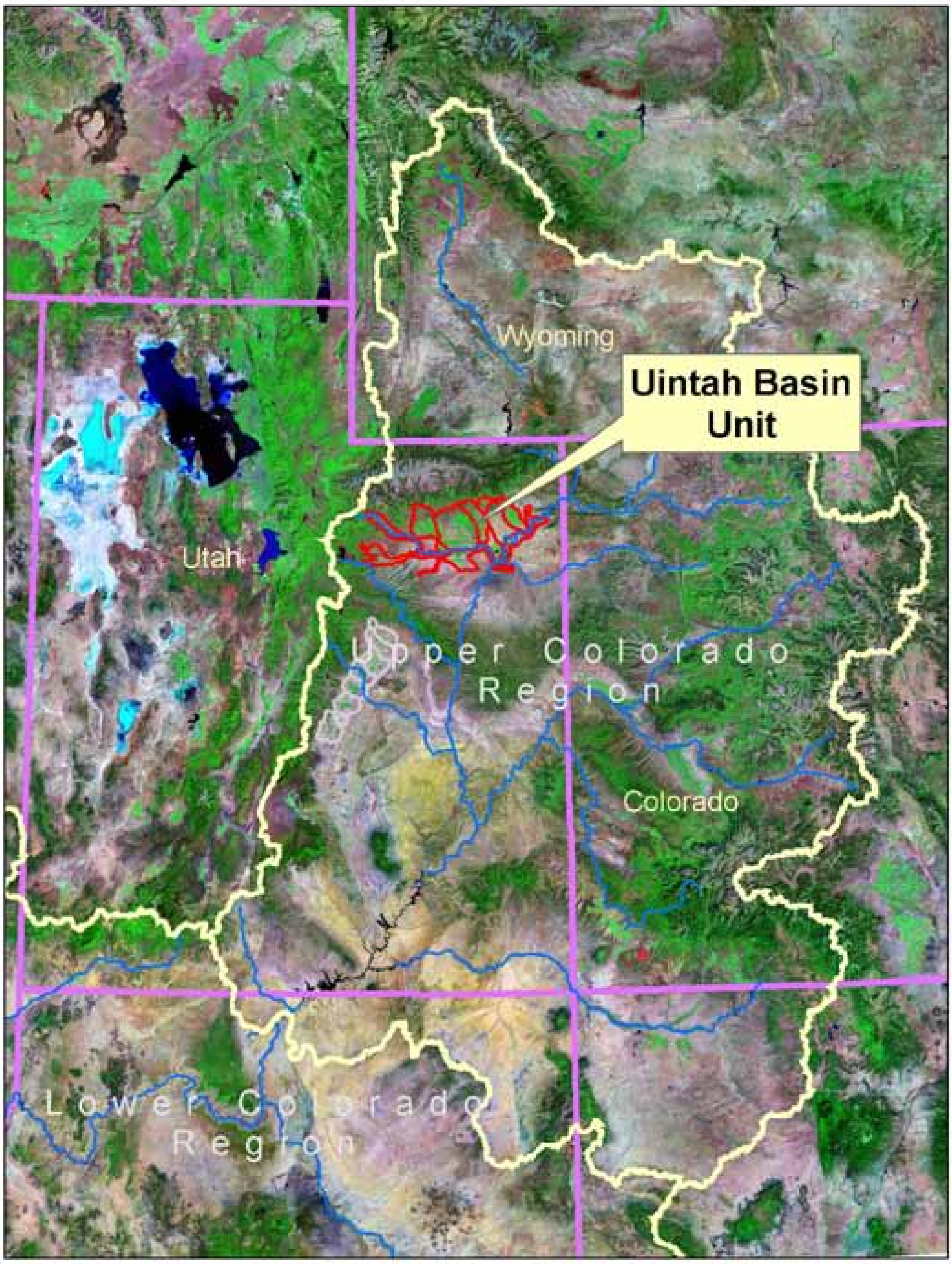
Colorado River Basin Salinity Control Program

Uintah Basin Unit

Monitoring and Evaluation Report, FY2010



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. Treatments on approximately 153,700 acres have been planned and 152,500 acres applied. In FY2010, 2,052 acres were planned and 4,058 acres applied.
- **ON-FARM SALT LOAD REDUCTION:** Of approximately 208,000 original on-farm tons/year of salt load, 124,000 tons/year salt load reductionhas been planned and 123,800 tons/year has been applied, calculated using procedures revised in 2007. In FY2010, 1,862 tons were planned and 4,029 tons applied, on-farm.
- **OFF-FARM SALT LOAD REDUCTION:** Of approximately 120,000 original off-farm tons/year, USDA programs have planned 27,400 tons/year and applied about 26,300 tons/year of salt load reductions. In FY2010, 690 tons were planned and 1,038 tons applied, off-farm.
- **PLANNED OBLIGATIONS:** For FY2010, NRCS obligated $4.46 million, FA. Cumulative obligations total $153.7 million FA (2010$).
- **APPLIED EXPENDITURES:** For FY2010, NRCS expended $4.06 million, FA. Cumulative expenditures total $137.2 million FA (2010$).
- **COST/TON:** Planned salt load reduction for FY2010 contracts is $194/ton, FA+TA. The cumulative cost is $146/ton, FA+TA (2010$) for planned practices. For practices applied in FY2010 the cost is $89/ton FA+TA, with a cost of $133/ton FA+TA (2010$), for cumulative applied practices.
- **NEPA PROJECTED COST/TON:** In 2010 dollars, pre-project NEPA documents anticipated salt load reduction costs of $175/ton to $186/ton. Cumulative planned cost is $146/ton, and cumulative applied cost is $133/ton.
- Deep percolation due to system leaks, inadequate 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.
- Passage of the 2008 Farm Bill has extended EQIP through 2012.

Wildlife Habitat and Wetlands

- Conversion of wetlands to uplands is far less than anticipated by the EIS.
- A total of 1,299 acres wildlife habitat creation/enhancement were planned and funded and 541 acres wildlife habitat creation/enhancement were applied in FY2010.
- Lower Lake Fork River Project (LLFRP) 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.
- Public benefits are perceived to exceed public liabilities for salinity control measures.

Table 1, Project progress summary

Uintah Basin Unit, All Programs				
CONTRACTS PLANNED	UNITS	CURRENT FY	CUMULATIVE	TARGET
1. CONTRACT STATUS				
A. Contracts Approved	Number	65	2,849	
	Dollars	4,463,030	90,159,622	
	Acres	2,052	153,743	160,000
On-farm	Tons/Year	1,862	123,524	140,500
Off-farm	Tons/Year	690	27,368	
B. Active Contracts	Number		276	
	Dollars		16,328,676	
	Acres		10,942	
On-farm	Tons/Year		9,445	
Off-farm	Tons/Year		2,369	
PRACTICES APPLIED	UNITS	CURRENT FY	CUMULATIVE	TARGET
2. EXPENDITURES				
Financial Assisstance (FA)	Dollars	4,060,951	82,180,777	
3. IRRIGATION SYSTEMS				
A. Sprinkler	Acres	3,884	138,748	160,000
B. Improved Surface System	Acres	171	13,657	
C. Drip System	Acres	3	86	
4. SALT LOAD REDUCTION				
A. Salt load reduction, on-farm	Tons/Year	4,029	123,766	140,500
B. Salt load reduction, off-farm	Tons/Year	1,038	26,293	
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

For further information, please contact:

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

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

Table of Contents

Executive Summary **2**
Project Status 2
Wildlife Habitat and Wetlands 2
Economics 2
Table of Contents **4**
Tables **5**
Figures **5**
Monitoring and Evaluation History and Background **8**
Project Status **9**
Annual Project Results 9
Cumulative Project Results 9
Detailed Analysis of Status **9**
Pre-Project Salt Loading 9
Colorado River Basin Salinity Control Project (CRBSCP) 11
Salinity Control Practices 11
Planning Documents 11
Distribution of Salt Concentration 13
SPARROW (Spatially Referenced Regressions on Watershed Attributes) 13
Planned Practices (Obligations) 15
FY2010 Obligation 15
Salt Load Reduction Calculation 15
Cost/Ton Calculation 15
Obligation Analysis 16
Cost Share Enhancement 17
System Upgrades 17
Replacement of Prior Treated Practices 18
Applied Practices 19
FY2010 Expenditures 19
Evaluation by Program **20**
Hydro Salinity Monitoring **21**
Salinity Monitoring Methods 22
Cooperator questionnaires 22
USU Study, FY2006 22
UACD Study, FY2007 22
Irrigation Water Management (IWM) 23
Irrigation Record Keeping 23
Soil Moisture Monitoring 26
Equipment Spot Checks and Evaluations 28
Long-term Sprinkler Water Budgets 28
Wildlife Habitat and Wetlands **29**
Background 29
1980 Utah Division of Water Resources Water Related Land Use (WRLU) 30
Basin Wide Wildlife Habitat Monitoring 31
Wildlife Habitat Contract Monitoring 32
Voluntary Habitat Replacement 32
Case Study: Lower Lake Fork River Project 32
Background 32

Results 35
Discussion 36
LLFRP Photo Gallery 39
Economics 55
Cooperator Economics 55
Production Information 55
Labor Information 56
Public Economics 56
Positive public perceptions of the Salinity Control Program include: 56
Negative public perceptions of the Salinity Control Program include: 56
Summary 57
Glossary and Acronyms 58
References 61

Tables

Table 1, Project progress summary 3
Table 2, FY2010 results 9
Table 3, Project goals and cumulative status, on-farm only 9
Table 4, Comparison of Project Cost Estimates 12
Table 5, Cost/Ton of annual obligations since 1980, in nominal and 2010 dollars 16
Table 6, Annual applied cost/ton, nominal and 2010 dollars. 19
Table 7, Summary of Applied Practices by Year 20
Table 8, Contracts Planned and Applied by Program 21
Table 9, FY2010 Wildlife habitat acres planned and applied 32
Table 10, Cumulative Wildlife habitat acres planned and applied by program 32

Figures

Figure 1, Uintah Basin Salt Load Allocation. The last bar indicates the consensus estimate. 10
Figure 2, Comparison of Federal Salinity Control Planning Documents 11
Figure 3, SPARROW91 Salt Load Comparisons 14
Figure 4, Salt loading distribution estimated by EIS. 14
Figure 5, Salt loading distribution estimated by SPARROW, adjusted to long-term averages. 15
Figure 6, Nominal planned cost/ton and cost/ton in 2010 dollars 17
Figure 7, FY2010 planned acres by contract type 17
Figure 8, FY2010 cost/ton by contract type 18
Figure 9, Comparison of Obligated and Expended funds by Program, 2010 dollars. 18
Figure 10, Cumulative applied salt load reduction. 18
Figure 11, Acres planned by program 21
Figure 12, Treated acres 21
Figure 13, Sample IWM Self Certification Spreadsheet – Data entry page 24

Figure 14, Sample graphs from the IWM Self Certification Spreadsheet. 25
Figure 15, Acres with deep percolation from IWM Certification Spreadsheets 26
Figure 16, Soil Moisture data recorder with graphing 26
Figure 17, AWC from Soil Moisture Data graphed in Microsoft Excel. 27
Figure 18, Wildlife habitat management cumulative status 31
Figure 19, Location Map for LLFRP. 33
Figure 20, Wildlife Habitat Development Plan Conservation Plan Map for LLFRP. 34
Figure 21, Irrigation Conservation Plan Map for LLFRP. 38
Figure 22, August 1, 2007; looking N, at overgrazed wetland area before practices were implemented. 39
Figure 23, August 1, 2007; overgrazed wetland area before enhancement with impoundment. 39
Figure 24, August 1, 2007; overgrazed wetland area before enhancement with impoundment. 40
Figure 25, August 1, 2007; looking SE before weed treatment were implemented. 40
Figure 26, August 1, 2007; Russian olive encroachment in wetland areas. 41
Figure 27, August 1, 2007; overgrazed wetland area before enhancement with impoundment and weed treatment. 41
Figure 28, August 1, 2007; overgrazed wetland area before enhancement with impoundment and weed treatment. 42
Figure 29, August 8, 2007; one week after first Russian olive treatment. 42
Figure 30, August 8, 2007; one week after first Russian olive treatment. 43
Figure 31, August 8, 2007; one week after first Russian olive treatment. 43
Figure 32, August 8, 2007; one week after first Russian olive treatment. 44
Figure 33, December 8, 2008; shallow-water wetland earthwork completed. 44
Figure 34, December 8, 2008; shallow-water wetland earthwork completed. 45
Figure 35, December 8, 2008; shallow-water wetland earthwork completed. 45
Figure 36, April 21, 2009; beaver proof structure for water control (intake) installed in preparation to fill wetland. 46
Figure 37, April 21, 2009; beaver proof structure for water control installed (Agri-drain). 46
Figure 38, April 21, 2009; mule deer crossing buck and pole fencing. 47
Figure 39, April 21, 2009; wetland starting to fill with groundwater. 47
Figure 40, April 30, 2009; smaller shallow-water wetland with newly planted trees and shrubs. 48
Figure 41, April 30, 2009; smaller shallow-water wetland with newly planted trees and shrubs and spillway. 48
Figure 42, April 30, 2009; wetland spillway and water control valve spillway. 49

Figure 43, April 30, 2009; wetland filled and spilling through spillway and water control structure. 49
Figure 44, April 30, 2009; spillway on large shallow-water wetland. 50
Figure 45, April 30, 2009; spillway from water control structure....50
Figure 46, November 24, 2009; tree and shrub protectors contributed by National Wild Turkey Federation in place as well as migratory bird nest on tall pole installed. 51
Figure 47, November 24, 2009; large wetland with tree protectors on plantings. 51
Figure 48, November 24, 20009; beaver can't figure out why water keeps spilling through water control structure and decides to bury valve cover with sticks and mud. 52
Figure 49, Close up of "still functioning" valve in spite of beaver's best efforts. 52
Figure 50, April 30, 2009; great horned owl with owlets nesting near constructed wetlands. 53
Figure 51, October 30, 2009; wild turkeys utilize property where improvements have been implemented. 53
Figure 52, October 30, 2009; wild turkeys utilize property where improvements have been implemented and become abundant and inquisitive. 54
Figure 53, October 30, 2009; wild turkeys improvise a handy roost structure (landowner's home). 54
Figure 54, Alfalfa Production and Annual average mountain precipitation....55

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

FY2010 project results are summarized in table 2.

Table 2, FY2010 results

FY2010	Planned	Applied
Irrigation Improvements, Acres	2,052	4,058
Federal Cost Share, FA, 2010 Dollars	4,463,000	4,061,000
Amortized Federal Cost Share, FA+TA, 2010 Dollars	495,200	450,600
Salt Load Reduction, Tons/Year	2,552	5,067
Federal Cost/Ton, FA+TA, 2010 Dollars	194	89

Cumulative Project Results

Cumulative results through FY2010 are tabulated in Table 3, along with EIS projections and an estimated projection of project completion. Off-farm activities are excluded from this table. Dollar amounts are expressed in 2010 dollars.

With respect to 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 a lower average cost/ton than expected at project inception.

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

Cumulative Improvements	Units	EIS[1]	Projected[2]	Planned	Applied
Irrigation Improvements	Acres	137,000	160,000	153,700	152,500
Federal Cost Share, FA+TA[3]	2010$	195,488,000	257,102,000	253,900,000	228,700,000
Amortized Fed Cost, FA+TA	2010$	19,686,000	24,563,000	22,100,000	20,000,000
Total Salt Load Reduction	Tons /year	106,800	140,500	150,900	150,100
Federal Cost/Ton, FA+TA	2010$ /ton	184	175	146	133

[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'.

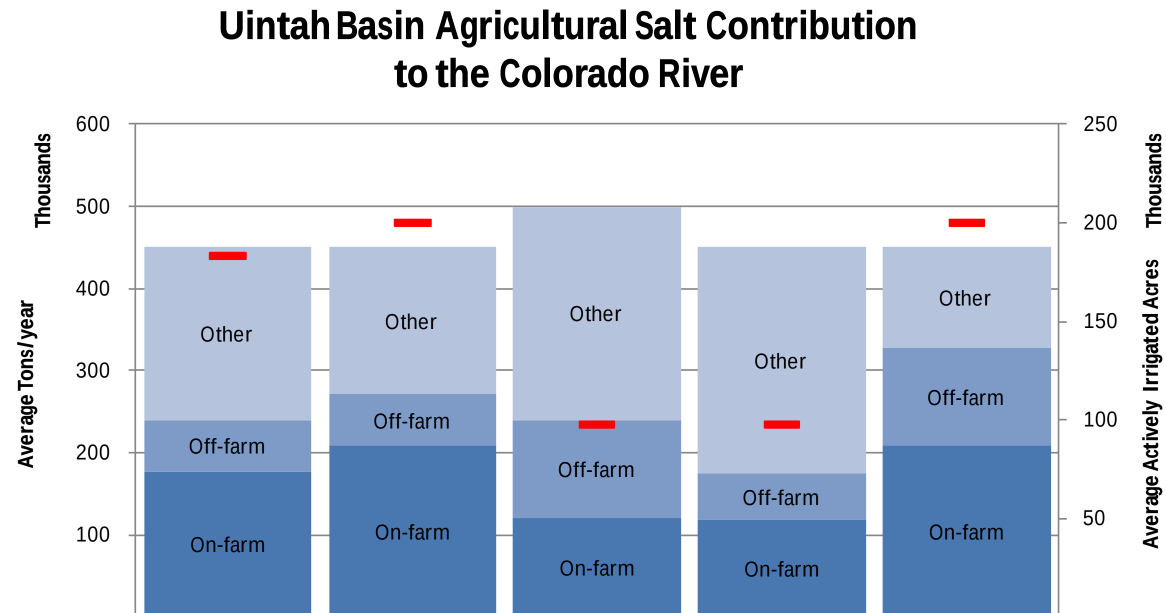
Detailed Analysis of Status

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 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. The result of this effort is depicted in figure 1.

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



	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

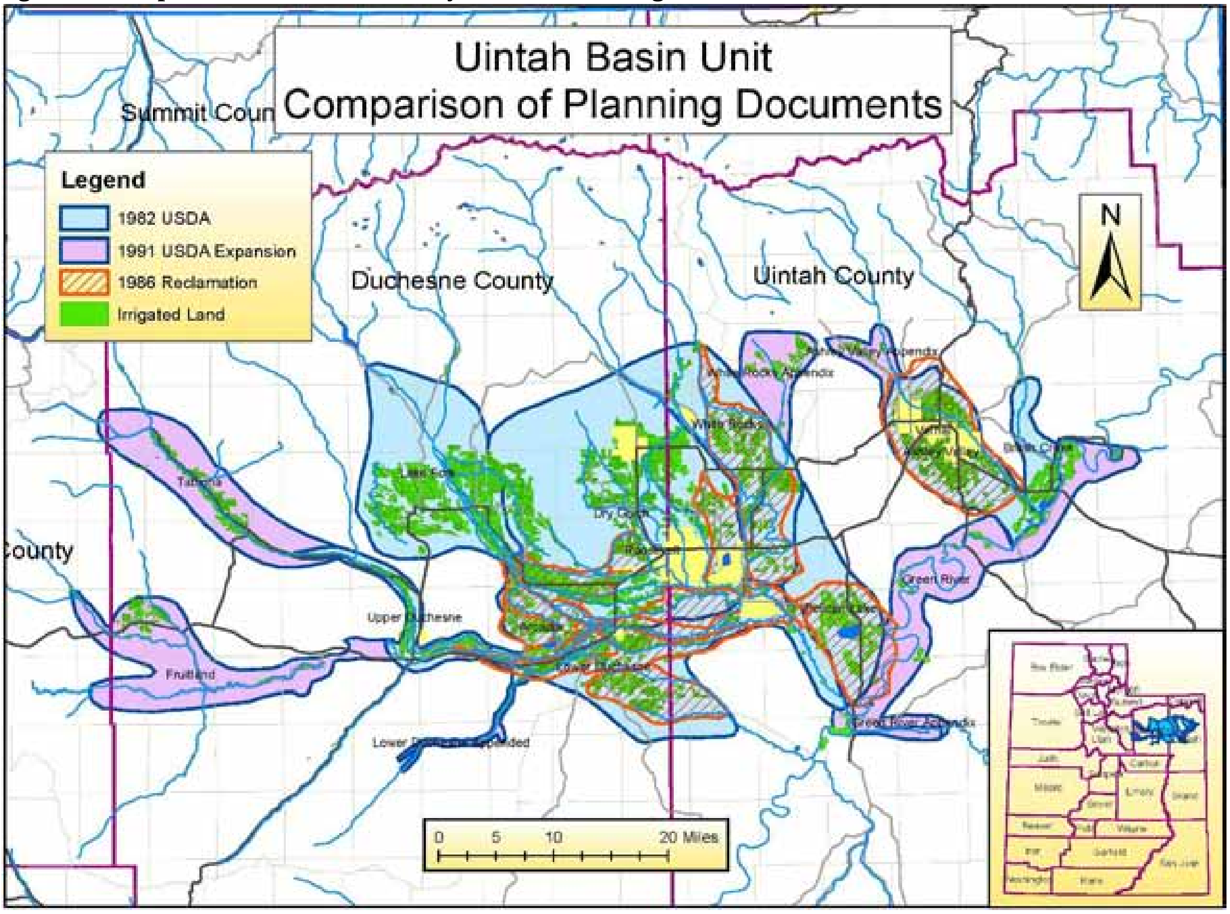
Between 1975 and 1991, at least six studies were completed by federal agencies to quantify the salt contribution of Uintah Basin irrigation to the Colorado River System. Three studies by US Department of Agriculture (USDA) Soil Conservation Service, predecessor to Natural Resource Conservation Service (NRCS) emphasized the contribution of on-farm irrigation systems and attempted to address all irrigated lands in the Uintah Basin. Two studies by US Department of Interior Bureau of Reclamation (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. Please refer to the map in figure 2.

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 less 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.

Figure 2, Comparison of Federal Salinity Control Planning Documents



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

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 planning documents indicates that the cost of treatment is generally less than anticipated pre-project. Table 4 summarizes USDA planning estimates of salt load reduction costs.

Table 4, Comparison of Project Cost Estimates

FA+TA	EIS, 1982	Holt Letter, 1987	EIS, 1991	2002 Adjustment
Added Irrigation Improvements, Acres		5,900	8,900	23,000
Irrigation Improvements, Acres	122,200	128,100	137,000	160,000
Incremental federal cost share, nominal	64,474,200		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%	8.875%	8.750%	6.125%
Amortized incremental treatment cost, nominal	5,848,000	7,659,000	713,000	3,166,000
Total amortized treatment cost, nominal	5,848,000	7,659,000	8,372,000	11,538,000
Total treatment cost, 2010 $	147,608,000	181,097,000	195,488,000	257,102,000
Total amortized treatment cost, 2010 $	13,388,000	18,250,000	19,686,000	24,563,000
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 2010 $	175	186	184	175

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 ($148 million in 2010 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.

Amortizing $148 million at 7.625% (the federal water project discount rate for FY1982) over 25 years and normalizing to 2010 using the PPI, results in an expected average cost of $175/ton (FA+TA) in 2010 dollars.

By 1987, it was apparent that USDA was installing more off-farm practices than anticipated and that 5,900 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, 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.

While the practice life of buried pipelines may be on the order of 25-50 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 $186/ton FA+TA, in 2010 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 ($14.4 million in 2010 dollars) to reduce salt load by 8,600 tons/year. Using the same reasoning as above, the amortized cost is $167/ton (FA+TA) for the incremental acres and $184/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 $175/ton, 2010 dollars, for the entire project, slightly less than 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. 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 and groundwater flowing from seeps below irrigated lands over 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 made 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 fields. 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. Attempts are underway to adapt SPARROW91 data to estimate average loads over longer periods of record by applying correction factors. The latest corrections are based on comparisons of long term average salt loading at USGS gauge stations and have been given the moniker "Anning 2.0".

Figure 3 depicts two comparisons based on SPARROW 91 Data for the Uintah Basin Unit.

The first two bars, in pink, compare total agricultural salt loading referenced in various NEPA documents (328,000 tons/year) with Anning 2.0 adjusted SPARROW91 levels (320,000 tons/year). The Anning adjusted SPARROW91 numbers are for the overall average salt load and have been influenced by thirty years of ongoing irrigation practice improvements.

The second two bars, in blue, compare the average post treatment annual agricultural salt loading minus projected salt load reductions from installed irrigation practice improvements through 1991 (278,000 tons/year) with the SPARROW91 estimate of 1991 agricultural salt loading (227,000 tons/year). 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 show salt load distribution from the EIS and from SPARROW91 values adjusted with Anning 2.0 factors to reflect long term averages.

Figure 3, SPARROW91 Salt Load Comparisons

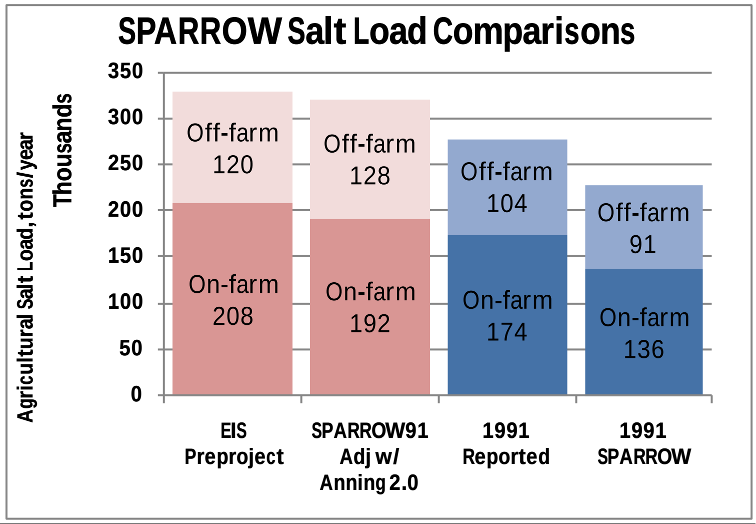


Figure 4, Salt loading distribution estimated by EIS.

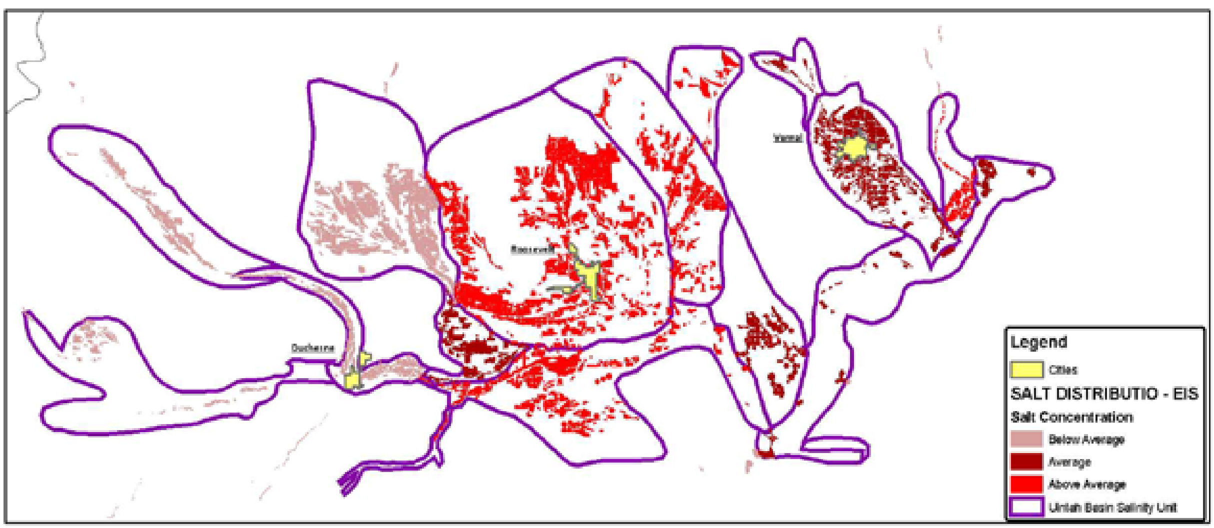
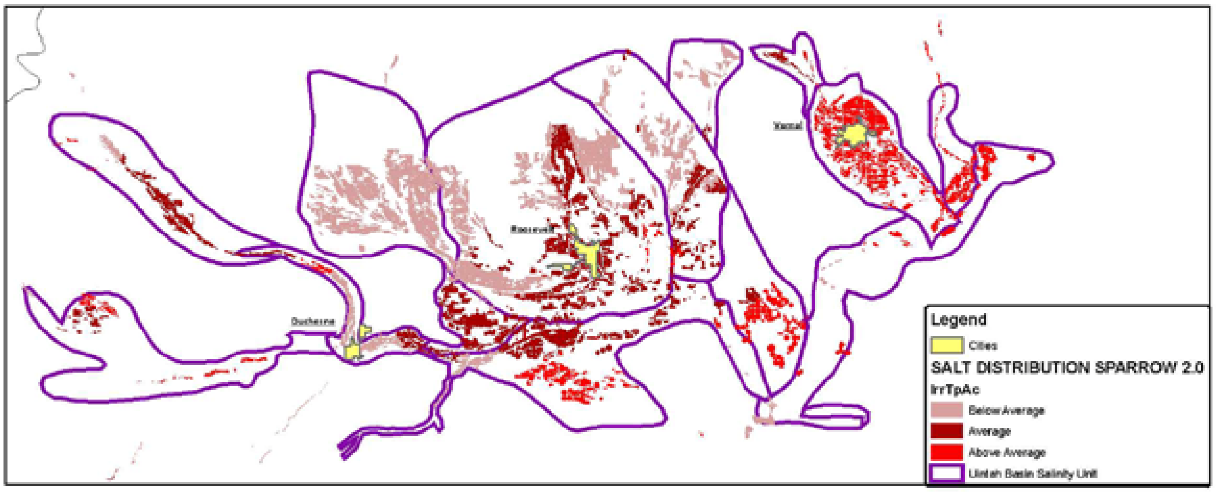


Figure 5, Salt loading distribution estimated by SPARROW, adjusted to long-term averages.



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.

FY2010 Obligation

In FY2010, $4.46 million was obligated in 65 contracts to treat 2,052 acres with improved irrigation. Of that amount, $396,000 was for wildlife habitat improvements.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2010 planned practices is 2,552 tons/year. The on-farm portion, 1,862 tons/year, 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% = 46 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, additional off-farm salt loading is also reduced, 690 tons/year in 2010.

Cost/Ton Calculation

The federal cost/ton for salt load reduction is calculated by amortizing the federal financial assistance (FA) over 25 years at the federal discount rate for water projects (4.375% for FY2010). Two-thirds of the FA is added for technical assistance (TA) (the average federal cost of planning, design, construction I nspection, monitoring and evaluation, etc.) and the amortized total cost is divided by tons/year to yield cost/ton. Normalization of past obligations/expenditures to 2010 dollars is done by using the Producer Price Index (PPI) for agricultural equipment purchased (1977 series).

For FY2010 the amortized cost of obligated planned projects is $194/ton (FA+TA).

Obligation Analysis

In 2010 dollars, cumulative obligation thru FY2010 is $152 million, planned on 153,700 acres, with a salt load reduction of 150,900 tons/year (on-farm and off-farm), resulting in an overall average cost of $146/ton. Note that in 2010 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.

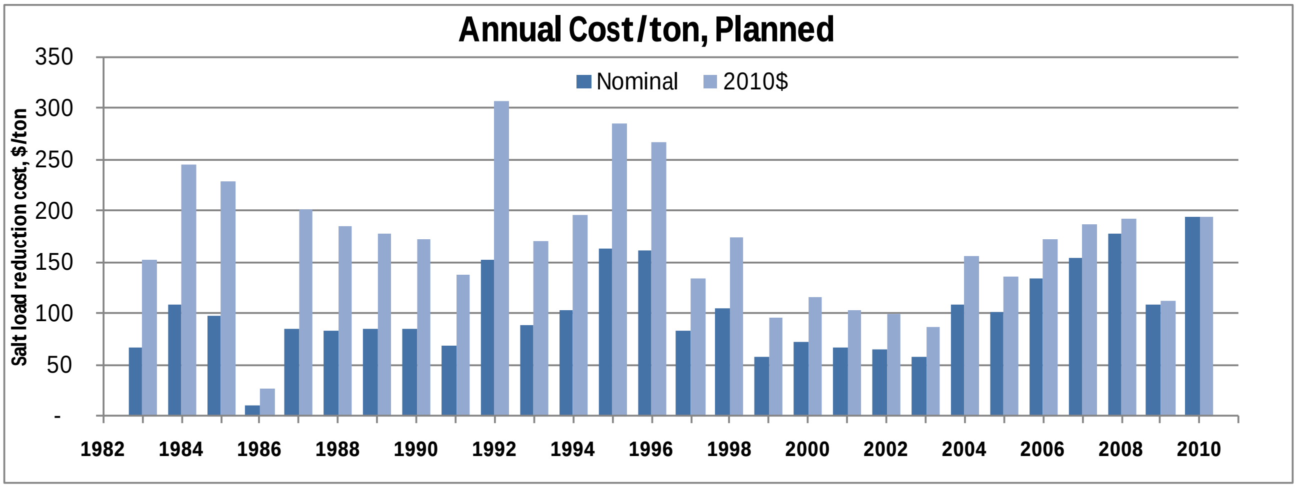
Table 5 depicts the historical cost/ton of planned practices, in nominal and 2010 dollars.

Figure 6 compares cost/ton by year, in nominal and 2010 dollars.

Table 5, Cost/Ton of annual obligations since 1980, in nominal and 2010 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	2010 PPI Factor	FA Planned 2010 Dollars	Amortized FA+TA 2010 Dollars	$/Ton 2010 Dollars	Cum $/Ton, 2010 Dollars
1980	7.125%	84	1,848,864	5,000	3,735	267,404		254%	4,692,899	678,742		
1981	7.375%	95	1,899,073	6,000	4,482	280,839		237%	4,494,644	664,676		
1982	7.625%	76	1,782,461	5,000	3,735	269,438		229%	4,080,787	616,855		
1983	7.875%	108	2,641,958	8,282	6,187	408,097	66	230%	6,088,323	940,449	152	160
1984	8.125%	36	1,107,903	2,152	1,608	174,829	109	226%	2,503,718	395,091	246	167
1985	8.375%	70	1,536,585	3,368	2,516	247,640	98	232%	3,564,470	574,459	228	174
1986	8.625%	39	1,176,359	2,885	18,055	193,569	11	243%	2,861,493	470,857	26	108
1987	8.875%	63	797,629	2,121	1,584	133,971	85	238%	1,900,636	319,234	201	111
1988	8.625%	127	6,153,570	16,362	12,223	1,012,567	83	223%	13,729,124	2,259,120	185	128
1989	8.875%	87	2,111,397	5,614	4,194	354,634	85	210%	4,428,624	743,839	177	131
1990	8.875%	75	2,963,581	7,880	5,887	497,768	85	205%	6,070,662	1,019,638	173	135
1991	8.750%	132	3,358,040	10,968	8,194	558,282	68	201%	6,760,082	1,123,880	137	135
1992	8.500%	284	3,382,799	4,826	3,605	550,898	153	201%	6,809,924	1,109,015	308	144
1993	8.250%	156	2,780,712	6,750	5,042	443,465	88	194%	5,381,369	858,215	170	145
1994	8.000%	113	3,317,415	6,741	5,036	517,952	103	191%	6,336,009	989,249	196	148
1995	7.750%	27	720,561	899	672	110,109	164	174%	1,251,354	191,220	285	149
1996	7.625%	161	5,840,101	6,816	5,483	882,794	161	166%	9,699,718	1,466,217	267	156
1997	7.375%	24	610,282	1,197	1,095	90,250	82	162%	987,837	146,083	133	156
1998	7.125%	17	641,994	759	889	92,853	104	166%	1,066,276	154,217	173	156
1999	6.875%	23	815,129	2,155	1,997	115,268	58	166%	1,353,833	191,447	96	155
2000	6.625%	44	1,620,953	3,316	3,093	224,048	72	159%	2,580,036	356,612	115	154
2001	6.375%	62	1,662,483	3,601	3,383	224,534	66	155%	2,581,599	348,669	103	152
2002	6.125%	121	3,597,696	7,784	7,304	474,646	65	154%	5,541,654	731,113	100	149
2003	5.875%	145	4,700,491	5,782	10,386	605,580	58	149%	7,014,066	903,646	87	143
2004	5.625%	140	5,075,673	6,019	5,853	638,361	109	144%	7,289,179	916,751	157	144
2005	5.375%	159	7,045,494	7,260	8,472	864,746	102	134%	9,410,485	1,155,019	136	143
2006	5.125%	115	5,460,823	4,366	4,884	653,879	134	129%	7,047,466	843,863	173	144
2007	4.875%	62	3,890,488	2,152	2,947	454,319	154	121%	4,703,065	549,210	186	145
2008	4.875%	77	4,364,084	3,233	2,866	509,624	178	108%	4,709,339	549,942	192	146
2009	4.625%	62	2,791,994	2,402	2,932	317,866	108	104%	2,914,036	331,760	113	146
2010	4.375%	65	4,463,030	2,052	2,552	495,203	194	100%	4,463,030	495,203	194	146
Totals		2,849	90,159,622	153,743	150,892	12,665,433	84		152,315,737	22,094,292	146	

Figure 6, Nominal planned cost/ton and cost/ton in 2010 dollars

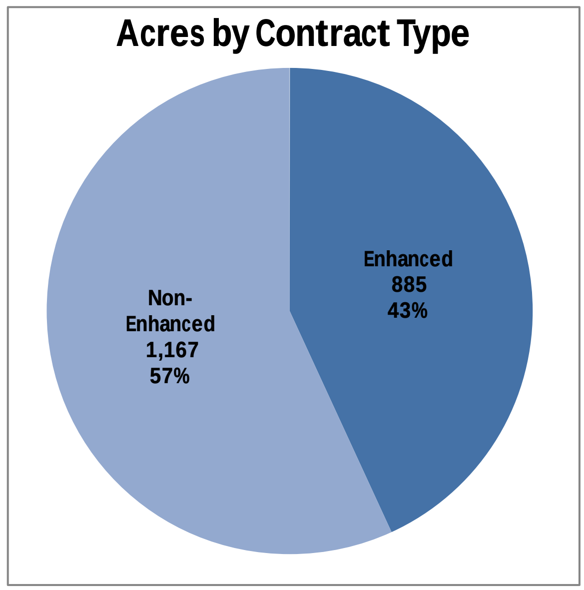


Cost Share Enhancement

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.

For FY2010 contracts, the average salt load reduction cost for cost-share enhanced contracts is $126/ton, compared to $194/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. Figure 7 depicts the ratio of enhanced contract acres to non-enhanced contract acres.

Figure 7, FY2010 planned acres by contract type



In the Uintah Basin Unit, a cumulative total of 172 contracts on 5,448 acres for $7.93 million FA (2010 dollars) are cost-share enhanced. Estimated salt load reduction is 5,792 tons on-farm and off farm. In 2010 dollars, the cumulative average cost for enhanced contracts is $160/ton compared to $146/ton for all contracts.

The incremental cost of enhancement is $1.32 million, less than 1% of total FA, but it has all been accumulated in the last seven years. A preponderance of enhanced contracts are with beginning farmers, at an approximate ratio of eight to one compared to limited resource farmers or historically underserved minorities.

System Upgrades

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

In FY2008 – FY2010, 23 improved flood practices that had exceeded their useful life, were obligated for upgrade to wheel line or center pivot systems. It was assumed that the application efficiency of these systems had declined from 55% to 45% 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).

In FY2010, 3 contracts for $91,705 FA were planned to upgrade irrigation practices on 63 acres. Salt load reduction is 27 tons/year on-farm and off-farm. The amortized cost is $383/ton FA+TA, compared to a cost of $194/ton for all FY2010 contracts.

Cumulatively, 23 contracts have obligated $1.10 million (2010 dollars) FA, to reduce salt loading by 443 tons/year at an amortized cost of $290/ton FA+TA. Cumulative cost for all salinity obligations is $146/ton.

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. 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%.)

For FY2010, 10 contracts obligated $644,000 FA, for a salt load reduction of 821 tons/year, resulting in an average planned cost of $87/ton.

For FY2009 – FY2010, 21 contracts have obligated $1.08 million FA (2010 dollars) to reduce salt loading by 1,344 tons/year, resulting in a cumulative cost of $92/ton.

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

Figure 8, FY2010 cost/ton by contract type

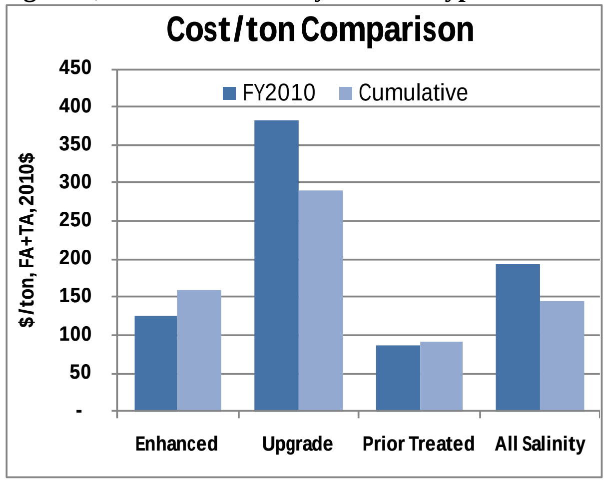
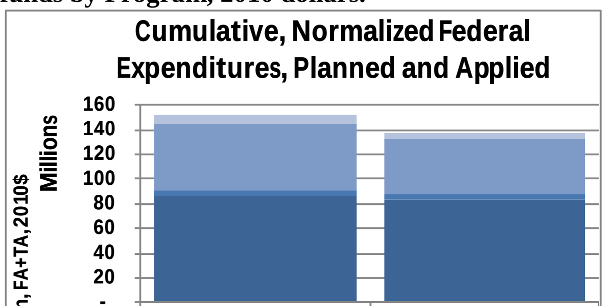
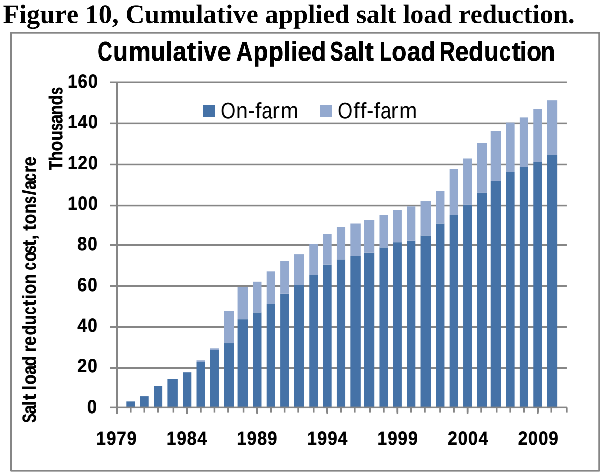


Figure 9, Comparison of Obligated and Expended funds by Program, 2010 dollars.



	Planned	Applied
BSPP	7,200,000	4,500,000
EQIP	54,400,000	45,200,000
IEQIP	3,700,000	3,600,000
CRSCP	87,000,000	83,800,000

Figure 10, Cumulative applied salt load reduction.



Applied Practices

FY2010 Expenditures

In FY2010, $4.06 million FA was expended applying 4,058 acres of irrigation improvements. The estimated salt load reduction is 5,067 tons/year, on-farm and off-farm, at an amortized cost of $89/ton (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, all salinity reducing practices in contracts are assumed to be applied in proportion to dollars paid out.

Cumulative expenditure FY1980-FY2010 is $137.2 million FA (2010 dollars), applied to 138,700 sprinkler acres, 13,700 improved flood acres, and 86 acres of drip irrigation, reducing salt loading by 123,800 tons/year on-farm and 26,300 tons/year off-farm at an average cost of $133/ton (2010 dollars).

Application of salinity control lags planning by the time needed for practice installation. Between planning and application, a few contracts are de-obligated for various reasons such as design modification, change in ownership or cancellation.

Figure 9 relates cumulative obligated FA to cumulative applied FA, by program, in 2010 dollars.

Figure 10 depicts cumulative applied salt load reduction, on-farm and off-farm, by year.

Table 6 summarizes annual expenditures and cost/ton calculations for applied practices, nominal and 2010$.

Table 6, Annual applied cost/ton, nominal and 2010 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	2010 PPI Factor	FA Applied 2010 Dollars	Amortized FA+TA 2010 Dollars	$/Ton 2010 Dollars	Cum $/Ton, 2010 Dollars
1980	7.125%	-	4,349	3,234	-	-	254%	-	-	-	-
1981	7.375%	1,450,506	3,919	2,928	214,504	73	237%	3,432,995	507,678	173	82
1982	7.625%	1,450,506	5,801	4,333	219,260	51	229%	3,320,806	501,975	116	96
1983	7.875%	1,899,239	4,823	3,603	293,371	81	230%	4,376,746	676,065	188	120
1984	8.125%	1,746,366	5,040	3,765	275,580	73	226%	3,946,562	622,774	165	129
1985	8.375%	1,324,218	6,131	5,405	213,414	39	232%	3,071,835	495,065	92	120
1986	8.625%	3,491,444	8,285	6,395	574,515	90	243%	8,492,939	1,397,508	219	142
1987	8.875%	1,500,879	3,691	17,847	252,090	14	238%	3,576,380	600,695	34	101
1988	8.625%	3,011,008	16,675	12,457	495,460	40	223%	6,717,808	1,105,412	89	99
1989	8.875%	2,327,840	3,400	2,540	390,988	154	210%	4,882,610	820,091	323	108
1990	8.875%	1,978,927	6,313	4,716	332,384	70	205%	4,053,676	680,862	144	110
1991	8.750%	2,823,067	6,922	5,171	469,342	91	201%	5,683,126	944,833	183	115
1992	8.500%	3,382,799	4,834	3,611	550,898	153	201%	6,809,924	1,109,015	307	124
1993	8.250%	2,752,919	6,750	5,042	439,032	87	194%	5,327,582	849,637	168	127
1994	8.000%	2,749,248	6,741	5,036	429,244	85	191%	5,250,854	819,823	163	129
1995	7.750%	4,071,491	3,965	2,962	622,167	210	174%	7,070,708	1,080,480	365	137
1996	7.625%	882,617	1,902	1,421	133,417	94	166%	1,465,923	221,590	156	137
1997	7.375%	4,277,813	1,991	1,703	632,611	371	162%	6,924,308	1,023,980	601	146
1998	7.125%	1,391,042	2,137	2,030	201,189	99	166%	2,310,357	334,151	165	146
1999	6.875%	852,084	2,481	2,103	120,494	57	166%	1,415,211	200,126	95	145
2000	6.625%	955,064	1,435	1,239	132,009	107	159%	1,520,154	210,115	170	146
2001	6.375%	1,104,669	2,218	2,107	149,196	71	155%	1,715,393	231,680	110	145
2002	6.125%	1,499,522	6,576	6,155	197,833	32	154%	2,309,765	304,728	50	139
2003	5.875%	3,040,199	4,470	9,867	391,679	40	149%	4,536,581	584,463	59	132
2004	5.625%	4,100,511	5,581	5,505	515,716	94	144%	5,888,748	740,621	135	133
2005	5.375%	4,149,302	6,309	6,376	509,275	80	134%	5,542,116	680,225	107	131
2006	5.125%	6,918,799	6,952	7,151	828,457	116	129%	8,929,057	1,069,165	150	132
2007	4.875%	5,359,278	5,015	4,929	625,840	127	121%	6,478,630	756,555	153	133
2008	4.875%	3,709,063	1,434	2,379	433,133	182	108%	4,002,497	467,399	197	134
2009	4.625%	3,919,406	2,640	2,981	446,220	150	104%	4,090,729	465,725	156	135
2010	4.375%	4,060,951	4,034	5,067	450,590	89	100%	4,060,951	450,590	89	133
Totals		82,180,777	152,815	150,059	11,539,907	77		137,204,970	19,953,028	133	

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

Table 7, Summary of Applied Practices by Year

Applied Practices										
FY	Nominal FA Applied	2010$ 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	-	-	3,651	698	-	4,349	-	-	3,234	-
1981	1,450,506	3,432,995	3,371	548	-	3,919	-	93	2,928	-
1982	1,450,506	3,320,806	4,452	1,349	-	5,801	-	435	4,333	-
1983	1,899,239	4,376,746	2,905	1,918	-	4,823	-	180	3,603	-
1984	1,746,366	3,946,562	3,122	1,918	-	5,040	-	181	3,765	-
1985	1,324,218	3,071,835	4,155	1,976	-	6,131	-	180	4,580	825
1986	3,491,444	8,492,939	6,642	1,643	-	8,285	102	1,013	6,395	-
1987	1,500,879	3,576,380	3,162	529	-	3,691	17	1,638	2,772	15,075
1988	3,011,008	6,717,808	15,201	1,474	-	16,675	15	-	12,457	-
1989	2,327,840	4,882,610	3,027	372	1	3,400	181	1,814	2,540	-
1990	1,978,927	4,053,676	6,060	253	-	6,313	252	625	4,716	-
1991	2,823,067	5,683,126	6,709	212	1	6,922	394	181	5,171	-
1992	3,382,799	6,809,924	4,666	160	8	4,834	154	3,004	3,611	-
1993	2,752,919	5,327,582	6,597	145	8	6,750	415	1,380	5,042	-
1994	2,749,248	5,250,854	6,581	150	10	6,741	213	868	5,036	-
1995	4,071,491	7,070,708	3,934	17	14	3,965	95	755	2,962	-
1996	882,617	1,465,923	1,856	42	4	1,902	655	404	1,421	-
1997	4,277,813	6,924,308	1,990	-	1	1,991	89	34	1,703	-
1998	1,391,042	2,310,357	1,950	156	11	2,117	19	17	1,836	194
1999	852,084	1,415,211	2,349	-	3	2,352	-	3	2,078	25
2000	955,064	1,520,154	1,200	115	-	1,315	-	-	1,180	59
2001	1,104,669	1,715,393	2,112	113	-	2,225	14	20	2,019	88
2002	1,499,522	2,309,765	6,288	254	-	6,542	-	-	5,975	180
2003	3,040,199	4,536,581	4,331	80	3	4,414	2	20	4,040	5,827
2004	4,100,511	5,888,748	5,531	108	1	5,640	22	259	5,161	344
2005	4,149,302	5,542,116	6,243	32	-	6,275	10	2,005	5,743	633
2006	6,918,799	8,929,057	6,848	85	4	6,937	15	15	6,271	880
2007	5,359,278	6,478,630	5,006	-	3	5,009	375	339	4,584	345
2008	3,709,063	4,002,497	2,324	(894)	4	1,434	479	270	2,131	248
2009	3,919,406	4,090,729	2,600	33	7	2,640	593	113	2,449	532
2010	4,060,951	4,060,951	3,884	171	3	4,058	379	162	4,029	1,038
Totals	82,180,777	137,204,970	138,748	13,657	86	152,491	4,490	16,008	123,766	26,293

Evaluation by Program

Since 1980, more than 2,800 contracts have been written with landowners to upgrade irrigation practices on approximately 154,000 acres. As of the end of FY2010, practices are applied on about 152,000 acres. Less than 10% of applied systems are improved flood systems, 90% being higher efficiency sprinkler systems.

Table 8 summarizes contract data by funding program, in 2010 dollars.

Figure 11 depicts acres planned by program.

Figure 12 depicts treatment status. Of 14,400 acres initially treated with improved flood, about 1,000 acres have since been converted to sprinkler systems.

Table 8, Contracts Planned and Applied by Program

FY2010	Planned				Applied				
Program	Contracts	FA, 2010 $	Irrigated Acres	Salt Load Reduction, Tons	FA, 2010 $	Irrigated Acres	$/Acre	Salt Load Reduction, Tons	Salt Load Reduction, Tons/Acre
ACP & CRSCP	1,984	86,959,814	99,185	89,994	83,831,652	101,850	823	91,985	0.90
IEQIP	62	3,694,022	2,480	2,244	3,646,560	2,581	1,413	3,395	1.32
EQIP	1,019	54,413,756	47,543	53,732	45,234,746	44,075	1,026	50,222	1.14
BSPP	88	7,248,144	4,535	6,839	4,492,012	2,581	1,740	5,420	2.10
Totals	3,153	152,315,737	153,743	152,809	137,204,970	151,087	908	151,022	1.00

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. It is estimated that upgrading an uncontrolled flood irrigation system to a well designed and operated sprinkler system will reduce deep percolation and salt load by 84-91%.

NRCS salinity control programs focus on helping cooperators improve irrigation systems 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.

Figure 11, Acres planned by program

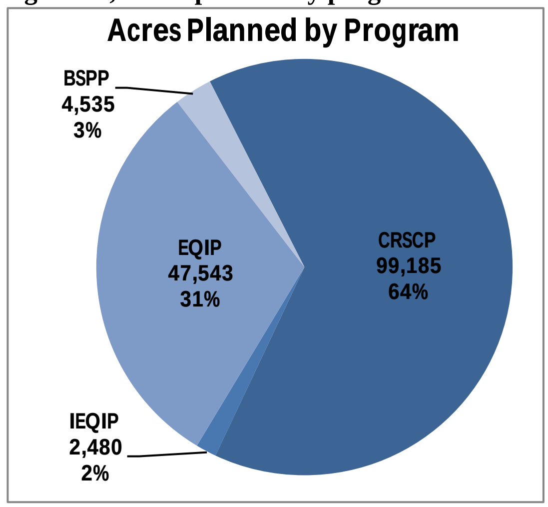
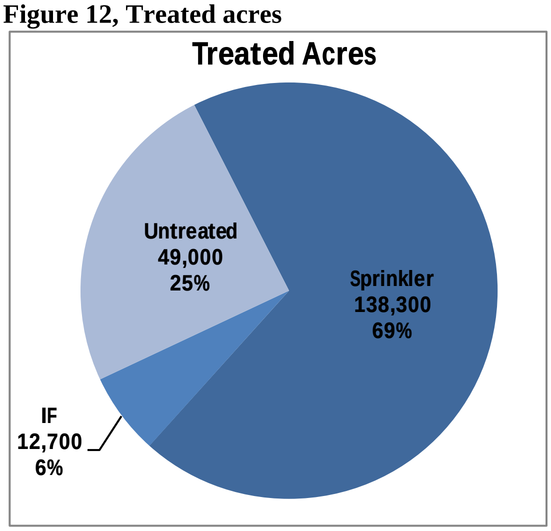


Figure 12, Treated acres



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.

USU Study, FY2006

In August, 2005, Utah State University 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.

UACD Study, FY2007

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.

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.

Over irrigating in early spring and late fall is somewhat mitigated by water storage aspects of the soil. 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 and fall. (See 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 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, and

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 creates two graphs, the first showing available water content (AWC) and deep percolation and the second comparing water applied with water required on a seasonal basis. See figures 13 and 14.

Figure 13, is the entry form part of the IWM Self Certification Spreadsheet, on which the irrigator can record irrigation dates and application rates. Data entered in the first four columns of the sheet is used to calculate the remaining columns and to create two graphs (see Figure 14).

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

Irrigation Water Use Record - Farmer Self Certification

Cooperator:		**Crop:**	Alfalfa
Year:	2011		
Tract/Field:	Tract 748, Fields 2-4	**Root Depth, ft:**	5.00
Date:	04/13/11	**Station:**	Pelican Lake/Ouray
CU:	40 inches	**Contract Eligible Acres:**	40.00
Soil Texture:	Silt Loam	**Irrigation method:**	Pod
AWC, In/Ft:	2.16	**Efficiency:**	65%
AWC Max, in:	10.80	**Evaluated Acres:**	0.96
MAD, in:	5.40	**Evaporation %:**	10%
Pre-season AWC, In.	5.40	**Cycle Hours:**	94
		Flow rate, gpm:	21

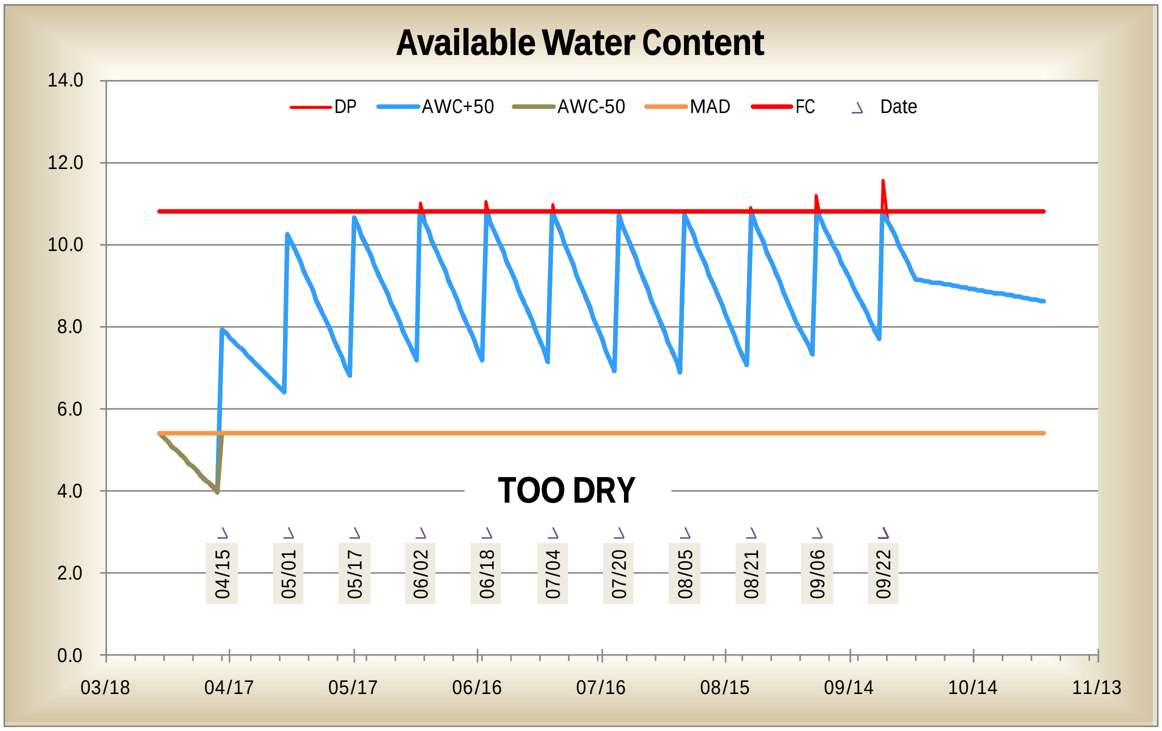
Start date of irrigation cycle	End date of irrigation	Total Cycle Hours	Alternate Cycle Hours	Flow, gpm	Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Irrigation Balance	AWC	Deep Perc
04/15/11	04/18/11	94		21.0	4.07	4.07	1.53	2.54	7.94	0.00
05/01/11	05/04/11	94		21.0	4.07	8.14	3.29	2.31	10.25	0.00
05/17/11	05/20/11	94		21.0	4.07	12.21	6.96	0.40	10.65	0.00
06/02/11	06/05/11	94		21.0	4.07	16.29	10.66	0.38	10.80	0.23
06/18/11	06/21/11	94		21.0	4.07	20.36	14.49	0.24	10.80	0.24
07/04/11	07/07/11	94		21.0	4.07	24.43	18.40	0.16	10.80	0.16
07/20/11	07/23/11	94		21.0	4.07	28.50	22.54	-0.07	10.73	0.00
08/05/11	08/08/11	94		21.0	4.07	32.57	26.61	0.00	10.73	0.00
08/21/11	08/24/11	94		21.0	4.07	36.64	30.53	0.15	10.80	0.09
09/06/11	09/09/11	94		21.0	4.07	40.72	34.21	0.39	10.80	0.39
09/22/11	09/25/11	94		21.0	4.07	44.79	37.50	0.79	10.80	0.79
Total inches of water applied during the season (total of all lines above):								44.79		1.89
Total Acre Feet Applied during the Season:								3.6		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								84%		

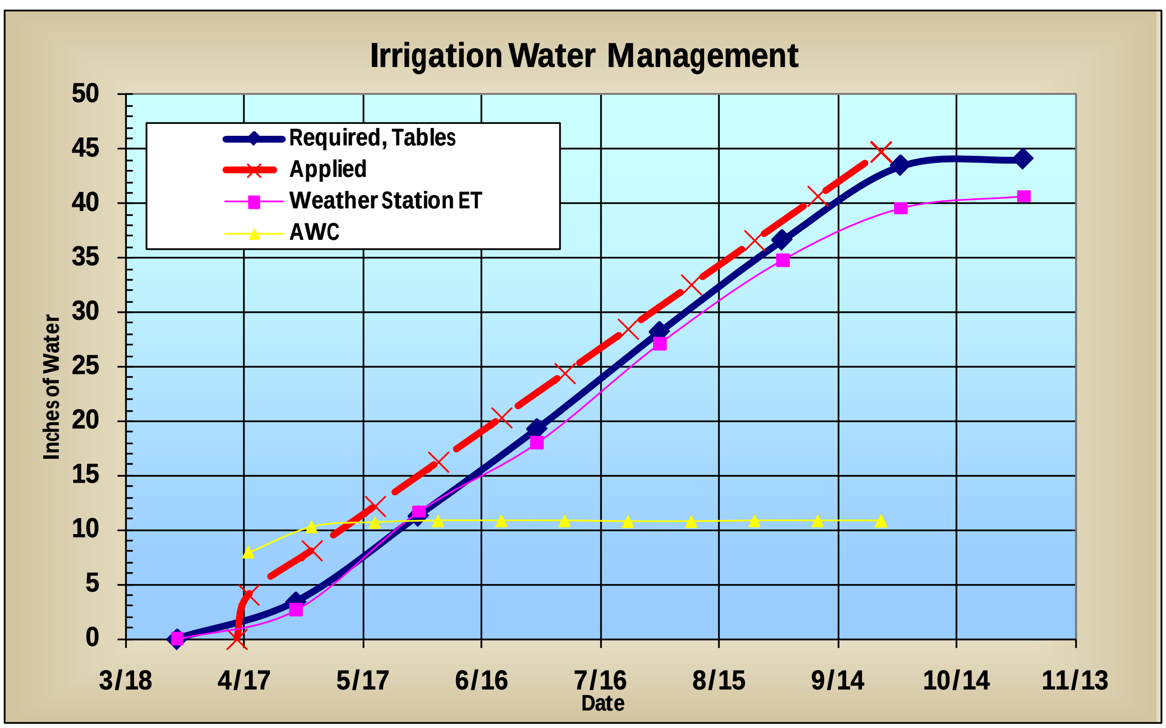
For maximum crop growth, AWC must be maintained in the upper 50% of its range. Some deep percolation is designed into each system as a leaching fraction to avoid buildup of salts in the soil. The first graph in figure 14 estimates water storage in the soil, indicating the preferred range of 50 – 100% of AWC in blue, and showing deep percolation in red, below capacity bars when it occurs.

On the second graph, if the red, actual-application line is below and to the right of the blue, consumptive use line, the crop is under irrigated. If the red, actual-application line is above the blue consumptive-use line, the field is over-irrigated and excessive deep percolation has occurred.

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

In the top graph, the blue line is the preferred AWC for the soil and crop. The red line is 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, using FAO's Penman-Montieth evapotranspiration model. The yellow line indicates AWC.



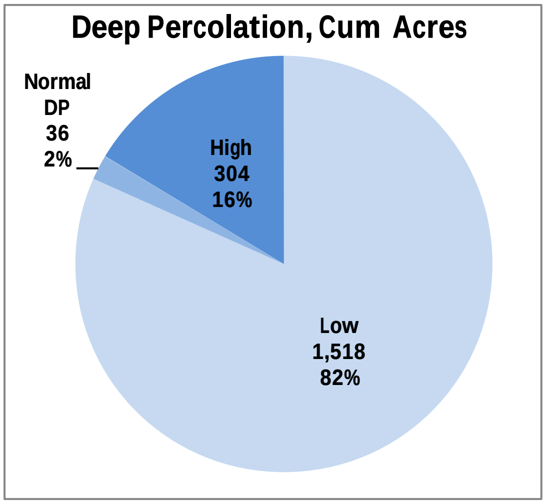


This spreadsheet is used by cooperators to self-certify their irrigation records when presented to and discussed with NRCS employees or contractors.

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.

In FY2010, 55 completed IWM self certification spreadsheets were delivered to the M&E team, representing 1,860 acres. On an acreage basis 82% had no deep percolation, 2% 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). See Figure 15.

Figure 15, Acres with deep percolation from IWM Certification Spreadsheets



Four years of IWM Self-certification data indicates that the average actual volume of deep percolation is about 57% 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 his 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. See

Figure 16, Soil Moisture data recorder with graphing

figure 16.

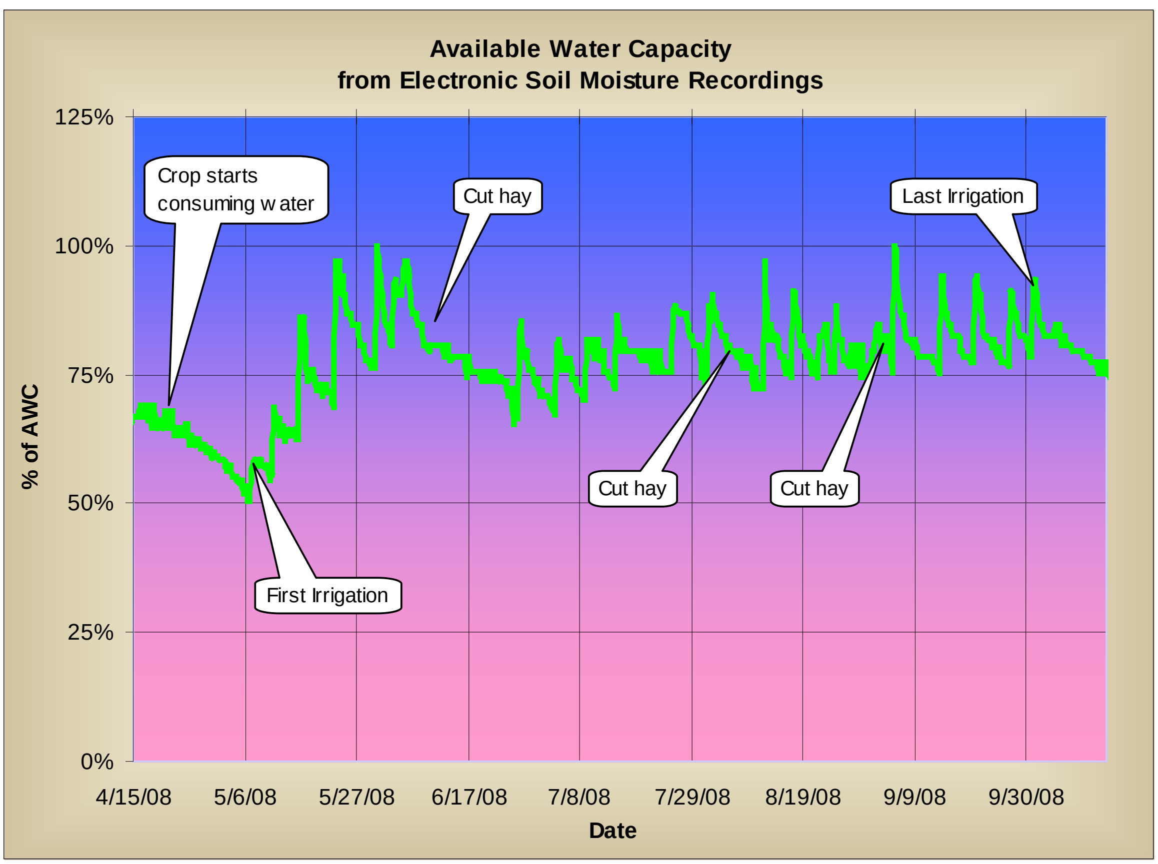
Since gravimetric drainage generally does not occur unless the soil horizon is nearly saturated (above field capacity), it is assumed that deep percolation is not occurring if the deepest probe reading is greater than -10 centibars. In the Uintah Basin, five installed data recorders indicate that deep percolation occurs less than 5% of the time on monitored fields.

If soil characteristics are known, recorded soil moisture data can be used to 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.

Figure 17 is a typical graph of estimated AWC for one set of three soil moisture probes in an alfalfa field.

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.



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.

Equipment Spot Checks and Evaluations

Catch-can Testing

Since FY2005, catch-can tests have only been ran on request, due to limitations described in the FY2005 M&E report. 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 the best operating, three adjacent sprinkler heads 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 would also be useful in documenting changes in vegetation type. Remote sensing alone will not achieve desired results sought by NRCS to report concurrency and proportionality of wildlife habitat replacement.

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. As this is more labor intensive, the M&E team believes it necessary to acquire additional workforce to assist in gathering data needed to create the most accurate and reliable land cover maps and detailed case studies.

At the end of FY2010 no additional workforce had been acquired to assist the M&E team in data gathering. Photo points have been established and will be displayed when relevant information can be extrapolated from photos. Case studies are on-going and will be reported in future versions of this document.

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, which was the source document for indentifying wetlands in the original EIS.

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-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.

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 the 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 that 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.

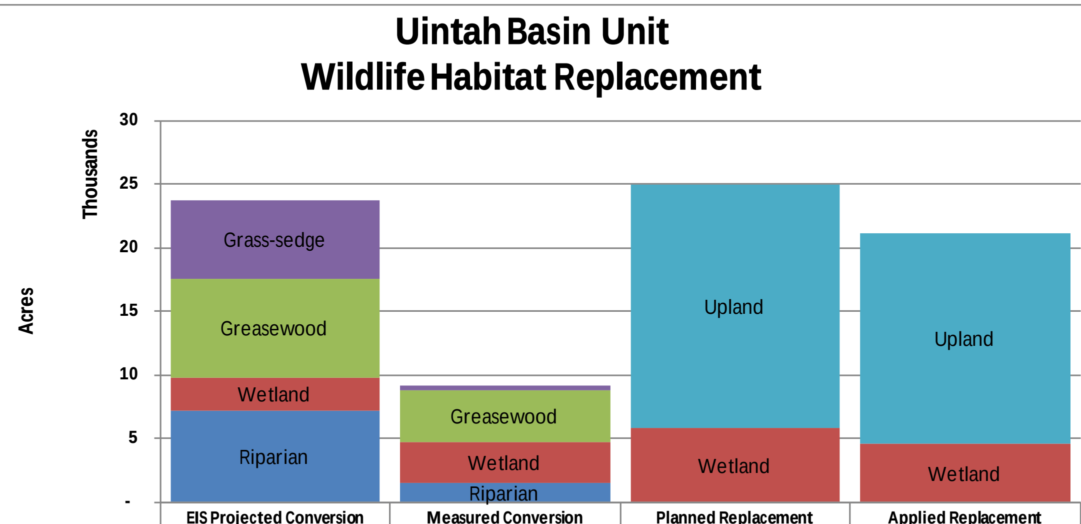
For the Uintah Basin, digital orthoimagery is available in gray scales from the early to mid 1990s. Color imagery is available for later dates, the most recent being the one meter National Agricultural Image Program (NAIP) from 2009. The 2006 NAIP is also available in CIR and high resolution (one foot) 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 presently. 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. Additional quadrangles will be evaluated as time permits.

The 1982 EIS for the Uintah Basin Unit combined eleven wetland types into 4 categories, greasewood, riparian, wetland, and grass-sedge. The EIS indicated that in the worst case, 37% of acres in these 4 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 4 categories.

Through FY2010, 152,500 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. In the same time frame, 5,800 acres of wetland replacement/improvement has been planned along with 19,200 acres of upland habitat improvement. Figure 18 summarizes cumulative progress with respect to wildlife habitat management and improvement. The first two bars of Figure 18 compare EIS projected wetland conversion to upland, with measured conversion. The second two bars depict funded habitat replacement, planned and applied. The wetland category includes both riparian and wetland practices.

Figure 18, Wildlife habitat management cumulative status



	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		

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

Ten Environmental Quality Incentive Program (EQIP) wildlife habitat improvement projects were planned and funded in the Uinta Basin in FY2010 for a total of 1,299 acres. No Wildlife Habitat Incentives Program (WHIP) or Basin States Parallel Program (BSPP) projects were planned or funded in FY2010. A total of 541 acres of wildlife habitat improvement projects were applied in the Uinta Basin Unit in FY2010 (Table 9).

For this document, all wildlife habitat creating/enhancing practices (acres applied) in contracts are assumed to be applied in proportion to dollars paid out .

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

Table 9, FY2010 Wildlife habitat acres planned and applied

Acres of Wildlife Habitat Creation or Enhancement by Program				
FY2010 Annual practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	36	1,263	379	162
WHIP	-	-	-	-
Total	**36**	**1,263**	**379**	**162**

*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				
FY2010 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	2,173	4,786	1,801	2,969
BSPP	150	239	88	239
WHIP	236	1,616	236	508
Total	**5,160**	**19,441**	**4,726**	**16,516**

*Wetland habitat type includes riparian areas

Voluntary Habitat Replacement

NRCS continues to encourage replacement of wildlife habitat on a voluntary basis. Federal and State funding programs are in place to promote wildlife habitat replacement. This information is advertised annually in local newspapers, in local workgroup meetings, and 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: Lower Lake Fork River Project

Background

The Lower Lake Fork River Project (LLFRP) is another excellent project from applications funded in 2007. The LLFRP is located near the end of the Lake Fork River approximately three miles before its confluence with the Duchesne River in a locality called Arcadia, approximately 10 miles NW of Myton, Utah (Figure 19).

The Lake Fork River is highly impacted by irrigation diversions throughout it length and at its lower reaches very little water flows in the late summer/fall months. The river experiences high springtime flows for brief periods. Much of the flow in the lower reaches is subterranean, except during spring run-off. The river flows though most all land ownership types (Federal, State, Private, and Tribal).

Traditional land use was cattle grazing and agriculture on developed fields. There are approximately 700 contiguous acres that range from the top of the bench to the lowland riparian zone. The 131 acres of land offered to be included in the Wildlife Habitat Conservation Plan (Figure 20) is located in the lowland riparian zone. This land is densely forested, in places, by narrow-leaved cottonwood, and a variety of willow species as well as Russian olive and tamarisk. The land has been heavily over grazed throughout the property except in the agricultural fields.

The Lake Fork River is an area of special concern for wildlife populations. The proximity to the Duchesne River, below the Myton Diversion, provides access to native endangered fishes found in the Colorado and Green River drainages. The Colorado Pike-minnow, the Bonytail Chub, the Razorback Sucker and the

Humpback Chub, may occur in the river along the LLFRP where there is permanent water. There are also several other Utah State Sensitive species that could occur in the project area such as: Yellow-billed cuckoo, Lewis' woodpecker, flannel mouthed sucker, bluehead sucker, round-tail chub, and River Otter.

Figure 19, Location Map for LLFRP.

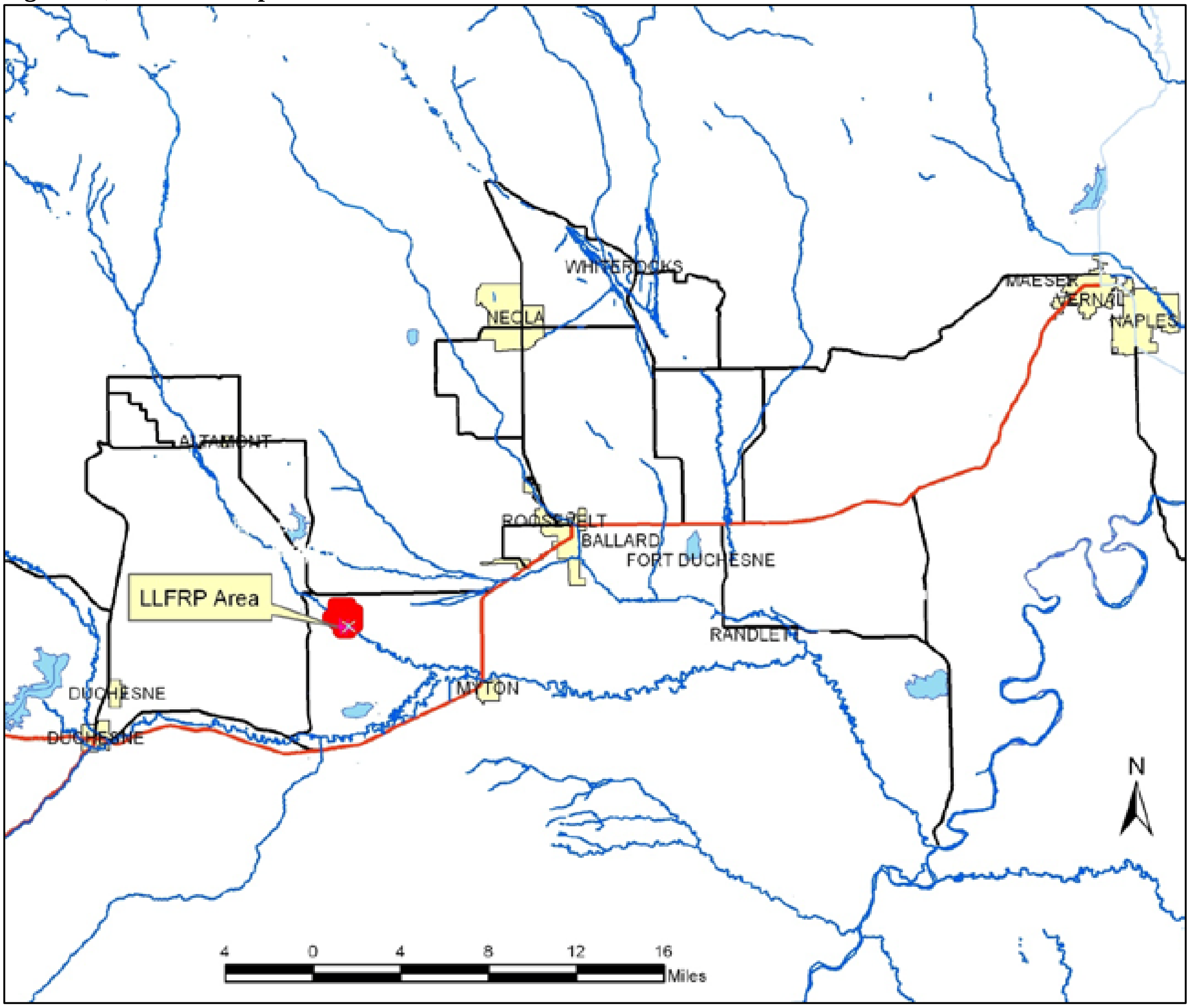
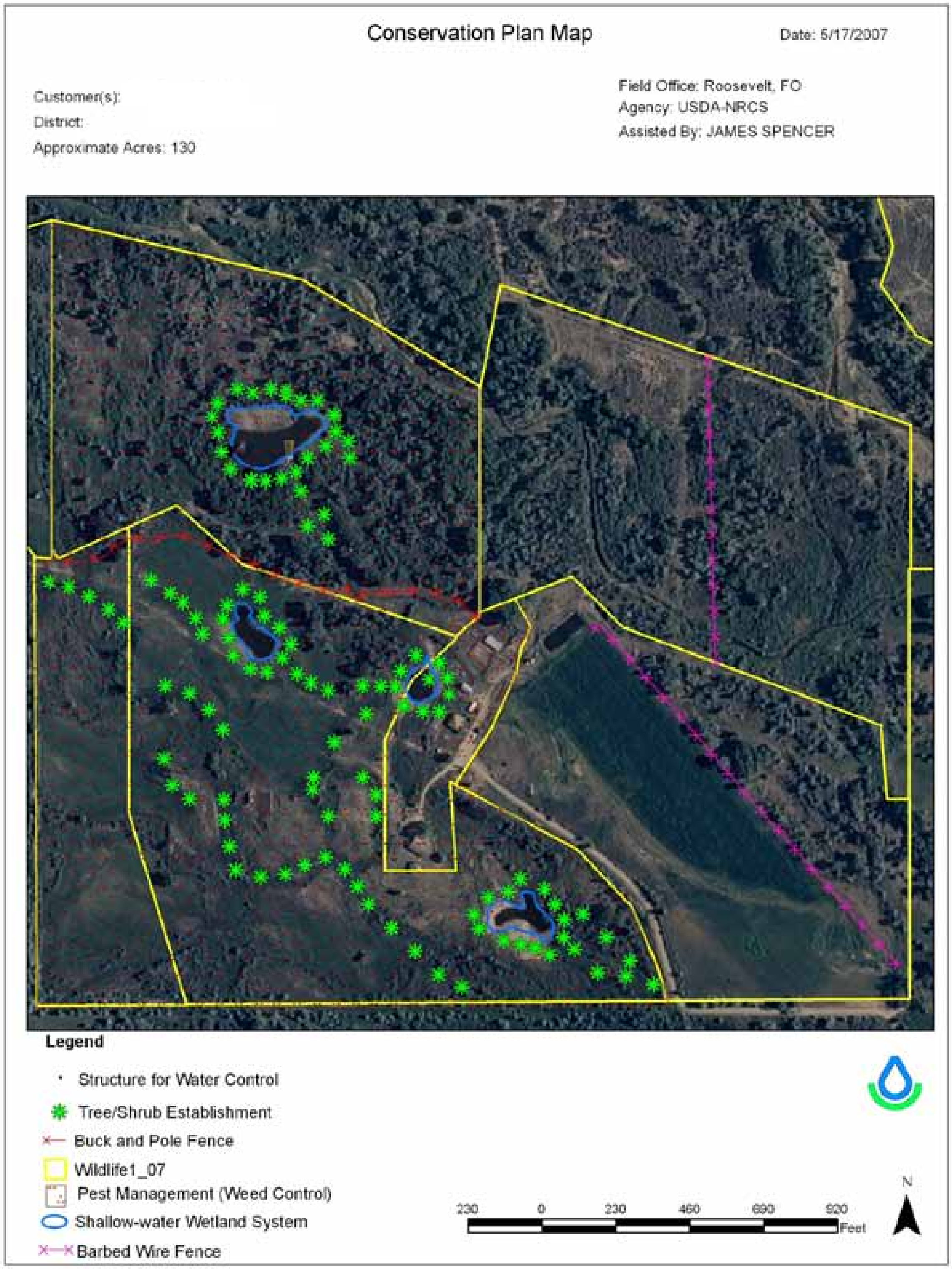


Figure 20, Wildlife Habitat Development Plan Conservation Plan Map for LLFRP.



Objectives

The LLFRP 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, and sensitive species (mentioned above). Most objectives revolve around these circumstances and are listed below, in no particular order:

- **Control and effective use of irrigation water on the property.** Poor "wild flood irrigation" was facilitating erosion, weed propagation, and mosquito production. It was also not effectively irrigating the agricultural land.

- **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 Russian olive (*Eleagnus angustifolia*), exist on the property to the detriment of the land and the exclusion of native species.

- **Reduce soil erosion and promote water conservation of "tail water" on agricultural fields.** Wild flood irrigation was producing large pools of standing water at the bottom of ag-fields creating noxious weed patches, and a mosquito breeding ground.

- **Increase wildlife food, shelter, and cover through woody and herbaceous vegetation planting.** Woody vegetation throughout the property primarily consists of Narrow-leaf 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 noxious weeds and non-native grasses.

- **Improve agricultural fields for best potential production.** Water dispersion (wild flood irrigation) was inefficient and more water was being used to effectively irrigate the hay fields.

- **Wetland wildlife habitat and migratory bird nesting cover enhancements were made throughout the property.** Shallow water impoundments "wetland systems" were created with the ability to manage water levels; and bird nest boxes were placed around the property.

Results

Reviewing the application for funding, it became apparent that there were two overarching objectives to meet; wildlife habitat restoration and agriculture. As a consequence, two separate Conservation Plans/Contracts were written to address both wildlife and agricultural land uses.

On-the-ground meetings were performed in fall 2006 through spring 2007 with the National Wild Turkey Federation (NWTF), the landowner, and NRCS to assess the resource concerns/objectives.

From these meetings consensus was achieved and the following practices (Figure 20) were included in the Wildlife Habitat Conservation Plan:

- 1,450 feet riparian buck and pole fence, and 2,475 feet of 41" high barbed wire fence

- 1,000 trees and shrubs

- Four shallow-water wetland systems

- A structure for water control, (on the large wetland system to control water level and inhibit beaver destruction of embankment by damming off the outlet-see photo gallery)
- 18 acres native grass/forb seeding
- 77 acres of weed spraying (pest management) over three years (including Russian olive removal)
- Four migratory bird nest boxes
- 57 acres of wildlife habitat management incentive payments over three years

The following are practices (Figure 21) included in the Agricultural Conservation Plan:

- 12 acres wheel-line sprinkler irrigation system w/ appurtenances
- 12 acres irrigation water management
- One irrigation regulating reservoir w/ compacted clay lining
- One irrigation water pumping plant
- One structure for water control
- 1,565 feet 12' PVC pipe w/ appurtenances

In summary, combining the two contracts, landowner and NRCS objectives were addressed as follows:

- Irrigation water was controlled by the use of pipelines, irrigation regulating reservoir, and more efficient sprinkler irrigation system
- Constructed shallow-water wetlands will provide habitat for multiple wetland species including waterfowl, bats, river otter, leopard frogs, chorus frogs, beaver, a host of neotropical birds as well as support an abundant variety of aquatic insects and larvae of insects that will in turn provide a baseline food source to higher vertebrate animals. Native wetland trees, shrubs and herbs will also thrive in the newly created wetland habitat.
- Livestock grazing has been reduced on agricultural fields. Pasture fences were built on surrounding rangeland so livestock can be rotated to a new pasture when timing is appropriate, allowing landowner to establish a progressive grazing management plan.
- A three year weed spraying program was completed in fall, 2009 eliminating most of the Russian olives, Canada thistle, and perennial pepperweed.
- The improved sprinkler irrigation system will distribute water to ag-fields, improving production and quality. It has also helped control the amount of water that collects at the bottom of the fields to reduce the noxious weed establishment.
- With newly planted, trees, shrubs, native grass and forbs, there will be abundant food, cover and shelter for wildlife species. Even the ag-fields contribute to wildlife benefit, such as the abundant wild turkey populations that frequently forage for insects in the ag-field

Discussion

Weed spraying and Russian olive removal was completed in 2007-2009, fencing was constructed in winter, 2007-2008, and most of the planting of trees, shrubs, native grasses and forbs were completed in 2009. It is anticipated that the project will be complete by May, 2011. The LLFRP is an excellent example of how agriculture and wildlife needs can be met on the same piece of property. The landowners have been attentive of all resource concerns from wildlife to production agriculture and have been willing to give and take as needed.

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. Landowners have also requested that a bat survey be performed on his property so they can create habitat improvements to attract bats to help control mosquito populations. It is anticipated that NRCS, UDWR, and USFWS will perform the survey in summer, 2011.

The Conservation Plans have 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 Duchesne River watershed.

Figure 21, Irrigation Conservation Plan Map for LLFRP.

LLFRP Photo Gallery

Figure 22, August 1, 2007; looking N, at overgrazed wetland area before practices were implemented.

Figure 23, August 1, 2007; overgrazed wetland area before enhancement with impoundment.

Figure 24, August 1, 2007; overgrazed wetland area before enhancement with impoundment.

Figure 25, August 1, 2007; looking SE before weed treatment were implemented.

Figure 26, August 1, 2007; Russian olive encroachment in wetland areas.

Figure 27, August 1, 2007; overgrazed wetland area before enhancement with impoundment and weed treatment.

Figure 28, August 1, 2007; overgrazed wetland area before enhancement with impoundment and weed treatment.

Figure 29, August 8, 2007; one week after first Russian olive treatment.

Figure 30, August 8, 2007; one week after first Russian olive treatment.

Figure 31, August 8, 2007; one week after first Russian olive treatment.

Figure 32, August 8, 2007; one week after first Russian olive treatment.

Figure 33, December 8, 2008; shallow-water wetland earthwork completed.

Figure **34,** December 8, 2008; shallow-water wetland earthwork completed.

Figure 35, December 8, 2008; shallow-water wetland earthwork completed.

Figure 36, April 21, 2009; beaver proof structure for water control (intake) installed in preparation to fill wetland.

Figure 37, April 21, 2009; beaver proof structure for water control installed (Agri-drain).

Figure 38, April 21, 2009; mule deer crossing buck and pole fencing.

Figure 39, April 21, 2009; wetland starting to fill with groundwater.

Figure 40, April 30, 2009; smaller shallow-water wetland with newly planted trees and shrubs.

Figure 41, April 30, 2009; smaller shallow-water wetland with newly planted trees and shrubs and spillway.

Figure 42, April 30, 2009; wetland spillway and water control valve spillway.

Figure 43, April 30, 2009; wetland filled and spilling through spillway and water control structure.

Figure 44, April 30, 2009; spillway on large shallow-water wetland.

Figure 45, April 30, 2009; spillway from water control structure.

Figure 46, November 24, 2009; tree and shrub protectors contributed by National Wild Turkey Federation in place as well as migratory bird nest on tall pole installed.

Figure 47, November 24, 2009; large wetland with tree protectors on plantings.

Figure 48, November 24, 20009; beaver can't figure out why water keeps spilling through water control structure and decides to bury valve cover with sticks and mud.

Figure 49, Close up of "still functioning" valve in spite of beaver's best efforts.

Figure 50, April 30, 2009; great horned owl with owlets nesting near constructed wetlands.

Figure 51, October 30, 2009; wild turkeys utilize property where improvements have been implemented.

Figure 52, October 30, 2009; wild turkeys utilize property where improvements have been implemented and become abundant and inquisitive.

Figure 53, October 30, 2009; wild turkeys improvise a handy roost structure (landowner's home).

Economics

Cooperator Economics

<u>Production Information</u>

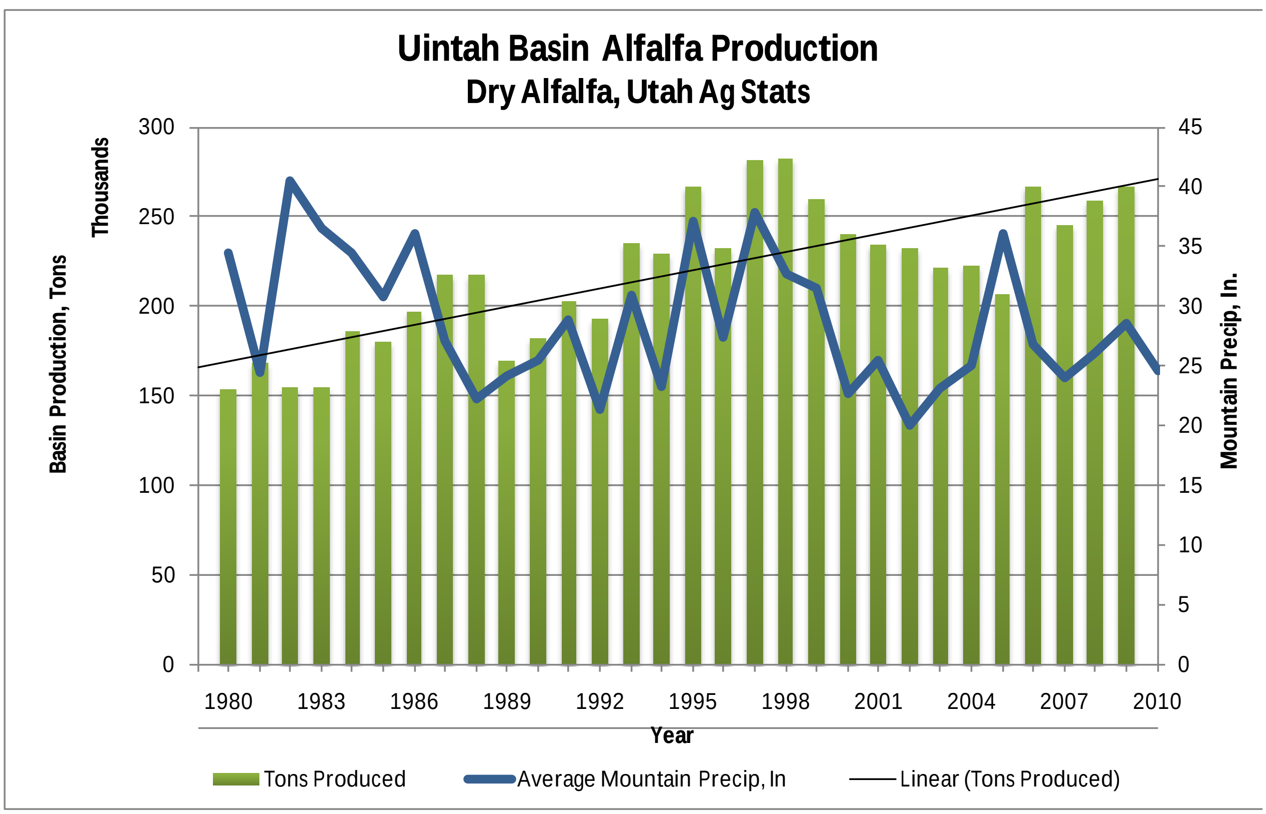
Field studies completed in 1995 concluded that upgrading from unimproved flood irrigation to improved flood or sprinklers, increased alfalfa crop yields from about 2.5 tons/acre to about 4.5 tons/acre. This magnitude of increase is consistent with anecdotal information from diligent cooperators.

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 154,000 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 74% since 1980, while alfalfa acreage has increased about 44%. From 1980 to 2009, average production increased from 161,000 tons to 270,000 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 4.9 tons/acre for acreage upgraded to alfalfa production from another crop, most often grass pasture (based on linear regression of the data).

Figure 54 is a graph of Uintah Basin alfalfa production and mountain precipitation.

Figure 54, 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 also 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 FY2010 average cost of $194/ton for planned practices is not the highest over the life of the program. 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 has leveled out, and upward pressure on labor and equipment prices is waning.

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/.