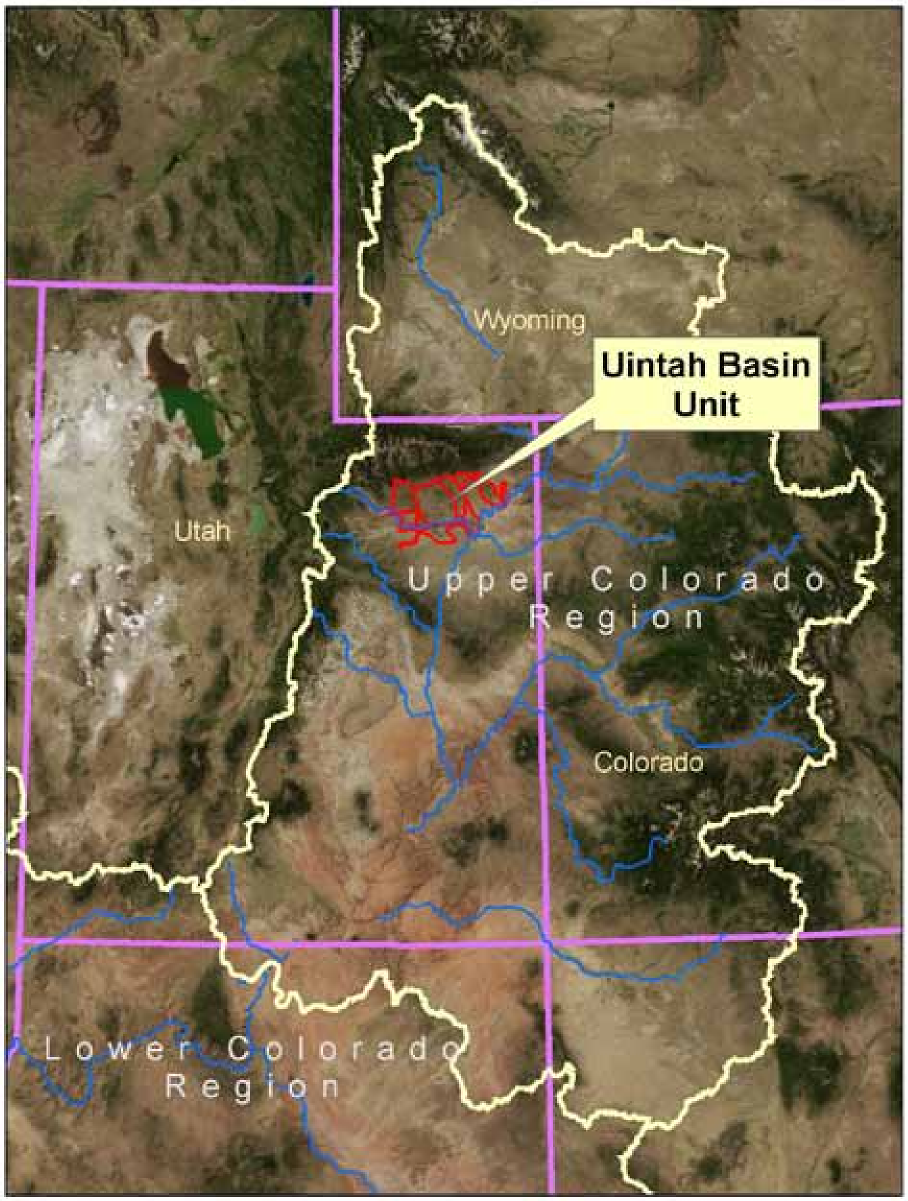
Colorado River Basin Salinity Control Program

Uintah Basin Unit

Monitoring and Evaluation Report, FY2011



U.S. Department of Agriculture

Natural Resources Conservation Service

Executive Summary

Project Status

- **TREATED ACRES:** Of 200,000 irrigated acres, perhaps 80% or 160,000 acres may ultimately be improved. Since 1980, treatments on approximately 157,400 acres have been planned and 152,400 acres applied. In FY2011, 3,624 acres were planned and 1,054 acres applied, of which 17 acres were upgraded from improved flood to sprinkler irrigation.
- **ON-FARM SALT LOAD REDUCTION:** Of approximately 208,000 original on-farm tons/year of salt load, 125,200 tons/year salt load reduction has been planned and 122,700 tons/year has been applied, calculated using procedures revised in 2007. In FY2011, 1,713 tons were planned and 737 tons applied on-farm.
- **OFF-FARM SALT LOAD REDUCTION:** Of approximately 120,000 original off-farm tons/year, USDA programs have planned 27,500 tons/year and applied about 25,800 tons/year of salt load reductions. In FY2011, no off-farm tons were planned and 78 off-farm tons were applied.
- **PLANNED OBLIGATIONS:** For FY2011, NRCS obligated $3.60 million in financial assistance (FA). Cumulative obligations total $93.7 million FA nominal ($168.5 million 2011 dollars).
- **APPLIED EXPENDITURES:** For FY2011, NRCS expended $1.44 million, FA. Cumulative expenditures total $82.93 million FA nominal ($149.2 million 2011 dollars).
- **COST/TON:** Planned salt load reduction cost for FY2011 contracts is $227/ton, FA+TA. The cumulative cost is $159/ton, FA+TA (2011 dollars) for planned practices. For practices applied in FY2011 the cost is $191/ton FA+TA, with a cost of $146/ton FA+TA (2011 dollars), for cumulative applied practices.
- **NEPA PROJECTED COST/TON:** In 2011 dollars, pre-project NEPA documents anticipated salt load reduction costs of $189/ton to $197/ton. Cumulative planned cost is $159/ton, and cumulative applied cost is $146/ton.
- **DEEP PERCOLATION** due to system leaks, inadequate irrigation water management (IWM), and poor system maintenance is relatively minor. New sprinkler operators are more likely to under-irrigate than to over-irrigate.
- **CONSISTENT TRAINING** and emphasis on IWM results in a better outcome for the Government and the participant.
- **INCENTIVE PAYMENTS FOR IWM** have resulted in enhanced interest in IWM and quality system maintenance.
- **THE 2008 FARM BILL** funds EQIP through FY2012.

Wildlife Habitat and Wetlands

- **CONVERSION OF WETLANDS TO UPLANDS** is far less than anticipated by the EIS.
- **WILDLIFE HABITAT CREATION/ENHANCEMENTS** were planned and funded on total of 66 acres and applied on 279 acres in FY2011.
- **Montez Creek Project** Case Study is photographically displayed.

Economics

- From the 2007 Census of Agriculture, **TWO-THIRDS OF UINTAH BASIN FARMERS HAVE FULL-TIME OCCUPATIONS** other than farming.
- Cooperators generally believe that their increase in production and decrease in labor adequately offset their participation cost.

Table 1. Project progress summary

Uintah Basin Unit, All Programs				
CONTRACTS PLANNED	UNITS	CURRENT FY	CUMULATIVE	TARGET
1. CONTRACT STATUS				
A. Contracts Approved	Number	89	2,935	
	Dollars	3,601,619	93,671,792	
	Acres	3,624	157,362	160,000
On-farm	Tons/Year	1,713	125,232	140,500
Off-farm	Tons/Year	-	27,507	
B. Active Contracts	Number		446	
	Dollars		24,543,301	
	Acres		17,380	
On-farm	Tons/Year		28,640	
Off-farm	Tons/Year		1,573	
PRACTICES APPLIED	UNITS	CURRENT FY	CUMULATIVE	TARGET
2. EXPENDITURES				
Financial Assisstance (FA)	Dollars	1,436,570	82,934,162	
3. IRRIGATION SYSTEMS				
A. Sprinkler	Acres	1,054	138,685	160,000
B. Improved Surface System	Acres	(17)	13,626	
C. Drip System	Acres	-	81	
4. SALT LOAD REDUCTION				
A. Salt load reduction, on-farm	Tons/Year	737	122,659	140,500
B. Salt load reduction, off-farm	Tons/Year	78	25,773	
C. Tons of salt controlled prior to EQIP	Tons/Year		93,389	

NRCS Salinity Control Programs			
Program Name	Acronym	Start Year	End Year
Agricultural Conservation Program	ACP	1980	1987
Colorado River Salinity Control Program	CRSCP	1987	1996
Interim Environmental Quality Incentive Program	IEQIP	1996	1996
Environmental Quality Incentive Program	EQIP	1997	Current
Basin States Parallel Program	BSPP	1998	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 means for the U.S. to comply with 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

Annual Project Results

FY2011 project results are summarized in table 2.

Table 2. FY2011 results

FY2011	Planned	Applied
Irrigation Improvements, Acres	3,624	1,054
Federal Cost Share, FA, 2011 Dollars	3,602,000	1,437,000
Amortized Federal Cost Share, FA+TA, 2011 Dollars	389,400	155,300
Salt Load Reduction, Tons/Year	1,713	815
Federal Cost/Ton, FA+TA, 2011 Dollars	227	191

Cumulative Project Results

Cumulative planned and applied results are in line with NEPA expectations and costs. (Table 3)

With respect to NEPA planning documents, salt load reduction has exceeded projections at a lower amortized cost/ton than anticipated. Cooperators continue to apply for salinity control contracts and opportunities still exist to further reduce salt loading at an average cost/ton in line with that expected at project inception.

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

Off-farm activities are excluded from this table. Dollar amounts are expressed in 2011 dollars.

Cumulative Improvements	Units	EIS[1]	Projected[2]	Planned	Applied
Irrigation Improvements	Acres	137,000	160,000	157,400	152,400
Federal Cost Share, FA+TA[3]	2011$	211,863,000	278,637,000	280,900,000	248,600,000
Amortized Fed Cost, FA+TA	2011$	20,933,000	26,219,000	24,300,000	21,700,000
Total Salt Load Reduction	Tons /year	106,800	140,500	152,700	148,400
Federal Cost/Ton, FA+TA	2011$ /ton	196	187	159	146

[1] Combined data from 1987 Holt Letter and 1991 expansion EIS.

[2] $33 million nominal FA added for on-farm practices on 23,000 acres.

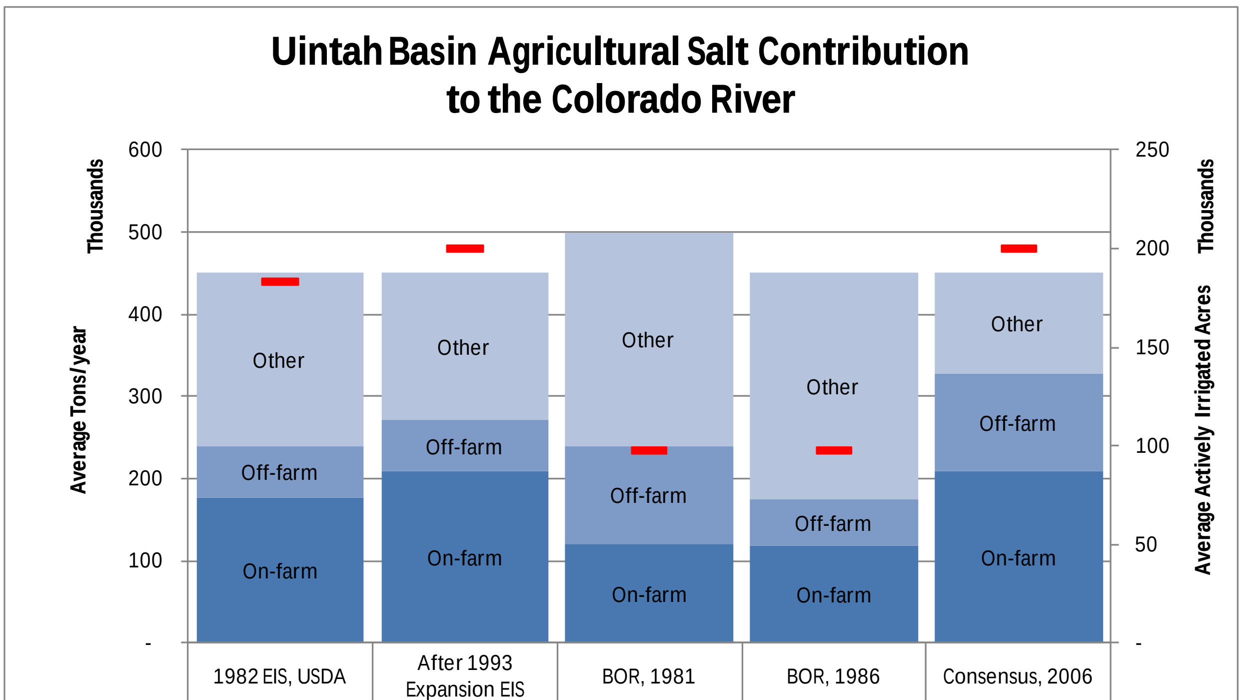
[3] FA+TA is used in this table only, to conform to procedures used in the EIS'.

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 2006 NRCS and the Bureau of Reclamation (Reclamation) reviewed available literature and came to a consensus agreement concerning the most reasonable pre-project salt contribution from agriculture in the Uintah Basin, prior to implementing Federal Salinity Control Programs. (Figure 1)



	1982 EIS, USDA	After 1993 Expansion EIS	BOR, 1981	BOR, 1986	Consensus, 2006
Other	210,000	179,080	260,000	275,360	121,880
Off-farm	62,800	62,800	120,000	56,760	120,000
On-farm	177,200	208,120	120,000	117,880	208,120
Active Acres	183,200	200,000	97,477	97,477	200,000

Figure 1. Uintah Basin Salt Load Allocation. The last bar indicates the consensus estimate.

Between 1975 and 1991, at least six studies were completed by federal agencies to quantify the salt contribution of Uintah Basin irrigation to the Colorado River System. Three studies by US Department of Agriculture (USDA) Soil Conservation Service, predecessor to Natural Resource Conservation Service (NRCS) emphasized the contribution of on-farm irrigation systems and attempted to address all irrigated lands in the Uintah Basin. Two studies by Reclamation focused on canals with the greatest water loss, addressing only half of irrigated lands. This discrepancy in scope has led to ambiguity as to the total salt contribution of agriculture. (Figure 2)

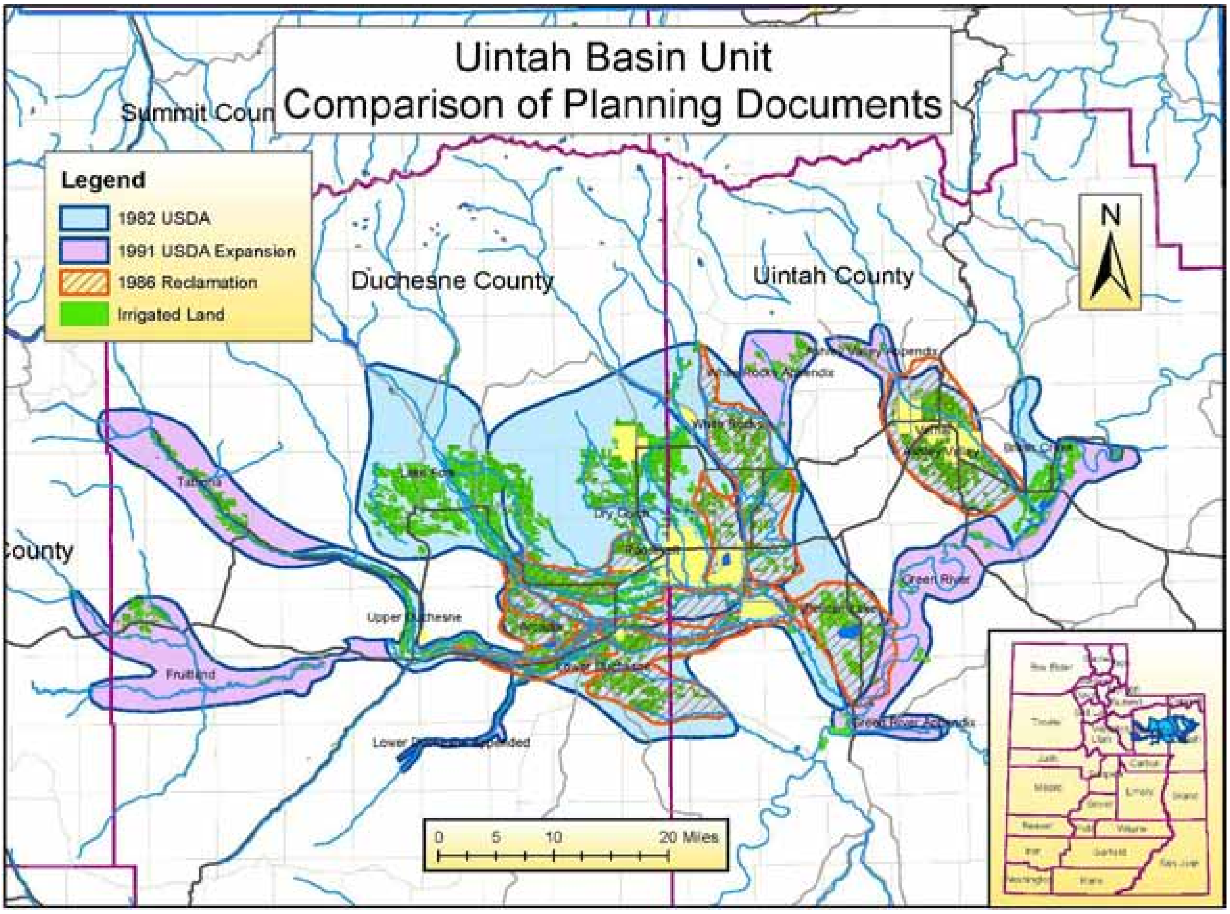


Figure 2. Comparison of Federal Salinity Control Planning Documents

Salt load at a given point in a watercourse is generally estimated by multiplying average flow by average salt concentration over a discreet time interval and summing the results to determine an average salt load. Since flow rates and concentrations are highly variable, shorter measurement intervals and longer periods of record result in more acceptable estimates.

The average salt pickup for a given drainage is the average salt load below the drainage minus the average salt load above the drainage.

Salt Pickup has various sources including natural processes, springs, wells, mines, and agricultural activity. Agricultural irrigation, a particularly large source, involves diverting relatively clean water from a watercourse, transporting diverted water to fields and applying water to the soil. Agricultural salt pickup occurs when seepage from canals and excess water application on fields allows water to percolate below the plant root zone, carrying salt dissolved from the soil back to the river system.

Colorado River Basin Salinity Control Project (CRBSCP)

The CRBSCP encompasses multiple federal agencies and programs intended to reduce salt loading to the Colorado River. USDA on-farm salinity control started about 1980, with the Agricultural Conservation Program (ACP) and Long Term Agreements (LTA). Contracts were made with agricultural land owners to install improved irrigation practices for salinity control purposes. In 1984, ACP and LTA were replaced by the Colorado River Salinity Control Program (CRSCP), which functioned until 1996. In 1996, the Interim Environmental Quality Incentive Program (IEQIP) operated for one year, until the current Environmental Quality Incentive Program (EQIP) was established. Salinity control on the Colorado River has been a part of EQIP through the 1996, 2002, and the 2008 Farm bills.

Salinity Control Practices

When more water is applied to the soil than can be absorbed by soil above the depth of the plant roots (root zone), excess water percolates below the roots and is lost forever (deep percolation). 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 efficient operation of irrigation systems. 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, typically by installing pipelines.

Planning Documents

A careful review of NEPA planning documents indicates that the cost of treatment is generally less than anticipated pre-project. (Table 4)

The Environmental Impact Statement (EIS) for the Uintah Basin Unit of the Colorado River Basin Salinity Control Project (CRBSCP) was published in April, 1982. The EIS contemplated treating 122,200 acres with improved irrigation practices at a cost of $64.5 million FA ($160 million in 2011 dollars), reducing salt loading by 76,600 tons/year. It was anticipated that 35% of treatments would be improved flood irrigation. The nominal projected cost was $76/ton, FA+TA. (TA, technical assistance, pays for NRCS services, including taking applications, contracting, designing, construction inspection, and monitoring.)

Amortizing $64.5 million at 7.625% (the federal water project discount rate for FY1982) over 25 years and normalizing to 2011 dollars, using the Producer Price Index for farm equipment purchased (PPI), results in an expected average cost of $189/ton (FA+TA) in 2011 dollars.

By 1987, it was apparent that USDA was installing more off-farm practices than anticipated and that 5,900 on-farm acres in the Whiterocks area, excluded from the initial EIS, would likely be treated after all. By a letter from the Utah State Conservationist, Francis T. Holt, dated July 14, 1987, (Holt Letter) projected treatments were increased to 128,100 acres and salt load reduction to 98,200 tons/year of which 82,300 tons/year were on-farm. The letter cites a total federal cost of $76 million at 70% cost-share (1986 dollars), a 50 year project life, and 8.625% discount rate.

Table 4. Comparison of Project Cost Estimates

FA+TA	EIS, 1982	Holt Letter, 1987	EIS, 1991	2002 Adjustment
Added Irrigation Improvements, Acres	122,200	5,900	8,900	23,000
Cumulative Irrigation Improvements, Acres	122,200	128,100	137,000	160,000
Incremental federal cost share, nominal	$64,474,200	$11,525,800	$7,148,700	$40,000,000
Total federal cost share, nominal	$64,474,200	$76,000,000	$83,148,700	$123,148,700
Federal water project discount rate	7.625%	8.625%	8.750%	6.125%
Amortized incremental treatment cost, nominal	$5,848,000	$7,503,000	$713,000	$3,166,000
Total amortized treatment cost, nominal	$5,848,000	$7,503,000	$8,216,000	$11,382,000
Total treatment cost, 2011 $	$159,972,000	$196,266,000	$211,863,000	$278,637,000
Total amortized treatment cost, 2011 $	$14,509,000	$19,377,000	$20,933,000	$26,219,000
Incremental total salt load reduction, tons/year	76,600	21,600	8,600	33,700
Total salt load reduction, tons/year	76,600	98,200	106,800	140,500
Total Cost/Ton 2011 $	$189	$197	$196	$187

While the practice life of buried pipelines may be on the order of 50 years, sprinkler and improved flood irrigation systems have a 15 year practice life (NRCS standards). Amortizing costs over 25 years or less seems more appropriate for on-farm practices than a 50 year amortization and a 25 year amortization has been widely used in recent years for NRCS' cost/ton analysis. Amortizing $76.0 million at 8.625% over 25 years yields an expected salt load reduction cost of $197/ton FA+TA, in 2011 dollars.

In December, 1991, a second EIS was completed, expanding the Uintah Basin Unit by 20,800 acres, of which 8,900 acres would be treated (7.5% improved flood) at a cost of $7.15 million FA+TA ($15.6 million in 2011 dollars) to reduce salt load by 8,600 tons/year. Using the same reasoning as above, the amortized cost is $181/ton (FA+TA) for the incremental acres and $196/ton for the entire project described by the Holt letter and the expansion EIS.

By 2002, it was obvious that improved flood installations were out of favor and nearly all future installations would be sprinklers. It is now anticipated that 160,000 acres may ultimately be treated, with a total salt load reduction of 140,500 tons/year, on-farm. Salt load reduction costs may settle around $187/ton, in 2011 dollars, for the entire project, in line with costs estimated in the Holt letter in 1987 and after the 1991 expansion EIS.

Distribution of Salt Concentration

Through the 1980s and 1990s, salt loads, for individual contracts, were calculated using a predetermined salt load factor, expressed in tons of salt/acre-foot, multiplied by the estimated return flow to the river in acre-feet/year. Return flow was calculated by using a water budget to estimate deep percolation and subtracting estimated phreatophyte consumption prior to ground water returning to the river system. The salt load factor was determined as part of the EIS, by measuring and comparing salt concentrations in water diverted from the rivers to groundwater flowing from seeps below irrigated lands over just one irrigation season. Salt load factors were always suspect, because they were derived from too few samples over too great an area over too short of time. There is no evidence that any ground water potential studies were done to determine the likely flow paths of return flow.

In FY2007, in an attempt to simplify salt accounting and minimize arbitrary estimates, new procedures were established to calculate salt load reductions on the basis of estimated original salt in place and potential salt load reduction based on years of intense monitoring of salt and water budgets on individual practices. In the Uintah Basin, original salt load was averaged over the entire basin with a pre-project load of 1.04 tons/acre.

SPARROW (Spatially Referenced Regressions on Watershed Attributes)

In 2009, USGS released 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). This report, which includes a user-interfaced GIS model to access and review data, provides opportunity to compare past salt-loading estimates with state-of-the-art, computerized efforts to numerically model salt transport in the river and its tributaries.

As published, SPARROW91 reports the estimated agricultural salt load for one year only, 1991. Planss are underway to improve input data and adapt the SPARROW91 Model to estimate average loads over longer periods of record. Until that effort is completed, conversion to long-term averages is accomplished by applying correction factors to each catchment. The latest correction factors are based on comparisons of long term average salt loading at USGS gauge stations and have been given the name “Anning 2.2”.

Comparison of total agricultural salt loading referenced in various NEPA documents (328,000 tons/year) with Anning 2.2 adjusted SPARROW91 levels (320,000 tons/year) is reasonably consistent. (Figure 3, pink bars) The Anning adjusted SPARROW91 numbers are for the overall average salt load and have been influenced by thirty years of ongoing irrigation practice improvements.

Similarly, the average post treatment annual agricultural salt loading minus projected salt load reductions from installed irrigation practice improvements through 1991 (278,000 tons/year), compares favorably with the SPARROW91 estimate of 1991 agricultural salt loading (227,000 tons/year). (Figure 3, blue bars) SPARROW91 represents only one year and not any type of long term average salt loading.

For the Uintah Basin Unit, adjusted SPARROW91 data seems to reasonably agree with other data sources.

Distribution of salt loading is of special interest, in that the SPARROW model indicates an entirely different distribution than the does the EIS. (Figures 4 and 5)

Salt load distribution from the EIS was always controversial, in that it was developed by measuring salinity in 64 drains, unevenly spread across 200,000 acres of irrigated land. There is no suggestion that potential flow paths back to the river were considered. In 2008, calculating salt load reductions was changed from using sub-basin salinity to a unit-wide beginning average salt loading.

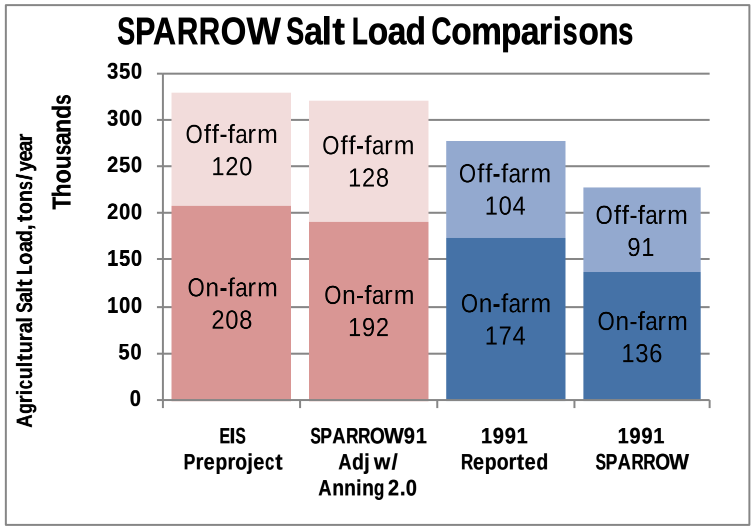


Figure 3. SPARROW91 Salt Load Comparisons

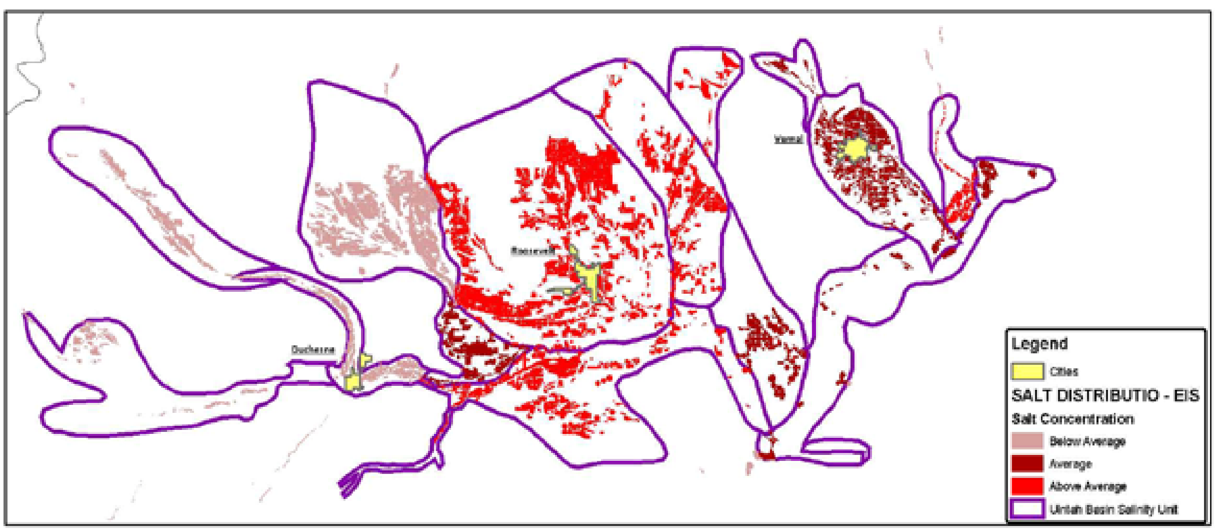


Figure 4. Salt loading distribution estimated by EIS.

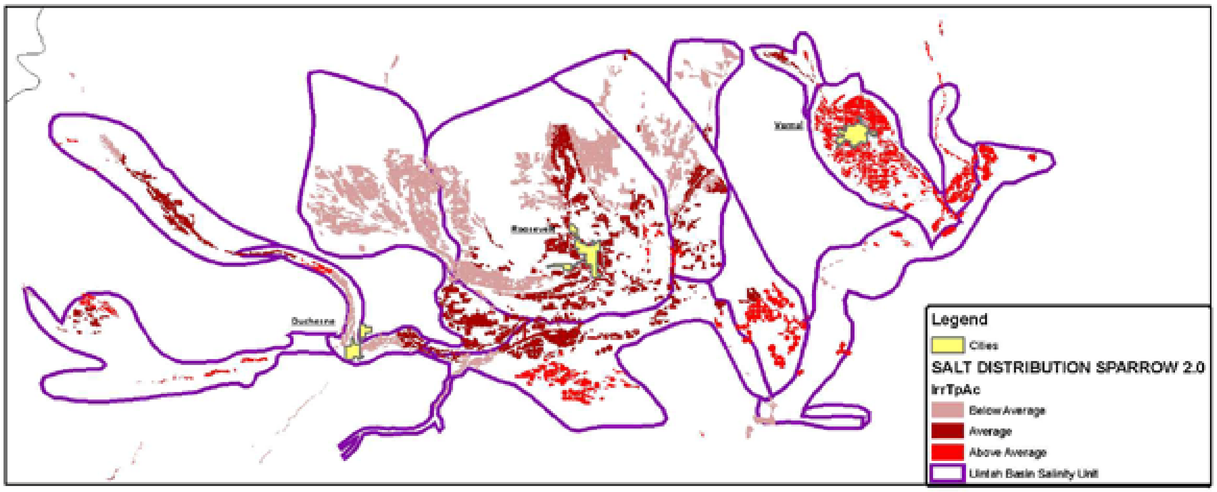


Figure 5. Salt loading distribution estimated by SPARROW, adjusted to long-term averages (Anning 2.2)

Planned Practices (Obligations)

Planned practices (obligations) represent contracts with participants to apply improved irrigation practices to the participant's agricultural operations. 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 installation using federal grants. In essence, federal cost-share purchases salt load reductions in the Colorado River, while the participants' cost-share buys them 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.

FY2011 Obligation

In FY2011, $3.60 million was obligated in 89 contracts to treat 3,624 acres with improved irrigation. Of that amount, $139,000 was for wildlife habitat improvements.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2011 planned practices is 1,713 tons/year, all on-farm. This on-farm salt load reduction is calculated by multiplying the original tons/acre-year for the entire basin, by the acres obligated for treatment and a percentage reduction based on change in irrigation practice. For the Uintah Basin, the consensus estimate of on-farm irrigation salt loading is 1.04 tons/acre-year. As an example, if 40 acres are converted from wild flood to wheel line sprinkler, an estimated 84% of the original salt load will be controlled. Hence, 40 acres x 1.04 tons/acre-year x 84% = 39.9 tons/year salt load reduction. Salt load reduction in this report is calculated using this method, as outlined in "*Calculating Salt Load Reduction*", July 30, 2007. In addition to on-farm salt load reduction, when ditches that cross non-irrigated acres are put in pipe, as part of the irrigation project, off-farm salt loading is also reduced. No off-farm tons were cited in FY2011.

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% for FY2011). Two-thirds of the FA is added for technical assistance (TA) (the average federal cost of planning, design, construction Inspection, monitoring and evaluation, etc.) and the amortized total cost is divided by tons/year to yield cost/ton. Normalization of past obligations and expenditures to 2011 dollars is accomplished using the Producer Price Index (PPI) for agricultural equipment purchased (1977 series).

For FY2011 the amortized cost of obligated planned projects is $227/ton (FA+TA).

Obligation Analysis

In 2011 dollars, cumulative obligation thru FY2011 is $169 million, planned on 157,400 acres, with a salt load reduction of 152,700 tons/year (on-farm and off-farm), resulting in an overall average cost of $159/ton. Note that in 2011 dollars, the normalized cost/ton has been relatively constant throughout the life of the project. Current cost/ton is not out of line with respect to past years performance or NEPA planning document projections. (Figure 6, table 5)

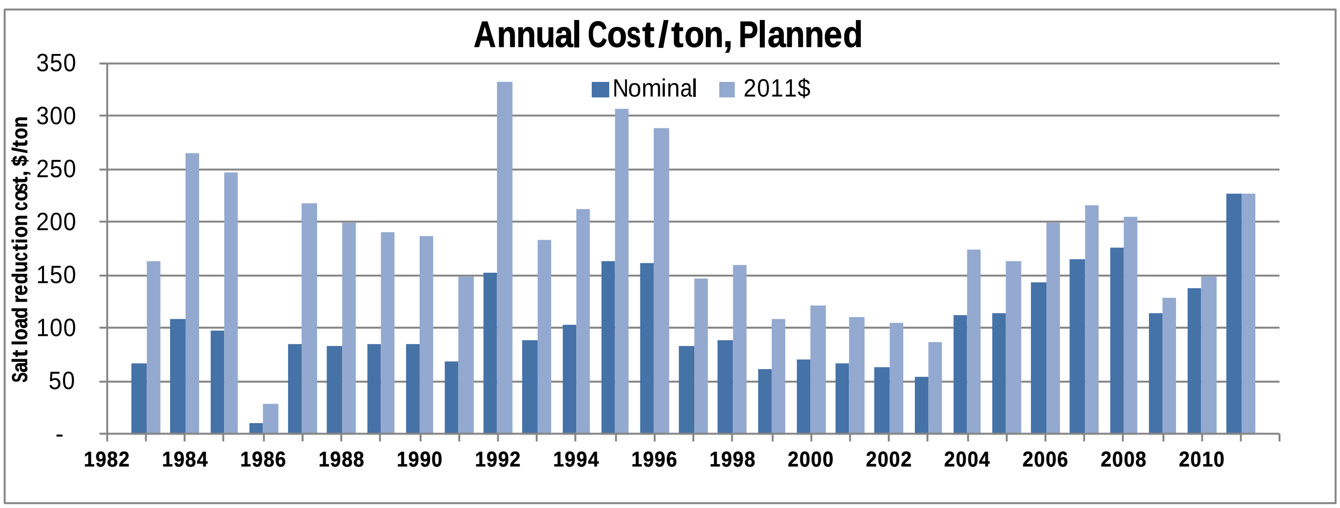


Figure 6. Nominal planned cost/ton and cost/ton in 2011 dollars

Table 5. Cost/Ton of annual obligations since 1980, in nominal and 2011 dollars

FY	Federal Water Project Interest Rate	Contracts Planned	FA Planned Nominal	Irrigation Acres Planned	Salt Load Reduction Tons/Year	Amortized FA+TA Nominal	$/Ton Nominal	2011 PPI Factor	FA Planned 2011 Dollars	Amortized FA+TA 2011 Dollars	$/Ton 2011 Dollars	Cum $/Ton, 2011 Dollars
1980	7.125%	84	1,848,864	5,000	3,735	267,404		274%	5,061,466	732,048		
1981	7.375%	95	1,899,073	6,000	4,482	280,839		255%	4,847,640	716,878		
1982	7.625%	76	1,782,461	5,000	3,735	269,438		247%	4,401,281	665,301		
1983	7.875%	108	2,641,958	8,282	6,187	408,097	66	249%	6,566,482	1,014,309	164	172
1984	8.125%	36	1,107,903	2,152	1,608	174,829	109	244%	2,700,353	426,120	265	180
1985	8.375%	70	1,536,585	3,368	2,516	247,640	98	250%	3,844,414	619,576	246	187
1986	8.625%	39	1,176,359	2,885	18,055	193,569	11	262%	3,086,227	507,837	28	116
1987	8.875%	63	797,629	2,121	1,584	133,971	85	257%	2,049,907	344,306	217	120
1988	8.625%	127	6,153,570	16,362	12,223	1,012,567	83	241%	14,807,371	2,436,545	199	138
1989	8.875%	87	2,111,397	5,614	4,194	354,634	85	226%	4,776,435	802,258	191	142
1990	8.875%	75	2,963,581	7,880	5,887	497,768	85	221%	6,547,434	1,099,718	187	146
1991	8.750%	132	3,358,040	10,968	8,194	558,282	68	217%	7,291,000	1,212,146	148	146
1992	8.500%	284	3,382,799	4,826	3,605	550,898	153	217%	7,344,757	1,196,114	332	155
1993	8.250%	156	2,780,712	6,750	5,042	443,465	88	209%	5,804,007	925,616	184	157
1994	8.000%	113	3,317,415	6,741	5,036	517,952	103	206%	6,833,622	1,066,942	212	160
1995	7.750%	27	720,561	899	672	110,109	164	187%	1,349,632	206,238	307	161
1996	7.625%	161	5,840,101	6,816	5,483	882,794	161	179%	10,461,507	1,581,369	288	169
1997	7.375%	24	610,282	988	1,076	90,250	84	175%	1,065,419	157,556	146	168
1998	7.125%	18	687,172	1,173	1,115	99,387	89	179%	1,230,947	178,034	160	168
1999	6.875%	22	770,221	1,950	1,784	108,918	61	179%	1,379,715	195,107	109	167
2000	6.625%	45	1,674,422	3,456	3,263	231,438	71	172%	2,874,454	397,307	122	166
2001	6.375%	60	1,604,814	3,461	3,265	216,745	66	167%	2,687,765	363,008	111	164
2002	6.125%	122	3,601,896	7,784	7,490	475,200	63	166%	5,983,857	789,453	105	160
2003	5.875%	143	4,681,846	5,782	11,176	603,178	54	161%	7,534,924	970,749	87	153
2004	5.625%	140	5,191,612	5,995	5,824	652,943	112	155%	8,041,227	1,011,335	174	154
2005	5.375%	158	6,177,762	7,285	6,669	758,243	114	144%	8,899,526	1,092,305	164	155
2006	5.125%	116	6,212,616	4,366	5,185	743,898	143	139%	8,647,379	1,035,437	200	156
2007	4.875%	62	3,890,488	2,152	2,749	454,319	165	130%	5,072,430	592,343	215	157
2008	4.875%	76	4,293,010	3,233	2,839	501,325	177	116%	4,996,476	583,473	206	158
2009	4.625%	62	2,791,994	2,402	2,770	317,866	115	113%	3,142,896	357,816	129	158
2010	4.375%	65	4,463,030	2,046	3,583	495,203	138	108%	4,813,544	534,095	149	158
2011	4.125%	89	3,601,619	3,624	1,713	389,338	227	100%	3,601,619	389,338	227	158
Totals		2,935	93,671,792	157,362	152,739	13,042,507	85		167,745,710	24,200,678	158	

Cost Share Enhancement

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

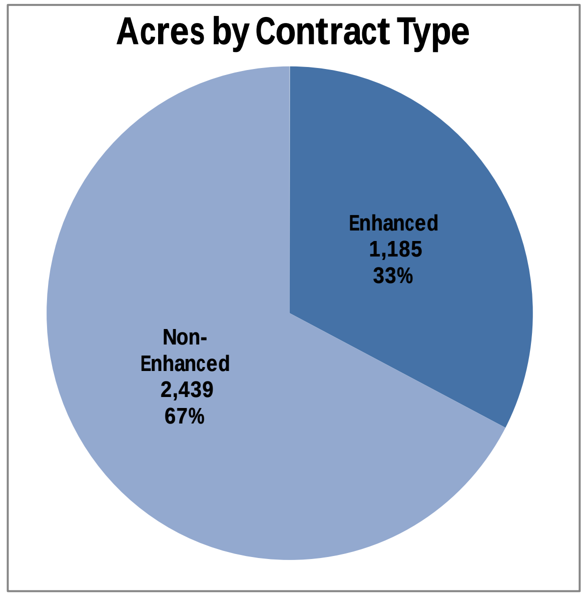


Figure 7. FY2011 planned acres by contract type

For FY2011 contracts, the average salt load reduction cost for cost-share enhanced contracts is $264/ton, compared to $227/ton for all contracts. It is not possible to determine how many of the enhanced contracts would be done without the incentive cost-share increase. About 33% of contracts in the Uintah Basin Unit are enhanced. (Figure 7)

In the Uintah Basin Unit, a cumulative total of 208 contracts on 6,633 acres for $10.19 million FA (2011 dollars) are cost-share enhanced. Estimated salt load reduction is 6,461 tons on-farm and off farm. In 2011 dollars, the cumulative average cost for enhanced contracts is $183/ton compared to $159/ton for all contracts.

From FY2003 to FY2011, the incremental cost of enhancement is $1.70 million in 2011 dollars, about 3% of total FA for the same period. A preponderance of enhanced contracts are with beginning farmers, at an approximate ratio of five to one compared to limited resource farmers or historically underserved minorities.

Irrigation System Replacements

In the Uintah Basin Unit, many salinity funded irrigation systems have reached their expected practice life of fifteen years. Sixty-five percent of applied systems are fifteen years old or older and twenty-one percent are twenty-five years old or older.

Many of these systems have been well maintained and continue to function well. Some have been abandoned for a variety of reasons. Some are poorly operated and maintained and in need of repair and careful attention.

Many NRCS funded practices are life limited and routinely replaced with new NRCS grants. The question of whether or not replacement of worn-out, salinity funded irrigation systems should also be considered for new federal grants is complicated and volatile, involving technical, social, and political issues.

NRCS policy continues to be fluid in regard to salinity control practice replacements in Utah. The following paragraphs describe what has taken place with regard to salinity control irrigation practices that have exceeded their prescribed service life.

Replacement of Prior Treated Practices

Some worn-out sprinkler systems, installed prior to federal salinity funding, have never claimed any federal cost-share or salt load reduction. These types of replacements have occasionally been funded with salinity money for many years. Such funding increased dramatically beginning with FY2008.

Starting in FY2008, replacement of worn-out, prior treated systems has been obligated using salinity funds at a federal payment percentage of about 65%. (About half of these contracts were with historically underserved cooperators and the average payment percentage was increased to 90%.)

Since no salt load reduction or federal funds have ever been used on these fields, cost per ton is calculated on the basis of practice improvement from wild flood to the improved practice.

For FY2011, 5 contracts obligated $254,000 FA, on 365 acres, for a salt load reduction of 342 tons/year, resulting in an average planned cost of $80/ton.

For FY2009 – FY2011, 26 contracts have obligated $1.45 million FA (2011 dollars) to reduce salt loading by 1,686 tons/year, on 1,791 acres, resulting in a cumulative cost of $96/ton (2011 dollars).

System Upgrades (Improved flood to Sprinkler)

In FY2008 – FY2011, 26 improved flood practices that had exceeded their useful life, were obligated for upgrade to more efficient wheel line or center pivot systems. These practices had previously had salinity grants and salt load reduction was claimed for their installation. It was assumed that the application efficiency of these improved flood systems had declined from 55% to 45% over the prescribed life of the system and that the average salt loading of these systems was 48% of original salt loading (0.50 tons/acre-year). Systems upgraded to wheel lines would therefore reduce salt loading by 36% of the original loading (0.37 tons/acre-year), and center pivots by 45% of the original load (0.47 tons/acre-year).

Federal payment percentage has been about 65% for normal contracts and 90% for contracts with historically underserved participants.

In FY2011, 3 contracts for $55,500 FA were planned to upgrade irrigation practices on 17 acres. Salt load reduction is 5 tons/year on-farm and off-farm. The amortized cost is $1,200/ton FA+TA, compared to a cost of $227/ton for all FY2011 contracts.

Cumulatively, 26 contracts have obligated $1.25 million (2011 dollars) FA, to reduce salt loading by 448 tons/year, on 974 acres, at an amortized cost of $324/ton FA+TA (2011 dollars). Cumulative cost for all salinity obligations is $159/ton.

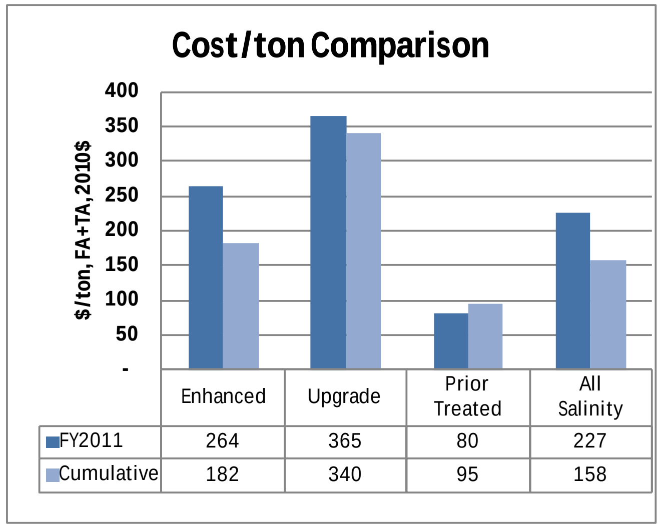


Figure 8. FY2011 cost/ton by contract type

System Upgrades (Periodic Move to Pivot)

In FY2011, 36 contracts for $1.56 million FA were planned to upgrade worn out periodic move sprinklers to center pivots on 2,256 acres. Salt load reduction is 475 tons/year on-farm and off-farm. The amortized cost is $356/ton FA+TA, compared to a cost of $227/ton for all FY2011 contracts.

Federal payment percentage has been about 65% for normal contracts and 90% for contracts with historically underserved participants.

Combining both improved-flood-to-sprinkler upgrades with periodic-move to pivot upgrades results in a FY2011 cost of $365/ton and a cumulative cost of $340/ton.

Figure 8 compares the relative cost/ton for FY2010 Enhanced, Upgrade, Prior Treated, and all salinity contracts.

Replacement of worn out like-for-like systems

There is ongoing public pressure and discussion about replacing worn out irrigation systems that have been in service beyond their prescribed life with new systems of the same type, using federal grants.

Through FY2011, no systems of this nature have been obligated with salinity funds. It is assumed that any future funding would be at lower federal payment percentages to keep cost/ton in line with other contract types. Salt load reduction would be calculated on the basis of a 10% drop in efficiency for worn out systems, compared to new systems.

Effect of not Replacing Worn-out Systems

The issue of what would happen to salt loading levels if replacements are not funded has not been fully resolved. Multiple surveys with participants have indicated that the majority would replace their systems without additional federal participation, when needed. Existing modifications to delivery systems would make returning to wild flood difficult. ***(See the "Hydrosalinity" Section below for more detail.)***

The most common concern of participants seems to be that any funding is distributed fairly and equitably. No one wants to replace their system on their own, only to have the federal government pay for replacing neighboring systems.

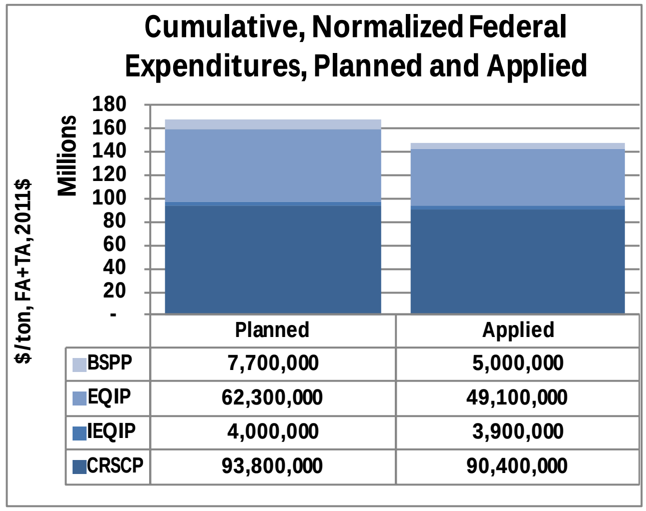
Applied Practices

FY2011 Expenditures

In FY2011, $1.44 million FA was expended applying 1,037 acres of irrigation improvements. The estimated salt load reduction is 815 tons/year, on-farm and off-farm, at an amortized cost of $191/ton FA+TA (includes WLO). This calculation is unreliable in that FA expended cannot be directly correlated to contract completion.

When is a contract completed? The cooperator may receive several partial payments in the course of construction. They may complete construction, commence operation, be reimbursed for 99% of FA and still have two years of IWM left in the contract before it is officially completed. For this document, practices in contracts are assumed to be applied in proportion to dollars paid out, on a contract by contract basis.

Cumulative expenditure FY1980-FY2011 is $149.2 million FA (2011 dollars), applied to 138,700 sprinkler acres, 13,600 improved flood acres, and 81 acres of drip irrigation, reducing salt loading by 122,700 tons/year on-farm and 25,800 tons/year off-farm at an average cost of $146/ton (2011 dollars).



	Planned	Applied
BSPP	7,700,000	5,000,000
EQIP	62,300,000	49,100,000
IEQIP	4,000,000	3,900,000
CRSCP	93,800,000	90,400,000

Figure 9. Comparison of Obligated and Expended funds by Program, 2011 dollars

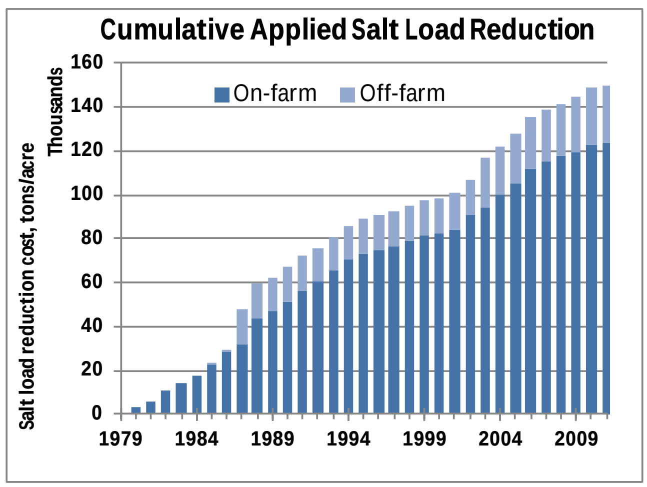


Figure 10, Cumulative applied salt load reduction

There is a time lag between obligating and installing salinity control practices. Between planning and application, a few contracts are de-obligated for various reasons such as design modification, change in ownership or cancellation. (Figure 9)

For NRCS funded projects, off-farm expenditures are a minor fraction of on-farm spending. (Figure 10)

Table 6 summarizes annual expenditures and cost/ton calculations for applied practices, nominal and 2011 dollars.

Table 6. Annual applied cost/ton, nominal and 2011 dollars.

FY	Federal Water Project Interest Rate	FA Applied Nominal	Irrigation Acres Applied	Salt Load Reduction Applied Tons/Year	Amortized FA+TA Applied Nominal	$/Ton Applied Nominal	2011 PPI Factor	FA Applied 2011 Dollars	Amortized FA+TA 2011 Dollars	$/Ton 2011 Dollars	Cum $/Ton, 2011 Dollars
1980	7.125%	-	4,349	3,234	-	-	274%	-	-	-	-
1981	7.375%	1,450,506	3,919	2,928	214,504	73	255%	3,702,613	547,549	187	89
1982	7.625%	1,450,506	5,801	4,333	219,260	51	247%	3,581,612	541,399	125	104
1983	7.875%	1,899,239	4,823	3,603	293,371	81	249%	4,720,484	729,162	202	129
1984	8.125%	1,746,366	5,040	3,765	275,580	73	244%	4,256,514	671,685	178	139
1985	8.375%	1,324,218	6,131	5,405	213,414	39	250%	3,313,088	533,946	99	130
1986	8.625%	3,491,444	8,285	6,395	574,515	90	262%	9,159,950	1,507,265	236	153
1987	8.875%	1,500,879	3,691	17,847	252,090	14	257%	3,857,259	647,872	36	109
1988	8.625%	3,011,008	16,675	12,457	495,460	40	241%	7,245,406	1,192,227	96	106
1989	8.875%	2,327,840	3,400	2,540	390,988	154	226%	5,266,076	884,499	348	116
1990	8.875%	1,978,927	6,313	4,716	332,384	70	221%	4,372,040	734,335	156	119
1991	8.750%	2,823,067	6,922	5,171	469,342	91	217%	6,129,463	1,019,038	197	124
1992	8.500%	3,382,799	4,834	3,611	550,898	153	217%	7,344,757	1,196,114	331	134
1993	8.250%	2,752,919	6,750	5,042	439,032	87	209%	5,745,995	916,365	182	137
1994	8.000%	2,749,248	6,741	5,036	429,244	85	206%	5,663,241	884,209	176	139
1995	7.750%	4,071,491	3,965	2,962	622,167	210	187%	7,626,022	1,165,338	393	148
1996	7.625%	882,617	1,902	1,421	133,417	94	179%	1,581,052	238,993	168	148
1997	7.375%	4,277,813	1,991	1,703	632,611	371	175%	7,468,123	1,104,400	648	157
1998	7.125%	1,391,042	2,193	2,030	201,189	99	179%	2,491,806	360,394	178	158
1999	6.875%	852,084	2,488	2,105	120,494	57	179%	1,526,358	215,843	103	157
2000	6.625%	955,064	1,275	1,239	132,009	107	172%	1,639,543	226,617	183	157
2001	6.375%	1,104,669	2,357	2,112	149,196	71	167%	1,850,115	249,876	118	156
2002	6.125%	1,499,522	6,458	6,160	197,833	32	166%	2,491,167	328,661	53	150
2003	5.875%	3,040,199	4,404	9,884	391,679	40	161%	4,892,871	630,365	64	143
2004	5.625%	4,096,866	5,517	5,512	515,258	93	155%	6,345,588	798,077	145	143
2005	5.375%	4,149,302	6,521	5,754	509,275	89	144%	5,977,378	733,648	127	142
2006	5.125%	6,918,799	6,896	7,080	828,457	117	139%	9,630,320	1,153,134	163	143
2007	4.875%	4,412,156	3,235	3,706	515,238	139	130%	5,752,583	671,769	181	144
2008	4.875%	3,424,172	2,104	2,750	399,864	145	116%	3,985,268	465,387	169	145
2009	4.625%	4,474,513	2,559	2,854	509,419	178	113%	5,036,877	573,443	201	146
2010	4.375%	4,058,317	3,815	4,261	450,298	106	108%	4,377,046	485,663	114	145
2011	4.125%	1,436,570	1,037	815	155,294	191	100%	1,436,570	155,294	191	145
Totals		82,934,162	152,392	148,432	11,613,778	78		148,467,183	21,562,569	145	

Table 7 is a detailed summary of applied practices since project inception.

Table 7. Summary of Applied Irrigation Practices by Year

Applied Practices										
FY	Nominal FA Applied	2011$ FA Applied	Sprinkler Acres	Improved Surface Acres	Drip Acres	Total Irrigation Acres	WL Wetland Habitat Mgmt	WL Upland Habitat Mgmt	Salt Load Reduced On-farm	Salt Load Reduced Off-farm
Projected						160,000			177,200	30,000
1980	$0	$0	3,651	698	-	4,349	-	-	3,234	-
1981	$1,450,506	$3,720,548	3,371	548	-	3,919	-	93	2,928	-
1982	$1,450,506	$3,598,961	4,452	1,349	-	5,801	10	435	4,333	-
1983	$1,899,239	$4,743,349	2,905	1,918	-	4,823	23	-	3,603	-
1984	$1,746,366	$4,277,132	3,122	1,918	-	5,040	23	-	3,765	-
1985	$1,324,218	$3,329,137	4,155	1,976	-	6,131	23	-	4,580	825
1986	$3,491,444	$9,204,320	6,642	1,643	-	8,285	23	-	6,395	-
1987	$1,500,879	$3,875,943	3,162	529	-	3,691	17	600	2,772	15,075
1988	$3,011,008	$7,280,502	15,201	1,474	-	16,675	15	1,638	12,457	-
1989	$2,327,840	$5,291,585	3,027	372	1	3,400	181	1,814	2,540	-
1990	$1,978,927	$4,393,218	6,060	253	-	6,313	252	625	4,716	-
1991	$2,823,067	$6,159,154	6,709	212	1	6,922	434	115	5,171	-
1992	$3,382,799	$7,380,334	4,666	160	8	4,834	154	3,004	3,611	-
1993	$2,752,919	$5,773,829	6,597	145	8	6,750	415	1,380	5,042	-
1994	$2,749,248	$5,690,674	6,581	150	10	6,741	213	868	5,036	-
1995	$4,071,491	$7,662,962	3,934	17	14	3,965	95	755	2,962	-
1996	$882,617	$1,588,711	1,856	42	4	1,902	655	404	1,421	-
1997	$4,277,813	$7,504,299	1,990	-	1	1,991	89	34	1,703	-
1998	$1,391,042	$2,503,876	1,946	236	11	2,193	29	27	1,836	194
1999	$852,084	$1,533,752	2,349	136	3	2,488	-	13	2,080	25
2000	$955,064	$1,647,485	1,200	75	-	1,275	-	-	1,180	59
2001	$1,104,669	$1,859,077	2,114	243	-	2,357	14	-	2,024	88
2002	$1,499,522	$2,503,234	6,322	136	-	6,458	-	-	5,980	180
2003	$3,040,199	$4,916,572	4,400	1	3	4,404	17	46	4,057	5,827
2004	$4,096,866	$6,376,325	5,513	3	1	5,517	22	271	5,168	344
2005	$4,149,302	$6,006,332	6,277	244	-	6,521	10	173	5,746	8
2006	$6,918,799	$9,676,969	6,863	29	4	6,896	15	245	6,274	806
2007	$4,412,156	$5,780,448	3,141	93	1	3,235	327	88	3,181	525
2008	$3,424,172	$4,004,572	2,993	(894)	5	2,104	152	2,308	2,682	68
2009	$4,474,513	$5,061,275	2,553	-	6	2,559	917	143	2,100	754
2010	$4,058,317	$4,398,248	3,878	(63)	-	3,815	342	131	3,344	917
2011	$1,436,570	$1,436,570	1,054	(17)	-	1,037	34	279	737	78
Totals	82,934,162	149,179,393	138,685	13,626	81	152,392	4,501	15,489	122,659	25,773

Evaluation by Program

Since 1980, more than 2,900 contracts have been written with landowners, through multiple funding programs, to upgrade irrigation practices on approximately 157,000 acres. (Table 8) As of the end of FY2011, practices are applied on about 152,000 acres. Less than 10% of applied systems are improved flood systems, 90% being higher-efficiency sprinkler systems.

EQIP and BSPP, current funding programs, represent about 35% of contracts. (Figure 11)

Twenty-four percent of irrigated acres remain untreated. (Figure 12) Of 14,800 acres initially treated with improved flood, about 1,200 acres have since been converted to sprinkler systems.

Table 8. Contracts Planned and Applied by Program

FY2011	Planned				Applied				
Program	Contracts	FA, 2011 $	Irrigated Acres	Salt Load Reduction, Tons	FA, 2011 $	Irrigated Acres	$/Acre	Salt Load Reduction, Tons	Salt Load Reduction, Tons/Acre
ACP & CRSCP	1,984	94,243,704	99,185	89,994	90,853,522	101,850	892	91,985	0.90
IEQIP	62	4,003,439	2,480	2,244	3,952,002	2,581	1,531	3,395	1.32
EQIP	1,117	62,573,156	51,168	53,481	49,355,941	44,253	1,115	49,249	1.11
BSPP	85	7,720,519	4,529	7,020	5,017,928	2,581	1,944	4,836	1.87
Totals	3,248	168,540,818	157,362	152,739	149,179,393	151,265	986	149,465	0.99

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).

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 to reduce deep percolation. 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%.

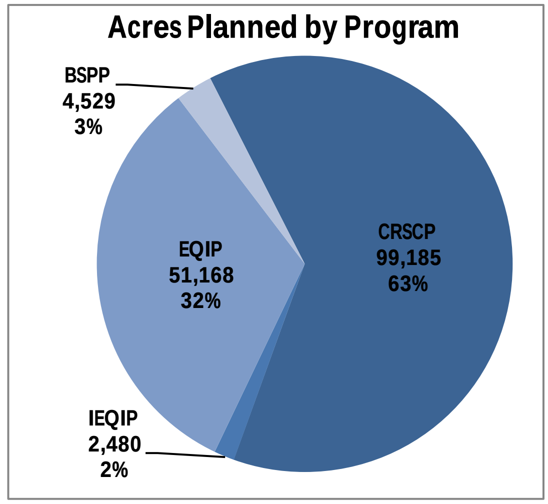


Figure 11. Acres planned by program

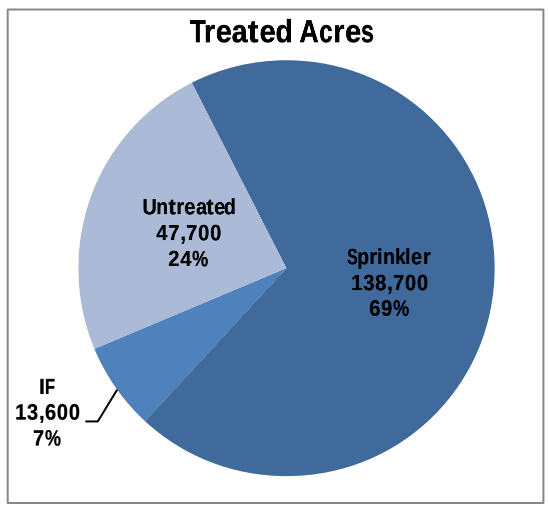


Figure 12. Treated acres

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

Over the life of the Colorado River Basin Salinity Control Program in the Uintah Basin, cooperator preference has made a distinct shift from improved flood to sprinkler systems. In the Uintah Basin, center pivots are the system of choice and now account for approximately two-thirds of acres obligated each year.

Salinity Monitoring Methods

The 1980 and 1991, "…Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program" focused on the following principles:

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

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

Due to budget restraints, field intensive M&E efforts were curtailed in the late 1990s and a new "Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program" was adopted in 2002. Having established that properly installed and operated practices yield predictable and favorable results, the 2002 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.

Cooperator questionnaires

From 2002 to 2005, 538 Cooperators were interviewed to determine perceptions and attitudes about salinity control practices installed on their property. In general, those surveyed are pleased with their involvement in salinity control programs. Most respondents claim to be operating within original design parameters and operating procedures. Detailed results of these surveys were reported in past M&E Reports.

While no direct questions were asked regarding potential like-for-like replacements, a large majority of participants expressed positive economic consequences from irrigation practice improvements. Ninety percent felt that their share of installation cost had been offset with improved production. Ninety-eight percent said that their initial investment resulted in substantial economic gain. Ninety-

nine percent thought that there was a positive economic effect on the area and region from the salinity program.

With individual benefits described, it seems unlikely that cooperators would willingly revert to flood systems.

USU Study, FY2007

In August, 2005, Utah State University (USU) was contracted to study the condition of wheel lines installed under the Colorado River Salinity Control Program (CRSCP) prior to 1995. USU has issued a final report for this study, "*Evaluation of Wheelmove Irrigation Systems Nearing End of Practice Life*".

This report was summarized in the FY2007 M&E report.

Of timely interest concerning the present replacement argument is this quote from the study: ***"Summary findings from 128 responses to the interview question "If or when the present system wears out to the point it can no longer be repaired, how will you continue to irrigate?" indicated that: 88 (69%) would repair or replace with wheel lines, 10 (7.8%) would only replace with financial assistance, 16 (12.4%) would not replace with a wheel line but would change to pivot or flood, and 14 (10.9%) had other responses. The interviewer did not indicate that any cost-share money would be available."***

UACD Study, FY2008

In April, 2007, the Utah Association of Conservation Districts (UACD) was contracted to study the condition of CRSCP improved irrigation systems for which landowners had applied for EQIP contracts to replace or upgrade aging systems. UACD has issued a final report for this study, "*Irrigation System Evaluation and Replacement Study*".

This report was summarized in the FY2007 M&E Report.

Of timely interest concerning the present replacement argument is this quote from the study: ***"In response to the question, "If or when the present system wears out to the point it can no longer be repaired, how will you continue to irrigate?," if cost-share funds were available, 69% of respondents would like to upgrade to a more efficient system, 30% would install a similar system, and 1% would consider returning to flood irrigation. If no cost-share assistance is available, 32% would use other programs or loans to upgrade their systems, 62% would simply replace their systems, and 6% would consider flood irrigation."***

Irrigation Water Management (IWM)

The goal of IWM is to assure that irrigated lands 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 limited over-irrigation.

Crops generally use water before irrigation begins and after irrigation ends, leaving the soil moisture profile partially depleted. Filling the soil with water may require additional water in the spring. (Figure 14) Some over-irrigation and deep percolation is necessary to leach salt buildup from the soil (leaching fraction), and is designed into the system.

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

Cooperator interest is enhanced by creating financial incentives for IWM. To fulfill their contractual obligation and collect payment for the IWM practice (449), a cooperator must accomplish three things:

1. Attend a two hour IWM training session, attend an approved water conference, or receive one-on-one training on their farm
2. Keep detailed irrigation records using the IWM Self-Certification Spreadsheet
3. Review the records with an NRCS employee or contractor trained to evaluate and explain IWM principals

Starting in FY2008, an additional "intensive" IWM practice was made available that pays a higher rate if the cooperator also purchases, installs, and utilizes a soil moisture monitor.

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

Irrigation Record Keeping

To help with irrigation timing, NRCS - Utah has developed and provided the "IWM Self-Certification Spreadsheet" which allows cooperators to graphically compare actual irrigation with mathematically modeled crop evapotranspiration (ET), using either long-term averages or real-time climate data. ET 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 includes input forms (figure 13) and creates two graphs (figure 14).

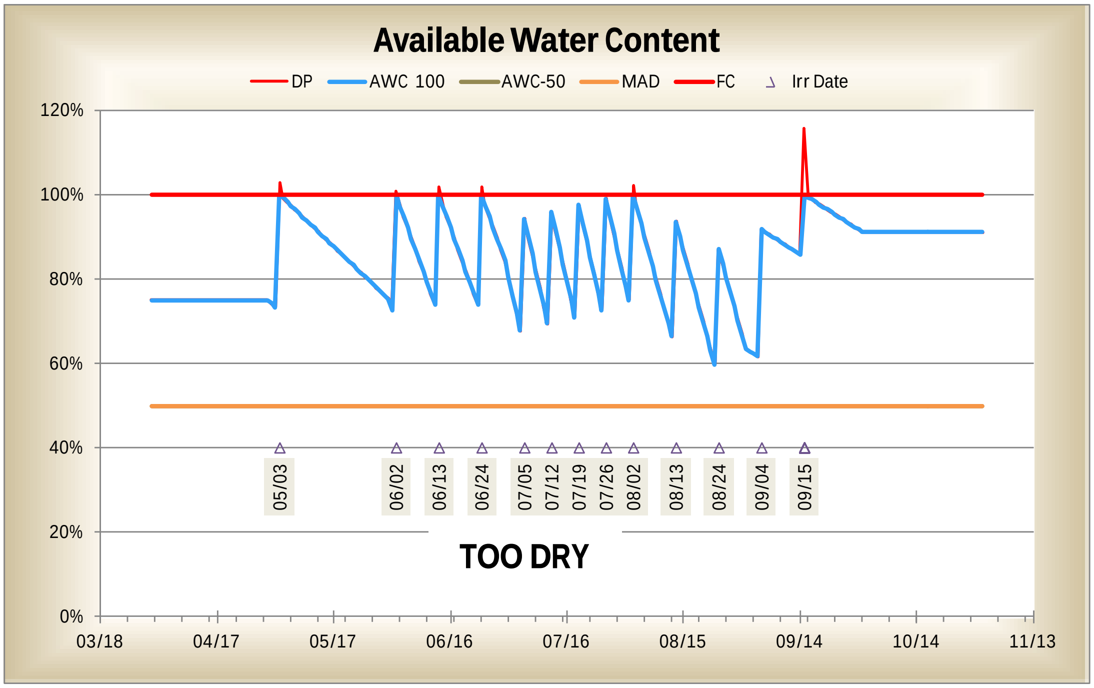
Irrigation Water Use Record - Farmer Self Certification

Cooperator:	Iris Irrigator	**Crop:**	Corn, Silage/Grain
Year:	2011		
Tract/Field:	Tract 9	**Root Depth, ft:**	3.50
Date:	01/30/12	**Station:**	Pelican Lake/Ouray
CU:	27 inches	**Contract Eligible Acres:**	70.00
Soil Texture:	Loamy Fine Sand	**Irrigation method:**	Pivot
AWC, In/Ft:	2.16	**Efficiency:**	75%
AWC Max, in:	7.56	**Evaluated Acres:**	129.98
MAD, in:	3.78	**Evaporation %:**	10%
Pre-season AWC, In.	5.67	**Cycle Hours:**	168
		Flow rate, gpm:	900

Start date of irrigation cycle	End date of irrigation	Total Cycle Hours	Alternate Cycle Hours	Flow, gpm	Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Irrigation Gain	AWC	Deep Perc
05/03/11	05/10/11	168		900.0	2.31	2.31	0.20	2.11	7.56	0.22
06/02/11	06/09/11	168		900.0	2.31	4.63	2.46	0.05	7.56	0.05
06/13/11	06/20/11	168		900.0	2.31	6.94	4.63	0.15	7.56	0.15
06/24/11	07/01/11	168		900.0	2.31	9.25	6.80	0.15	7.56	0.15
07/05/11	07/12/11	168		900.0	2.31	11.57	9.55	-0.43	7.13	0.00
07/12/11	07/19/11	168		900.0	2.31	13.88	11.74	0.12	7.25	0.00
07/19/11	07/26/11	168		900.0	2.31	16.19	13.93	0.12	7.37	0.00
07/26/11	08/02/11	168		900.0	2.31	18.51	16.12	0.12	7.49	0.00
08/02/11	08/09/11	168		900.0	2.31	20.82	18.20	0.24	7.56	0.17
08/13/11	08/20/11	168		900.0	2.31	23.14	21.00	-0.49	7.07	0.00
08/24/11	08/31/11	168		900.0	2.31	25.45	23.81	-0.49	6.58	0.00
09/04/11	09/11/11	168		900.0	2.31	27.76	25.77	0.35	6.93	0.00
09/15/11	09/22/11	168		900.0	2.31	30.08	26.26	1.82	7.56	1.19
Total inches of water applied during the season (total of all lines above):								30.08		1.93
Total Acre Feet Applied during the Season:								325.8		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								87%		

Figure 13. Sample IWM Self Certification Spreadsheet – Data entry page

System design, climate, crop, and soil data are entered into this sheet. Then all that is required is the start date of each irrigation cycle. The spreadsheet makes the calculations and tracks AWC and deep percolation. For maximum crop growth, AWC must be maintained in the upper 50% of its range. Some deep percolation is designed into each system as a leaching fraction to avoid buildup of salts in the soil.



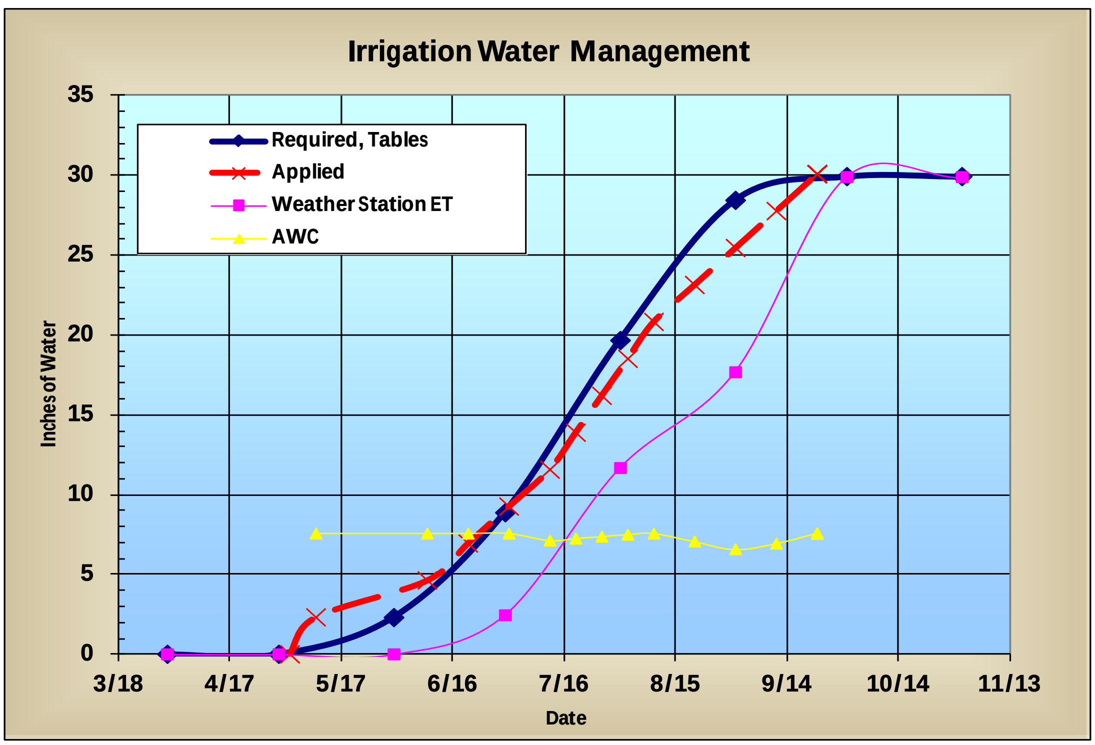


Figure 14. Sample graphs from the IWM Self Certification Spreadsheet.

In the top graph, the blue line is AWC in the soil. Red spikes above the red 100% line are deep percolation. In the bottom graph, the blue line is the 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 near real-time data collected at a nearby weather station. The yellow line indicates AWC.

This spreadsheet is used by cooperators to self-certify their irrigation records when presented to and discussed with NRCS employees or contractors.

IWM incentive payments have created the opportunity to meet with sprinkler owners, discuss IWM principles, and graphically illustrate how they can reduce deep percolation and increase production by properly timing irrigation and keeping quality records. NRCS personnel anticipate that nearly all new sprinkler owners will improve their IWM in future years, based on IWM training and their expressed interest in irrigation water management.

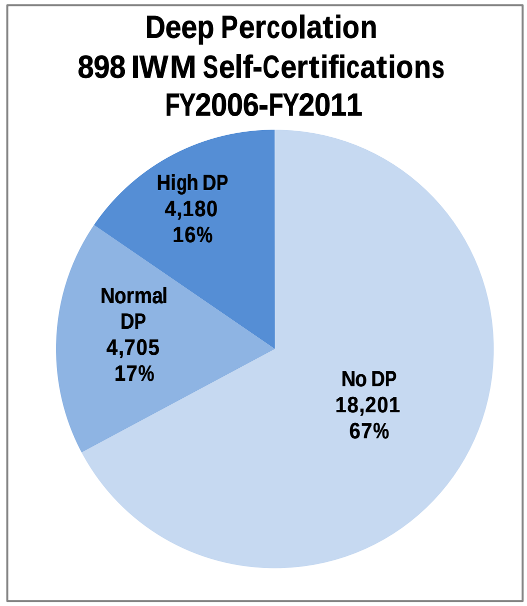


Figure 15. Acres with deep percolation from IWM Certification Spreadsheets

Since FY2006, 898 completed IWM Self Certification Spreadsheets have been delivered to the M&E team, representing 27,000 acres. On an acreage basis 67% had no deep percolation, 17% were within design limits of deep percolation for the irrigation system, and 16% exceeded design limits of deep percolation (after compensating for average soil moisture storage effects). (Figure 15)

Six years of IWM Self-certification data indicates that the average actual volume of deep percolation is about 64% of the expected volume, based on normal leaching fractions and system efficiencies.

Soil Moisture Monitoring

A historically proven method for timing irrigation involves augering a hole and determining the water content of the soil to help decide when the next irrigation should be applied. 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 operators in the use of another tool for timing irrigation - modern soil moisture monitoring systems utilizing electronic probes and data recorders. The IWM incentive payment is higher for participants that elect to install soil moisture monitors. Such systems can be installed for as little as $600, giving the operator information, at a glance, about the water content of their soil at multiple depths and locations.

In a typical case, electronic probes are installed at three or more different depths, such as 12”, 24” and 48”, along with a single temperature probe. Using a simple data recorder, indicated soil pore pressure (implied soil moisture content) is sampled 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 16)

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 the Uintah Basin, three installed data recorders indicate that deep percolation occurs less than 5% of the time on monitored fields.

Figure 16. Soil Moisture data recorder with graphing

If soil characteristics are known, recorded soil moisture data can be used to accurately estimate AWC. The lower limit of the Readily Available Water Content (RAW) may fall in the range of -80 to -120 centibars. Assuming a linear relationship from 0 to -200 centibars, and knowing the AWC/foot of soil, the soil profile can be divided into layers and total AWC estimated for each layer, knowing soil pore pressure (and derived saturation), layer thickness, and capacity. Summing AWC for all layers yields total AWC for the soil profile.

Since actual water storage characteristics are highly variable, based on soil properties, calibrating a soil moisture monitor to accurately reflect actual AWC is tedious. However, the soil moisture monitor is still a useful tool to indicate when water is needed, if operators pay enough attention to get a sense for what it is telling them.

In a graph of AWC, based on recorded soil moisture data, each irrigation cycle is clearly visualized. (Figure 17)

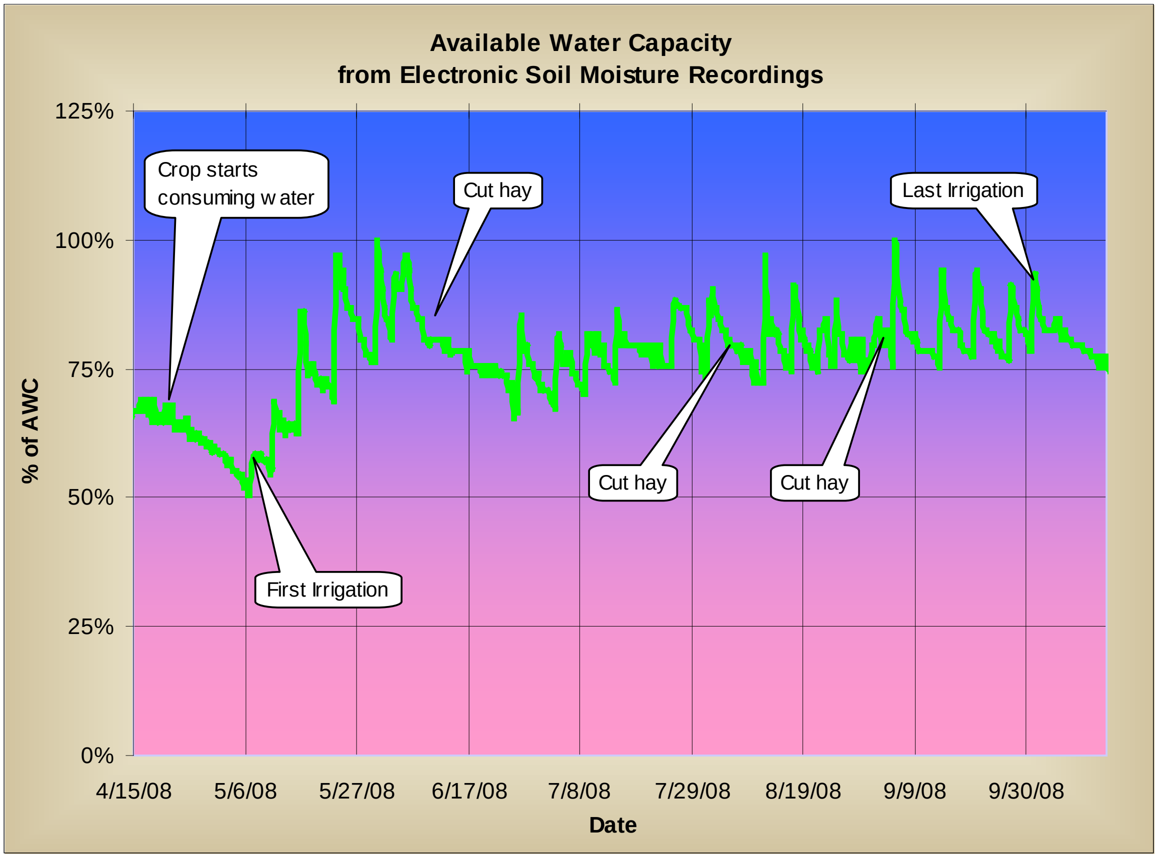


Figure 17. AWC from Soil Moisture Data graphed in Microsoft Excel

This rich loam soil absorbs moisture readily and has good water storage characteristics. In early spring, alfalfa starts to grow, pulling stored moisture from the soil. Irrigation begins, adding water to the soil profile. Each pass of the pivot is a peak in the curve. It is simple to pick cutting times and down times where peaks are missed and total soil moisture declines then peaks because the cut hay uses less water than applied. At the end of the season, irrigation ends, but the crop continues to draw water from the soil profile for a few weeks, leaving soil moisture partially depleted. The soil moisture profile was kept in the MAD zone from 50% to 100% of AWC, through the entire irrigation season, yielding a satisfying crop.

Equipment Spot Checks and Evaluations

Catch-can Testing

Since FY2005, catch-can tests have only been ran on request. As reported in the FY2005 M&E Report, for wheel lines, catch-can testing is most useful to evaluate design, but is not particularly useful in determining condition, since three adjacent sprinkler heads, appearing to be the best functioning, are typically picked to run the test, assuring an optimum outcome.

Operating Sprinkler Condition Inventory

In FY2006-FY2008 irrigation seasons two thousand and sixty systems were visually evaluated for age, leaks, and general condition. Sixteen hundred, eighty-eight were operating wheel lines, pod-lines, or hand-lines.

This study concluded that age is a major factor in system condition and overall leakage, as would be expected. However, even with the oldest systems, average leakage amounts to only 1.45% of water applied, much smaller than evaporation, and somewhat minor in the overall scheme of things. Most needed repairs could be avoided with consistent, quality maintenance. There are more than a few 25 year old systems operating without leaks.

A detailed report of the study was included in the FY2008 M&E Report.

Long-term Sprinkler Water Budgets

Long term monitoring of water budgets on fields has ended. No additional, useful data has been collected for several years. The effectiveness of irrigation improvements on salinity control is well established.

Wildlife Habitat and Wetlands

Background

In accordance with "*The Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program" (USDA-NRCS 2002),* first issued in 1980 and later revised in 1991 and 2002, wildlife habitat monitoring in the Uintah Basin was performed from 1984 to 1999 at 90 selected sites throughout the area. These 90 sites were monitored on a three-year rotation by visiting 30 sites each year. A monitoring team collected data on site for habitat quality to be evaluated, utilizing Habitat Evaluation Procedures (HEP, 1980).

Along with 90 HEP sites, 18 vegetative transects were monitored using species frequency sampling methods and a Daubenmire cover class frame. These transects are located on various parts of the landscape, and were also evaluated on a three year rotation period by evaluating six transects per year. The purpose of the information gathered from these transects was to provide insight on changes occurring in habitat composition and also changes in wetland plant communities.

Due to a decrease of funding, 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 new Monitoring and Evaluation (M&E) team.

In 2002 "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 is primarily driven by budget constraints 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, to 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 Salinity Control Program to the present.

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 wetlands within Salinity Units.

Classification of 30-meter Landsat images is an efficient 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 wetlands and wildlife habitat areas; once located, detailed mapping of actual 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 is also 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.

In 2005 the M&E team decided to redirect its methodology to include more precise measurement of actual habitat extents by incorporating detailed mapping, establishment of permanent photo points, and smaller-scale case studies. This methodology is still in effect as of the current date, or until other more effective methods become available.

1980 Utah Division of Water Resources Water Related Land Use (WRLU)

In 1971, the Utah Division of Water Resources published *Water Related Land Use in the Uinta Hydrologic Area.*

In 1980, the Center for Remote Sensing and Cartography of the University of Utah Research Institute updated the *Water Related Land Use inventory for the Uintah Basin*. This update was done in cooperation with Utah Division of Water Resources (Water Resources), USDA Soil Conservation Service, and National Aeronautics and Space Administration. The 1980 update is the second in a series of land use inventories that has evolved into Water Resources' Water Related Land Use (WRLU), a GIS layer updated every five to seven years and made available to the public.

While the 1971 and 1980 WRLUs focused specifically on wetlands, later versions emphasize crops and have little wetland data. The 1980 version is deemed to be more relevant to salinity projects, installation of which began in 1980, and is assumed to be the source document for indentifying wetlands in the original 1982 EIS.

The 1980 WRLU was developed by categorizing land use on the basis of a Color Infrared (CIR) image shot from a U2 reconnaissance aircraft and overlaid onto a contemporary 60 meter Landsat image. The stated objective of this study was to "…classify and map the wetlands and "water-related" land use of the Uinta Basin". Thirty-eight USGS 7½ minute quadrangles were mapped. The final product included data tables and a Mylar overlay for each quadrangle, depicting polygons of each category, to be overlaid on USGS 7½ minute Quadrangle maps. The Mylar overlays were to be kept on file at Water Resources. When attempting to access overlays, none could be found at Water Resources. NRCS' M&E team has located copies of all but one of the overlays (Myton Quadrangle). Thirty-seven overlays have been digitized for use in evaluating changes in habitat associated with salinity control projects.

Land cover mapping is a subjective science. It is unlikely that multiple detailed land cover maps of the same area and time would yield reproducible results. Past attempts by M&E at creating new land cover maps using Landsat images and remote sensing techniques proved futile, largely because typical wetlands were relatively small compared to the 30 meter resolution of newer Landsat images, but also because the landscape is continually changing and one good rain storm can immeasurably alter the landscape and its associated image. That is to say, a large rainfall would greatly increase detected wetlands on the next image, if the same digital signatures were used for categorization.

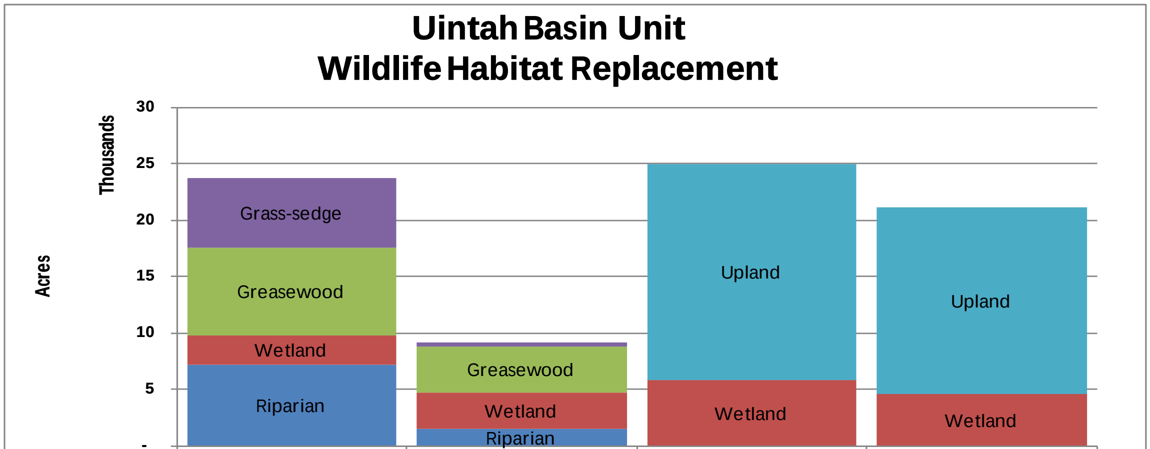
With the ability to electronically overlay the 1980 WRLU on modern aerial images, it is possible to detect changes from 1980 to later images. A detected difference in land use must indicate either a change in use or an error in the original classification.

For the Uintah Basin, digital orthoimagery is available in gray scales from the early to mid 1990s. Color and infrared imagery is available for later dates, the most recent being the one meter National Agricultural Image Program (NAIP) from 2011. The 2006 NAIP is also available in CIR and high resolution (one foot) for agricultural areas. Pre-1980 images are available in hard copy, but require digitizing, orthorectification and assembly into a mosaic, at some appreciable expense, to be useful for detecting temporal landscape changes. Having a pre-1980 image would allow direct comparison with contemporary images to detect changes in raster imagery, in support of the polygon overlay. Although it would be extremely interesting, such expense may not be justifiable for this effort.

By overlaying the 1980 WRLU on the NAIP, it is reasonably straight forward to determine if a polygon classified as wetland in 1980 is no longer wetland on the image date. However, without an older image, it is impossible to verify that it was indeed wetland in 1980. Using the 2006 NAIP, M&E evaluated wetland changes on four quadrangles; Bridgeland, Hancock Cove, Vernal NE, and Altonah.

The 1982 EIS for the Uintah Basin Unit combined eleven wetland types into four categories, greasewood, riparian, wetland, and grass-sedge. The EIS indicated that in the worst case, 37% of acres in these four categories might be converted to upland habitat as the result of irrigation system improvements. The four quadrangles studied by M&E contain 17% of 1980 WRLU wetland acres in the same four categories.

Through FY2011, 152,400 acres have been treated with improved irrigation systems, 125% of the 122,200 acres originally projected for treatment. Based on the four quadrangles analyzed, an estimated 9,100 acres have been converted from wetland to upland habitat, compared to 22,200 acres projected by the original EIS. (Figure 18, first two bars) In the same time frame, 4,500 acres of wetland replacement or improvement has been applied along with 15,500 acres of upland habitat improvement. (Figure 18, last two bars)



	EIS Projected Conversion	Measured Conversion	Planned Replacement	Applied Replacement
Upland			19,209	16,635
Grass-sedge	6,185	292		
Greasewood	7,755	4,092		
Wetland	2,625	3,284	5,818	4,574
Riparian	7,205	1,480		

Figure 18. Wildlife habitat management cumulative status 90

Basin Wide Wildlife Habitat Monitoring

Permanent photo points, representative locations throughout the Uinta Basin of wetlands, wildlife habitat, agricultural areas, and areas where pipelines have recently been built were selected in FY2007 and a protocol established to compare across the years. Photographs will be taken near the same date annually, and compared.

Wildlife Habitat Contract Monitoring

Three Environmental Quality Incentive Program (EQIP) wildlife habitat improvement projects were planned and funded in the Uinta Basin in FY2011 for a total of 66 acres. No Wildlife Habitat Incentives Program (WHIP) or Basin States Parallel Program (BSPP) projects were planned or funded in

Table 9. FY2010 Wildlife habitat acres planned and applied

Acres of Wildlife Habitat Creation or Enhancement by Program				
FY2011 Annual practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	66	34	279
WHIP	-	-	-	-
Total	**-**	**66**	**34**	**279**

*Wetland habitat type includes riparian areas

Table 10. Cumulative Wildlife habitat acres planned and applied by program

Acres of Wildlife Habitat Creation or Enhancement by Program				
FY2011 Cumulative practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
CRSCP	2,600	12,799	2,600	12,799
IEQIP	1	1	1	1
EQIP	2,296	6,316	1,835	3,248
BSPP	128	395	19	326
WHIP	2	164	1	125
Total	**5,027**	**19,675**	**4,456**	**16,499**

*Wetland habitat type includes riparian areas

FY2011 in the UB Salinity Area. A total of 34 acres of EQIP habitat improvement projects were applied in the Uinta Basin Unit in FY2011. (Table 9)

Cumulative wildlife habitat replacement/enhancement is summarized, by program, in table 10.

Tables 11 and 12 provide more insight as to the amount of money spent on the ground for wildlife habitat replacement using EQIP, BSPP, and WHIP funding.

When is a contract completed? As stated above in the Hydro-salinity portion of this document, the cooperator may receive several partial payments in the course of construction. They may complete construction, commence operation, be reimbursed for 99% of FA and still have two years of Upland Wildlife Habitat Management left in the contract before it is officially completed. For this document, all practices in contracts are assumed to be applied in proportion to dollars paid out, on a contract by contract basis.

Table 11. Annual Habitat Obligated, nominal and 2011 dollars.

FY	Contracts	Obligation	Wetland Planned	Upland Planned	PPI Factor	Normalized Obligation
	Number	$	Acres	Acres		2011$
1997	2	$63,968	7	19	175%	$112,215
1998	2	$8,500	30	100	180%	$15,300
1999	0	$0	0	0	180%	$0
2000	1	$8,550	1	17	173%	$14,749
2001	1	$0	8	27	168%	$0
2002	2	$126,029	0	15	167%	$210,387
2003	8	$35,113	75	257	162%	$56,784
2004	9	$574,802	95	2,597	156%	$894,617
2005	8	$195,558	68	200	145%	$283,080
2006	10	$515,447	87	1,795	140%	$720,929
2007	8	$590,663	1,794	219	131%	$773,839
2008	3	$119,977	44	67	117%	$140,313
2009	3	$122,744	181	233	113%	$138,840
2010	10	$396,068	36	1,263	108%	$429,243
2011	4	$139,334	0	66	100%	$139,334
Totals	71	$2,896,753	2,426	6,875		$3,929,631

Table 12. Annual Habitat Applied, Nominal and 2011 Dollars

FY	Payments	Wetland Applied	Upland Applied	PPI Factor	Normalized Payments
	$	Acres	Acres		2011$
1997	$0	89	34	175%	$0
1998	$4,545	29	27	180%	$8,181
1999	$9,559	0	13	180%	$17,206
2000	$0	0	0	173%	$0
2001	$17,206	14	0	168%	$28,957
2002	$0	0	0	167%	$0
2003	$14,269	17	46	162%	$23,076
2004	$360,104	22	271	156%	$560,462
2005	$15,440	10	173	145%	$22,351
2006	$169,374	15	245	140%	$236,895
2007	$441,686	327	88	131%	$578,662
2008	$309,083	152	2,308	117%	$361,473
2009	$443,862	917	143	113%	$502,068
2010	$160,592	342	131	108%	$174,043
2011	$193,020	34	279	100%	$193,020
Totals	$2,138,741	1,968	3,758		$2,706,393

Voluntary Habitat Replacement

NRCS continues to encourage replacement of disturbed 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 Soil Conservation District meetings throughout the Salinity Areas. The Utah NRCS Homepage (http://www.ut.nrcs.usda.gov) also has information and deadlines relating to Farm Bill programs.

Case Study: Montez Creek Project

Background

The Montez Creek Project was funded in 2008, and is located on the extreme western border of Uintah County, approximately three miles northeast of Roosevelt, Utah. (Figure 19)

As seen on the Conservation Plan Map below (Figure 20), Montez Creek (MC) proper occupies the most northern edge of the land within the project area. There are approximately 670 contiguous acres that encompass the creek in the north to the badlands on the southern end. The 90 acres of land offered to be included in the Wildlife Habitat Conservation Plan is located mostly in the lowland riparian zone on the north end.

The non-agricultural land has been heavily grazed by horses, mostly, and is dominated in the lowlands by Russian olive, tamarisk, narrowleaf and Fremont cottonwood, and a variety of willow species. The understory vegetation is mostly saltgrass, wiregrass, and an assortment of agricultural weeds.

Montez Creek is a drainage highly impacted by irrigation practices and frequently suffers from water depletion. Montez Creek is impounded just below the project area in Montez Creek Reservoir and Little Montez Creek Reservoir. Montez Creek above the reservoir mostly runs across private land with some tribal land at its upper reaches. Little Montez Creek Reservoir is located on a Utah Division of Wildlife (DWR), Wildlife Management Area (WMA) where a previous WHIP project was completed in early 2003. This project, along with the reservoir, link land managed under NRCS Conservation plans and provides a corridor of land managed for wildlife species.

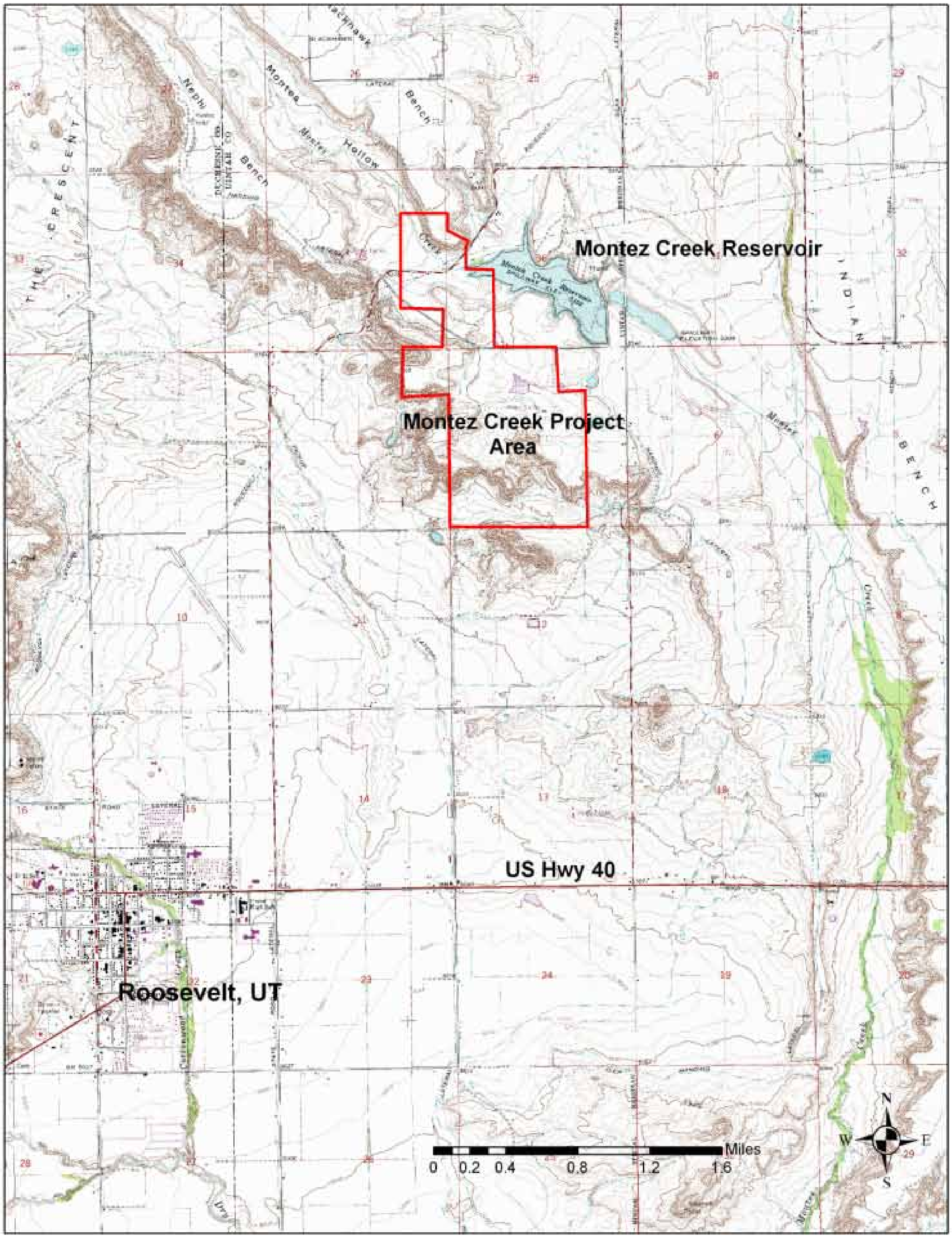


Figure 19. Location Map for Montez Creek Project

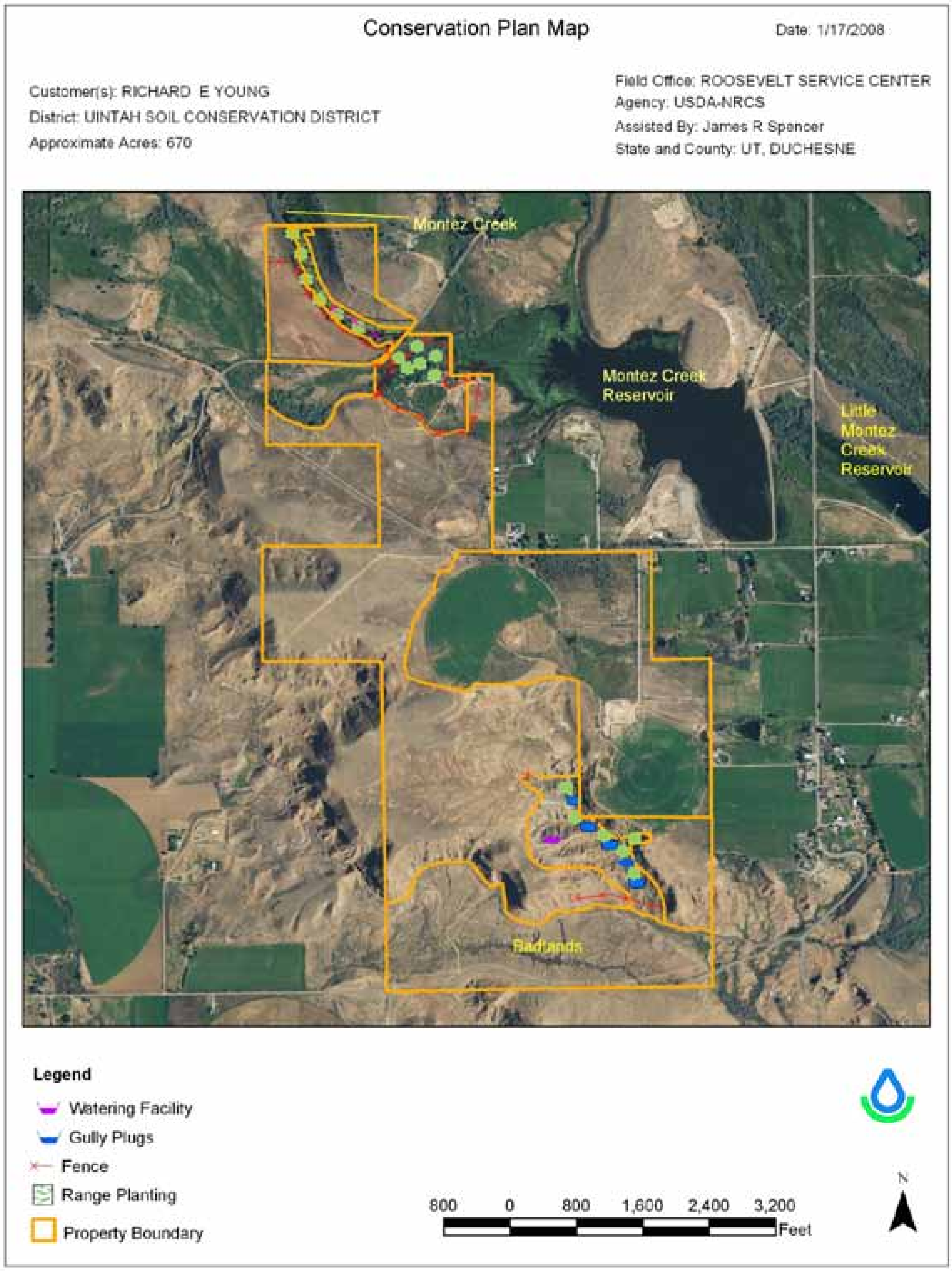


Figure 20. Wildlife Habitat Development Plan Conservation Plan Map for Montez Creek Project.

Objectives

The Montez Creek Project is a comprehensive Conservation Plan with multiple objectives. Aspects of this project that facilitated funding were: location in the landscape, nature of the habitat (riparian/wetland), range and pasture management, noxious weeds, upland and big game species. Most objectives revolve around these circumstances and are listed below, in no particular order:

- Control land degradation by livestock and improper grazing practices. Year-round grazing above carrying capacity resulted in erosion, land degradation, loss of native woody and herbaceous plant species, and noxious weed infestation.
- Eliminate or greatly reduce noxious weeds throughout the property. Russian Knapweed (*Centaurea repens*), perrenial pepperweed (*Lepidium latifolium*), tamarisk (*Tamarix chinensis*), Canada thistle (Cirsium arvense), and hoary cress (*Cardaria draba*), exist on the property to the detriment of the land and the exclusion of native species.
- Wildlife food, shelter, and cover such as woody and herbaceous vegetation were lacking or of poor quality. Woody vegetation throughout the property primarily consists of cottonwood, tamarisk, Russian olive and a scattered assortment of willow species. Little or no recruitment of native woody riparian vegetation was present before project inception because of livestock herbivory. Herbaceous vegetation was dominated by saltgrass, wiregrass, and noxious weeds.
- On the southern end of the property soil erosion and classic gullies were forming in a dry ravine. Weeds dominate and soil is lost during every precipitation event. Available wildlife water was also scarce on the badlands portion of the property.

Results

On-the-ground meetings took place in fall 2007 through spring 2008 with the landowner to assess the resource concerns/objectives. From these meetings consensus was achieved and the following practices were included in the Wildlife Habitat Conservation Plan:

- 6,485 feet riparian buck and pole fence, and 1,210 feet of 41" high barbed wire fence including two cattle guard gates
- 1,100 trees and shrubs
- Five structures for water control or "gully plugs"
- One wildlife guzzler (water catchment structure)
- 13.5 acres grass seeding
- 101 acres of weed spraying (pest management) over three years
- 90 acres of wildlife habitat management incentive payments over three years

Discussion

Most practices were applied in 2009, and 2011. The landowner was not able to work on his project in 2010 as the landowner had applied for and was awarded six other EQIP irrigation, pasture, and range contracts, and was busy completing them. As a result, this contract needed to be modified to bring it back into compliance with the schedule of operations. The contract is now in compliance and will be completed by December, 2012.

The Conservation Plan has addressed all six resource concerns in the NRCS' Conservation Planning Model: Soil, Water, Air, Plants, Animals, and Human aspects, and the needs for each acre have been considered in the planning process. It is anticipated that this project will be a success and a great asset to the Montez Creek watershed.

NRCS will continue to monitor the progress of applied practices and supply the landowners with technical assistance and guidance for future improvements and resource concerns.

Montez Creek Project Photo Gallery

Figure 21. June 1, 2009; looking north, just west of Montez Creek Reservoir @ tree and shrub planting

Figure 22. June 1, 2009; looking west, just west of Montez Creek Reservoir @ tree and shrub planting

Figure 23. June 1, 2009 looking east toward Montez Creek Reservoir

Figure 24. June 1, 2009 looking west toward tree and shrub planting

Figure 25. June 1, 2009, looking west along Montez Creek

Figure 26. June 1, 2009, looking WNW along at field to be seeded along Montez Creek

Figure 27. June 1, 2009, hoary cress (Cardaria draba) to be sprayed in field where grass seeding will occur

Figure 28. June 1, 2009, Montez Creek with tree and shrub plantings with tree protectors and weed barrier

Figure 29. June 1, 2009, rainstorm tests the newly built "gully plugs" on south end of property

Figure 30. November 19, 2010, overview of the lowland riparian area looking ENE toward reservoir

Figure 31. November 19, 2010, overview of the lowland riparian area looking WNW along Montez Creek

Figure 32. November 19, 2010, riparian area fencing

Figure 33. November 19, 2010, year and a half old plantings three feet out of protectors

Figure 34. November 19, 2010, riparian area fencing over Montez Creek

Figure 35. November 19, 2010, riparian area fencing

Figure 36. November 19, 2010, badlands area fencing to exclude ravine from grazing

Figure 37. November 19, 2010, badlands area ravine with gully plugs, excluded from grazing

Figure 38. November 19, 2010, badlands area fencing used natural barrier to tie in “cliff to cliff”.

Figure 39. November 15, 2011, field seeded as buffer along Montez Creek, looking west

Figure 40. November 15, 2011, field seeded as buffer along Montez Creek, looking east

Figure 41. November 15, 2011, Montez Creek, buffered and seeded looking east

Figure 42. November 15, 2011, Montez Creek, buffered and seeded looking east

Figure 43. November 15, 2011, Montez Creek, buffered and seeded on both sides, looking south

Figure 44. November 15, 2011, Montez Creek, buffered and seeded on both sides, looking NE

Figure 45. November 15, 2011, Montez Creek, buffered and seeded on south side, looking west

Figure 46. November 15, 2011, Montez Creek, buffered and seeded on south side, looking east

Figure 47. November 15 2011, cattleguard installed with ingenious horse gate

Figure 48. November 15 2011, cattleguard installed with ingenious horse gate

Economics

Cooperator Economics

Production Information

Field studies completed in 1995 concluded that upgrading from unimproved flood irrigation to improved flood or sprinklers, increased alfalfa crop yields from about 2.5 tons/acre to about 4.5 tons/acre. This magnitude of increase is consistent with anecdotal information from diligent cooperators.

Alfalfa production data downloaded from the National Agricultural Statistics Service (NASS) indicate that yields from the entire Uintah Basin Unit have increased from about 3.5 tons/acre to about 4.0 tons/acre since 1980, based on a linear regression of the data set. With 152,000 acres treated out of 200,000 acres originally producing, the projected yield increase would be expected to be nearer one ton/acre than two.

However, more interesting than yields, are total production data. Total tons of alfalfa produced in the Uintah Basin has increased 58% since 1980, while alfalfa acreage has increased about 44%. From 1980 to 2010, average production increased from 167,000 tons to 265,000 tons, while alfalfa acreage increased from 47,000 acres to 68,000 acres (Utah Division of Water Resource's Water Related Land Use data indicates an acreage change from 41,000 to 93,000 acres for all hay land), implying a yield on the order of 4.6 tons/acre for acreage upgraded to alfalfa production from another crop, most often grass pasture (based on linear regression of the data). (Figure 49)

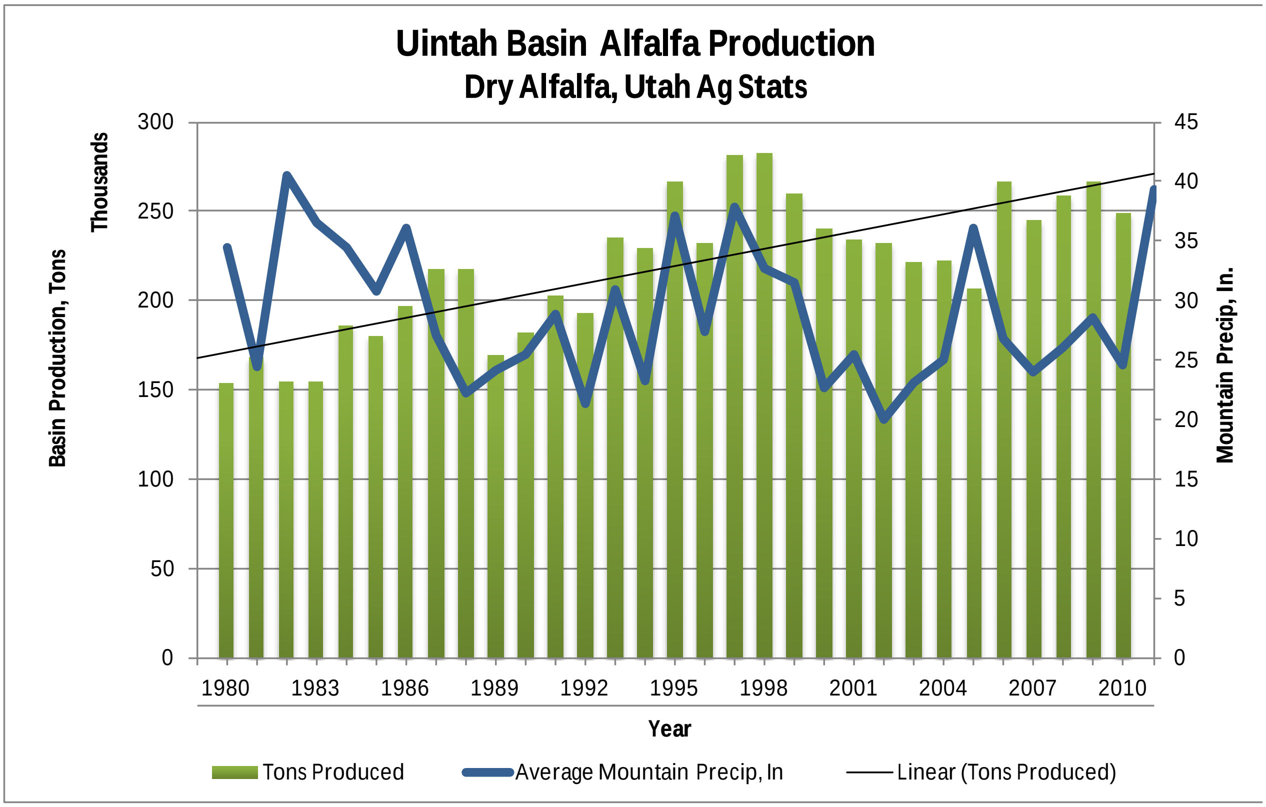


Figure 49, Alfalfa Production and Annual average mountain precipitation

Labor Information

From 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 inconclusive, anecdotal information is positive.

Since the majority of farmers (77%) reported in the 2007 Agricultural Census, do not hire outside labor, it is assumed that most cooperators are satisfied with their own personal labor savings. The 2007 Agricultural Census also reports that 66% of Uintah Basin farmers have full-time occupations other than farming. The local labor market seems steady.

Another perceived labor effect concerns an aging farmer population. Definitive data is not available, but it appears that most Uintah Basin farmers are beyond middle age, and are simply not willing or able to take water turns at night. A distinct preference for Center Pivot Systems has developed -- further evidence of a desire to reduce personal labor commitments.

Public Economics

Ninety-nine percent of survey respondents believe that salinity control programs have a positive economic affect on the area and region.

Companies in the sprinkler supply business are now a significant part of the local economy and other sprinkler related businesses appear to be thriving. The availability of a strong local sprinkler business simplifies purchase, installation, and maintenance of sprinkler systems for the cooperator, and improves local competition and pricing.

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 cost of $227/ton for planned practices is not the highest over the life of the program (in 2011 dollars). The cost of downstream damages from excess salt is an elusive target and not well defined. Colorado River Basin Salinity Control Programs are successful and cost effective in reducing salt load in the Colorado River.

Positive public perceptions of the Salinity Control Program include:

- Reduced salinity in the Colorado River and its tributaries
- 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 Land Use

Summary

Local landowners 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. 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. The local economy is thriving, and upward pressure on labor and equipment prices is substantial.

Glossary and Acronyms

Available Water Content (AWC) – Water contained in the soil that can be utilized by the plant, defined to be the difference between Field Capacity and Permanent Wilting Point, usually expressed as inches/foot.

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, 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 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 dependent on many factors including altitude, temperature, wind, humidity, and solar radiation.

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.

Field Capacity – The total volume of water contained in the soil after gravimetric drainage has occurred. The soil pore pressure is 0 to -33 cb.

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.

Gravimetric drainage – The volume of water that will drain from a saturated soil profile due to gravity alone.

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.

Management Allowed Depletion (MAD) – The fraction of AWC that allows for maximum production. Typically 50%, only the top 50% of AWC should be used for crop growth.

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

NEPA – National Environmental Policy Act which sets out requirements for Federal Agencies to evaluate impacts of Federal projects on the environment, prior to initiating the project.

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.

Permanent Wilting Point (PWP) – The volume of water in a soil profile that cannot be extracted by the plant. Normally, watering a plant at this point will not restore its vitality. Soil pore pressure is about -1,500 cb at the pwp.

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.

Readily Available Water (RAW) – The volume of water in the soil profile that should be used for normal plant growth.

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

Salt Budget – Balancing the inflow and outflows of a salinity project to estimate unknown salt pickup.

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 the Christiansen Coefficient of Uniformity (CCU) and Distribution Uniformity (DU).

Utah Division of Wildlife Resources (UDWR or DWR) – Managing division for wildlife resources in the State of Utah.

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.

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.

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

References

1. U.S. Department of the Interior, Bureau of Land Management, The Effects of Surface Disturbance on the Salinity of Public Lands in the Upper Colorado River Basin, 1977 Status Report, February, 1978.
2. U.S. Department of Agriculture, Soil Conservation Service, U.S.D.A. Salinity Report Uintah Basin Unit, Utah, January, 1979.
3. U.S. Department of Agriculture, Soil Conservation Service, Colorado River Water Quality Improvement Program Final Environmental Impact Statement for Lower Gunnison Basin Unit, Montrose and Delta Counties, Colorado and Uintah Basin Unit, Duchesne, Wasatch and Uintah Counties, Utah, April, 1982.
4. U.S. Department of Agriculture, Soil Conservation Service, Final Environmental Impact Statement, Uintah Basin Unit Expansion – Colorado River Salinity Control Program, Utah, December, 1991
5. U.S. Department of the Interior, Bureau of Reclamation, Colorado River Water Quality Improvement Program, Uinta Basin Unit Utah Status Report, July, 1981.
6. U.S. Department of the Interior, Bureau of Reclamation, Colorado River Water Quality Improvement Program Uinta Basin Unit Planning Report/Final Environmental Impact Statement, April 25, 1987.
7. U.S. Department of Agriculture, Soil Conservation Service, Colorado River Water Quality Improvement Program, Letter from Utah State Conservationist, Francis T. Holt, Review Report, January, 1987.
8. U.S. Department of Agriculture, Natural Resources Conservation Service, "Calculating Salt Load Reduction", internal memo, July 30, 2007, Frank Riggle, Colorado State Agronomist and Ed Whicker, Utah M&E Engineer.
9. "Salt Primer – Water and Salt Budgets", John C. Hedlund, Soil Conservation Service, 1992.
10. "FRAMEWORK PLAN FOR MONITORING AND EVALUATING THE COLORADO RIVER SALINITY CONTROLL PROGRAMS of the U.S. Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS)", May, 2002.
11. "QUALITY OF WATER COLORADO RIVER BASIN – Progress Report #20", U.S. Department of the Interior, 2001.
12. "Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation Reports", 1989 – 2001.
13. 2002 Final Mason Report 1016021. An Excel spreadsheet by David Mason, National Salinity Program Manager, NRCS Headquarters.

14. "Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2001 Report", Draper, Brent W., Goins, Donald J., Lundstrom, D. Nick.
15. "Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2005 Report", USDA-NRCS.
16. Habitat Evaluation Procedures, U.S. Fish and Wildlife Service 1980.
17. 1987, 1992, 1997, 2003 "Census of Agriculture", United Stated Department of Agriculture, National Agricultural Statistics Service.
18. "USDA Salinity Report Uintah Basin Unit, Utah, January 1979", Review Report, January, 1987.
19. Center for Remote Sensing and Cartography, University of Utah Research Institute, "Land Use Inventory of Uinta Basin, Utah From Color Infrared Aerial Photography", 1980.
20. Center for Remote Sensing and Cartography, University of Utah research Institute for Utah Division of Water Resources, Department of Natural Resources, Land Use Inventory of Uintah Basin, Utah, 1984.
21. Allen, Richard G. etal., FAO Irrigation and Drainage Paper No. 56, Crop Evapotranspiration, http://www.fao.org/docrep/X0490E/X0490E00.htm.
22. U.S. Department of the Interior, Bureau of Reclamation, "Quality of Water Colorado River Basin, Progress Report No. 17, January 1995".
23. U.S. Department of the Interior, US Geological Survey, Spatially Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin, Scientific Investigations Report 2009-5007, http://pubs.usgs.gov/sir/2009/5007/.