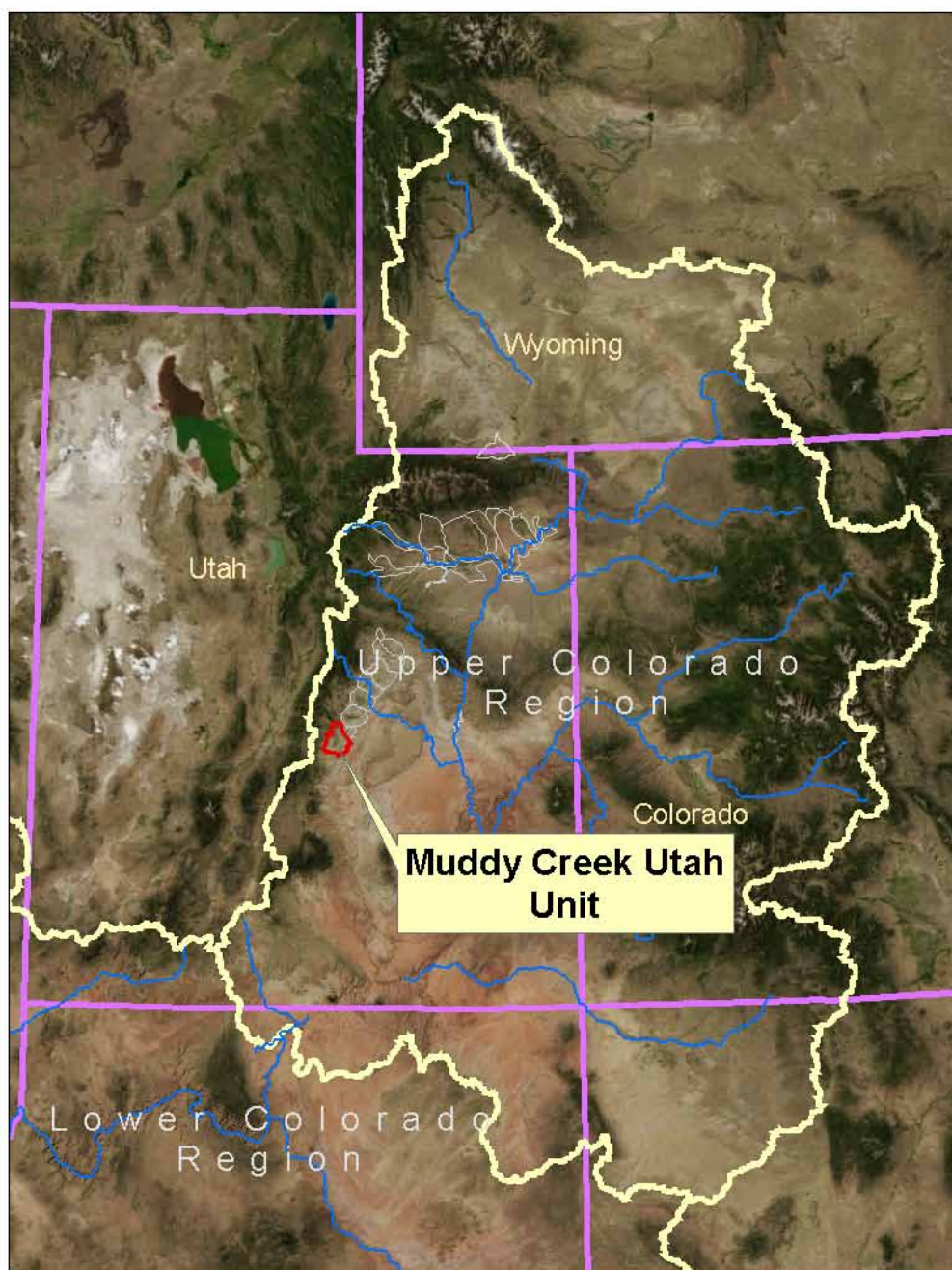


Muddy Creek Utah Unit

Monitoring and Evaluation Report, FY2011



*U.S. Department of Agriculture
Natural Resources Conservation Service*

Executive Summary

Project Status

- The Environmental Assessment (EA) for the Muddy Creek Unit was published in July, 2004. The Proposed Action anticipates treating 6,050 acres of flood irrigated fields with sprinkler systems, building a small reservoir, two settling ponds, and 28.66 miles of pipeline, reducing salt load by 11,677 tons/year at a cost of \$139/ton (2011 Dollars).
- In FY2010, the first contract in the unit, obligated \$114,000 FA, planning 71 acres to reduce salt loading by 100 tons/year at an amortized cost of \$127/ton (\$137/ton in 2011 dollars). No additional money was obligated in FY2011.
- In FY2011, 36 acres were applied at a cost of \$57,900, reducing salt loading by 50 tons/year at a cost of \$125/ton.

Table 1. Project Progress Summary

Muddy Creek Utah Unit, All Programs				
CONTRACTS PLANNED	UNIT (S)	CURRENT FY	CUMULATIVE	TARGET
1. CONTRACT STATUS				
A. Contracts Approved	Number	-	1	
	Dollars	-	114,112	
	Acres	-	71	6,050
On-farm	Tons/Year	-	100	8,150
Off-farm	Tons/Year	-	-	3,500
B. Active Contracts				
	Number		1	
	Dollars		114,112	
	Acres		71	
On-farm	Tons/Year		100	
Off-farm	Tons/Year		-	
PRACTICES APPLIED				
PRACTICES APPLIED	UNIT(S)	CURRENT FY	CUMULATIVE	TARGET
2. EXPENDITURES				
Financial Assistance (FA)	Dollars	57,914	57,914	
3. Irrigation Systems				
A. Sprinkler	Acre	36	36	6,050
B. Improved Surface System	Acre	-	-	
C. Drip System	Acre	-	-	
4. Salt Load Reduction				
A. Salt Load Reduction, On-farm	Tons/Year	47	47	8,150
B. Salt Load Reduction, Off-farm	Tons/Year	3	3	3,500
C. Tons of salt controlled prior to EQIP	Tons		-	

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Monitoring and Evaluation History and Background

The Colorado River Basin Salinity Control Program was established by the following Congressional Actions:

- The Water Quality Act of 1965 (Public Law 89-234) as amended by the Federal Water Pollution Control Act of 1972, mandated efforts to maintain water quality standards in the United States.
- Congress enacted the Colorado River Basin Salinity Control Act (PL 93-320) in June, 1974. Title I of the Act addresses the United States' commitment to Mexico and provided the means for the U.S. to comply with the provisions of Minute 242. Title II of the Act created a water quality program for salinity control in the United States. Primary responsibility was assigned to the Secretary of Interior and the Bureau of Reclamation (Reclamation). USDA was instructed to support Reclamation's program with its existing authorities.
- The Environmental Protection Agency (EPA) promulgated a regulation in December, 1974, which established a basin wide salinity control policy for the Colorado River Basin and also established a water quality standards procedure requiring basin states to adopt and submit for approval to the EPA, standards for salinity, including numeric criteria and a plan of implementation.
- In 1984, PL 98-569 amended the Salinity Control Act, authorizing the USDA Colorado River Salinity Control Program. Congress appropriated funds to provide financial assistance through Long Term Agreements administered by Agricultural Stabilization and Conservation Service (ASCS) with technical support from Soil Conservation Service (SCS). PL 98-569 also requires continuing technical assistance along with monitoring and evaluation to determine effectiveness of measures applied.
- In 1995, PL 103-354 reorganized several agencies of USDA, transforming SCS into Natural Resources Conservation Service (NRCS) and ASCS into Farm Service Agency (FSA).
- In 1996, the Federal Agricultural Improvement and Reform Act (PL 104-127) combined four existing programs, including the Colorado River Basin Salinity Control Program, into the Environmental Quality Incentives Program (EQIP). EQIP has been extended through FY2012 by the 2002 and 2008 Farm Bills.

Over the years, Monitoring and Evaluation (M&E) has evolved from a mode of labor/cost intensive detailed evaluation of a few farms and biological sites to a broader, but less detailed evaluation of many farms and environmental concerns, driven by budgetary restraints and improved technology.

M&E is conducted as outlined in "The Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program", last revised in 2001.

Project Status

FY2011 Project Results

FY2011 project results for the Muddy Creek Utah Unit (MCU) are summarized in table 2. No new contracts were written in FY2011.

Cumulative Project Results

Cumulative results through FY2011 are tabulated in Table 3, along with EA projections. Dollar amounts are expressed in 2011 dollars.

Table 2. FY2011 results

FY2011	Units	Planned	Applied
Irrigation Improvements	acres		36
Federal cost share, FA	\$		\$57,914
Amortized federal cost share, FA+TA	\$/year		\$6,261
Salt load reduction	tons/year		50
Federal cost, FA+TA	\$/ton		\$125

Table 3. Project goals and cumulative status

FY2011 Cumulative Improvements	Units	NEPA	Planned	Applied
Irrigation improvements	acres	6,050	71	36
Federal cost share, FA+TA	2011\$	18,100,000	\$206,000	\$97,000
Amortized federal cost share, FA+TA	2011\$/yr	1,630,000	\$13,700	\$6,300
Salt load reduction, tons/year	tons/year	11,700	100	50
Federal cost/ton, FA+TA	2011\$	\$139	\$137	\$125

Detailed Analysis of Status

Pre-Project Salt Loading

Agricultural irrigation is a major source of salt loading into the Colorado River and is completely human induced. Irrigation improvements have great potential to control salt loading.

In the 2004 EA for Muddy Creek Utah Unit, agricultural salt loading was estimated to be 15,000 tons/year with non-agricultural loading to be about 75,000 tons/year from intermittent seeps on BLM lands. A salt budget allocated agricultural salt loading to 5,393 tons/year off-farm and 9,587 tons/year on-farm. (Figure 1)

Salinity Control Practices

On-farm practices used to reduce salt loading in MCU are expected to be exclusively sprinkler systems supplied, for the most part, by gravity pressurized pipelines. On-farm salt load reduction is achieved by reducing over-irrigation and deep percolation.

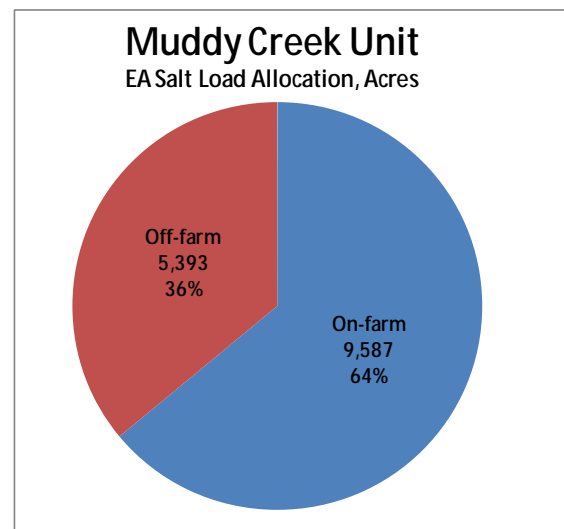


Figure 1. Initial Salt Load Allocation

Off-farm practices used to reduce salt loading are associated with the reduction and/or elimination of canal/ditch seepage, usually by installing pipelines. Twenty-nine miles of pipelines were proposed in the EA.

Planning Documents

For the Muddy Creek Utah Unit, in 2004, NRCS developed an Environmental Assessment (EA) for which a Finding of No Significant Impact (FONSI) was issued by the Utah State Conservationist. Development of salinity control contracts started in FY2010.

The recommended alternative in the EA addresses a complete system, on-farm and off-farm, with 100% participation.

Planned Practices (Obligations)

Planned practices (obligations) represent contracts with participants to apply improved irrigation practices to the participant’s agricultural activities. Only the federal share of project cost is analyzed in this section.

The installation of salinity control practices is voluntary on the part of landowners. An incentive to participate is created by cost-sharing on practice purchase and installation using federal grants. In essence, federal cost-share purchases salt load reductions in the Colorado River, while the participant’s cost-share buys him/her reduced operating costs and increased production.

Federal cost-share is obligated when a contract is signed with the participant, assuring timely installation, to federal standards, of salt load reducing irrigation practices.

Only one contract has been obligated in the Muddy Creek Unit. (Table 4)

Table 4. Planned practices, cost/ton, nominal and 2011 dollars

FY	Federal Water Project Discount Rate	Contracts Planned	FA Planned Nominal	Acres Planned	Salt Load Reduction Planned	Amortized FA+TA Nominal	\$/ton FA+TA Nominal	2011 PPI Factor	FA Planned 2011\$	Amortized FA+TA 2011\$	\$/ton 2011\$	Cum \$/ton 2011\$
2010	4.375%	1	\$114,112	71	100	\$12,661	\$127	108%	\$123,670	\$13,722	137	137
2011	4.125%							100%				137
Totals		1	\$114,112	71	100	\$12,661	\$127		\$123,670	\$13,722	137	

FY2011 Obligation

In FY2011, no new contracts were obligated.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2010 planned practices was 71 tons/year, calculated by multiplying the original tons/acre for the entire unit, by the acres to be treated and a percentage reduction based on change in irrigation practice. For MCU, the initial estimate of on-farm irrigation salt loading is 1.58 tons/acre-year. If 71 acres are converted from wild flood to periodic-move sprinklers, an estimated 84% of the original salt load will be eliminated. Hence, 71 acres x 1.58 tons/acre-year x 84% = 94 tons/year on-farm salt load reduction. In this case, another 6 tons/year off-farm was claimed for replacing 1,200’ of off-farm open ditch with a pipeline.

Cost/Ton Calculation

The federal cost/ton for salt load reduction is calculated by amortizing the federal financial assistance (FA) over 25 years at the federal discount rate for water projects (4.375% for FY2010). Two-thirds of FA is added for technical assistance (TA) and the amortized total cost is divided by tons/year to yield cost/ton.

Normalization to 2011 dollars utilizes the Producer Price Index (PPI) for agricultural equipment purchased.

Obligation Analysis

In FY2011, no new contracts were obligated

Cost-Share Enhancement

Typical federal cost-share, over the last several years, has been about 75% of total installation cost. A feature of the 2002 and 2008 Farm Bills is cost-share enhancement, increasing the federal cost-share, from 75% to 90% of total cost for beginning farmers (those who have not claimed agricultural deductions on income tax for 10 years), limited resource farmers (a farmer with gross farm income below a specified level), and producers from historically underserved minorities.

In MCU, the first contract was with a beginning farmer.

Applied Practices

FY2011 Expenditures

In FY2011, \$57,900 was expended applying sprinklers to 36 acres and reducing salt loading by 50 tons/year at a cost of \$125/ton, FA+TA.

Hydro Salinity Monitoring

Before implementation of salinity control measures, Muddy Creek Utah Unit agricultural operations contributed an estimated 15,000 tons of salt per year to the Colorado River (on-farm and off-farm), from an average of 6,050 acres of annually irrigated land. Salt loading of 9,587 tons/year was allocated to on-farm activities and 5,393 tons to off-farm canals and large laterals.

Three assumptions guide the calculation of salt load reduction from irrigation improvements:

1. Salt concentration of subsurface return flow from irrigation is relatively constant, regardless of the amount of canal seepage or on-farm deep percolation.
2. The available supply of mineral salts in the soil is essentially infinite and salinity of out-flowing water is dependent only on solubility of salts in the soil. Therefore, salt loading is directly proportional to the volume of subsurface return flow.
3. Water that percolates below the root zone of the crop and is not consumed by plants or evaporation will eventually find its way into the river system. Salt loading into the river is reduced by reducing deep percolation. (Hedlund, 1994).

Deep percolation and salt load reductions are achieved by reducing or eliminating canal/ditch seepage/leakage and by improving the efficiency and uniformity of irrigation. It is estimated that upgrading an uncontrolled flood irrigation system to a well designed and operated sprinkler system will reduce deep percolation and salt load by 84-91%.

NRCS salinity control programs focus on helping cooperators improve irrigation systems, better manage water use, and sharply reduce deep percolation/salt loading.

Salinity Monitoring Methods

The 1991, "*...Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program*" as utilized in the Uintah Basin and adopted by the EIS for the Price – San Rafael Rivers Unit, focused on:

- Intensive instrumentation and analysis on several irrigated farms, requiring expensive equipment and frequent field visits to ensure and validate collected data
- Detailed water budgets to determine/verify deep percolation reductions
- Multi-level soil moisture measured weekly, with a neutron probe
- Detailed sprinkler evaluations, using catch cans, ran annually on selected farms
- Crop yields physically measured and analyzed

As a result of labor intensive testing in the Uintah Basin Unit, it was confirmed that irrigation systems installed and operated as originally designed, produced the desired result of improved irrigation efficiencies and sharply reduced deep percolation rates, concurrent with reduced farm labor and improved yields.

A new "*Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program*" was adopted in 2001. Having established that properly installed and operated practices yield predictable and favorable results, the 2001 Framework Plan addresses hydro-salinity by:

- Utilizing random cooperator surveys to collect and evaluate cooperator understanding, and impressions concerning contracts and equipment
- Formal and informal Irrigation Water Management (IWM) training and encouragement
- Equipment spot checks and operational evaluations
- Agricultural statistics collected by government agencies

In MCU, virtually all salinity program irrigation improvements are expected to be sprinkler systems.

Cooperator questionnaires, interviews, and training sessions

No cooperator questionnaires have been done in the Muddy Creek Utah Unit. It is anticipated that it will take two or three years for cooperators to become familiar with system operations before interviews would become practical.

Irrigation Water Management (IWM)

The goal of IWM is to assure that irrigated crops get the right amount of water at the right place at the right time, which will accomplish the goal of minimizing deep percolation and salt loading in the river. Proper IWM is achieved by careful equipment design, cooperators education, and maintenance resulting in implementation of effective water management techniques.

In general, sprinkler systems designed by NRCS are capable of irrigating the most water-consumptive projected crop in the hottest part of the year. When growing crops with lower water needs, or at other times in the growing season, these systems are capable of over-irrigating to some extent.

Crops generally use water before the irrigation season begins and after the irrigation season ends, leaving the soil moisture profile partially depleted. Filling the soil with water requires additional irrigation, over and above crop needs, in the spring. Farms in MCU have historically ran short of full season irrigation water.

Preventing over-irrigation is a contractual obligation of the cooperator. To help cooperators fulfill this obligation they must be educated and coached in the proper use and maintenance of their irrigation systems.

This is achieved by creating financial incentives for IWM, initial IWM training sessions, periodic water conferences, and developing IWM tools that simplify record keeping and help cooperators properly time irrigation cycles. Incentive IWM payments have resulted in a contractual obligation to learn and apply water management principles to fields receiving federal grants. In other salinity units, IWM practices have resulted in greater interest in keeping records and understanding soil/water relationships.

Water management seminars and conventions are sponsored by various government, educational, and commercial groups, encouraging everyone to manage and conserve water. NRCS is a willing and eager participant in these partnership educational endeavors.

Additionally, personal guidance is available to cooperators, on request, at local NRCS field offices.

Intensive and continuous IWM training is essential to successful long term salt load reduction.

To help cooperators with irrigation timing, a major part of IWM, NRCS demonstrates two simple, low-cost approaches:

1. Irrigation record keeping, wherein the cooperator keeps track of water put on the field and compares the volume used to the volume required by the crop
2. Soil moisture monitoring, wherein the cooperator determines when to irrigate, based on measured available water content (AWC) of the soil

Irrigation Record Keeping

To help with irrigation timing, NRCS has developed and provided the, "IWM Self Certification Spreadsheet" which allows cooperators to graphically evaluate available water content (AWC) of the

soil and compare actual irrigation with projected average crop water requirements and/or with modeled crop evapotranspiration. Evapotranspiration is calculated from climate data collected by NRCS and other public agencies, using Penman-Montieth procedures outlined by the Food and Agriculture Organization of the United Nations (FAO). The final output of the spreadsheet is two graphs comparing water applied, with water required, on a seasonal basis. See figures 2 and 3.

On the input page, the participant enters system design data, crop data, soil data, and the beginning date of each irrigation cycle. The spreadsheet calculates AWC and deep percolation, which is graphed on the following pages of the spreadsheet. (Figure 2 and 3)

A modest amount of deep percolation is designed into all irrigation systems to compensate for distribution anomalies and to leach accumulated salts from the root zone.

In order to receive incentive payment for IWM, each irrigator must

1. attend a two hour IWM training session or a water conference
2. with help, augur a hole and determine the soil moisture by the feel method, and
3. present their irrigation records to the local field office, where data is entered into the spreadsheet and results are calculated, graphed, and discussed. Graphs are printed for the farmer's reference.

In general, cooperators respond positively to this training and work hard to irrigate more efficiently.

In MCU, no IWM Self Certifications have been completed.

Irrigation Water Use Record - Farmer Self Certification

Cooperator: <u>Muddy Creek Client</u>	Crop: <u>Alfalfa</u> Year: <u>2012</u>
Tract/Field: _____	Root Depth, ft: <u>5.00</u>
Date: <u>3/7/2012</u>	Station: <u>Emery</u> CU: <u>30</u> inches
	Contract Eligible Acres: <u>70.00</u>
Soil Texture: <u>Silty Clay Loam</u>	Irrigation method: <u>Pivot</u>
AWC, In/Ft: <u>1.92</u>	Efficiency: <u>75%</u>
AWC Max, in: <u>9.60</u>	Evaluated Acres: <u>36.36</u>
MAD, in: <u>4.80</u>	Evaporation %: <u>10%</u>
Pre-season AWC, In. <u>7.20</u>	Cycle Hours: <u>170</u>
	Flow rate, gpm: <u>275</u>

Start date of irrigation cycle	End date of irrigation	Total Cycle Hours	Alternate Cycle Hours	Flow, gpm	Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Irrigation Gain	AWC	Deep Perc
05/01/12	05/08/12	170		275.0	2.56	2.56	0.53	2.03	9.23	0.00
05/15/12	05/22/12	170		275.0	2.56	5.11	2.89	0.20	9.42	0.00
05/29/12	06/05/12	170		275.0	2.56	7.67	5.25	0.20	9.60	0.02
06/10/12	06/17/12	170		275.0	2.56	10.23	7.60	0.21	9.60	0.21
06/22/12	06/29/12	170		275.0	2.56	12.79	10.00	0.15	9.60	0.15
07/04/12	07/11/12	170		275.0	2.56	15.34	12.55	0.02	9.60	0.02
07/16/12	07/23/12	170		275.0	2.56	17.90	15.35	-0.25	9.35	0.00
07/28/12	08/04/12	170		275.0	2.56	20.46	18.16	-0.25	9.10	0.00
08/09/12	08/16/12	170		275.0	2.56	23.02	20.68	0.04	9.14	0.00
08/21/12	08/28/12	170		275.0	2.56	25.57	23.10	0.13	9.27	0.00
09/02/12	09/09/12	170		275.0	2.56	28.13	25.36	0.30	9.57	0.00
09/23/12	09/30/12	170		275.0	2.56	30.69	27.91	0.01	9.58	0.00
Total inches of water applied during the season (total of all lines above):								30.69		0.40
Total Acre Feet Applied during the Season:								93.0		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								97%		

Figure 2. IWM Self Certification Spreadsheet input page

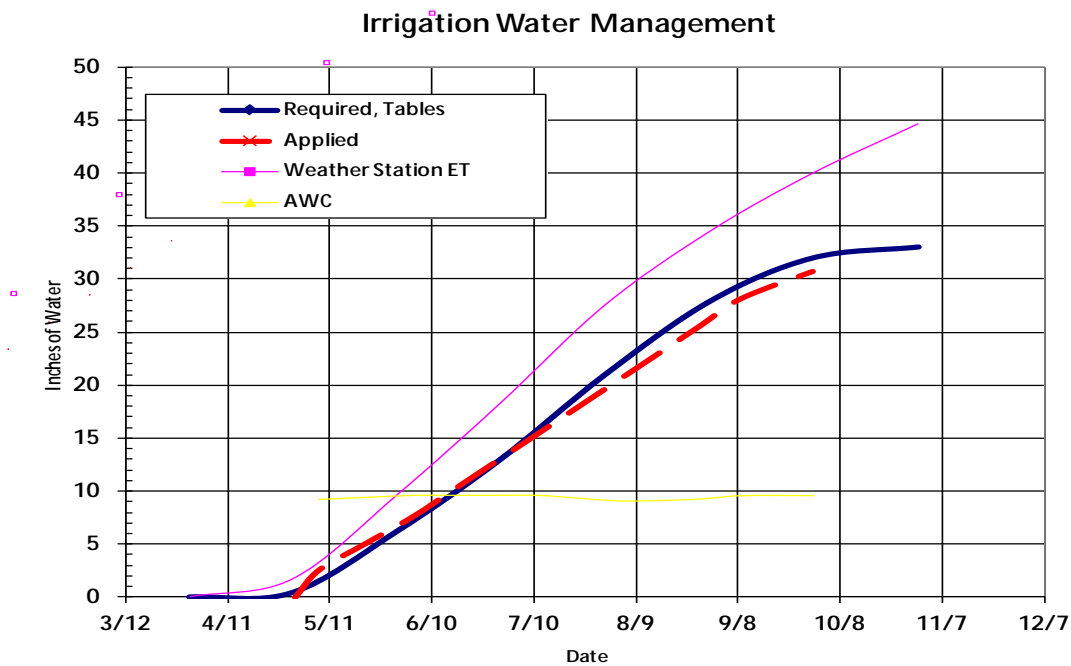
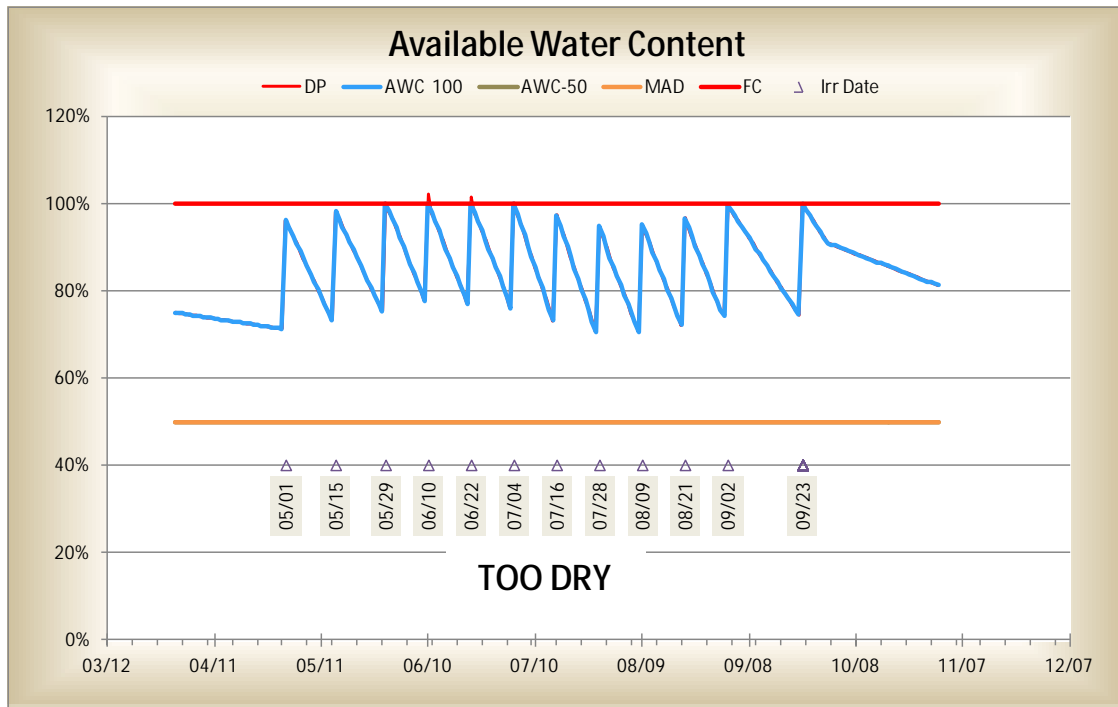


Figure 3. Sample graphs from the IWM Self Certification Spreadsheet

In the first graph, AWC is the blue line. Deep percolation appears as red spikes above the 100% level. For maximum crop growth, soil moisture must be kept between 50% and 100% (MAD range).

In the second graph, the blue line is average Crop CU. The red line is actual water applied. The purple line is ET_c , calculated from real time data at a nearby weather station and is specific to the current year. The yellow line is AWC.

Soil Moisture Monitoring

A time-tested method for timing irrigation involves augering a hole and determining the water content of the soil to decide when to apply the next irrigation. This may well be the best method available for irrigation timing, both simple and inexpensive. However, few irrigators take time to do it.

NRCS is demonstrating and guiding cooperators in the use of modern soil moisture monitoring systems, utilizing electronic probes and data recorders. Such systems can now be installed for about \$600, giving the cooperator information on the water content of his soil at several different depths, without time-consuming augering.

In a typical case, electrical resistance based probes are installed at various depths, such as 12", 24" and 48". Using a simple data recorder, indicated soil pore pressure (implied soil moisture content) is read and recorded multiple times per day. With some recorders, soil pore pressure is presented graphically on an LCD display in the field, making it a simple matter to estimate when the next irrigation will be required. (Figure 4)



Figure 4. Sample Soil Moisture Data Logger with graphing

Since gravimetric drainage generally does not occur unless the soil horizon is nearly saturated (above field capacity), it is assumed that deep percolation is not occurring if the deepest probe reading is below -10 centibars. Installed data recorders in other salinity units indicate that deep percolation occurs less than 3% of the time on monitored fields.

Soil moisture data recorders typically store 10 months of data or more in nonvolatile memory and can be downloaded using a laptop computer or PDA. Battery life is over a year, using AA or 9 volt batteries. When carefully installed, maintenance requirements are minimal.

Available water content (AWC), the soil moisture available to the plant, can be roughly estimated, using multiple probes. The AWC calculation is dependant on many soil and environmental parameters and is tedious to model accurately, but when an operator becomes familiar with the system, he will be able to use it well for irrigation timing. (Figure 5)

No data recorders have been installed in MCU.

NRCS EQIP Salinity payment schedules include two IWM practice options:

- 1. Normal IWM, requiring the participant to receive IWM training and keep irrigation records, and
- 2. IWM Intense which includes the training requirement with additional incentive payment to purchase and install soil moisture monitoring equipment .

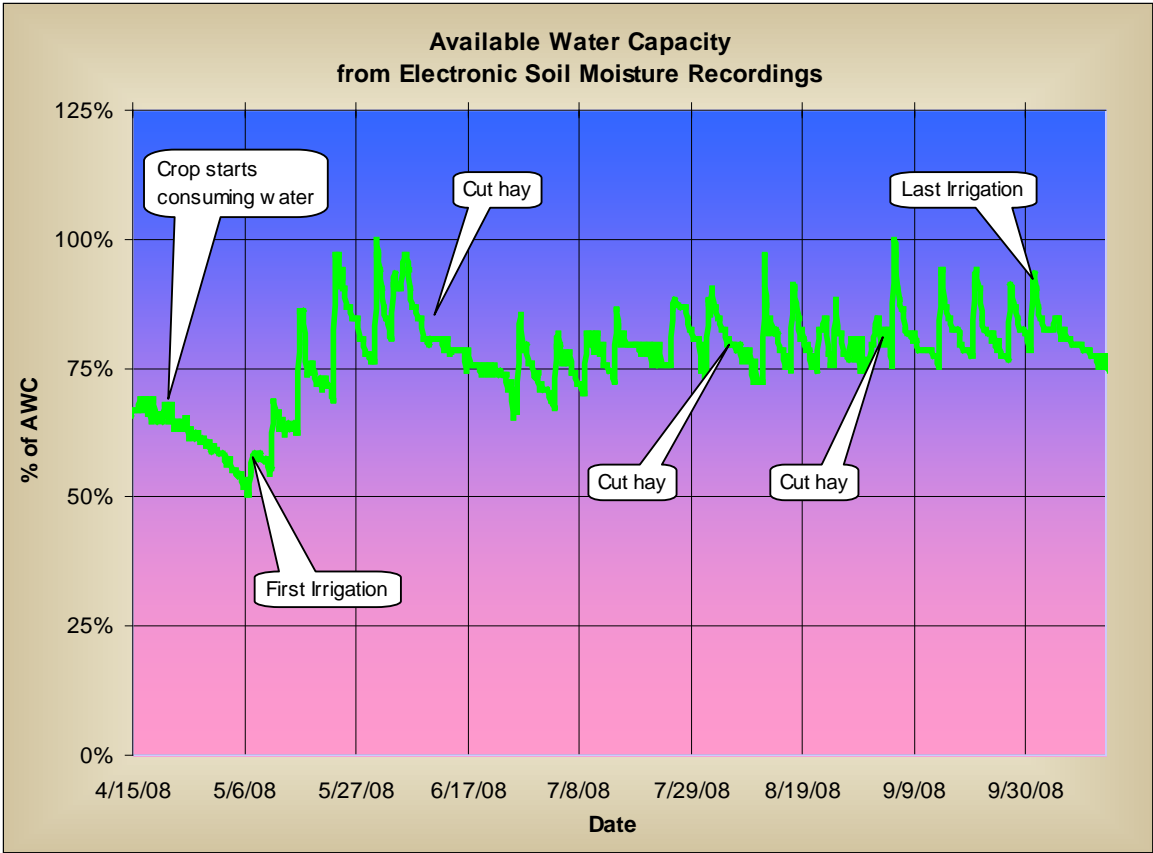


Figure 5. AWC estimated from downloaded soil moisture data

Wildlife Habitat and Wetlands

Background

In July, 2004, the Muddy Creek Utah Unit (MCU) was recognized as a Colorado River Basin Salinity Control Program (CRBSCP) Salinity Area. Salinity irrigation and wildlife habitat development plans are now eligible to compete for funds allocated to the CRBSCP. Impacts from this project to wildlife habitat and wetlands will be monitored and evaluated and subsequently compensated. Compensation is accomplished on a voluntary basis from private landowners through applications for funding from the Environmental Quality Incentives Program (EQIP). Impacts may include loss of wildlife habitat and wetlands, conversion of wetland habitats to upland areas such as agricultural fields, or other vegetation changes brought about by the more efficient use of irrigation water.

In the upper Colorado River Basins there are several Salinity Areas, each with its own unique methodology for monitoring and evaluating impacts and replacement of wildlife habitat and wetlands. The Muddy Creek Utah Salinity Project is a relatively small project, and impacts from the project can be observed from project inception. The Monitoring and Evaluation Team (M&E) will monitor land cover maps utilizing aerial photography from the National Agricultural Image Program (NAIP). The NAIP images are one meter resolution true color or color-infrared aerial photos planned to be re-flown tri-annually. With these high resolution photos, M&E has the ability to zoom in close and create a reasonably accurate land cover map which can be verified with minimal ground truthing. These images can be compared through time to monitor land cover changes. By the use of Geographical Information System (GIS) software, estimates of gains or losses in wildlife habitat or wetlands can be quantified.

Representative photographic points will also be established, to be compared throughout the years, to assist with land cover mapping efforts, defining vegetation composition of the land cover elements and what impacts, if any, are occurring.

Area-wide Wildlife Habitat Monitoring

As mentioned above, M&E will monitor land cover maps utilizing aerial photography from the National Agricultural Image Program (NAIP). As new images become available the land cover maps may be presented in future versions of this document. The initial years will be baseline data as there will be no comparison photos. Photographs will be taken near the same date annually, and compared.

Wildlife Habitat Contract Monitoring

In this sixth year of eligibility (FY2011) for salinity projects, there have been no awarded contracts for salinity wildlife only habitat improvement project funds. Table 5 represents annual acres of wildlife habitat improvement planned and applied within the MCU Salinity Area.

Table 6 represents cumulative acres of wildlife habitat improvement planned and applied within the MCU Salinity Area.

Voluntary Habitat Replacement

NRCS continues to encourage replacement of wildlife habitat on a voluntary basis. Federal and State funding programs are in place to promote wildlife habitat replacement. This information is advertised annually in local newspapers, in Local Workgroup meetings, and Conservation District meetings throughout the Salinity Areas. The [Utah NRCS Homepage](#) also has information and deadlines relating to Farm Bill programs.

Table 5. Wildlife Habitat Replacement

Acres of Wildlife Habitat Creation or Enhancement				
FY2011 Annual practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	-	-	-
WHIP	-	-	-	-
Total	-	-	-	-

*Wetland acres include riparian habitat

Table 6. Wildlife Habitat Replacement

Acres of Wildlife Habitat Creation or Enhancement				
Cumulative practices thru FY 2011				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	-	-	-
WHIP	-	-	-	-
Total	-	-	-	-

*Wetland acres include riparian habitat

Economics

Cooperator Economics

It is logical to expect that upgrading from flood to sprinkler irrigation improves profitability by increasing production while decreasing costs for water, fertilizer, labor, and field maintenance. Irrigation system maintenance may increase somewhat, but should be less variable on an annual basis.

Production Information

In MCU, forage crops and grass pasture account for nearly all producing acres.

Agricultural statistics do not separate Emery, Utah production from other areas in Emery County. Since MCU production is a minor portion of production in Emery County, it is impossible to accurately measure production from statistical sources.

Water for MCU comes directly from Muddy Creek and a few smaller tributaries. Irrigation water storage facilities are minimal. Nearly all of the irrigated acres are water short and cannot irrigate for the full season.

Expense Information

Reliable expense information is difficult to obtain. Many of the farms are family operations and the cost of family labor is rarely evaluated or reported. From National Agricultural Statistics Service (NASS) data, labor benefits are elusive as both *Hired Farm Labor* and *Total Farm Production Expenses* have increased steadily over the 1987, 1992, 1997, 2002, and 2007 Agricultural Censuses.

As with production data, labor statistics for MCU is pretty well masked by larger producing areas in the county.

Public Economics

Only one irrigation improvement has been contracted in MCU and no cooperator surveys have been completed in MCU. Local farmers in other parts of Emery County seem to have positive attitudes about the salinity program. There is fairly strong interest in installing sprinkler systems, which is expected to increase with time in MCU. Lack of water storage and delivery systems are the major impediment to progress on-farm.

Positive public perceptions of the Salinity Control Program include:

- Reduced salinity in the Colorado River
- Lengthened irrigation season
- Increased flows in streams and rivers
- Economic lift to the entire community from employment and broadened tax base
- Aesthetically pleasing, green fields, denser, for longer periods of time
- Improved safety and control of water resources, with a reduction in open streams

Negative public perceptions of the Salinity Control Program include:

- Conversion of artificial wetlands to upland habitat and other shifts in wildlife habitat
- Changes in Water Related Land Use (WRLU)

Land Use Land Cover

Figure 6 is a graphical presentation of pre-project land use in the Muddy Creek Utah Unit. This data was derived from the 2004 Environmental Assessment.

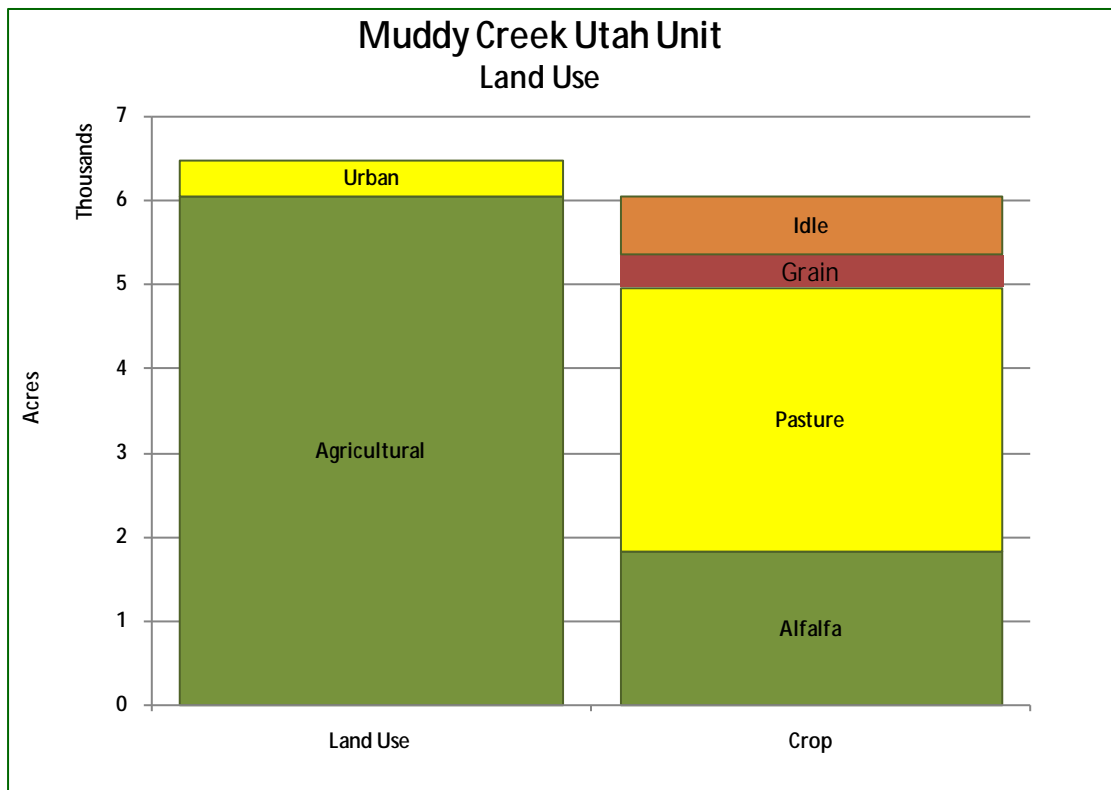


Figure 6. Pre-project land use land cover, used in preparing 2004 EA

Summary

Local land owners are willing and able to participate in salinity control programs. At present funding levels, ample opportunities exist to install improved irrigation systems and reduce salt loading to the Colorado River system. In MCU, the lack of off-farm irrigation infrastructure is impeding the creation of on-farm grant opportunities. Salinity programs in other salinity units indicate that participants are apparently satisfied with results and generally positive about salinity control programs.

Glossary and Acronyms

Average salt pickup – The increase in the amount of salt carried by a stream as it flows as a result of inflows containing increased salt from dissolution of the soil. Usually expressed as tons/acre-foot.

Annual average salt load – The average estimated annual salt load carried by a stream, based on a period of record of several years. Usually expressed as tons/year.

Application efficiency – The portion of the irrigation water delivered to the soil that is captured, stored, and available to the crop, expressed as a percentage of the total delivery volume.

Applied Practices – Functioning practices for which Federal cost share dollars have been expended.

BSPP – Basin States Parallel Program

Bureau of Reclamation (Reclamation) – A branch of the U.S. Department of Interior charged with water interests in the United States. Reclamation is the lead agency for salinity control in the Colorado River Basin.

Catch can testing – a procedure whereby dozens of containers are spread out under a sprinkler system in an array, to determine how much water is being applied to different spots of ground under the sprinkler to evaluate uniformity.

cfs – Cubic feet per second or second-feet.

Cover Map – a map categorizing land use based on surface cover, e.g. urban, crop type, wetlands, etc.

Crop Consumptive Use (CU) – The amount of water required by the crop for optimal production. It is dependant on many factors including altitude, temperature, wind, humidity, and solar radiation. CU and ET are generally synonymous.

CRBSCP – Colorado River Basin Salinity Control Program

Daubenmire cover class frame – An instrument used to quantify vegetation cover and species frequency occurrences within a sampling transect or plot.

Deep Percolation – The amount of irrigation water that percolates below the root zone of the crop, usually expressed in acre-feet.

Dissolved salt or Total Dissolved Solids (TDS) – The amount of cations and anions in a sample of water, usually expressed in milligrams/liter, but often expressed in Tons/Acre-foot for salinity control programs.

Distribution Uniformity (DU) – A measure of how evenly the irrigation water is applied to the field. If DU is poor, more water is needed to assure that the entire crop has an adequate supply.

EQIP – Environmental Quality Improvement Program

Evapotranspiration (ET) - The amount of water used by the crop. ET is generally synonymous with CU and is frequently mathematically modeled from weather station data.

Financial Assistance (FA) – The Federal cost share of conservation practices. FA is normally 60% of total cost of conservation practices.

Gated Pipe – Water delivery pipe with individual, evenly spaced gates to spread water evenly across the top of a field.

Hand line – An irrigation system composed of separate joints of aluminum pipe, each with one sprinkler, designed to irrigate for a period of time and be moved to the next parallel strip of land.

Improved Flood – Increasing the efficiency of flood irrigation systems with control and measurement structures, corrugations, land-leveling, gated pipe, etc.

Irrigation Water Management (IWM) – Using practices and procedures to maximize water use efficiency by applying the right amount of water at the right place at the right time.

Leakage – Water loss from ditches and canals through fissures, cracks or other channels through the soil, either known or unknown.

National Agricultural Statistics Service (NASS) - A branch of the U.S. Department of Agriculture (USDA) charged with the collection of agricultural data

Natural Resource Conservation Service (NRCS) A branch of the U.S. Department of Agriculture (USDA) charged with providing technical assistance to agricultural interests and programs.

Periodic Move – A sprinkler system designed to irrigate in one position for a set amount of time, then be periodically moved to a new position by hand or on wheels repeatedly until the field is covered.

Pivot or Center Pivot – A sprinkler system that uses moving towers to rotate a sprinkler lateral about a pivot point.

Planned Practices – Practices for which Federal cost share dollars have been obligated by contract.

Ranking – A process by which applications for federal funds are prioritized, based on their effectiveness in achieving Federal goals.

Return Flow – The fraction of deep percolation that is not consumed by plants, animals, or evaporation and returns to the river system, carrying salt.

Salts – Any chemical compound that is dissolved from the soil and carried to the river system by water. Salt concentration is frequently expressed as “Total Dissolved Solids” measured in parts per million (ppm) or milligrams per liter (mg/l). For salinity control work, it is often converted to Tons per acre-foot of water.

Salt load – The amount of dissolved salt carried by a flowing stream

Seepage – Fairly uniform percolation of water into the soil from ditches and canals.

Salt Load Reduction – A measure of the annual tons of salt prevented from entering the waters of the Colorado River. As applied to agriculture, salt load reduction is achieved by reducing seepage and deep percolation from over-irrigating.

Soil Conservation Service – The predecessor agency to NRCS.

Technical Assistance (TA) – The cost of technical assistance provided by Federal Agencies to design, monitor, and evaluate practice installation and operation, and to train and consult with cooperators. TA is generally assumed to be 40% of the total cost of conservation practices.

Uniformity – A mathematical expression representing how evenly water is applied to a plot of ground by a sprinkler system. The two most common measures used by NRCS are Christiansen Coefficient of Uniformity (CCU) and Distribution Uniformity (DU).

Utah Division of Wildlife Resources (UDWR or DWR) – The State of Utah’s agency for managing wildlife resources.

Wheel line, Wheeline, Sideroll – A sprinkler system designed to be moved periodically by rolling the sprinkler lateral on large wheels.

WHIP – Wildlife Habitat Incentives Program, a Farm bill program instituted in 1997, designed to create, restore, and enhance wildlife habitat.

Water Budget – An accounting for the amount of water entering (irrigation and precipitation) and the amount of water leaving (evaporation, CU, deep percolation) a given plot of land to determine efficiency and estimate deep percolation.

Yield (or Crop Yield) – The amount of a given crop harvested from an acre of ground. Yield is usually expressed as Tons/Acre or Bushels/Acre, depending on the crop.

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