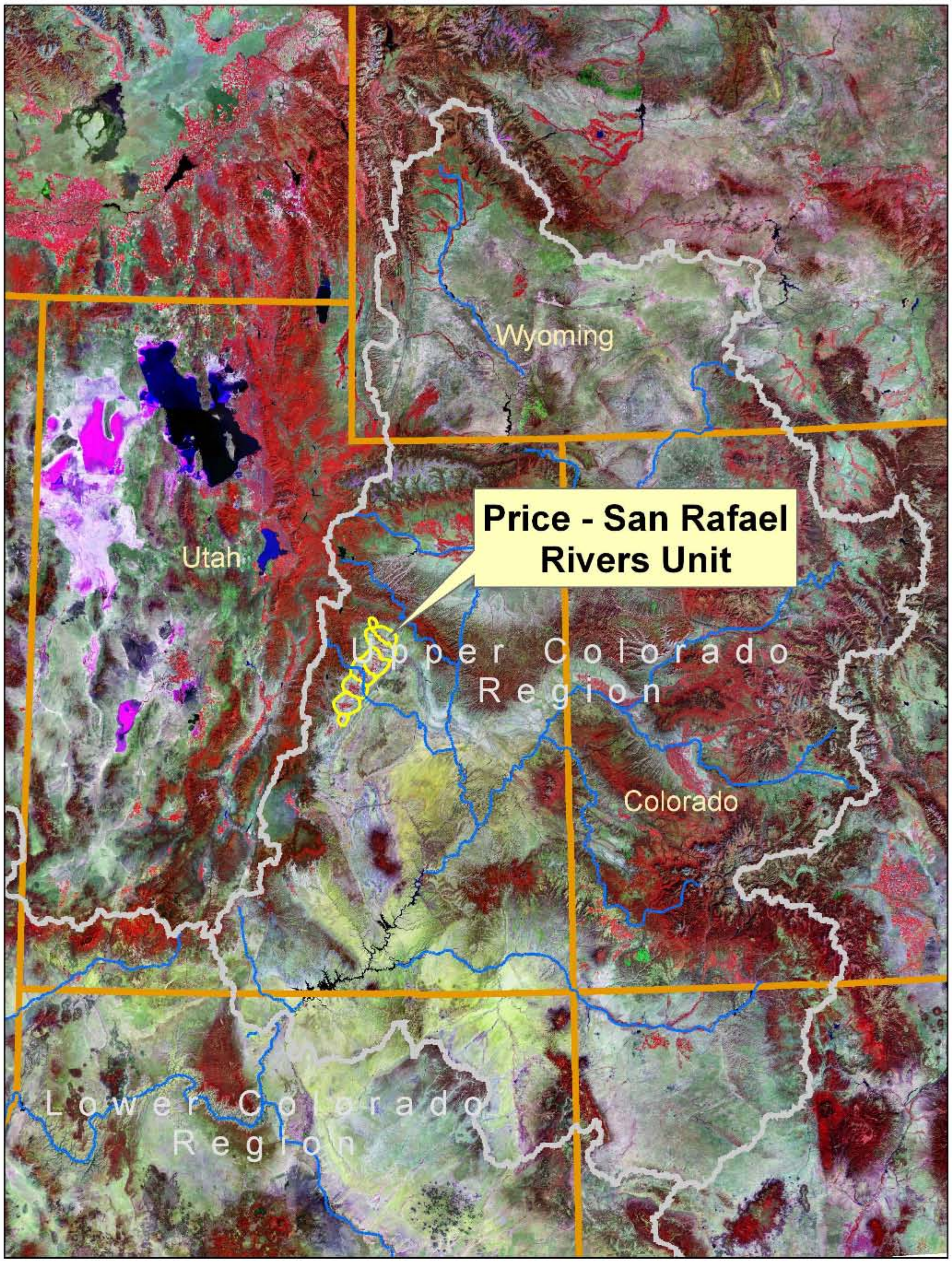
Colorado River Basin Salinity Control Program

Price – San Rafael Rivers Unit

Monitoring and Evaluation Report, FY2009



U.S. Department of Agriculture

Natural Resources Conservation Service

Executive Summary

Project Status

- For FY2009, $3.93 million was obligated planning 1,147 acres to reduce salt loading by 3,280 tons at an amortized cost of $136/ton FA+TA.
- Since 1997, $32.5 million (2009 dollars) has been obligated planning 28,100 acres to reduce salt loading by 79,000 tons at an amortized cost of $51/ton FA+TA, very near the $53/ton implied in the 1993 EIS.
- For FY2009, $3.94 million was applied on 1,560 acres to reduce salt loading by 4,424 tons at an amortized cost of $101/ton FA+TA.
- Since 1997, $22.2 million (2009 dollars) has been applied on 23,000 acres to reduce salt loading by 67,500 tons at an amortized cost of $40/ton FA+TA.
- In 2009 dollars, pre-project NEPA documents anticipated a salt load reduction cost of $53/ton-year. Cumulative planned cost is $51/ton, and cumulative applied cost is $40/ton. Cumulative costs are expected increase due to more complex irrigation projects that are underway.
- Of 66,000 water-rights acres, 36,050 acres were projected to be improved by the EIS.
- Of approximately 73,000 original off-farm tons, USDA programs have applied 1,550 tons of salt load reduction for lateral construction.
- Passage of the 2008 Farm Bill has extended EQIP through 2012.

Hydro-salinity

- IWM record keeping, soil moisture monitoring, and sprinkler condition surveys all indicate that salt load reduction estimates, using current calculation procedures, are probably conservative.
- An intense IWM practice is included in the NRCS salinity payment schedule to help encourage Soil moisture monitor installation.

Wildlife Habitat and Wetlands

- In FY2009, no wildlife habitat replacement projects were planned or funded.
- 166 acres of wildlife habitat replacement were applied in FY2009.

Economics

- Alfalfa production is clearly in an upward trend, but yield/acre is declining slightly.
- Applications for salinity control projects remain strong.

Table 1, Project progress summary

Price - San Rafael Rivers Unit FY2009 Program Summary				
Planned Irrigation Practices	**Units**	**FY2009**	**Cumulative**	**Target**
Contracts (Planned)	**Number**	45	733	
	2009$, FA	3,929,835	32,544,574	
	Acres	1,147	28,068	
	Tons	3,280	79,015	147,000
	2009 $/Ton	136	51	
Applied Irrigation Practices	**Units**	**FY2009**	**Cumulative**	**Target**
Expenditures	**2009$, FA**	3,936,953	22,205,031	
Sprinkler Systems	**Acres**	1,555	22,981	36,000
Improved Surface Systems	**Acres**	-	-	
Drip Irrigation Systems	**Acres**	5	30	
Salt Load Reduction, on-farm*	**Tons/Year**	4,424	65,894	147,000
Salt Load Reduction, off-farm	**Tons/Year**	-	1,553	
Federal cost	**2009 $/ton**	101	40	

***Note: On-farm Salt Load Reduction has been recalculated using the procedure adopted in FY2007 by three Upper Basin States. All EQIP and BSPP contracts were reviewed and acres corrected. All cumulative numbers reflect results of recalculation.**

NRCS Salinity Control Programs			
Program Name	**Acronym**	**Start Year**	**End Year**
Environmental Quality Incentive Program	EQIP	1997	Current
Basin States Parallel Program	BSPP	1998	Current

For further information, please contact:
Jim Spencer, Wildlife Biologist
USDA-NRCS
240 West Highway 40 (333-4)
Roosevelt, UT 84066
(435)722-4621 ext 128
jim.spencer@ut.usda.gov

Ed Whicker, Civil Engineer
USDA-NRCS
240 West Highway 40 (333-4)
Roosevelt, UT 84066
(435)722-4621 ext 124
ed.whicker@ut.usda.gov

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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 required 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).
- The Farm Security and Rural Investment Act of 2002 and the Food, Conservation, and Energy Act of 2008 reauthorized and amended EQIP, continuing opportunities for USDA funding of salinity control measures.

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", first issued for Uintah Basin Unit in 1980 and revised in 1991 and 2001.

Project Status

FY2009 Project Results

FY2009 project results for the Price – San Rafael Rivers Unit (PSR) are summarized in table 2.

Cumulative Project Results

Cumulative results through FY2009 are tabulated in Table 3, along with EIS projections and an estimated projection of project completion. Off-farm activities are excluded from this table. Dollar amounts are expressed in 2009 dollars.

The amortized cost of salt load reduction is less than anticipated by the EIS. Cooperators continue to apply for salinity control contracts and opportunities still exist to further reduce salt loading at an average cost/ton comparable to that expected at project inception.

Table 2, FY2009 results

FY2009	Units	Planned	Applied
Irrigation improvements	Acres	1,147	1,560
Federal cost share, FA	2009 $	3,930,000	3,937,000
Amortized federal cost share, FA	2009 $	268,500	268,900
Salt load reduction	tons /yr	3,280	4,424
Federal cost, FA+TA	2009 $ /ton	136	101

Table 3, Project goals and cumulative status, on-farm only, 2009 dollars

Cumulative Improvements	Units	EIS	Projected	Planned	Applied
Irrigation improvements	Acres	36,050	45,000	28,100	23,000
Federal cost share, FA	2009 $	62,860,000	78,470,000	32,540,000	22,210,000
Amortized federal cost share, FA+TA	2009 $	6,330,000	7,900,000	4,070,000	2,720,000
Salt load reduction	tons /yr	120,000	150,000	79,000	67,000
Federal cost, FA+TA	2009 $ /ton	53	53	51	40

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 U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) and U.S. Department of the Interior, Bureau of Reclamation (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 Programs. The result of this effort is depicted in figure 1.

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. Salt load reduction is achieved by improving uniformity of water application and 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 PSR, in 1993, U.S. Department of Agriculture (USDA) Soil Conservation Service (now NRCS) and U.S. Department of Interior Bureau of Reclamation (Reclamation) developed a joint environmental impact statement (EIS).

Using the same salt cost calculation used in the Colorado River Basin Salinity Control Project (CRBSCP) today, the initial EIS suggested that the cost of on-farm salt load reduction would be about $53/ton in 2009 dollars. ($27/ton in 1989)

Table 4, an updated version of Table IV-12 of the EIS, summarizes cost calculations using current procedures with EIS data.

Amortized at 8.875% (1989 discount rate) over 25 years, as is typical for today's salt cost calculations, the combined cost of on-farm and off-farm improvements, less winter water improvements, cited in Table IV-12 of the EIS, would have been $51/ton

Figure 1, PSR pre-project agricultural salt load allocation.

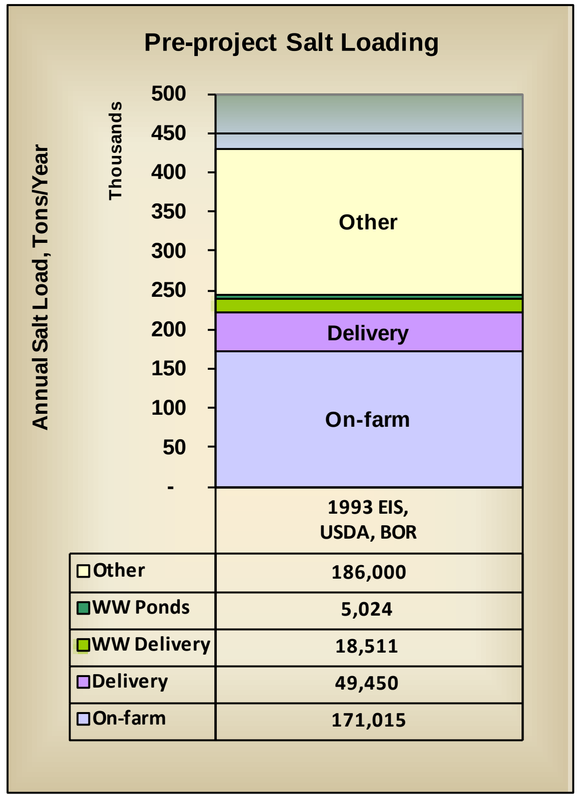


Table 4, Calculation of salt load reduction cost using pre-project, EIS projections, 2009 dollars

1993 EIS, Federal Project Cost		On-farm	Off-farm	Winter Water	Total Project
Irrigation projects	acres	36,050			36,050
Canals and ditches	miles		156		156
Winter Water Improvements				Various	
Salt Load Reduction	tons/year	120,220	7,937	32,885	161,042
Total Federal Cost (1989)	$	32,522,760	31,962,300	5,547,000	70,032,060
Amortized @ 8.875%, 25 years[1]	$/year	3,277,546	3,221,065	559,010	7,057,621
Salt Load Reduction Cost, nominal	$/ton	27	406	17	44
Salt Load Reduction Cost	2009 $/ton	53	784	33	85
Salt Load Reduction Cost, combined on-farm & off-farm	2009 $/ton	98		33	
Salt Load Reduction Cost, combined off-farm and winter water	2009 $/ton	53	179		

[1] The EIS amortized at 8.875% (1989 discount rate) over 50 years. Typically, contemporary salt load calculations use a 25 year life.

nominal, not the $45/ton calculated using a 50 year practice life. The equivalent cost in 2009 dollars is $98/ton, which might be a good target estimate of the cost of a combined on-farm/off-farm project in 2009.

With the joint EIS in place, Reclamation initiated Requests for Proposals (RFP) under the Water Challenge Grant Program which resulted in several joint proposals over the years. The costs of these projects were generally justified by combining the total federal cost of on-farm and off-farm salinity control components and weighing the cost against total salt load reduction, as was done in the EIS. Regardless of how a project is justified, each agency remains accountable for federal dollars expended by their agency and salt load reduction directly associated with those federal expenditures.

In general, on-farm practices are much more cost effective at reducing salt loading than are off-farm practices. However, quality off-farm practices help to maximize and optimize the installation of on-farm practices by providing pressure and delivery scheduling not available from open delivery systems. Like a highway, where it is often necessary to build expensive bridges along with less expensive miles of roadway, the most effective irrigation projects include more expensive off-farm practices along with less expensive on-farm practices in a combination that ultimately produces the most cost effective results.

Implementation has not always been divided along agency lines or on-farm/off-farm boundaries. Traditionally NRCS has focused on on-farm projects and Reclamation has emphasized off-farm projects. (Where on-farm and off-farm come together is blurry at times.) However, this tradition is not hard and fast and Reclamation has done some on-farm projects and NRCS has done some off-farm projects. Consequently, it is expected that Reclamation and NRCS will each allocate salt load reduction to on-farm and off-farm practices funded through their agency. This report deals only with NRCS funding and associated salt load reduction.

FY2009 Obligations

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 installation using Federal grants. In essence, federal cost-share purchases salt load reductions in the Colorado River, while the participant's cost-share buys her/him 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. A few of these contracts are never completed, for various reasons, making tracking of the cumulative federal obligation problematic in that it decreases over time, as contracts are modified or cancelled. Table 5 lists annual planned obligations and cost/ton in nominal and 2009 dollars.

In FY2009, $3.93 million was obligated in 45 contracts to treat 1,147 acres with improved irrigation.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2009 planned practices is 3,280 tons/year, calculated by multiplying the original tons/acre for the entire basin, by the acres to be treated and a percentage reduction factor based on change in irrigation practice. For PSR, the initial estimate of on-farm irrigation salt loading is 3.28 tons/acre-year. As an example, if 40 acres are converted from wild flood to wheel line sprinkler, an estimated 84% of salt loading will be eliminated. Hence, 40 acres x 3.28 tons/acre-year x 84% = 110 tons/year salt load reduction.

Table 5, Cost/Ton of annual planned obligations, in nominal and 2008 dollars

FY	Federal Water Project Discount Rate	Contracts Planned	FA Planned Nominal	Acres Planned	Salt Load Reduction Planned, Tons/Year	Amortized FA+TA Nominal	$/Ton FA+TA Nominal	2009 PPI Factor	FA Planned, 2009 Dollars	Amortized FA+TA 2009 Dollars	$/Ton 2009 Dollars	Cum $/ton, 2009 Dollars
1997	7.375%	25	692,191	1,614	4,606	102,363	22	149%	1,032,425	152,677	33	33
1998	7.125%	41	613,448	1,291	3,684	88,724	24	153%	938,846	135,787	37	35
1999	6.875%	32	862,047	1,706	4,868	121,903	25	153%	1,319,312	186,565	38	36
2000	6.625%	53	875,959	1,563	4,460	121,075	27	147%	1,284,745	177,577	40	37
2001	6.375%	93	1,718,908	3,302	9,423	232,155	25	143%	2,459,585	332,190	35	36
2002	6.125%	108	1,359,897	2,912	8,310	179,412	22	142%	1,930,185	254,650	31	35
2003	5.875%	38	1,186,360	1,261	3,550	152,843	43	138%	1,631,252	210,160	59	37
2004	5.625%	70	3,044,481	4,508	12,864	382,901	30	132%	4,028,803	506,698	39	38
2005	5.375%	50	2,477,342	2,499	7,131	304,063	43	123%	3,049,049	374,232	52	40
2006	5.125%	45	3,344,938	3,222	7,482	400,523	54	119%	3,977,780	476,299	64	42
2007	4.875%	39	2,416,159	1,353	4,545	282,152	62	111%	2,691,412	314,295	69	44
2008	4.875%	94	4,295,563	1,690	4,812	501,623	104	99%	4,271,346	498,795	104	48
2009	4.625%	45	3,929,835	1,147	3,280	447,408	136	100%	3,929,835	447,408	136	51
Totals		733	26,817,128	28,068	79,015	3,317,142	42		32,544,574	4,067,333	51	

Cost/Ton Calculation

The federal cost/ton for salt load reduction is calculated by amortizing the federal cost over 25 years at the federal discount rate for water projects (4.625% for FY2009). Two-thirds of FA is added for TA and the amortized total cost is divided by tons/year to yield cost/ton. The Producer Price Index (PPI) for agricultural equipment purchased is applied to normalize past obligations to 2009 dollars.

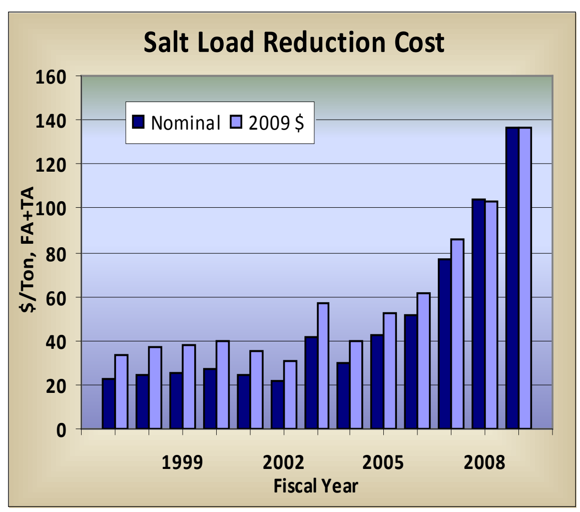
Obligation Analysis

In FY2009, $3.93 million was obligated to treat 1,147 acres, reducing salt loading by 3,280 tons. The resulting cost is $136/ton. FY2009 obligations included a large number of contracts in the Huntington–Cleveland project (HCIC), which require moderate near-farm delivery systems to tie into HCIC pipelines. This resulted in higher-than-usual cost/ton for the year.

In 2009 dollars, cumulative obligation thru FY2009 is $32.5 million, planned on 28,100 acres, with a salt load reduction of 79,000 tons resulting in an overall cost of $51/ton, close to the $53/ton cost projected by the EIS for on-farm practices.

Figure 2, is a graph of annual salt load reduction costs planned in nominal and 2009 dollars.

Figure 2, Cost/Ton planned, nominal and 2009 dollars



Cost-Share Enhancement

Typical federal cost-share, over the last several years, has been 75% of total installation cost. A feature of the 2002 and 2008 Farm Bills is cost-share enhancement, increasing the federal share, from 75% to 90% of the 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 less than a proscribed limit), and members of historically underserved minorities.

In PSR, 165 contracts, written since 2003, on 6,906 acres for $8.66 million FA (2009 dollars) are cost-share enhanced. Estimated salt load reduction is 19,740 tons/year on-farm and off-farm. The cumulative average salt load reduction cost for enhanced contracts is $52/ton FA+TA (2009 dollars), compared to $40/ton FA+TA for non-enhanced contracts from the same time period. (See figure 3). The incremental cost of enhancement is $1.28 million FA, about 6% of total FA for all contracts in the FY2003-FY2009 time period. One-hundred, forty-nine contracts are beginning farmers and sixteen are limited resource farmers.

Figure 4 depicts the number of acres receiving enhanced funding.

Applied Practices

FY2009 Expenditures

In FY2009, $3.94 million FA was expended applying 1,560 irrigated acres. The estimated salt load reduction is 4,424 tons/year, on-farm and off-farm, at an amortized cost of $101/ton.

Cumulative expenditure FY1997-FY2009 is $22.21 million FA (2009 dollars), applied to 23,000 irrigated acres, reducing salt loading by 67,400 tons/year, on-farm and off-farm, at a cost of $40/ton (2009 dollars).

Application of salinity control practices lags planning by the time required for practice installation. Between planning and application, a few contracts are de-obligated for various reasons.

Table 6 details annual applied expenditures over the life of the project.

Figure 5, compares acres planned and applied.

For tracking, irrigation contracts are assumed to be applied in proportion to dollars expended on September 30th, the last day of the fiscal year.

Salt load reduction in this report is calculated using the procedure outlined in "CALCULATING SALT LOAD REDUCTION", July 30, 2007, found in appendix I.

Evaluation by Program

Funding for the Colorado River Salinity Control Project in the Price – San Rafael Rivers Unit (PSR) has been provided by two programs, EQIP and BSPP (defined in table 1 at the beginning of this report).

Table 7 compares planned and applied amounts for EQIP and BSPP funds.

Figure 6 depicts acres planned by program.

Figure 7 compares acres planned and unplanned.

Figure 3, Cost/Ton, comparison

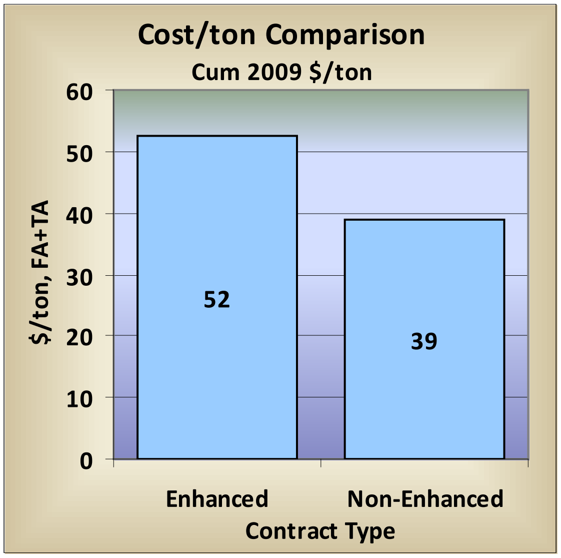


Figure 4, Enhanced Acres

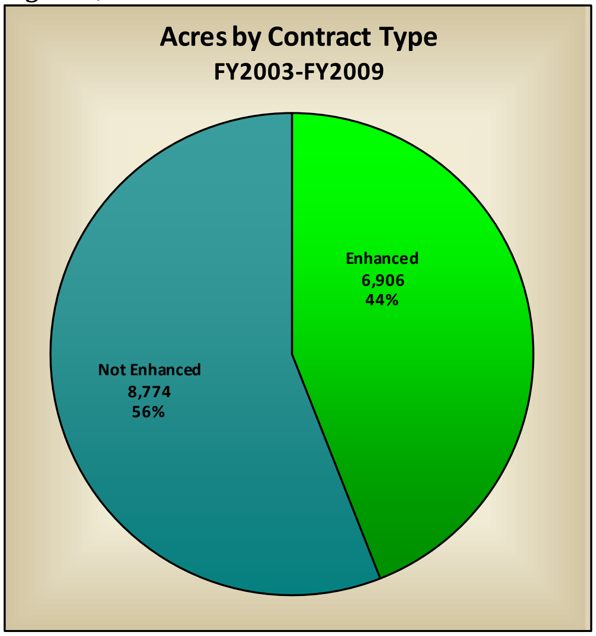


Table 6, Summary of annual applied expenditures and cost/ton

FY	Federal Water Project Discount Rate	FA Applied, Nominal	Irrigation Acres Applied	Salt Load Reduction Applied, Tons/Year	Amortized FA+TA, Nominal	$/Ton Applied, Nominal	2009 PPI Factor	FA Applied, 2009 Dollars	Amortized FA+TA 2009 Dollars	$/Ton 2009 Dollars	Cum $/ton, 2009 Dollars
1997	7.375%	-	-	-	-	-	149%	-	-	-	-
1998	7.125%	-	-	-	-	-	153%	-	-	-	-
1999	6.875%	606,962	1,085	3,096	85,831	28	153%	928,920	131,359	42	42
2000	6.625%	464,327	937	2,674	64,179	24	147%	681,016	94,130	35	39
2001	6.375%	252,215	746	2,129	34,064	16	143%	360,894	48,742	23	35
2002	6.125%	2,062,990	2,617	7,469	272,171	36	142%	2,928,127	386,309	52	43
2003	5.875%	1,542,280	2,619	7,474	198,697	27	138%	2,120,644	273,210	37	41
2004	5.625%	1,016,295	1,445	4,123	127,818	31	132%	1,344,877	169,144	41	41
2005	5.375%	1,072,550	1,898	5,416	131,642	24	123%	1,320,067	162,022	30	39
2006	5.125%	2,037,288	2,971	8,479	243,945	29	119%	2,422,731	290,098	34	38
2007	4.875%	2,842,897	2,975	8,586	331,985	39	111%	3,166,765	369,805	43	39
2008	4.875%	3,011,013	4,158	13,577	351,617	26	99%	2,994,038	349,635	26	36
2009	4.625%	3,936,953	1,560	4,424	448,218	101	100%	3,936,953	448,218	101	40
Totals		18,845,770	23,011	67,447	2,290,167	34		22,205,031	2,722,671	40	

Table 7, Project funding by program in 2009 dollars

FY2009	Planned			Applied				
Program	Contracts	FA, 2009 $	Irrigated Acres	FA, 2009 $	Irrigated Acres	$/Acre Irrigated	Salt Load Reduction Tons	Salt Load Reduction Tons/Acre
EQIP	607	25,379,808	21,699	16,260,612	17,589	924	50,508	2.87
EQIP WLO	6	263,002		201,406				
BSPP	128	6,901,764	6,047	5,743,012	5,392	1,065	16,940	3.14
Totals	741	32,544,574	27,746	22,205,031	22,981	966	67,447	2.93

Figure 5, Cumulative Planned and Applied Acres

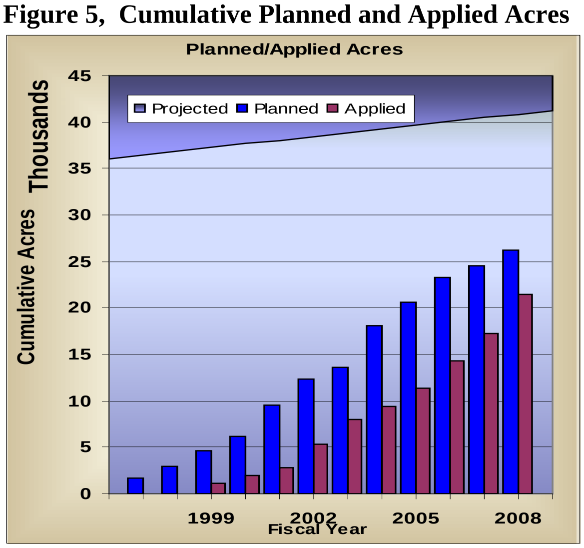
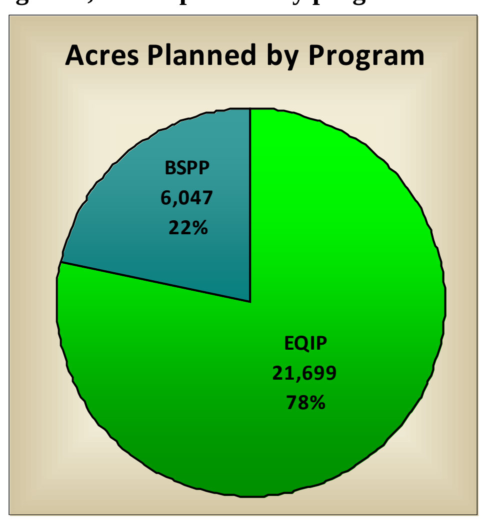


Figure 6, Acres planned by program



Hydro Salinity Monitoring

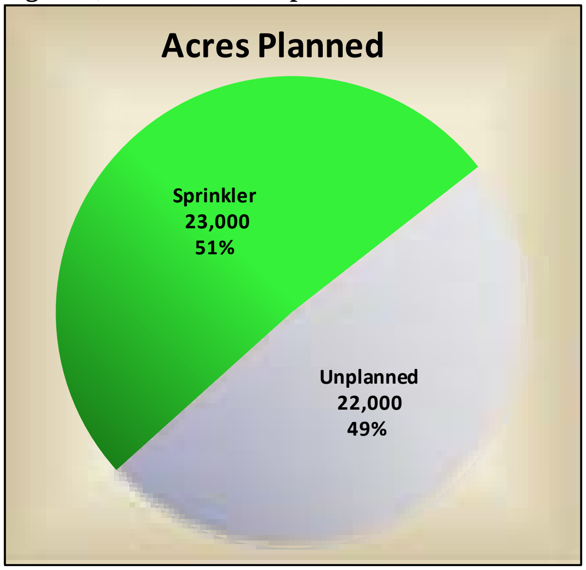
Three assumptions guide the calculation of salt load reduction from irrigation improvements:

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).

Figure 7, Planned and unplanned acres



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 average uncontrolled flood irrigation system to a well designed and operated sprinkler system will reduce deep percolation and salt loading by 84-91%. (See appendix I.)

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.

Due to budget restraints, field intensive M&E efforts were never fully implemented in PSR. 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 PSR, virtually all salinity program irrigation improvements are sprinkler systems. Wheel lines out number center pivots by about two to one, on an acreage basis, presumably due to relatively small average field size. The average contract size is 44 acres. The median size is 20 acres. Half of all contracts are 20 acres or less and two-thirds of contracts are 40 acres or less.

Cooperator questionnaires, interviews, and training sessions

In FY2002 and FY2003, 164 cooperators, selected randomly, were surveyed. No additional surveys were done in FY2004 through FY2009.

Appendix III is a summary of cooperator responses to past NRCS surveys.

Irrigation Water Management (IWM)

The goal of IWM is to assure that irrigated crops receive 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 potential crop in the warmest months 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.

Over irrigating in early spring and late fall is mitigated by water storage aspects of the soil. Crops generally use water before irrigation begins and after irrigation ends, leaving the soil moisture profile somewhat depleted. Filling the soil with water requires additional irrigation, over and above crop needs, in the spring.

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.

Cooperator interest is enhanced by creating financial incentives for IWM. To collect payment for the IWM practice (449), a cooperator must:

1. Attend a two hour IWM training session or attend an approved water conference,
2. Keep detailed irrigation records using the IWM Self-certification spreadsheet, and
3. Review the records with an NRCS employee or contractor trained to evaluate and explain IWM principals.
4. Starting in FY2008, an additional “intensive” IWM practice was made available that would pay a higher rate if the cooperator purchases, installs, and utilizes a soil moisture monitor (explained below) with the additional compensation.

Most operators are keenly interested in learning to understand IWM principals and operate their irrigation systems professionally, and profitably.

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

In addition, personal guidance is available to cooperators, on request, at the local NRCS field office.

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

Irrigation Record Keeping

NRCS has developed and provided the, "IWM Self Certification Spreadsheet" which allows cooperators to graphically evaluate available water content (AWC) in the soil and compare actual irrigation with projected average crop water requirements and/or with modeled crop evapotranspiration. Evapotranspiration is calculated from weather data collected by NRCS and other public agencies, using the Penman-Montieth method developed by the Food and Agriculture Organization of the United Nations (FAO). The spreadsheet generates two graphs comparing water applied with water required on a seasonal basis and depicting soil moisture volumes. See figures 8 and 9.

Figure 8 is the input form, on which the irrigator enters data into the blue shaded cells. The spreadsheet then calculates the remaining data.

The first plot in figure 9 is available water content (AWC). To optimize production and minimize deep percolation, AWC must be maintained between 50 and 100%. As indicated by the blue bars. Red bars descending below the blue bars indicate deep percolation. (A small amount of deep percolation is designed into all irrigation systems to compensate for distribution anomalies and to leach accumulated salt from the root zone.)

In the second plot of figure 9 if the red actual application line is below and to the right of the blue consumptive use line, the crop is under irrigated. If the red actual use line is above the blue consumptive use line, the field is over-irrigated and excessive deep percolation may have occurred.

In order to receive incentive payment for IWM, each irrigator must log irrigation data and present the logs to the field office, where data is entered into the spreadsheet and the results are discussed. Graphs are plotted for the farmer's reference. In general, cooperators respond positively to this training and strive to irrigate more efficiently.

Irrigation records and subsequent training are very important to cooperator understanding and should be an integral part of any IWM certification effort.

From completed IWM certification records, it appears that 97% of acres in PSR do not deep percolate excessively. (See figure 10.) New sprinkler owners in PSR are much more likely to under-irrigate than to over-irrigate. Typically, the price for under-irrigation is reduced yield, not dead crops. Without careful record keeping, the farmer may not recognize this error.

Due to the prevalence of under-irrigation, it can be assumed that, based on irrigation record keeping, salt load reduction projections are probably conservative.

Figure 8, Sample IWM Self Certification Spreadsheet – Data Entry Page

Irrigation Water Use Record - Farmer Self Certification

Cooperator: Joe Waterman **Crop:** Alfalfa **Year:** 2008

Location: Myton Bench- **Station:** Pleasant Valley/Myton **Field Acreage:** 72

Tract/Field #: 1 **Annual Irrigation Requirement:** 34 inches

Irrigation Type (Flood, Pivot, Wheeline, etc): Pivot **Desired Efficiency:** 75 %

Soil Type: Clay Silt **AWC, In/Ft** 2.00 **Root Depth:** 5.00 **AWC, Max** 10.00

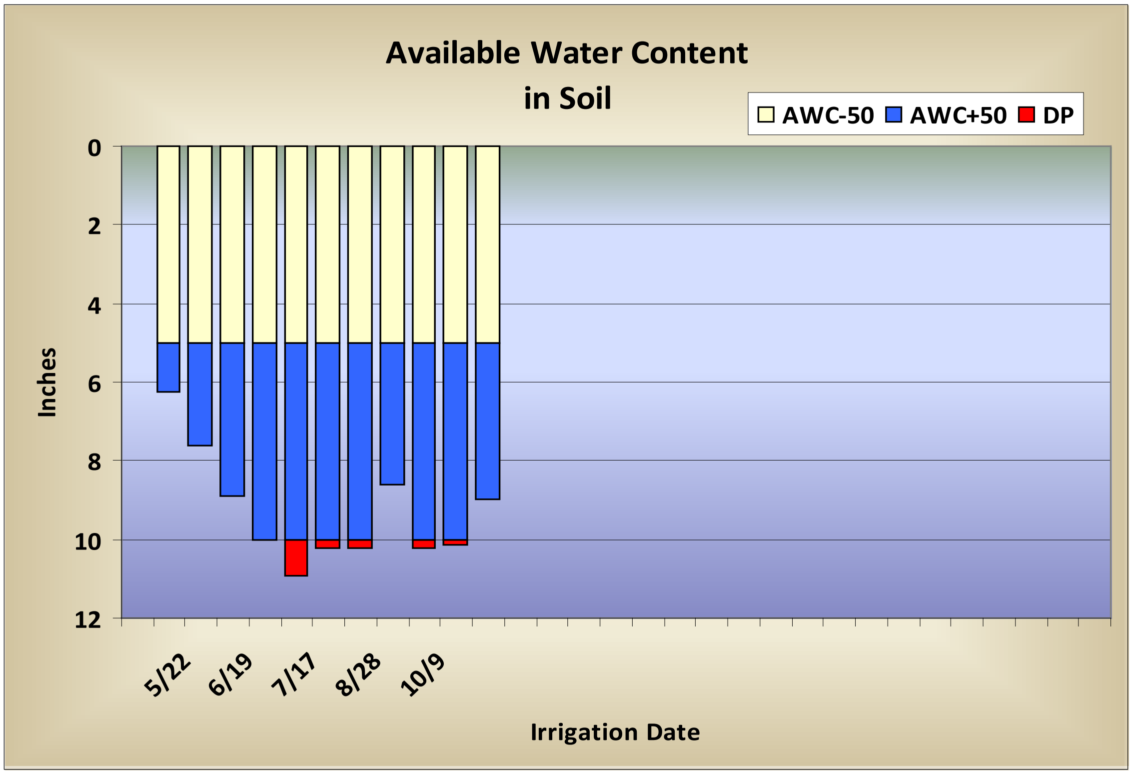
AWC, In.

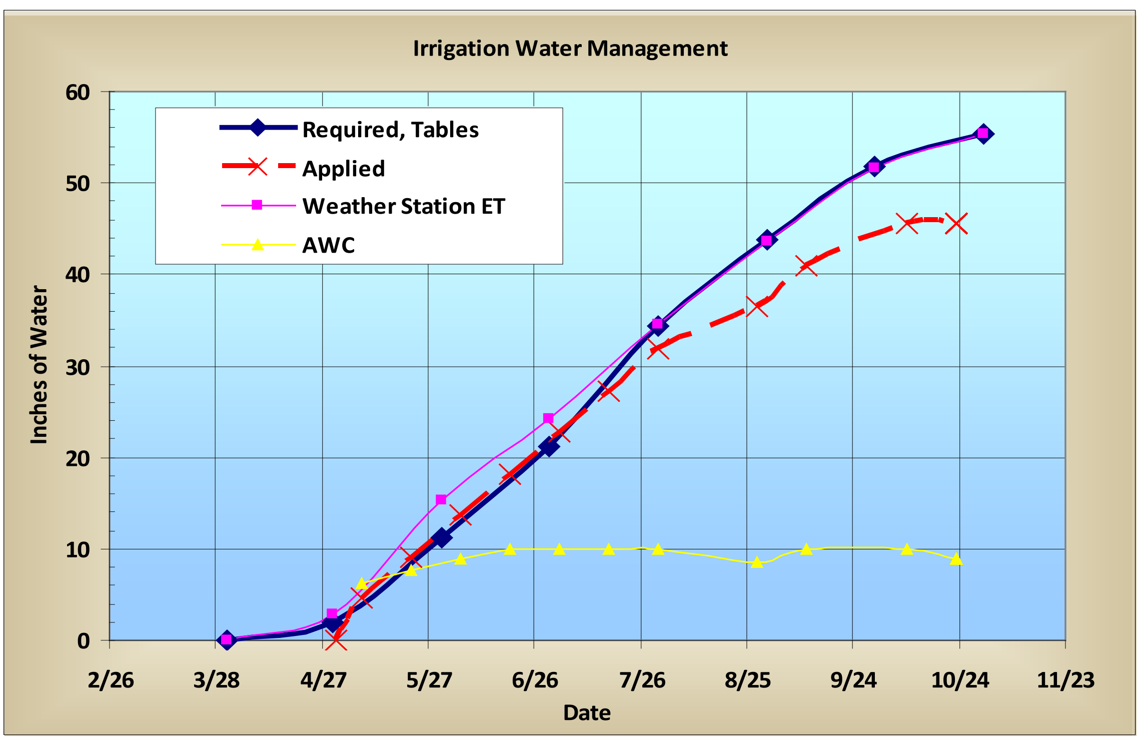
Application Evaporation % 10%

Start date of irrigation	End date of irrigation	Total Cycle Hours	Flow (cfs) OR number of nozzles multiplied by nozzle flow (gpm)		Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Inches Available	AWC	Deep Perc
04/23/07	04/27/07	96	685.0	gpm	2.04	2.04	1.18	6.83	6.83	0.00
04/30/07	05/08/07	192	685.0	gpm	4.08	6.12	2.50	9.18	9.18	0.00
05/12/07	05/16/07	96	685.0	gpm	2.04	8.15	3.69	9.83	9.83	0.00
05/19/07	05/27/07	192	685.0	gpm	4.08	12.23	5.33	11.86	10.00	1.86
06/14/07	06/26/07	288	685.0	gpm	6.12	18.35	12.02	8.81	8.81	0.00
07/02/07	07/10/07	192	685.0	gpm	4.08	22.43	15.81	8.69	8.69	0.00
07/14/07	07/18/07	96	685.0	gpm	2.04	24.46	18.09	8.25	8.25	0.00
08/01/07	08/18/07	288	685.0	gpm	6.12	30.58	26.05	5.79	5.79	0.00
08/15/07	08/19/07	96	685.0	gpm	2.04	32.62	26.29	7.38	7.38	0.00
08/22/07	08/26/07	96	685.0	gpm	2.04	34.66	27.95	7.56	7.56	0.00
09/21/07	09/29/07	192	685.0	gpm	4.08	38.74	33.26	5.92	5.92	0.00
Total inches of water applied during the season (total of all lines above):								38.74		1.86
Total Acre Feet Applied during the Season:								232.4		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								86%		

Figure 9, Sample graphs from the IWM Self Certification Spreadsheet.

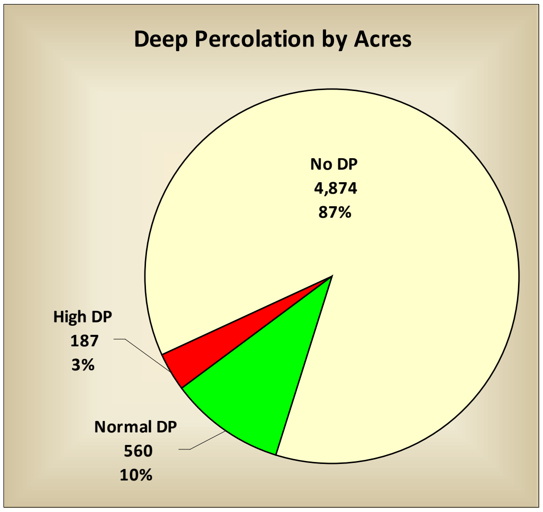
In the first plot the goal is to keep AWC in the blue zone to maximized production and minimize deep percolation (indicated by red bars). A moderate amount of deep percolation is designed into the system as a leaching fraction. In the second plot, the blue line is a long-term average water requirement, based on location and crop. The red line is actual water applied. Where data is available, the purple line is modeled from near-real-time data collected at a nearby weather station, using the FAO-56 evapotranspiration model.





Soil Moisture Monitoring

Figure 10, Deep percolation, acres



A time-tested method for timing irrigation involves augering a hole and determining the water content of soil in the root zone 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 operators 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 multiple depths and locations without time-consuming augering.

In a typical case, electronic 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 (see figure 11).

Figure 11, Soil moisture data recorder with graphing

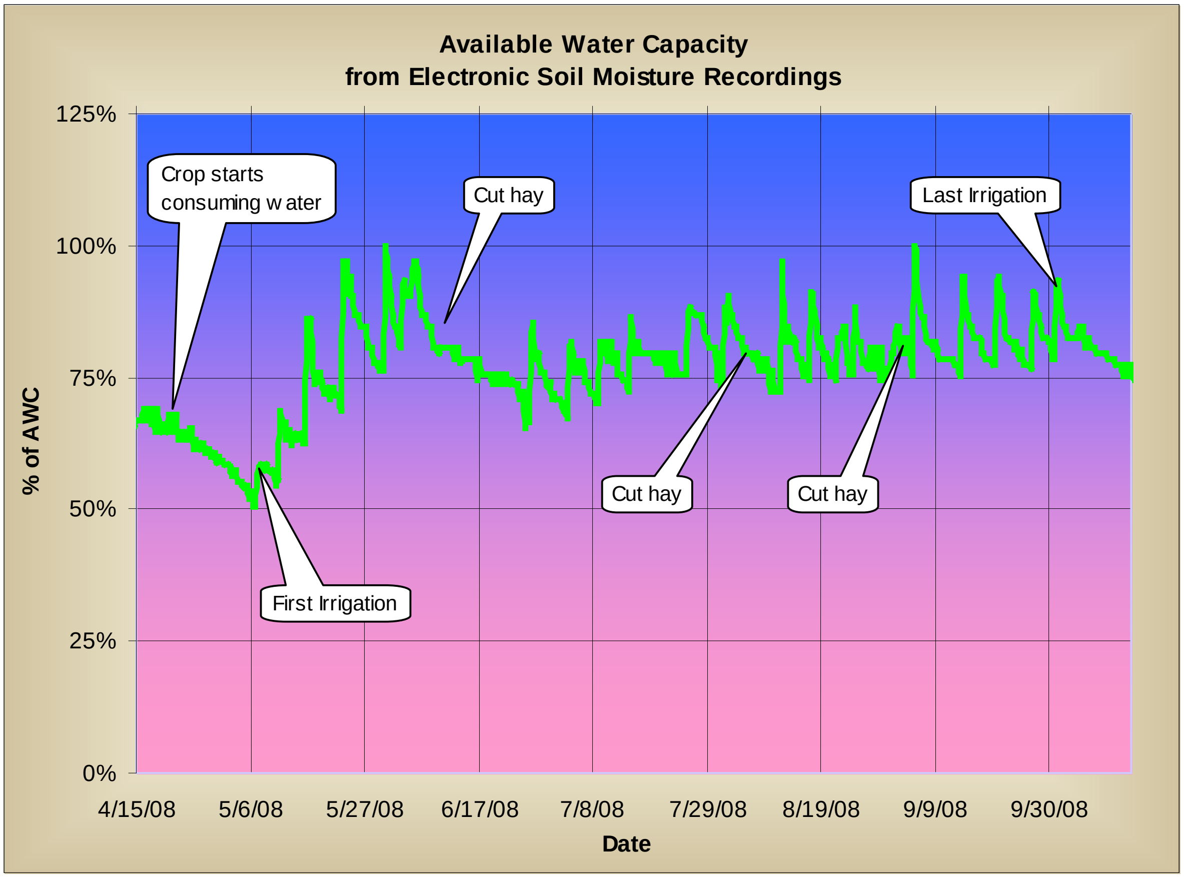
Since gravimetric drainage generally does not occur unless the soil horizon is nearly saturated (above field capacity), it is assumed that deep percolation is not occurring if the deepest probe reading is less than -10 centibars. In PSR, six installed data recorders indicate that deep percolation occurs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

PSR also has several fields with probes but no data recorder. When they were installed, the Soil Conservation District intended to read all of the probes manually, on a weekly basis, and plot the results. Unfortunately, personnel changes have thwarted this effort. Installing data recorders at each of these fields would be much less expensive and more reliable than manual reading. Funding has been granted by the Forum to proceed with recorder installations.

In the FY2008 and FY2009 payment schedules, an additional IWM Intense (449) practice was added that increased 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 12 is an Excel graph of AWC calculated from downloaded soil moisture data.

Figure 12, AWC estimated from downloaded soil moisture data.



Equipment Spot Checks and Evaluations

Catch-can Testing

In FY2009, no catch-can tests were run, due to limitations described in the FY2005 M&E report. As reported in the FY2005 M&E Report, the most useful aspects of catch-can testing on wheel lines were observations made before the test was ran. With sprinkler systems running, an assessment of leaks and malfunctioning heads can be made very quickly, often without leaving the vehicle.

Operating Sprinkler Condition Inventory

From FY2006 to FY2008 two hundred and thirty-nine systems were visually evaluated, of which 218 were operating wheel-lines, hand-lines, or k-lines.

The sprinklers in PSR are relatively new, compared to other salinity areas. No operational or maintenance trends were identified that would significantly increase deep percolation.

Study results were detailed in the FY2008 M&E Report.

Wildlife Habitat and Wetlands

Background

The Final Environmental Impact Statement (EIS) for the Price/San Rafael Rivers Unit was completed in December, 1993. The EIS discusses at length anticipated impacts the application of the preferred plan will have on the landscape. The EIS states "The replacement of wetland/wildlife habitat with like habitat is a goal of USDA in all of its programs; however, the primary goal of the CRBSCP - to reduce salinity in the Colorado River - is not compatible with the preservation and/or replacement of wetlands supported by over irrigation." This persistent quandary caused much discussion of the necessity of wetland replacement. In the beginning, Soil Conservation Service (SCS) met with Utah Division of Wildlife Resources (UDWR), U.S. Bureau of Reclamation (BOR), U.S. Environmental Protection Agency (EPA), and U.S. Fish and Wildlife Service (USFWS), to discuss alternatives to wetland vegetation replacement. The EIS also states "…physical limitations severely restrict of placement of wetlands in close proximity to irrigated areas". Lined ponds with no outlets, ponds in sandstone members of the Mancos Shale Formation, and many other alternatives were discussed in the EIS.

Guidelines in the 1991 "The Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program" were adopted and placed in the EIS for the Price San/San Rafael Rivers Salinity Unit. In accordance with this framework plan, wildlife habitat monitoring would be performed along 18 selected transects throughout the area. Color aerial photography would be taken every three years to monitor changes in the extents of wetlands as a result of project implementation of the CRSC Program. These photographs would be scanned and wetlands digitized and compared to prior year baseline maps. Changes over time would create inferences for the basin as a whole. To supplement aerial photographs, Wildlife Habitat Evaluations from individual plans or contracts would be analyzed to determine accumulated changes in wildlife habitat, both upland and wetland.

Due to a decrease in funding for technical assistance, wildlife habitat monitoring efforts were reduced in 1997 and discontinued in 1999. Two employees, a biologist and a civil engineer, were hired in September 2002 as the Monitoring and Evaluation (M&E) team.

In 2001 "The Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program" was revised and M&E evolved from a labor/cost intensive, detailed evaluation of a few biological sites, to a broader, less detailed evaluation of large areas and many resource concerns. This change was primarily driven by budget restraints and improved technology. Methodology adopted in 2002 was to utilize remotely sensed images (Landsat), analyze them with commercial geospatial imagery software, classify, map, and measure vegetation extents, quantify losses or gains of wetlands and wildlife habitat. It was also anticipated that with the use of Landsat images NRCS could extrapolate results from current images back in time to images acquired prior to implementation of the Colorado River Salinity Control Program. Thus NRCS could compare wetland/wildlife habitat extents from pre-Colorado River Basin Salinity Control Program to the current date.

In FY2005 it was determined by the M&E Team that use of Landsat images alone was not sufficient to accurately monitor and track small narrow wetland extents within Salinity Units. Classification of 30-meter Landsat images is an excellent tool for quantifying and assessing land cover classes on large scale projects where there are large tracts of similar vegetation. The M&E team has found it difficult to accurately interpret subtle differences in vegetation types at smaller scales such as presented by small, narrow wetlands found in arid Salinity Units. Landsat images help locate areas of potential wetland and wildlife habitat areas; once located, detailed mapping of actual extents of features is required to accurately identify and define real losses or gains of wetland/wildlife habitat. This can be accomplished with the help of current year, high resolution, aerial photograph interpretation and on-site visits. A photographic history would also be useful in documenting changes in vegetation type. Remote sensing alone will not achieve desired results sought by NRCS to report concurrency and proportionality of wildlife habitat replacement.

The M&E team changed its methodology to include more precise measurements of actual habitat extents by incorporating detailed mapping, establishment of permanent photo points, and smaller-scale case studies. This approach is more labor intensive. The M&E Team believes that additional staff is needed to assist in gathering data needed to create accurate land cover maps to achieve the most accurate and reliable result possible.

At the end of FY2009 no additional workforce had been acquired to assist the M&E team in data gathering. Photo points will be established and displayed when relevant information can be extrapolated from photos. Case studies are on-going and will be reported in future versions of this document.

Basin Wide Wildlife Habitat Monitoring

Permanent photo points, at representative locations throughout the area, of wetlands, wildlife habitat, agricultural areas, and areas where pipelines have recently been built, have been selected and a protocol established to compare across the years. 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 approximately every five years in a visual display in M&E Reports.

Wildlife Habitat Contract Monitoring

In the PSR Salinity Unit there were no wildlife habitat replacement projects planned in FY2009 (Table 8). Applied habitat acres from prior year contracts are also listed in Table 8.

Cumulative acreage of practices planned and applied are tabulated in Table 9.

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 Area. The Utah NRCS Homepage also has information and deadlines relating to Farm Bill programs.

Table 8, Wildlife Practices Planned and Applied in FY2009

Acres of Wildlife Habitat Creation or Enhancement by Program				
FY2009 practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland (*644)	Upland (*645)	Wetland (*644)	Upland (*645)
BSPP	-	-	-	-
EQIP	-	-	7	101
WHIP	-	-	58	-
Total	**-**	**-**	**65**	**101**

*Wetland Acres Include Riparian Habitat

Table 9, Cumulative Wildlife Practices Applied in FY2009

Acres of Wildlife Habitat Creation or Enhancement by Program				
Cumulative practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland (*644)	Upland (*645)	Wetland (*644)	Upland (*645)
BSPP	-	40	-	39
EQIP	613	473	607	305
WHIP	1,050	-	58	-
Total	**1,663**	**513**	**665**	**344**

*Wetland Acres Include Riparian Habitat

Economics

Cooperator Economics

Production Information

While alfalfa yields have not improved markedly since inception of salinity control measures, total production of alfalfa is trending up.

Figure 13 reflects total alfalfa production and yield over a 23 year period. The green line is a linear regression on production. The brown line is a linear regression on yield. Yield may be more closely related to precipitation than anything else.

Figure 14 depicts historical mountain precipitation.

Figure 13, PSR alfalfa production

Source data is tabulated in Appendix VI

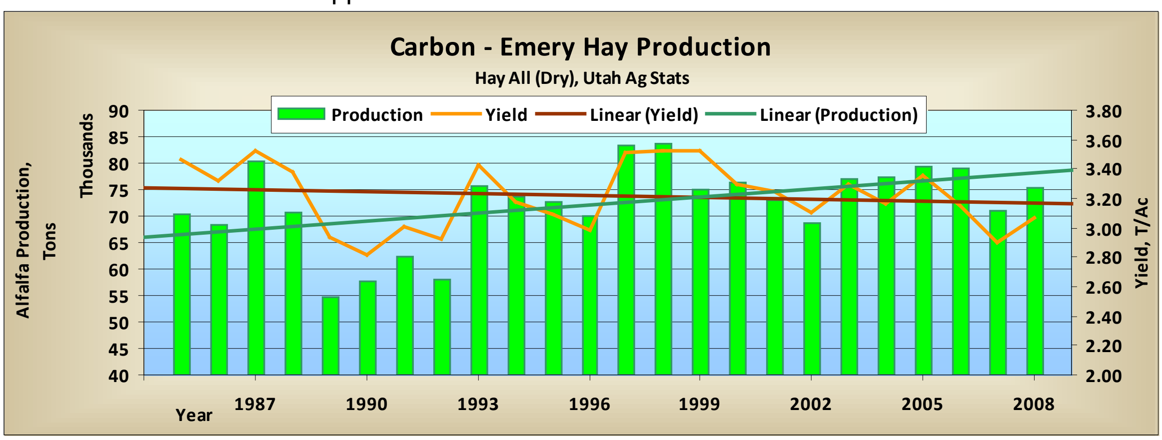
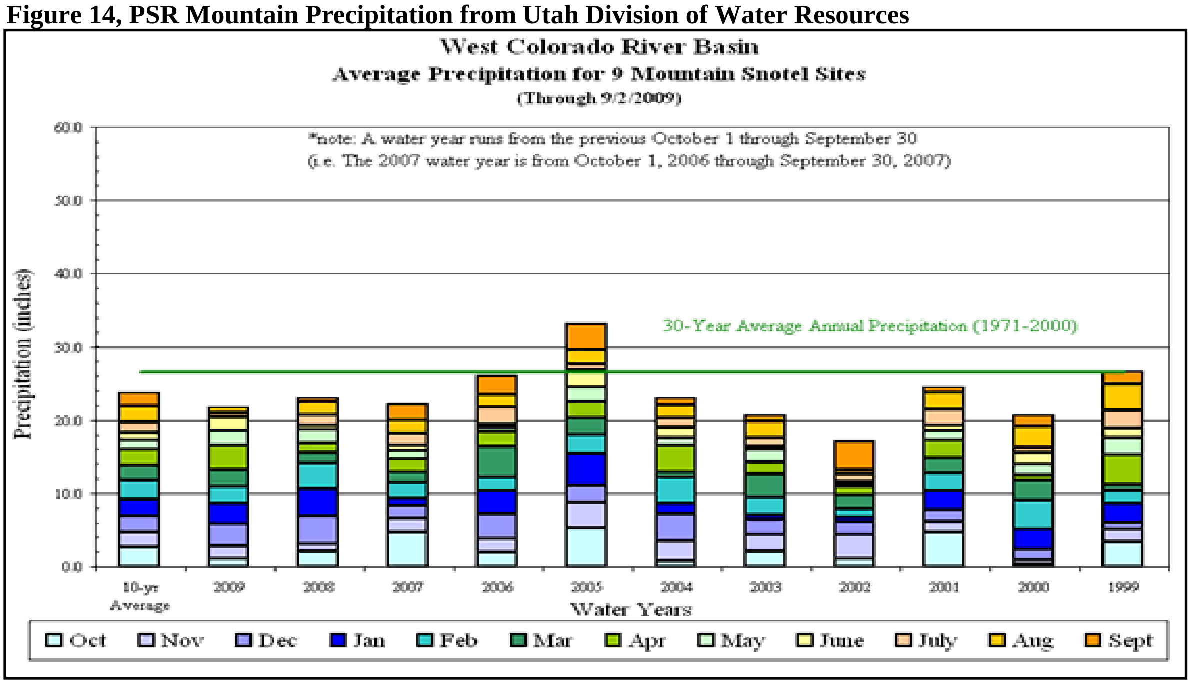


Figure 14, PSR Mountain Precipitation from Utah Division of Water Resources



Labor Information

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.

While numerical data seems negative, anecdotal information is positive.

According to the 2007 Census of Agriculture, 66% of farmers have full-time occupations other than farming. Only 27% of farm owners hire any outside help. Since the majority of farmers do not hire outside labor, it is assumed that most cooperators are satisfied with their own personal labor savings. The local labor market has softened, due to uncertain energy policies, in spite of very strong energy prices.

Public Economics

Ninety-five percent of survey respondents 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
- Increased flows in streams and rivers
- Economic lift to the entire community from employment and broadened tax base
- Local availability of expertise, information, and materials for public conservation
- 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:

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

Water Related Land Use (WRLU)

The State of Utah Division of Water Resources tracks land use on a regular basis. Figure 15 is a graphical presentation of land use changes in PSR from past WRLU reports. The goal of the WRLU report is to account for all agricultural lands in the State along with immediately adjacent water related land uses.

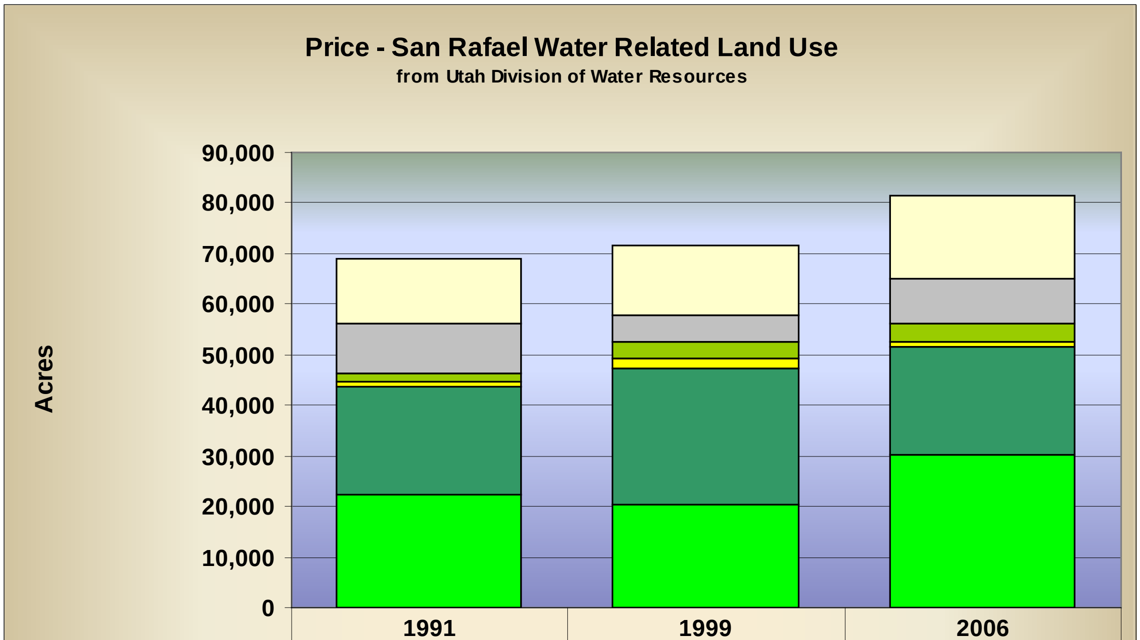
Summary

Local land owners seem willing and able to participate in salinity control programs although the future economic environment is uncertain. The effect of current economic conditions on future participation remains to be seen.

Past participants are apparently satisfied with results and generally positive about salinity control programs.

Colorado River Basin Salinity Control Programs are successful and cost effective in reducing salt load in the Colorado River.

Figure 15, Water Related Land Use



	1991	1999	2006
Developed	12,832	13,727	16,348
Idle Agricultural	9,868	5,360	8,900
Other Crop	1,472	3,252	3,599
Corn	1,080	2,048	1,030
Pasture	21,213	26,684	21,215
Alfalfa /Hayland	22,414	20,477	30,254

Year

Appendices

Appendix I – Revised salt load reduction calculation

COLORADO RIVER BASIN
SALINITY CONTROL PROGRAM

CALCULATING SALT LOAD REDUCTION

MODIFICATION OF PROCEDURE
JULY 30, 2007

Prepared by
Natural Resources Conservation Service

Ed Whicker, Civil Engineer, Roosevelt, Utah, Email: ed.whicker@ut.usda.gov

Frank Riggle, Assistant State Conservationist for Water Resources, Lakewood, CO, Email: frank.riggle@co.usda.gov

Travis James, Salinity Coordinator, Salt Lake City, Utah, Email: travis.james@ut.usda.gov

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

Executive Summary

The Salinity Worksheet for Ranking has been modified to simplify use, assure proportionality with the EIS/EA and to make calculations uniform in Utah and Colorado by making the following changes:

- Inputs for net irrigation requirement and seasonal irrigation factor have been eliminated.
- Minimum initial efficiency has been increased to 32%.
- Salt Load Factors have been developed that express a percentage of original salt load for a given irrigation efficiency.
- The original salt load has been determined for each salinity area from the EIS/EA or reasonable proxy data where EIS data is inconclusive.
- The salt load reduction calculation is greatly simplified. The salt load reduction is calculated by multiplying the original salt load by a factor related to the initial and final irrigation practice.
- As an example, a 20 acre flooded field has an irrigation efficiency of 32% and a salt load factor of 100%. The salinity area has an original salt load of 2.0 Tons/acre/year. It is proposed to install wheel lines with an efficiency of 65% and a salt load factor of 16%. The change in salt load is (100%-16%) x (2.0 tons/acre/year) x (20 acres) = 34 tons/year.
- Since the difference in salt load factor is always less than 100%, the cumulative tons/acre/year due to on-farm irrigation will never be exceeded, relative to the EIS/EA.
- The original salt load, SL_0 is unique to each salinity area. All salinity areas in Colorado and Utah will use the same salt load factors, SLF_e. The derived cost/ton will have the same computational basis for all salinity areas.

SALT LOAD CALCULATION

Salt loading from on-farm irrigation is the result of excess irrigation water percolating through the soil, dissolving salt, carrying it to the river.

On-farm salt load is reduced by improving irrigation efficiency, reducing the amount of excess water that deep percolates, dissolves salt from the soil, and returns to the river. Improving irrigation practices for salinity control in the Colorado River Basin began in the late 1970s and continues today.

There are or have been salinity control programs in four states, Arizona, Colorado, Utah, and Wyoming. In order to evaluate the effectiveness of treatment, it is desirable to have an evaluation procedure that is broadly applicable and that can be used for all CRSCP installations, allowing reasonable comparisons across State and Salinity Area Boundaries.

Since the inception of the CRBSCP, several different procedures have been used to estimate salt load for salinity control practices. Most procedures involved the input of numerous variables, based on the judgment of the technician doing the analysis. The expectation was that values derived from the procedures would be similar and reasonable, and would, over time, be proportional to salt load reductions anticipated by the EIS/EA upon which program economics were based, approved, and publicly accepted.

Reality is that dozens of variables affect salt pickup and transport and the confidence of any calculation cannot be determined. The potential cost of measuring each variable to develop discreet solutions is not viable. In addition, human nature is such that field staff evaluating salt load frequently move toward a worst case solution, maximizing calculated salt load reduction. While various procedures have worked well for ranking projects within specific salinity areas, the level of detail and variability in actual field computations compromised their usefulness for comparing with projects in other salinity areas and/or states.

Since discreet solutions to the salt load reduction problem are financially daunting, it makes sense to start with publicly accepted values from the EIS/EA, or a reasonable proxy for them. Using EIS/EA derived basin wide ton/acre values as a starting point and reducing ranking complexity makes this problem an accounting issue, rather than a technical issue.

By dividing the EIS anticipated salt load due to on-farm practices in tons/year, by the average irrigated acres, a maximum initial value for tons/year/acre is derived.

$$SL_0 = \frac{Tons_0}{Acres_0}$$

Where

SL_0 = The Salt Load before any treatment

$Tons_0$ = Total ton/year contributed by on-farm practices from the EIS/EA

$Acres_0$ = The average number of irrigated acres, pre-project

To determine salt load at any given efficiency, SL_e, SL_0 is multiplied by a salt load factor, SLF_e appropriate for that efficiency.

Where

SLe = the salt load at a given efficiency

SLFe = a salt load factor that is a function of efficiency

The Salt Load Factor (SLF_e) is derived using the following formula:

$$SLF_e = \frac{\left(\frac{1}{eff} - 1\right)^{1.33} \times 0.25}{\left(\frac{1}{eff_0} - 1\right)^{1.33} \times 0.25} = \left(\frac{\left(\frac{1}{eff} - 1\right)}{\left(\frac{1}{eff_0} - 1\right)}\right)^{1.33}$$

Where

eff_0 = the average efficiency of the salinity area, prior to any treatment under CRSCP.

eff = Irrigation efficiency at the time of evaluation

Values for SLF_e may be obtained from the table in figure 1.

By multiplying SL_0, by SLF_e and the number of treated acres in the project, the total tons attributed the subject acres are derived for specific irrigation efficiency.

$$SL_e = \mathrm{SL}_0 \times \mathrm{A} \times SLF_e$$

Where

A = Area in acres

Knowing the on-farm salt load before and after practice installation, a simple difference is the Salt Load Reduction, SLR, for the project.

$$SLR = SL_1 - SL_2 = (SLF_1 - SLF_2) \times SL_0 \times A$$

Where

SL_1 = the beginning salt load

SL_2 = the final salt load

SLF_1 = the beginning salt load factor

SLF_2 = the final salt load factor

Natural Resources Conservation Service (NRCS) for Colorado and Utah have agreed to use an initial irrigation efficiency of 32% for all salinity areas in both states.

Salt Load Factor, SLF_e			
	Efficiency	SLF_e	SLR due to Upgrade from UF
Unimproved Flood	32%	100%	
Improved Flood PC	40%	63%	37%
Improved Flood +	45%	48%	52%
Improved Flood M	55%	28%	72%
Wheel line	65%	16%	84%
Center Pivot	75%	9%	91%
High Tech	85%	4%	96%

Figure 1. Salt Load Factors vs. Irrigation Efficiency. Last column reflects salt load reduction for improving irrigation from flood at 32% efficiency to an appropriate new efficiency from the second column, marked Efficiency.

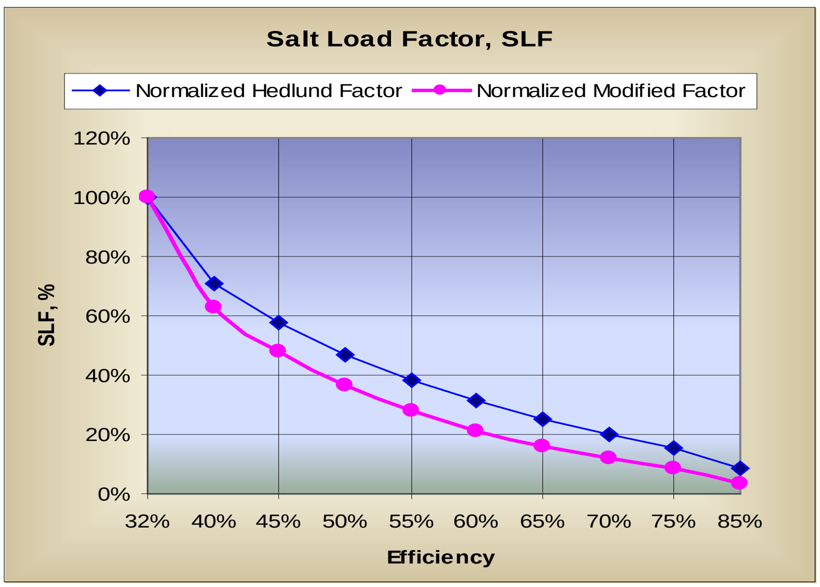


Figure 2 Graph of salt load factor, SLF. The upper line was used in the Ranking Worksheet FY2004 – FY2007. The lower line is used in new Salinity Worksheets for Ranking, beginning with FY2008 contracts and is mathematically defined above.

The adoption of this procedure will result in the following improvements from past procedures:

1. Assure that salt load reduction claims will not exceed EIS/EA expectations

2. Calculations from Colorado and Utah will use the same procedure and results will be comparable

3. Worksheet user inputs have been minimized, also minimizing opportunity for error

Appendix II - Salt Load Reduction Worksheet

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM

Utah NRCS

WATER AND SALT SAVING WORKSHEET for Ranking

Version 070824

Client:		**Date:**	
Salinity Area:	**Dry Gulch**	**Planner:**	

Irrigation System Changes

System Before	Eff	System After	Eff	Acres	EIS Salt Load Tons/Ac	Effective Salt Load Reduction	Salt Load Reduction Tons
UF	32%	**Wheel Line**	65%	**40**	1.04	84%	35
		System Totals		**40**			**35**

Ditch Losses, Off-farm

	Feet Replaced		Tons /Mile	Tons Salt
			80.0	**-**

Contracts - On-farm

Contract Number	Date	Amount	Treatment Description		Treated Area	Interest Rate	FA	Amortized $/Acre FA+TA
		$			Acres	%	$/Acre	$/Acre
748D43yyXnnn	06/01/07	30,000	Pivot			4.875%	750	88
							-	-
					40		-	-
							-	-
							-	-
							-	-
Totals	**1**	**30,000**			**40**		**$750**	**$88**
							Tons/Ac	0.87

Amortized $/Ton, FA+TA	**$100**

Appendix III - 2002 – 2004 Cooperator's Survey Summary

Random Selection Number	All				
Operation Name	Price - San Rafael Totals*				
Contract Number or Year/Years	Various				
Irrigated Acres	Flood	Wheel Line	Hand Line	Pivot	Total
	0%	30%	18%	2%	50%
Is the contract active and the land being cropped? (Circle One)	Yes	No			
	94%	6%			
Crop Acres	alfalfa	pasture	grains	other	
	46%	28%	14%	11%	
Is the current irrigation system the same as designed and planned at start of contract? (Circle one)	Substantially improved	Slightly improved	Same as designed	Slightly degraded	Substantially degraded
	68%	14%	14%	1%	3%
Is water measured? (Circle one)	Yes	No			
	75%	25%			
If Yes, acre-ft/acre applied?					
Is soil moisture monitoring used for irrigation scheduling? (Circle one)	Yes	No			
	40%	60%			
If yes, what type? (Circle all that apply)	"Feel" method	Tensio-meters	Gypsum blocks	Neutron probe	Remote sensing
	94%	3%	3%	0%	0%
Are Evapotranspiration calculations used for irrigation timing? (Circle one)	Yes	No			
	13%	87%			
Have you attended any irrigation water management classes, workshops, or demonstrations? (Circle one)	In the last 12 months?	In the last 2 years?	In the last 5 years?	Never?	
	50%	14%	7%	29%	
Do you employ or use a consultant or service that advises irrigation scheduling? (Circle one)	Yes	No			
	36%	64%			
Have the changes in yield, labor used, irrigation operation and maintenance cost as well as other pre-harvest and harvest costs offset your share of the practice costs? (Circle one)	Yes	No			
	74%	26%			
My initial investment for the new system resulted in: (Circle one)	Substantial economic gain	Minor economic gain	No economic change	Minor economic loss	Substantial economic loss
	18%	55%	21%	6%	0%
Do you feel that there is an effect economically overall to your area and region from this program? (Circle one)	Substantial positive effect	Slight positive effect	No effect	Slight negative effect	Substantial negative effect
	53%	42%	1%	4%	0%
Has this project changed the quantity and quality of wildlife on your property? (Circle one)	Substantial positive effect	Slight positive effect	No effect	Slight negative effect	Substantial negative effect
	11%	21%	50%	13%	5%

Appendix IV - Price – San Rafael Rivers Unit Hay Production

Utah Crop Group - All Hay (Dry)					
Commodity	**Year**	**County**	**Harvested**	**Yield**	**Production**
			Acre	**T/Ac**	**Tons**
Hay All (Dry)	1985	PSR	20,300	3.46	70,200
Hay All (Dry)	1986	PSR	20,600	3.33	68,500
Hay All (Dry)	1987	PSR	22,800	3.53	80,400
Hay All (Dry)	1988	PSR	20,900	3.38	70,700
Hay All (Dry)	1989	PSR	18,700	2.93	54,800
Hay All (Dry)	1990	PSR	20,500	2.82	57,800
Hay All (Dry)	1991	PSR	20,700	3.01	62,300
Hay All (Dry)	1992	PSR	19,800	2.92	57,900
Hay All (Dry)	1993	PSR	22,100	3.43	75,800
Hay All (Dry)	1994	PSR	23,200	3.18	73,800
Hay All (Dry)	1995	PSR	23,500	3.09	72,600
Hay All (Dry)	1996	PSR	23,400	2.99	69,900
Hay All (Dry)	1997	PSR	23,800	3.51	83,500
Hay All (Dry)	1998	PSR	23,800	3.52	83,800
Hay All (Dry)	1999	PSR	21,300	3.52	75,000
Hay All (Dry)	2000	PSR	23,100	3.30	76,200
Hay All (Dry)	2001	PSR	22,500	3.24	73,000
Hay All (Dry)	2002	PSR	22,100	3.11	68,700
Hay All (Dry)	2003	PSR	23,400	3.29	77,000
Hay All (Dry)	2004	PSR	24,500	3.16	77,500
Hay All (Dry)	2005	PSR	23,700	3.35	79,500
Hay All (Dry)	2006	PSR	25,100	3.15	79,000
Hay All (Dry)	2007	PSR	24,500	2.90	71,000
Hay All (Dry)	2008	PSR	24,600	3.07	75,500

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 field that is stored in the soil to be consumed by 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.

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 areas 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. CU is dependant on many factors including altitude, temperature, wind, humidity, and solar radiation. In general use, CU and ET are synonymous.

CRBSCP – Colorado River Basin Salinity Control Program. The overall federal effort to control salinity in the Colorado River.

CRSCP – Colorado River Salinity Control Program. A specific USDA/SCS funding program which ran from 1987 to 1997.

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 or parts per million, 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 federal 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 collecting, analyzing, and disseminating 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.

Salt Pickup – The difference in salt load measured above and below an irrigated treatment area.

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 (SCS) – 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 federal 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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