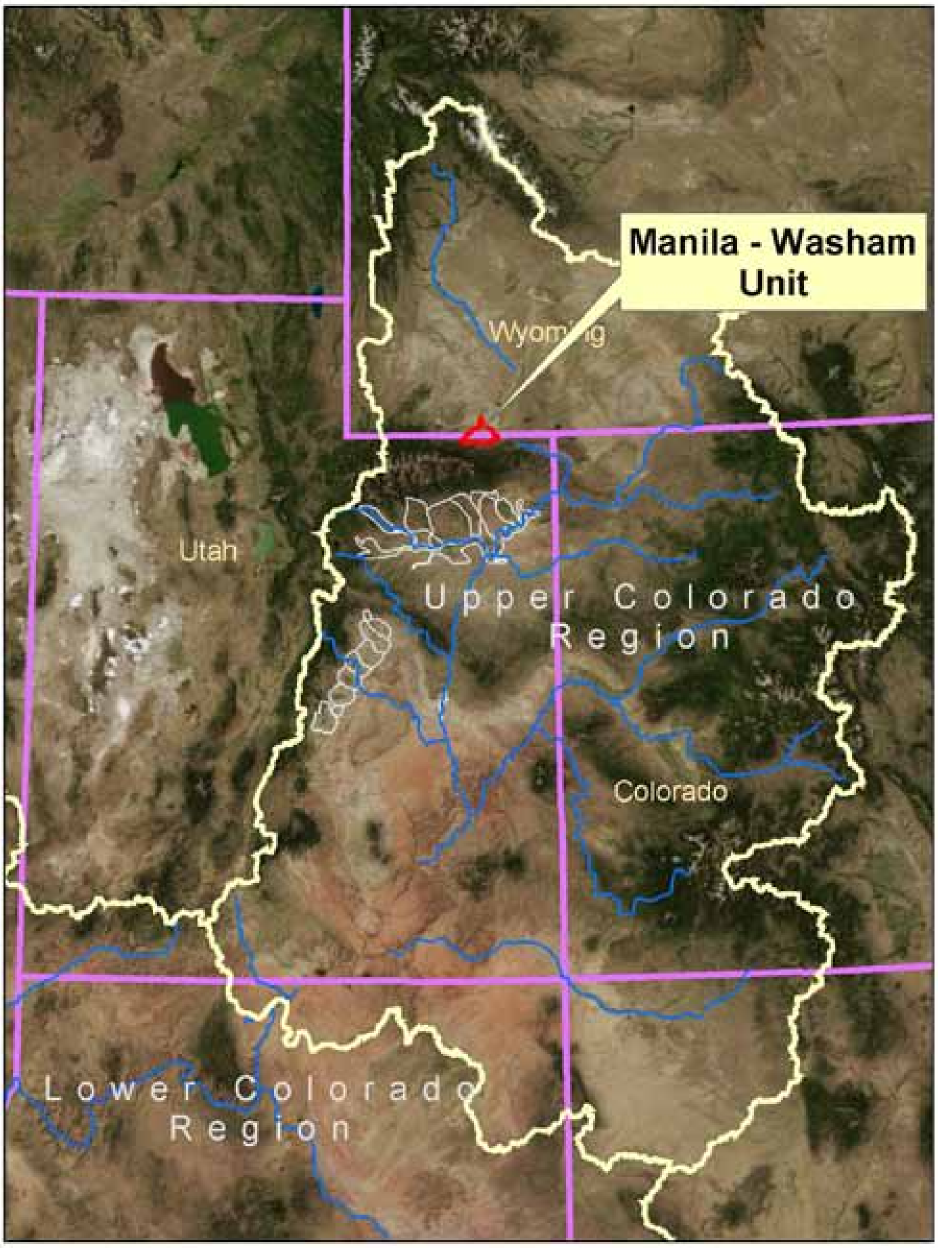
Colorado River Basin Salinity Control Program

Manila - Washam Unit

Monitoring and Evaluation Report, FY2011



U.S. Department of Agriculture

Natural Resources Conservation Service

Executive Summary

Project Status

- NRCS and Reclamation have reviewed and concurred on an initial agricultural salt loading of 27,000 tons on-farm and 13,000 tons off-farm pre-project salt loading. The calculated cost, from data in the 2006 EA, is estimated to be $87/ton in 2011 dollars.
- For FY2011, $37,000 FA was obligated planning 32 acres to reduce salt loading by 72 tons/year at an amortized cost of $55/ton.
- Cumulative federal obligation planned through FY2011 is $7.18 million FA (2011 dollars), planned on 4,487 acres, reducing salt loading by 10,003 tons/year at an average cost of $83/ton FA+TA.
- In FY2011, $404,000 FA was applied treating 368 acres, reducing salt loading by 873 tons/year at an amortized cost of $50/ton FA+TA.
- Cumulative funds applied are $4.61 million FA (2011 dollars), on 3,321 acres, reducing salt loading by 7,960 tons/year at an average cost of $66/ton.
- Of 11,100 water-rights acres, 7,780 acres are projected to be improved, reducing salt loading by 18,000 tons/year.
- Ongoing USGS salt load monitoring is inconclusive.
- The 2008 Farm Bill funds EQIP through 2012.

Hydro-salinity

- IWM record keeping reports indicate that average deep percolation on treated fields is less than anticipated.

Wildlife Habitat and Wetlands

- There were no wildlife habitat development projects planned and funded in FY 2011. One acre of wildlife habitat replacement was applied in FY 2011 through EQIP.
- US Bureau of Reclamation has completed piping Peoples Canal in FY2010. USFS Wetland Complexes continue to be monitored.

Economics

- Alfalfa production is in an upward trend.
- Interest in salinity control projects has waned.

Table 1. Project Progress Summary

Manila Washam Unit, All Programs				
CONTRACTS PLANNED	UNITS	CURRENT FY	CUMULATIVE	TARGET
1. CONTRACT STATUS				
A. Contracts Approved	Number	2	50	
	Dollars	36,872	5,934,029	
	Acres	32	4,487	7,780
On-farm	Tons/Year	72	10,003	18,500
Off-farm	Tons/Year	-	-	
B. Active Contracts	Number		31	
	Dollars		2,367,355	
	Acres		2,050	
On-farm	Tons/Year		4,853	
Off-farm	Tons/Year		-	
PRACTICES APPLIED	UNITS	CURRENT FY	CUMULATIVE	TARGET
2. EXPENDITURES				
Financial Assisstance (FA)	Dollars	403,838	4,118,003	
3. IRRIGATION SYSTEMS				
A. Sprinkler	Acres	368	3,317	7,780
B. Improved Surface System	Acres	-	-	
C. Drip System	Acres	-	4	
4. SALT LOAD REDUCTION				
A. Salt load reduction, on-farm	Tons/Year	873	7,960	18,500
B. Salt load reduction, off-farm	Tons/Year	-	-	

*Note: On-farm Salt Load Reduction has been calculated using the procedure adopted in FY2007 by three Upper Basin States.

NRCS Salinity Control Programs in Manila - Washam Unit				
Program Name		Acronym	Start Year	End Year
Environmental Quality Incentive Program		EQIP	FY2007	Current
Basin States Parallel Program		BSPP	FY2007	Current

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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), which has continued through 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 Manila-Washam Unit (MW) are summarized in table 2.

Table 2. FY2011 results

FY2011	Units	Planned	Applied
Irrigation Improvements	acres	32	368
Federal cost share, FA	$	$37,000	$404,000
Amortized federal cost share, FA+TA	$/year	$4,000	$43,700
Salt load reduction	tons/year	72	870
Federal cost, FA+TA	$/ton	$55	$50

Cumulative Project Results

Cumulative cost/ton through FY2011 is below the cost of $87/ton (2011 dollars) anticipated by the EA. (Table 3)

Table 3. Project goals and cumulative status

FY2011 Cumulative Improvements	Units	NEPA	Planned	Applied
Irrigation improvements	acres	7,780	4,487	3,321
Federal cost share, FA	2011$	13,050,000	$7,180,000	$4,610,000
Amortized federal cost share, FA+TA	2011$/yr	1,563,000	828,900	524,400
Salt load reduction, tons/year	tons/year	18,000	10,003	7,960
Federal cost/ton, FA+TA	2011$	$87	$83	$66

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 2007 NRCS and Reclamation reviewed available literature and came to a consensus agreement on the most reasonable pre-project salt contribution from agriculture prior to implementing federal salinity control measures in the Manila – Washam Unit (MW). The result of this effort is depicted in figure 1.

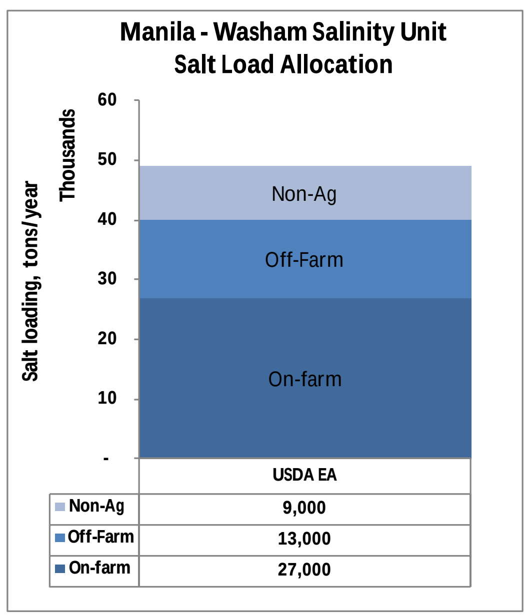


Figure 1. Consensus Initial Salt Load Allocation

Salinity Control Practices

On-farm practices, used to reduce salt loading, include improved flood systems, sprinkler systems, and advanced irrigation systems, along with diversions, water delivery systems, pumps, ponds, etc., required for the proper operation of irrigation systems. On-farm salt load reduction is achieved by reducing over-irrigation and deep percolation.

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

Planning Documents

For the Manila-Washam Salinity Area (MW), in 2006, NRCS developed an Environmental Assessment (EA) for which a Finding of No Significant Impact (FONSI) was issued by the NRCS State Conservationist for Utah. Development of salinity control contracts started in FY2007.

In FY2007, recalculation of potential salt load reduction was reduced from 24,900 tons/year to 18,000 tons/year, based on a reanalysis of data in the EA.

The EA and NRCS plans address only on-farm practices in MW. In FY2009, Peoples Canal Company received a Reclamation grant to pipe the entire Peoples Canal using American Recovery and Reinvestment Act (ARRA) funds. The pipeline was completed in 2010.

It is anticipated that the remaining canal company, Sheep Creek Canal Company, will continue to seek funding for off-farm improvements.

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.

FY2011 Obligation

In FY2011, $37,000 was obligated in 2 contracts to treat 32 acres with improved irrigation.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2011 planned practices is 72 tons/year, calculated by multiplying the original tons/acre for the entire basin, by the acres to be treated and a percentage reduction based on change in irrigation practice (84% for periodic move). For MW, 32 acres x 2.67 tons/acre-year x 84% = 72 tons/year salt load reduction.

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 (4.125% in FY2011). Two-thirds of FA is added for technical assistance (TA) and the amortized total cost is divided by tons/year to yield cost/ton. TA covers the cost of contract administration, project design and construction inspection, and contract review and maintenance through the life of the project.

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

Obligation Analysis

In FY2011, $37,000 was obligated to treat 32 acres, reducing salt loading by 72 tons/year. The resulting cost is $55/ton.

In 2011 dollars, cumulative obligation thru FY2011 is $7.18 million, planned on 4,487 acres, with a salt load reduction of 10,003 tons/year, resulting in an overall cost of $83/ton. (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 $/ton 2011$
2007	4.875%	17	$2,596,059	1,835	3,609	$303,160	$84	131%	$3,401,145	$397,175	110	110
2008	4.875%	9	$802,932	708	1,700	$93,764	$55	117%	$939,030	$109,657	65	95
2009	4.625%	16	$2,073,407	1,506	3,649	$236,055	$65	113%	$2,345,302	$267,010	73	86
2010	4.375%	6	$424,759	406	973	$47,130	$48	108%	$460,337	$51,078	52	83
2011	4.125%	2	$36,872	32	72	$3,986	$55	100%	$36,872	$3,986	55	83
Totals		48	$5,934,029	4,487	10,003	$684,095	$68		$7,182,687	$828,906	83	

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 MW, 18 contracts on 756 acres for $1.47 million (2011 dollars) are cost-share enhanced. Estimated salt load reduction is 1,779 tons/year. The average enhanced salt load reduction cost is $96/ton FA+TA (2011 dollars), compared to $83/ton for all contracts and $80/ton for unenhanced contracts. (Figure 2)

The incremental cost of enhancements is $244,000 FA, about 3.4% of total FA. All 18 enhanced contracts are beginning farmers.

About 17% of contracted acres have federally enhanced funding. (Figure 3)

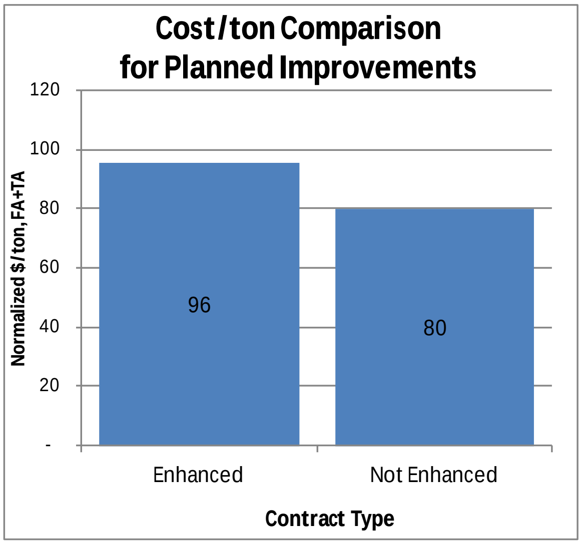


Figure 2. Cost of Contract Enhancement

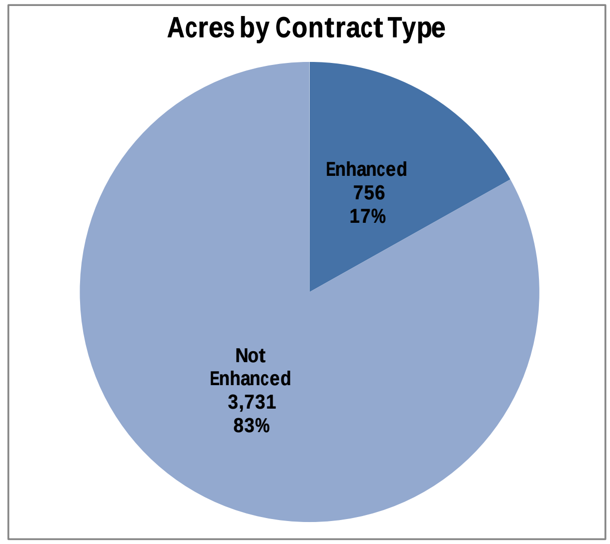


Figure 3. Enhanced Acres

Applied Practices

FY2011 Expenditures

In FY2011, $404,000 FA was expended applying practices to 368 irrigated acres. The estimated salt load reduction is 873 tons/year, at an amortized cost of $50/ton FA+TA.

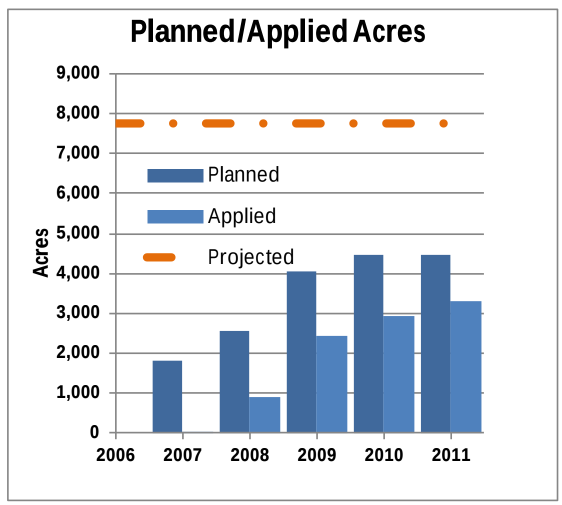


Figure 4. Planned and applied acres

Cumulative expenditure FY2007-FY2011 is $4.61 million FA (2011 dollars), applied to 3,321 irrigated acres, reducing salt loading by 7,960 tons/year at a cost of $66/ton FA+TA (2011 dollars). (Table 5)

There is a time lag between obligating funds and constructing salinity control practices (application). Between planning and application, a few contracts are de-obligated for various reasons such as design modification, change in ownership or cancellation. (Figure 4)

For tracking, acres treated and salt load reductions are assumed to be proportional to dollars paid out.

Salt load reduction in this report is calculated using procedures from "*Calculating Salt Load Reduction*", July 30, 2007.

About 58% of 7,780 acres, anticipated by the environmental assessment (EA) to be treated, have be planned and obligated. (Figure 5)

Table 5. Applied practices, cost/ton, nominal and 2011 dollars

FY	Federal Water Project Discount Rate	FA Applied Nominal	Acres Applied	Salt Load Reduction Applied	Amortized FA+TA Nominal	$/ton FA+TA Nominal	2010 PPI Factor	FA Applied 2011$	Amortized FA+TA 2011$	$/ton 2011$	Cum $/ton 2011$
2007	4.875%	$32,363	32	72	$3,779	52	131%	$42,399	$4,951	69	69
2008	4.875%	$1,068,816	857	2,046	$124,813	61	117%	$1,249,981	$145,969	71	71
2009	4.625%	$1,832,775	1,566	3,764	$208,660	55	113%	$2,073,115	$236,022	63	66
2010	4.375%	$780,211	497	1,205	$86,570	72	108%	$845,563	$93,821	78	68
2011	4.125%	$403,838	368	873	$43,655	50	100%	$403,838	$43,655	50	66
Totals		$4,118,003	3,321	7,960	$467,477	59		$4,614,896	$524,418	66	

The cost/ton is below the cost anticipated by the EA. (Figure 6)

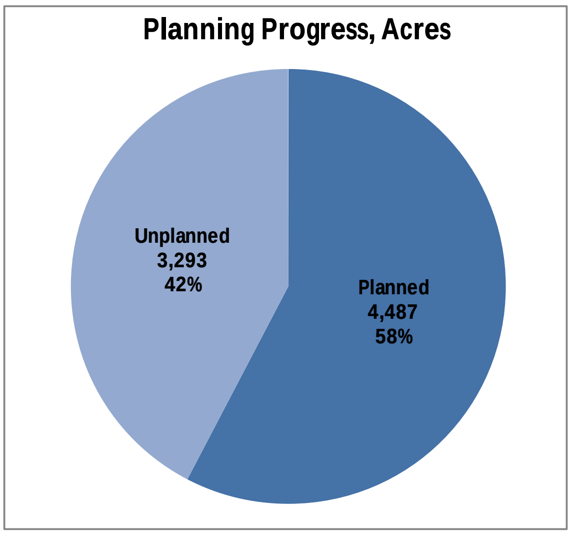


Figure 5. Planned and unplanned acres

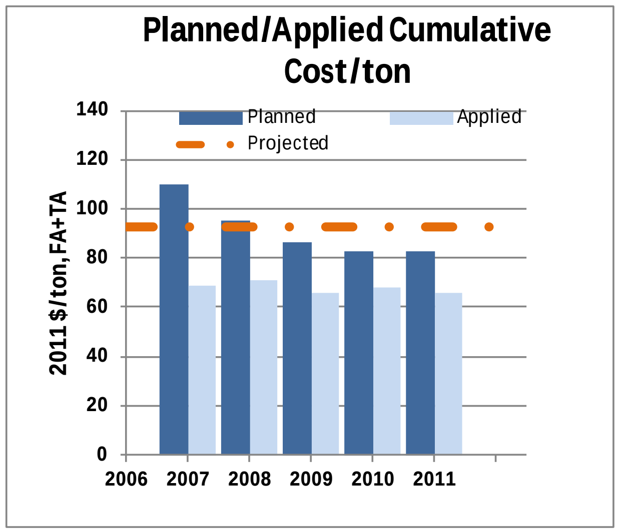


Figure 6. Cost/ton, planned, applied, projected

Figure 7 is a map displaying planned and applied acres.

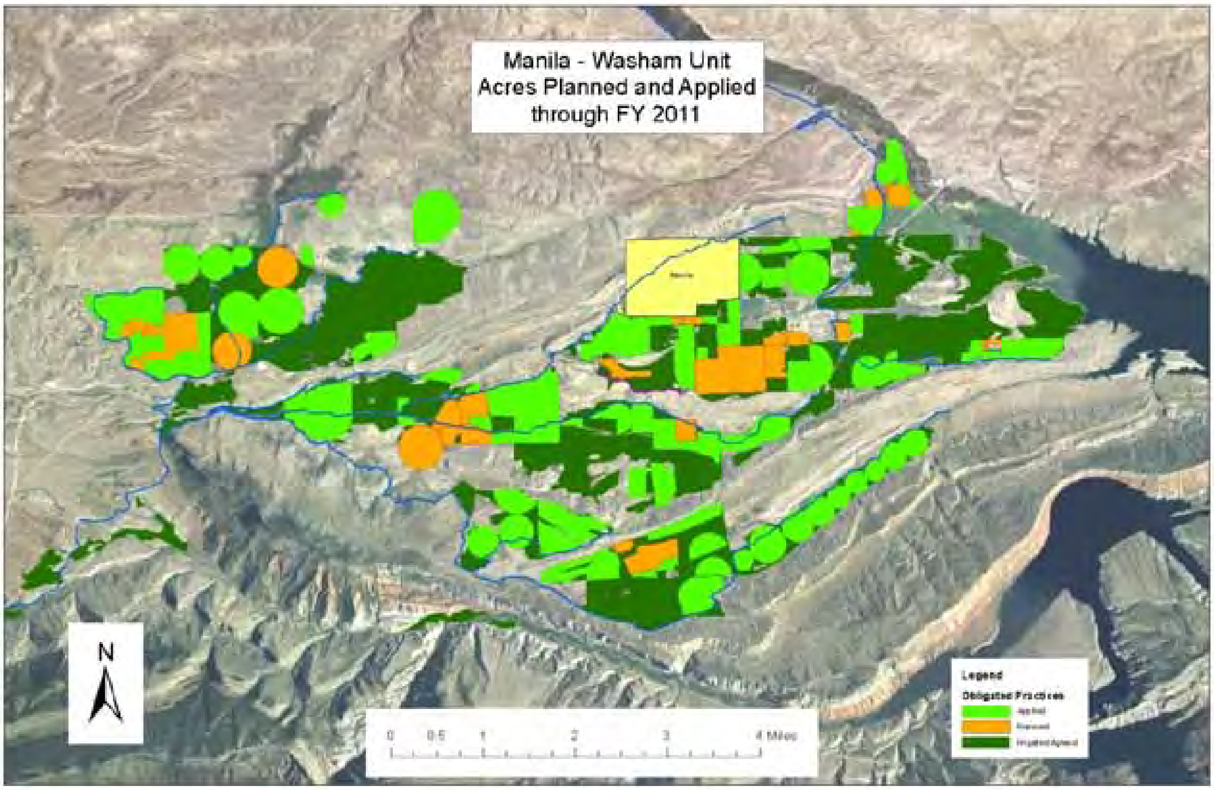


Figure 7. Planned and applied acres.

Hydro Salinity Monitoring

Before implementation of salinity control measures, Manila - Washam Unit agricultural operations contributed an estimated 40,000 tons of salt per year to the Colorado River (on-farm and off-farm), from an average of 10,100 acres of annually irrigated land. Salt loading of 27,000 Tons/year was allocated to on-farm activities and 13,000 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 MW, virtually all salinity program irrigation improvements are sprinkler systems. Center Pivot systems are preferred by three to one over wheel lines, on an acreage basis, presumably due to large average field size. The average contract size is 93 acres.

Cooperator questionnaires, interviews, and training sessions

No cooperator questionnaires have been done in the Manila – Washam 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, cooperator 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 irrigation begins and after irrigation ends, leaving the soil moisture profile partially depleted. Filling the soil with water requires additional irrigation, over and above crop needs, in the spring, to fill the soil profile.

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 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 spreadsheet contains an input form used to enter system design data, location, crop data, soil data, and the date when each irrigation cycle begins. AWC and deep percolation are calculated and transferred to the graph portion of the spreadsheet. (Figures 8 and 9)

In order to receive incentive payment for IWM, each irrigator must do the following:

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
3. present 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.

From FY2008 to FY2011, 32 IWM Self Certification Spreadsheets were submitted for payment. Two projects were deep percolating excessively. Total deep percolation from all 32 fields was about 61% of design deep percolation, suggesting that salt load reduction estimates are conservative.

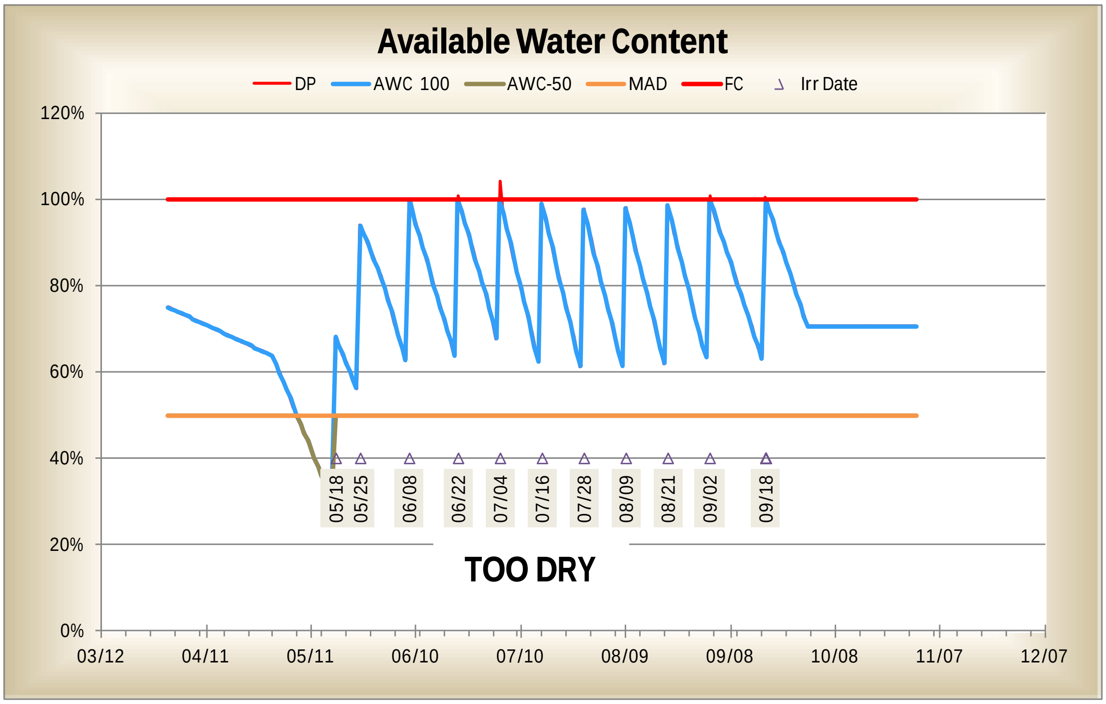
Irrigation Water Use Record - Farmer Self Certification

Cooperator:		Crop:	Grass Hay/Pasture	Year:	2010
Tract/Field:		Root Depth, ft:	2.50		
Date:	02/02/11	Station:	Manila	CU:	24 inches

Soil Texture:	Loam	Irrigation method:	Pivot
AWC, In/Ft:	2.16	Efficiency:	75%
AWC Max, in:	5.40	Acres:	69.74
MAD, in:	2.70	Evaporation %:	10%
Pre-season AWC, In.	2.70	Cycle Hours:	168
		Flow rate, gpm:	450

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 Balance	AWC	Deep Perc
05/18/10	05/25/10	168		450.2	2.42	2.42	3.27	-1.09	1.61	0.00
05/25/10	06/01/10	168		450.2	2.42	4.84	4.06	1.39	3.00	0.00
06/01/10	06/08/10	168		450.2	2.42	7.26	5.10	1.13	4.13	0.00
06/08/10	06/15/10	168		450.2	2.42	9.68	6.15	1.13	5.26	0.00
06/19/10	06/26/10	168		450.2	2.42	12.10	7.79	0.54	5.40	0.40
06/30/10	07/07/10	168		450.2	2.42	14.52	9.68	0.29	5.40	0.29
07/11/10	07/18/10	168		450.2	2.42	16.94	11.71	0.15	5.40	0.15
07/22/10	07/29/10	168		450.2	2.42	19.37	13.73	0.15	5.40	0.15
08/02/10	08/09/10	168		450.2	2.42	21.79	15.69	0.23	5.40	0.23
08/13/10	08/20/10	168		450.2	2.42	24.21	17.62	0.24	5.40	0.24
08/24/10	08/31/10	168		450.2	2.42	26.63	19.56	0.24	5.40	0.24
09/04/10	09/11/10	168		450.2	2.42	29.05	21.02	0.72	5.40	0.72
09/15/10	09/22/10	168		450.2	2.42	31.47	22.48	0.72	5.40	0.72
Total inches of water applied during the season (total of all lines above):								31.47		3.14
Total Acre Feet Applied during the Season:								182.9		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								71%		

Figure 8. IWM Self Certification Spreadsheet input page



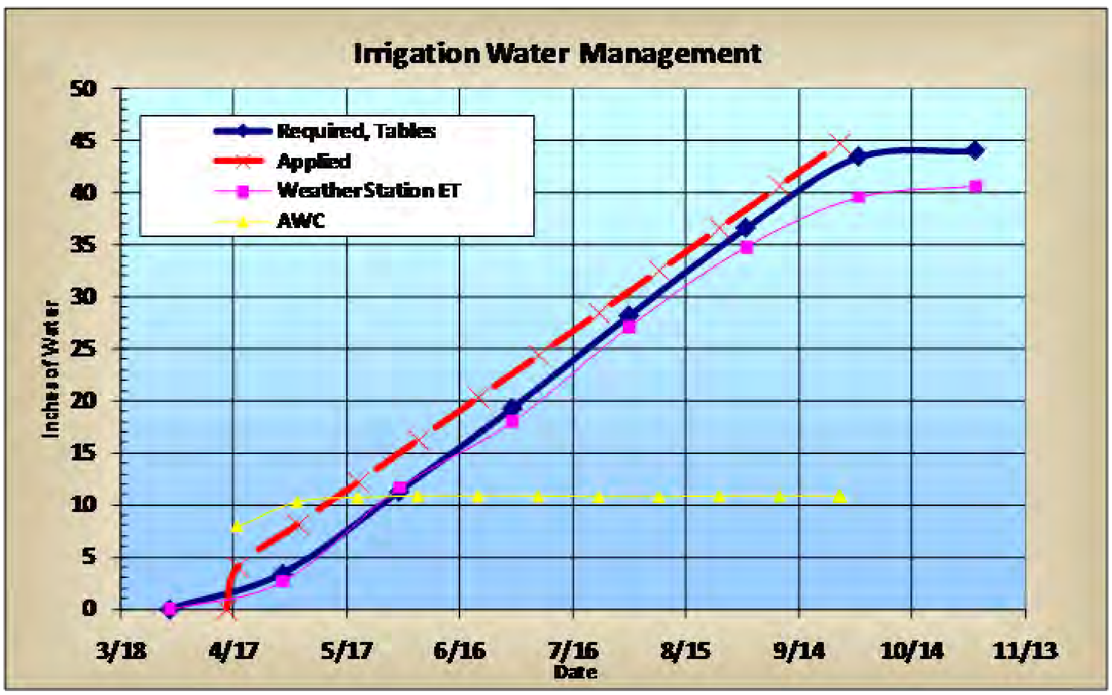


Figure 9. Sample graphs from the IWM Self Certification Spreadsheet

In the first graph, the blue line represents AWC, which should be maintained in the Managed Allowable Depletion (MAD) range of 50 to 100% for maximum crop growth. Red peaks above the 100% line indicate deep percolation. In the second graph, the blue line is a long-term average water requirement, based on location and crop. The red line is the actual water applied. Where data is available, the purple line is modeled from current local data collected at a nearby weather station.

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.

Figure 10. Sample Soil Moisture Data Logger with graph

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 their 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 10).

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. In MW, one installed data recorder indicates that deep percolation occurs less than 3% of the time on the monitored field.

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 11)

In the Manila – Washam Unit, four data recorders have been purchased and installed by Daggett Soil Conservation District members.

In the NRCS payment schedule, an additional IWM Intense (449) practice is included that increases the IWM payment for participants who agree to install soil moisture monitoring equipment in addition to taking classes, attending workshops, and keeping records. It is hoped that future contracts will capitalize on this opportunity to enhance instrumentation and IWM interest at the field level.

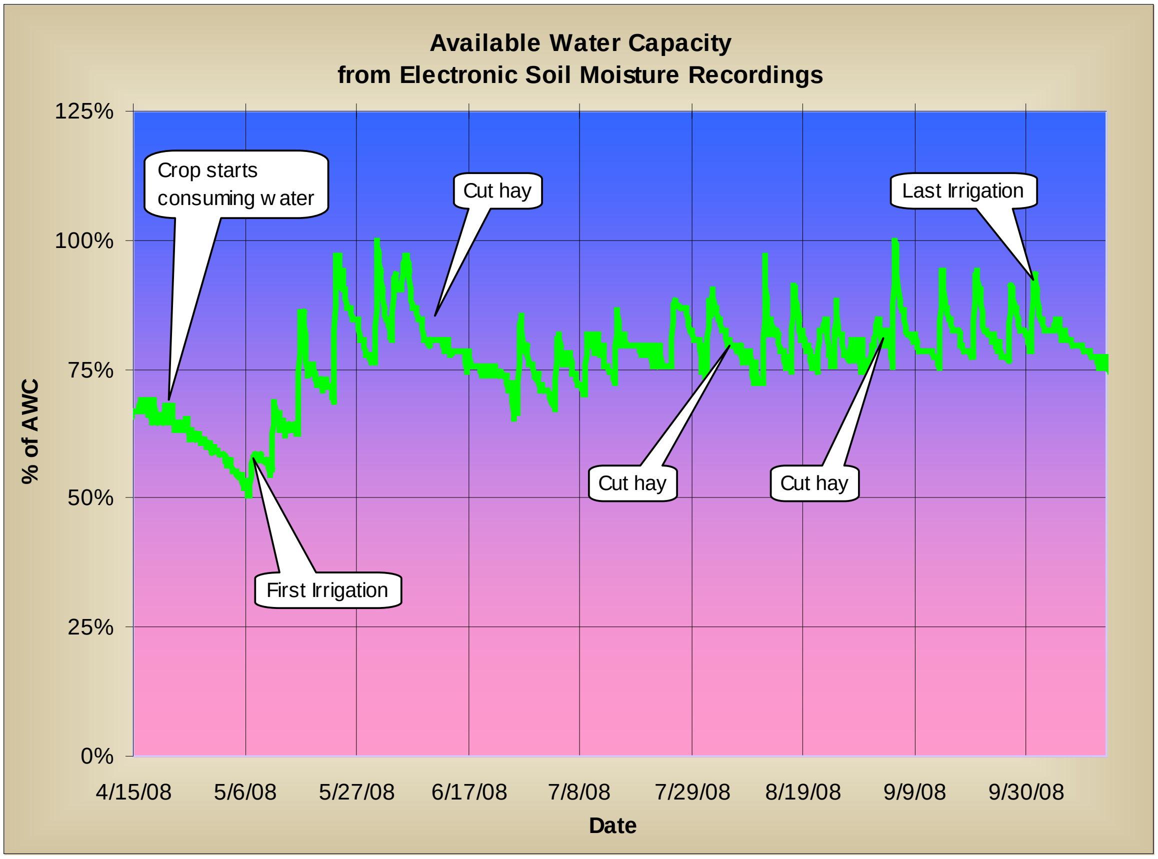


Figure 11. AWC estimated from downloaded soil moisture data

USGS Water Quality Monitoring

US Geological Survey (USGS) studied salt loading from the Manila-Washam Salinity Area (MW) from July 1, 2004 to June 30, 2005. From this data they prepared Scientific Investigations Report 2004-05, entitled "*Characterization of Dissolved Solids in Water Resources of Agricultural Lands near Manila, Utah, 2004-2005*". The amended final report estimated the total agricultural salt loading to be 31,200 tons/year. Of the 31,200 tons/year, NRCS estimates that 8,000 tons/year has been eliminated due to the installation of sprinkler systems.

Because MW is small in size, isolated, and with well defined water sources and drains, USGS continued to monitor the discharge of dissolved salts into Flaming Gorge Reservoir through the end of 2011. Provisional data provided from USGS by email, is enigmatic. Data indicates that salt loading initially dropped by nearly half but has steadily increased since the first year of practice installations. We can speculate that the initial drop was due to irrigation interruptions while sprinklers were being installed. As irrigation came back on line, salt loading increased, but never to the levels of 2004-2005. Weather may have also influenced salt loading.

Continued monitoring of drains in the MW area might lead to better insight to changes in loading.

Applied on-farm practices through April, 2011 should have reduced salt loading by about 7,100 tons/year. USGS provisional data indicates that salt loading for the 12 months from May, 2004 to April, 2005 was about 38,500 tons. For May, 2010 to April 2011, the provisional load was about 25,800 tons, fitting nicely with a 7,100 ton decrease since project inception. (Figure 12)

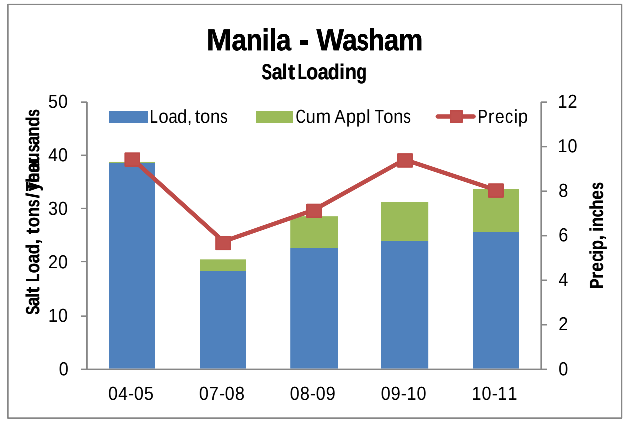


Figure 12. USGS Salt Load Monitoring (provisional)

SPARROW

In 2009, USGS issued Scientific Investigations Report 2009-5007, "Spatially Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin" (SPARROW91), which models salt loading throughout the Upper Colorado River Basin. This model is based on water and weather data from 1991.

Adjustment factors have been established to make the data more relevant to long term averages as opposed to the most data rich year, 1991. The most current adjustment factors are signified as Anning 2.2. The Anning 2.2 adjusted SPARROW model estimates the total on-farm and off-farm agricultural salt load in MW to be 18,000 tons/year with a potential margin of error of ±51%.

Wildlife Habitat and Wetlands

Background

In February, 2007, the Manila-Washam project 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 Basin there are several Salinity Areas, each with its own unique methodology for monitoring and evaluating impacts and replacement of wildlife habitat and wetlands. The Manila-Washam Salinity Area is a relatively small project, and impacts from the project can be observed from project inception. The Monitoring and Evaluation Team (M&E) will create a series of 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 intended 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 any 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.

The U.S. Forest Service (USFS) has created two wetland complexes west of Flaming Gorge reservoir. The Henry's Fork complex, located north of the Utah-Wyoming border, has a secure water right which may need to be more carefully managed in the event that irrigation improvements reduce the amount of excess run-off now being collected and channeled through this USFS property. The Linwood Pond complex, located south of the Utah-Wyoming border has no secure water right and could be impacted by reduced tailwater availability associated with irrigation improvements.

USFS has been encouraged to obtain more secure water rights for this wetland complex. As irrigation improvements are planned, NRCS cooperators will be encouraged to work with USFS to assure an adequate water supply for the complex.

These wetland complexes represent an important aspect of wildlife habitat found in the Manila-Washam Salinity Area. Many species of plants and animals are found in these areas and they are also used by many members of the public for recreation such as wildlife viewing. These wetlands are located on federal, public land and provide access to all people wishing to enjoy their natural resources.

M&E intends to work with USFS personnel and NRCS customers to help monitor the health of these systems, and provide input for solutions to the uncertain outcome of potential tailwater reduction.

Area-wide Wildlife Habitat Monitoring

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

Reclamation funded a project to pipe the Peoples Canal near the town of Manila in FY2009. This project was completed in FY2010. Piping of this canal, and the subsequent change of irrigation type (flood to sprinkler), may impact USFS constructed wetland complexes and other wetlands downstream from the development. Photographs of the areas below the canal were taken in late summer 2010, to attempt to capture changes (if any) in subsequent years. Changes will also be monitored using current and updated NAIP aerial photos. USFS wetlands are also being monitored by comparative photographs and plant species list comparisons, to determine if any impacts will be realized from the piping of the Peoples Canal and irrigation conversion.

Wildlife Habitat Contract Monitoring

FY2011 is the fifth year MW Salinity Unit has been eligible for CRBSCP funding. There were no Salinity Wildlife Only contracts planned and funded in FY2011, and only one acre of upland habitat was applied under EQIP (Table 6). Table 7 represents total cumulative acres of wildlife habitat improvement planned and applied in the MW Salinity Unit. The wildlife habitat improvement projects applied have all been sub-items included in irrigation projects. Land owners appear to be completing these practices in a timely manner.

Table 6. Wildlife Habitat Replacement Planned and Applied in FY2011

Acres of Wildlife Habitat Creation or Enhancement				
FY2011 practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland	Upland	Wetland	Upland
BSPP	-	-	-	-
EQIP	-	-	-	1
WHIP	-	-	-	-
Total	-	-	-	1

Table 7. Cumulative Wildlife Habitat Replacement since Project Inception

Acres of Wildlife Habitat Creation or Enhancement				
Cumulative practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland	Upland	Wetland	Upland
BSPP	-	-	-	-
EQIP	-	8	-	7
WHIP	-	-	-	-
Total	-	8	-	7

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.

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

Farming in the Manila area is principally related to livestock production. Crops are generally forage related and alfalfa production is a reasonable indicator of output. In the Manila – Washam Unit, alfalfa yields have been cyclical over the past twenty years. A linear regression on production indicates an uptrend. (Figure 13)

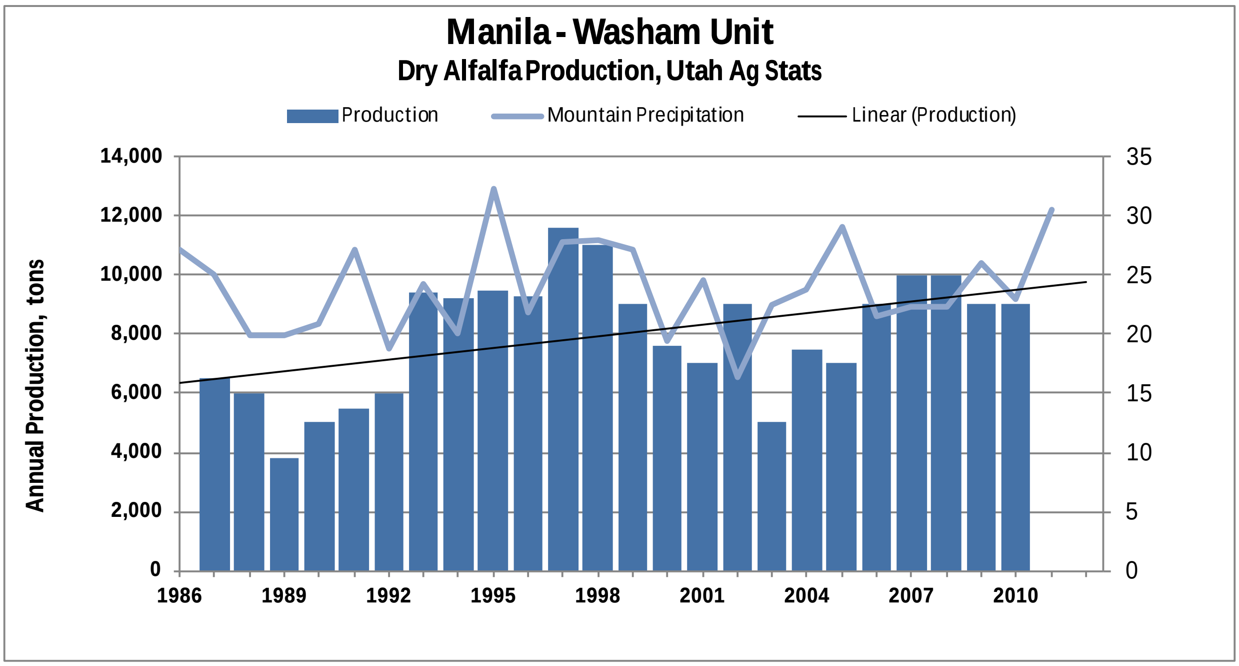


Figure 13. Manila - Washam Unit alfalfa production and Mountain Precipitation

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.

From the 2007 Census of Agriculture, 85% of farmers hire no outside labor and 62% have full-time occupations other than farming, it is assumed that most cooperators are satisfied with their personal labor savings.

Public Economics

No cooperator surveys have been completed in MW, but local farmers seem to have positive attitudes about the salinity program. Ninety-five percent of survey respondents, from other salinity areas, believe that salinity control programs have a positive economic affect on the area and region.

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

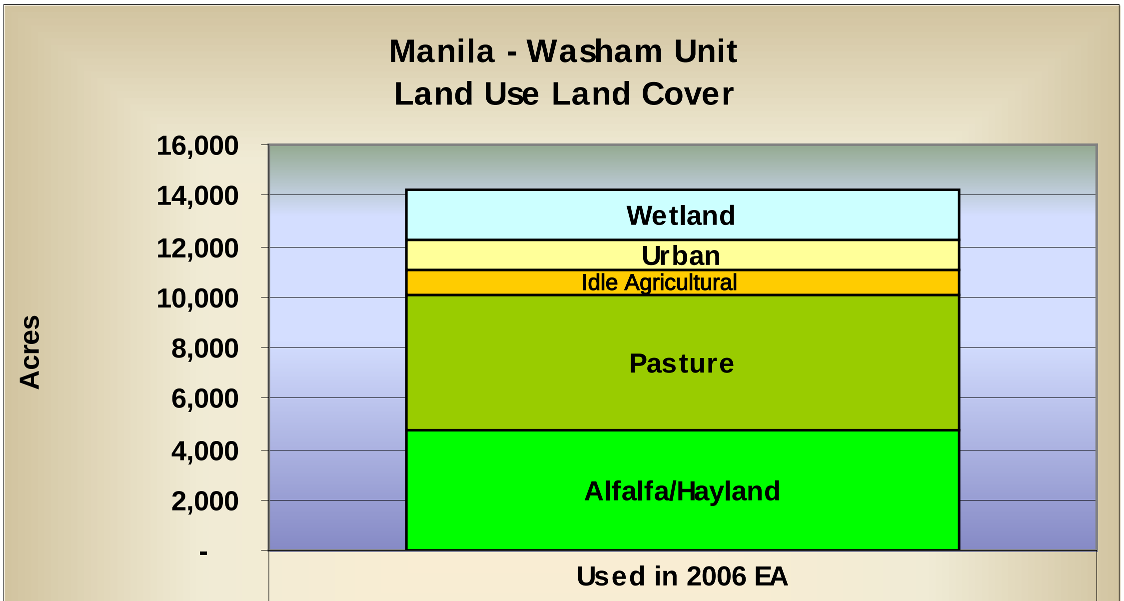
Figure 14 is a graphical presentation of pre-project land use in the Manila-Washam Unit. This data was derived by comparing the Utah Division of Water Resources Water Related Land Use layer (for the Utah portion) with a cover map created by overlaying orthoimagery. Changes to land cover will be tracked in future reports.

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. Salinity programs in other areas indicate that participants are apparently satisfied with results and generally positive about salinity control programs.

Irrigation installation costs are escalating. Increased world energy prices have resulted in much higher costs for pipe, transportation, labor, and equipment. It can be assumed that the value of downstream damages will also be escalating due to energy impacts.

With labor, material, and equipment prices rising, it is expected that the cost/ton of salinity control measures will also increase. However, the FY2011 average planned cost of $55/ton does not approach the cost of downstream damages from excess salt. Colorado River Basin Salinity Control Programs are successful and cost effective in reducing salt load in the Colorado River.



	Used in 2006 EA
Wetland	2,000
Urban	1,100
Idle Agricultural	1,000
Pasture	5,400
Alfalfa/Hayland	4,700

Figure 14. Pre-project land use land cover, used in preparing 2006 EA

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, and 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.

Pod – A periodic move sprinkler system consisting of sprinklers mounted in plastic pods, spaced along an HDPE flexible lateral. The lateral is generally moved by dragging it with a four wheeler.

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, Periodic Move – 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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