Colorado River Basin Salinity Control Program
Federal Accomplishments Report for Fiscal Year 2018

Presented to

Colorado River Basin Salinity Control Advisory Council

by

United States Department of Agriculture
Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
Bureau of Land Management
Bureau of Reclamation

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Colorado River Basin Salinity Control Program
Federal Accomplishments Report for Fiscal Year 2018
Acronyms and Abbreviations

Advisory Council	Colorado River Basin Salinity Control Advisory Council
ASCS	Agricultural Stabilization and Conservation Service
Basinwide Program	Basinwide Salinity Control Program
BLM	Bureau of Land Management
BSP	Basin States Program
CAP	Central Arizona Project
CDPHE	Colorado Department of Public Health and Environment
CRBSCP	Colorado River Basin Salinity Control Program
CRSS	Colorado River Simulation System
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FAIRA	Federal Agricultural Improvement and Reform Act
FOA	Funding Opportunity Announcement
Forum	Colorado River Basin Salinity Control Forum
FSRIA	Farm Security and Rural Investment Act
FY	Fiscal Year
GGNCA	Gunnison Gorge National Conservation Area
GIS	Geographic Information System
HDB	Hydrologic Date Base
NCA	National Conservation Area
NIWQP	National Irrigation Water Quality Program
NRCS	Natural Resources Conservation Service
Reclamation	Bureau of Reclamation
RMP	Resource Management Plan
Service	U.S. Fish and Wildlife Service
TDS	Total Dissolved Solids
TMS	Technical Modeling Subcommittee
USDA	United States Department of Agriculture
USGS	U.S. Geological Survey
UVWUA	Uncompahgre Valley Water Users Association
Work Group	Colorado River Basin Salinity Control Forum's Work Group

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U.S. Department of Agriculture (USDA)
Natural Resources Conservation Service (NRCS)

Colorado River Basin Salinity Control Program (CRBSC)
Accomplishments for Fiscal Year (FY) 2018

The NRCS of the USDA conducts CRBSC activities primarily under the authorities of the Environmental Quality Incentives Program (EQIP). EQIP was authorized by the 1985 Food Security Act (1985 Farm Bill) but received its first appropriation with passage of PL104-127, Federal Agricultural Improvement Act of 1996, a.k.a. "1996 Farm Bill."

EQIP has been reauthorized three times; (1) PL 107-171, The Farm Security and Rural Investment Act of 2002, (2) PL 110-246, The Food, Conservation, and Energy Act of 2008, and most recently (3) PL 113-79, The Agricultural Act of 2014, known as the 2014 Farm Bill, enacted February 7, 2014.

Through EQIP, NRCS offers voluntary technical and financial assistance to agricultural producers, including Native American tribes, to assist decision-makers to install conservation practices that correct environmental problems and that meet their environmental goals. Within the twelve salinity project areas, producers may be offered additional financial incentives and technical assistance to implement salinity control measures with the primary goal of reducing offsite and downstream damages to the Colorado River and its tributaries and to replace wildlife habit impacted as a result of the salinity measures.

In FY 2018, about $14.3 million of appropriated-EQIP financial assistance funding was obligated into new EQIP contracts for salinity control and wildlife habitat as follows:

Obligation	
Colorado -	$7,191,493
Utah -	$6,903,059
Wyoming -	$200,361
Totals	$14,294,913

Colorado's total includes $1,045,770 obligated into Tier II areas including the completed Grand Valley Unit. Utah and Wyoming did not obligate any salinity EQIP funds into Tier II areas. Original allocations amounted to about $13.9 million but additional funds were acquired and obligated to salinity contracts in each state.

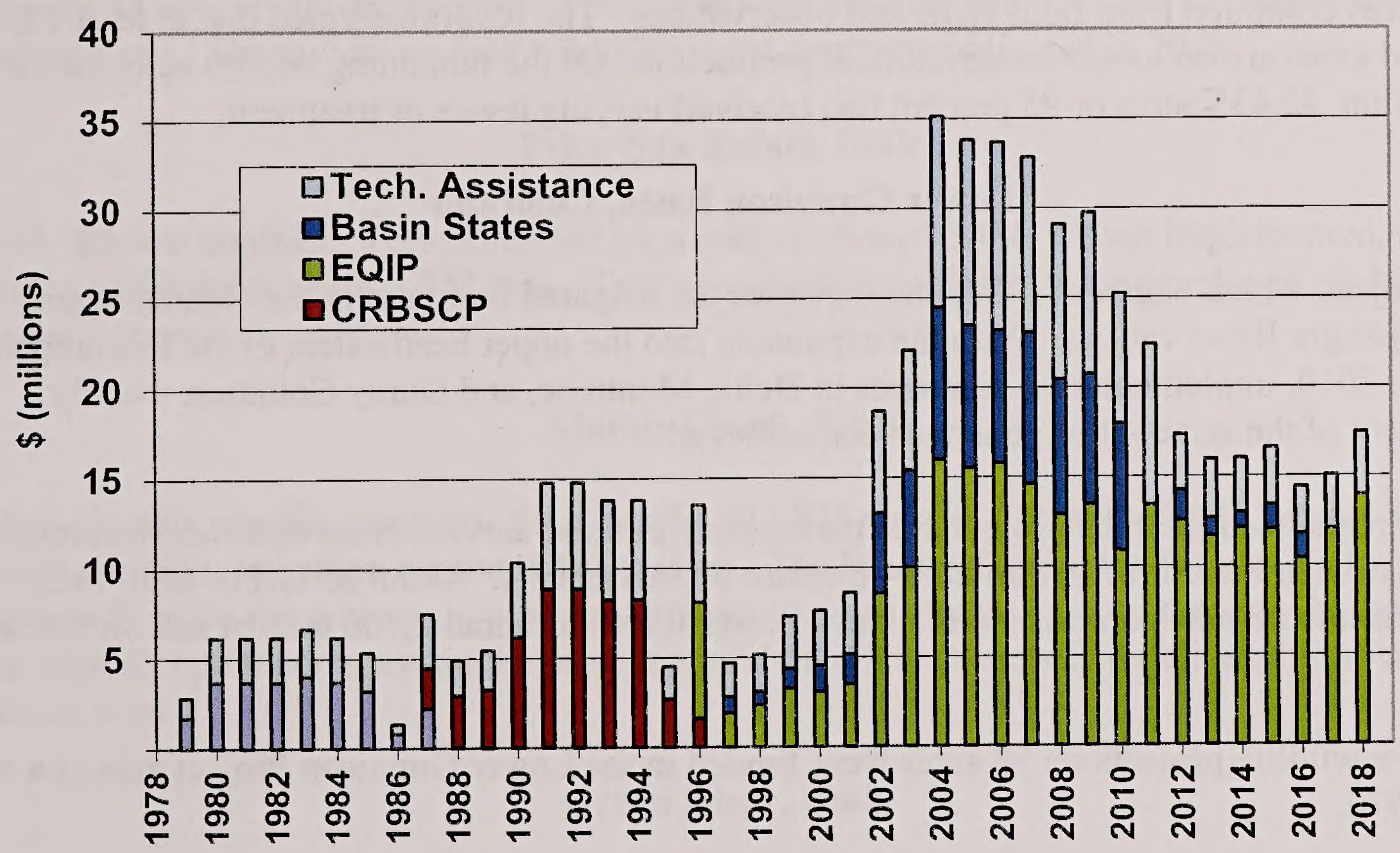
Program History

Progress in implementing the various projects is controlled primarily by annual federal appropriations. The Salinity Control Act provides funds for additional implementation from the Basin States Salinity Program. From the 1970s through 1986, the Agricultural Conservation Program (ACP) administered by the Agricultural Stabilization and Conservation Service (ASCS) provided financial assistance (cost share) to land users through long term agreements (LTAs) and the Soil Conservation Service (SCS) provided the technical assistance to plan, design, and certify practice implementation. From 1987 through 1996, the CRSCP received dedicated annual funding, again with the ASCS administering the financial assistance and SCS providing the technical assistance. In 1995, Public Law 103-354 authorized the reorganization of several agencies of USDA. The ASCS was reorganized as the Farm Service Agency. The SCS was reorganized as the NRCS. Financial administration of the CRSCP was transferred to the NRCS where it has remained to the present.

The Federal Agricultural Improvement and Reform Act (FAIRA) of 1996 (Public Law 104127) combined four existing programs including the CRBSCP into the newly authorized EQIP. Since the 1996, EQIP has been reauthorized through four consecutive farm bills and is currently authorized through FY 2018.

In FY 1997, the Bureau of Reclamation began on-farm cost sharing from the Basin States funds that would parallel and supplement the EQIP.

Figure 1 - On-farm/Near-farm Allocations



Monitoring and Evaluation

NRCS personnel from project and area offices monitor and evaluate the effectiveness and quantity of salinity control, wildlife habitat, and economic trends in order to improve overall performance and management of the program. The program continues to function effectively and economically, though the nominal cost per ton of salt control is escalating in some areas. The Monitoring and Evaluation Reports for FY 2017 can be found at: https://www.usbr.gov/uc/progact/salinity/pdfs/UtahSalinityControlReport2017.PDF

Status of Planning and Implementation

USDA-NRCS continues to provide technical and financial assistance to landowners and operators to implement on-farm salinity control measures in twelve approved project areas in three Upper Basin states.

Grand Valley, Colorado

Implementation has been underway in this unit since 1979 and NRCS considers that the salt control measures of the project have been successfully completed as planned. In 2010, a status report was compiled from field visits and observations. The report indicated that at least 12,000 irrigated acres are no longer in agricultural production. Of the remaining 44,700 acres still in production, 42,435 acres or 95 percent had received varying levels of treatment.

Lower Gunnison Basin, Colorado

This project, which began in 1988, encompasses the irrigated farmland in the Gunnison and Uncompahgre River valleys. With the expansion into the upper headwaters of the Uncompahgre River in 2010, implementation continues in Delta, Montrose, and Ouray Counties. Nearly 70 percent of the salt control goal has been achieved.

Interest remains high in the project area particularly in those service areas that were awarded Reclamation grants for irrigation infra-structure improvements. About $5.6M of EQIP was obligated into 48 new contracts with plans to control an additional 2,700 tons of salt on 2,424 acres.

Two new wildlife projects on 58 acres were funded in the Lower Gunnison Project area at a cost of $57,670.

Mancos Valley, Colorado

This project, near the town of Mancos, Colorado, was initiated and approved for funding and implementation by USDA-NRCS in April 2004. In 2018, one new EQIP contract was developed for $94,207 to control 39 tons of salt.

McElmo Creek, Colorado

Implementation was initiated in this unit in 1990. Application of salinity reduction and wildlife habitat replacement practices continue to be implemented in this area with sprinkler systems, underground pipelines, and gated pipe being installed. In 2018, 11 new contracts were developed for $322,817. These contracts will provide 213 tons of salt control when fully implemented.

Manila-Washam, Utah

Three new contracts were developed in 2018 by the Vernal Field Office staff for $175,781 and will control 137 tons.

Uintah Basin, Utah

Implementation began in this unit in 1980. The original salt control goal was reached several years ago but about 60,000 acres might still be improved. This project obligated more contracts than other projects in Utah. Producer participation is exceeding the original projections. In 2018 there were 44 new contracts reported. These contracts obligate about $3.1M to control about 867 tons of salt. There were no new wildlife habitat contracts obligated in 2018.

Price-San Rafael, Utah

In 2018, 20 new contracts were obligated for a sum of about $2.4M. When implemented, these measures will control about 2,753 tons. Two new wildlife contracts were developed on 46 acres in the project area.

Muddy Creek, Utah

In 2018, ten new pipeline contracts for about $1,023,875 were obligated under EQIP that will facilitate sprinkler irrigation on about 4,000 acres. The Muddy Creek area has received significant funding for projects to pipe canals from various sources and the majority of the approximately 6,000 acres within the project area should have access to pipelines for pressurized irrigation soon.

Green River, Utah

There were three new contracts in the project area in 2018 for $226,060. When implemented, these contracts will control about 458 tons. Significant new lands are being brought under irrigation on the bench east of the Green River. As many as 200 center pivots may eventually be installed. None of these practices receive incentives from the salinity control program.

Big Sandy River, Wyoming

Implementation has been underway in this unit since 1988. Approximately 13,700 acres of the planned 15,700 acres have been treated (87 percent) and about 70 percent of the salt control goal has been reached. Producers also report that the water savings from improvements in irrigation systems now allows a full irrigation season of water for the entire irrigation district. There were 4 new contracts in 2018 on 45 acres that will control 173 tons of salt.

Henrys Fork (of the Green River), Wyoming

The Henrys Fork Project was officially adopted with the issuance of the Record of Decision, June, 2013. In 2018, one new project was funded in the Henrys Fork Project Area for a cost of $105,432 that will control 25 tons of salt on 31 acres.

San Juan Basin, New Mexico and Arizona

The San Juan River Dineh Water Users, Inc. (SJRDWU, Inc.) provides irrigation water to Navajo Nation farmers along the San Juan River from Farmington past Ship Rock, New Mexico. The SJRDWU, Inc. has been aggressive in seeking funding to upgrade its delivery system. While NRCS has never designated this area a salinity control project there is hope that the improvement of delivery infrastructure will spur on-farm irrigation improvements.

Areas Beyond Current Project Boundaries

Even though some relatively high salt loading basins exist in both Colorado and New Mexico, local sponsors have not yet been inclined to pursue a salinity project designation.

Colorado NRCS continues to have success in funding salinity control practices outside of its five designated project areas but within the Colorado River Basin. In 2018, 16 projects were contracted on 987 acres outside of existing project areas for $1,045,770.

Table 1 - Implementation Status (October 1, 2018)

			Irrigated Acres	Treated Acres	EIS Goal (tons)	On-Farm Controls (tons)	Off-Farm Controls (tons)	[1]Total Tons Controlled	Indexed Initial Cost ($/ton)	Nominal 2018 ($/ton)
Colorado	Grand Valley	1977	44,600	43,256	132,000	137,263	6,780	144,043	105	196
	Lower Gunnison	1982	171,000	71,044	186,000	102,363	22,026	124,389	176	257
	McElmo Creek	1989	29,000	17,369	46,000	28,283	2,486	30,769	200	174
	Mancos Valley	2004	11,700	2,942	11,940	2,520	2,113	4,633	135	184
	Silt	2005	7,400	1,827	3,990	1,486	878	2,364	188	263
Utah	Uintah Basin	1982	226,000	160,380	140,500	141,181	9,262	150,443	357	332
	Price-San Rafael	1997	66,000	36,423	146,900	86,863	1,553	88,416	73	68
	Manila-Washam	2005	8,000	4,056	17,430	8,649	0	8,649	107	120
	Muddy Creek	2004	6,000	596	11,677	750	6	756	194	57
	Green River	2009	2,600	872	6,540	2,675	0	2,675	210	51
Wyoming	Big Sandy River	1988	18,000	13,828	83,700	58,553	114	58,667	81	50
	Henrys Fork	2013	20,700	174	6,540	149	0	149	476	185
Tier II	(all)		0	591	0	6,809	979	7,568	0	0

Environmental Protection Agency

Colorado River Basin Salinity Control Program
Fiscal Year 2018

During Fiscal Year 2018, EPA continued to provide coordination and assistance to the Colorado River Basin Salinity Control Forum and Advisory Council involving salinity control activities.

Several key items;

- The renewed Colorado River Basin Salinity Control Advisory Council Charter was signed by the EPA Administrator on August 31, 2018.

- EPA provided informational updates to the Forum and Advisory Council including updated State and Tribal Water Quality Standards, related program information and changes in organizational contacts.

- EPA continues to participate as a Cooperating Agency in the Bureau of Reclamation's effort to prepare an Environmental Impact Statement for the Paradox Valley Salinity Control Unit. The Regional Salinity Control Coordinator as well as Underground Injection Control program and National Environmental Policy Act staff are actively participating in this important effort.

- EPA Region 8 has continued the lead role for EPA Regions 6 and 9 for coordination with the Forum and Advisory Council and continues to be available for responding to questions, requests, and other needs.

EPA has approved the applications of six Tribes within the Colorado River basin for "treatment in a manner similar to a state" (TAS) to administer the Water Quality Standards (WQS) and §401 Certification programs on their respective tribal lands, and four tribes have approved WQS.

Specifically;

- The **Southern Ute Indian Tribe (SUIT)** WQS TAS was approved 3-28-2018. SUIT anticipates holding public/ informational hearings in fall 2018.

- The WQS for the **Ute Mountain Ute Tribe (UMU)** were approved by EPA Region 8 on October 19, 2011. The UMU is scoping issues and revisions for this triennial. UMU anticipates they'll hold a public hearing sometime in Fall 2018. The Tribe has salinity and selenium standards and has several on-going selenium and salinity projects examining potential effects on groundwater, irrigation and endangered species in Tribal and downstream waters.

- The **Hualapai Tribe** adopted revised WQS in July 2009, including the 2008 Forum Policies and Plan of Implementation. These revised standards were approved by EPA Region 9 September 25, 2009.

- The **Navajo Nation** adopted revised WQS in May 2008 that included the 2005 Forum Policies and Plan of Implementation; the revised WQS were approved by EPA in March 2009. They have developed draft WQS that refer to the 2011 Forum WQS and conducted their public process on this revision but have not yet completed their action to adopt.

- The **Hopi Tribe** included the 2005 Forum Policies and Plan of Implementation in WQS revisions which were adopted by the Tribe March 21, 2011, and approved by EPA August 24, 2011.

- The **Havasupai Tribe** received its TAS approval on April 26, 2011; EPA Region 9 is working with the Tribe in completing development of their WQS.

The adopted and approved WQS for the four Tribes have been published and are available for review on-line. https://www.epa.gov/wqs-tech/epa-actions-tribal-water-quality-standards-and-contacts The attached table indicates the status of all the Colorado River Basin States in adoption of the Colorado River Basin Control Forum's salinity standards (Policies and Plan of Implementation).

EPA Region – State	2005 Update Adopted[1] by State	2005 State Adoption Approved by EPA	2008 Update Adopted[1] by State	2008 State Adoption Approved by EPA	2011 Update Adopted[1] by State	2011 State Adoption Approved by EPA	2014 Update Adopted[1] by State	2014 State Adoption Approved by EPA	2017 Update Adopted by State	2017 State Adoption Approved by EPA
R9 – Arizona	Yes 12/02/08	Yes 1/21/09	In draft	--	In draft	--	Yes 10/18/16	12/23/16		
R9 – California	Yes 2/01/06	Yes 3/16/06	Yes 8/04/09	Yes 3/09/10	In draft	--	Yes 5/05/15			
R9 – Nevada	Yes 9/06/06	Yes 4/05/07	Yes 10/05/10	Yes 6/15/11	Yes 10/11/12	Yes 2/12/13	In Draft[2] Dec. 2017			
R8 – Colorado	Yes	Yes	Yes 12/08/08	2005 adoption reaffirmed	Yes 12/12/11	2008 adoption reaffirmed	Yes 12/8/14	--	Reaffirmed[5] Dec. 2017	
R8 – Utah	Yes 10/22/08	Yes 9/30/09	Yes 10/22/08	Yes 9/30/09	Yes 4/1/12	Yes 11/20/12	Partial[3] 8/15/14	Anticipated Fall 2018		
R8 – Wyoming	Adopted by reference – Water Quality Rules and Regulations (1982)						Yes[4] 3/23/15			
R6 – N. Mexico	Yes – by reference in WQS	Yes	Earlier version not changed	April 2011	Earlier version not changed	Previously approved with adoption by reference				

[1] Adopted/Approved – Some states chose not to adopt Forum Standards during previous review periods because the salinity standards had not changed significantly.

[2] Nevada will also adopt a measure to automatically adopt future salinity standards updates unless the State Environmental Commission disapproves the revisions.

[3] UT WQS triennial review package was received 7-31-18. EPA anticipates approval within the next 60-90 days

[4] Adopted criteria and (by reference) the implementation policies in State permit regulations. 2017 Forum Review referenced on State website. http://deq.wyoming.gov/wqd/surface-water-quality-standards-2/

[5] Colorado - The Water Quality Control Commission (WQCC) conducted an informational hearing for triennial review of the Colorado River Salinity Standards, Regulation #39 (5 CCR 1002-39). The WQCC reaffirmed the salinity standards in Regulation #39 without change and stated its support of the plan of implementation set forth in the 2017 review prepared by the Colorado River Basin Salinity Control Forum.

Fish and Wildlife Service (Service)

Colorado River Basin Salinity Control Program FY 2018

During FY 2018, the Service continued to provide coordination and assistance to the Colorado River Basin Salinity Control Forum and Advisory Council involving salinity control activities. We look forward to providing the same coordination in FY 2019. Creed Clayton continues in his role as Acting Salinity Control Coordinator; the position has not yet been officially filled since the retirement of Barb Osmundson at the end of March 2016.

Summary of FY18 Fish and Wildlife Activities-At a Glance

1. Salinity Control Program Meeting Attendance

   a. Forum, Advisory Council, and Workgroup
      - Sacramento, CA 2017.10.23-27
      - Boulder City, NV 2018.2.12-14
      - Salt Lake City, UT 2018.7.19-20

   b. Paradox Salinity Removal Unit
      - . Site visit to see zero liquid discharge demonstration and EIS Alternatives, 2018.3.7
      - i. Cooperating Agency Meeting for draft EIS, Grand Junction, CO 2018.7.26

   c. Lower Gunnison Basin Selenium Management Program meetings
      - NRCS, Delta 2017.10.6
      - NRCS, Delta 2018.3.20
      - NRCS, Delta 2018.7.31

2. Environmental Documents

   a. Wildlife Habitat Replacement Plan Review
      - Farson, WY F2 & F5 laterals, approval (for Reclamation 2018.3.30, TAILS 2018-CPA-0009)
      - Flaming Gorge NRA habitat improvement project, Ashley N.F., reviewed for potential habitat replacement for local NRCS salinity control projects (TAILS 2018-CPA-0011)
      - Letter of support for Olsen Project (to NRCS 2018.7.12, TAILS 2018-CPA-0010)

   b. Endangered Species Act Consultations
      - NRCS RCPP Lower Gunnison Salinity Control, sponsored by the Colorado River Water Conservation District (for NRCS, signed 2017.11.30, TAILS 2018-F-0035)
      - Grand Valley Irrigation Company Canal Lining Phase IV – 540 (for RECLAMATION, signed 2017.12.14, TAILS 2018-I-0068)
      - Lewis Wash Culvert Replacement, Colorado River Wildlife Area (for Reclamation, signed 2018.1.3, TAILS 2018-I-0116)

- Orchard Ranch Ditch Piping Project (for Reclamation, signed 2018.2.2, TAILS 2018-I-0090)
- Fire Mountain Canal Piping Project (for Reclamation, signed 2018.2.9, TAILS 2017-F-0464)
- Horsethief Canyon State Wildlife Area Bank Stabilization Project (2018.5.9, TAILS 2018-I-0210)

c. Response to Salinity Control Advisory Council 2017 Annual Report (2018.4.10, TAILS 2018-CPA-0008)

d. Review NRCS Monitoring & Evaluation reports from UT, WY, and CO for status of Wildlife Habitat Replacement progress (TAILS 2018-CPA-0048)

3. <u>Wildlife Habitat Replacement Activities</u>

a. Wildlife Habitat Replacement Project Site Visits
- Grand Valley Salinity Control Area
    - o Colorado River Wildlife Area, with Reclamation, 2017.12.12
    - o Horsethief State Wildlife Area, with Reclamation, 2018.2.9
    - o Orchard Mesa Wildlife Area, with Reclamation, 2018.6.15

- Lower Gunnison Salinity Control Area
    - o Welfelt Property, near Delta, with Reclamation 2018.1.17
    - o Hotchkiss Fish Hatchery, Hotchkiss Ranch, with Reclamation and Western Slope Conservation Center 2018.5.18
    - o Waterdog & Shinn Park Piping Project, with Reclamation 2018.5.23

- Price-San Rafael Salinity Control Area
    - o Olsen Reservoir baseline habitat evaluation 2018.5.30-6.1
    - o Price River baseline habitat evaluation 2018.7.10-11

- Uintah Basin Salinity Control Area, site visits with NRCS planned for 2018.9.27
- Manila-Washam & Blacks Fork SCUs, site visits with NRCS planned for 2018.9.28

b. Wildlife Habitat Replacement project meetings, presentations
- Olsen Reservoir Project
    - o Conference call with Reclamation 2017.11.15
    - o Conference call with Reclamation, UDWR, TNC, BLM 2018.3.6
    - o Meeting with Reclamation, UDWR, TNC, BLM in SLC, UT 2018.4.11
    - o Conference call with Reclamation, UDWR to seek support of UDWR to use Olsen habitat credits outside of watershed 2018.7.26

- Price River Restoration Project
    - o Conference call with Reclamation, UDWR, TNC, BLM on Price River 2018.4.10
    - o Conference call with Reclamation, UDWR, TNC, BLM on Price River 2018.6.12
    - o Conference call with Reclamation, UDWR, TNC, BLM on Price River 2018.6.25

- Two-day meeting with Reclamation to revise Fish and Wildlife Habitat Evaluation Procedures, Grand Junction, CO 2018.1.31-2.1

- Conference call with Reclamation on portability of habitat credits 2018.7.12
- Conference call with Reclamation on portability of habitat credits 2018.8.15
- Conference call with Reclamation on portability of habitat credits 2018.9.6

4. Trainings and Conferences

- Endangered Fish Researchers Meeting, Vernal, UT 2018-1.23-24
- Riparian Restoration Workshop, Tamarisk Coalition, Grand Junction, participated in Selenium and Wildlife Habitat Panel 2018.2.6-8

Expanded Discussion of Select Items Listed Above

Endangered Species Act Section 7 Consultations. In accordance with section 7 of the Endangered Species Act (ESA) of 1973, the Service Salinity Control Program Coordinator conducted section 7 consultations on various salinity control projects that may affect threatened or endangered species in the Grand Valley and Lower Gunnison salinity control areas, including ditch-to-pipeline and canal lining projects. Section 7 consultation was also completed on maintenance projects on two state wildlife areas that are serving as habitat replacement sites in the Grand Valley. Additionally, a programmatic level consultation was completed for a variety of salinity control methods proposed in the Lower Gunnison RCPP salinity control project. These projects involved effects to: the four endangered fish of the Colorado River (Colorado pikeminnow, razorback sucker, humpback chub, and bonytail) through downstream water depletions; Gunnison sage-grouse critical habitat adjacent to agricultural areas; and the western yellow-billed cuckoo, which occurs in riparian habitats along major rivers. Salinity control projects affecting these or other threatened or endangered species in Utah or Wyoming would undergo section 7 consultation with the respective Fish and Wildlife offices in those states.

Water diversions and depletions from the Colorado River Basin adversely affect downstream endangered fish. Alternatively, the return of water to the river, which is saved through increased water delivery and irrigation system efficiencies, would benefit endangered fish found downstream. When possible, we recommend this beneficial use for endangered fish. Because a significant amount of water is being diverted outside of the Colorado River Basin via trans-mountain diversions, the return of any water to river segments occupied by these endangered fish would be a benefit to them.

Paradox Valley Salinity Control Unit. The Service remains engaged as a cooperating agency with Reclamation on the Paradox EIS. The Service Salinity Control Program Coordinator provides input on the potential effects to listed species (Gunnison sage-grouse, western yellow-billed cuckoo) and migratory birds from the various EIS alternatives. We remain concerned about the difficulty of minimizing hazards to migratory birds presented by one of the EIS alternatives. We are hopeful that an alternative can be found that is both economical and minimizes effects to migratory birds and listed species.

Wildlife Habitat Replacement Activities. The Service appreciates the on-going efforts of Reclamation and NRCS staff to replace wildlife habitat values forgone. The Service Salinity Control Program Coordinator assisted Reclamation in the evaluation of several sites in Colorado for wildlife habitat replacement and potential loss of wildlife habitat via salinity control. Sites in Utah were also visited with NRCS to assess wildlife habitat replacement effectiveness and methodology for wildlife habitat acreage calculation.

Olsen Reservoir and Price River Restoration Project (Price-San Rafael Salinity Control area). The Service Salinity Control Program Coordinator attended numerous site visits, meetings, and conference calls involving the potential wildlife habitat credits that are expected to arise from habitat improvements to the Olsen Reservoir and downstream along the Price River. New wetland acres would be created to the benefit of waterfowl and other native wildlife. Roundtail chub, a native fish of concern, would likely be stocked in the new reservoir. These fish and other native species, including the endangered Colorado pikeminnow, would benefit from increased, more reliable base flows downstream in the Price River. Downstream riparian areas, including scarce cottonwood galleries, could benefit from increased summer-time base flows as well. The Service Salinity Control Program Coordinator also assisted with the assessment of selenium concentrations, a potential contaminant of concern to wildlife, in bird eggs collected at Olsen Reservoir.

Habitat Evaluation Procedures. Reclamation instigated an update to the Wildlife Habitat Evaluation Procedures this year in order to improve their effectiveness and increase flexibility in how habitat credits can be generated. The Service Salinity Control Program Coordinator assisted Reclamation with this effort. Certain types of legitimate habitat improvements were not recognized by the process, such as stream restoration and increasing base flows in a stream system. The updated procedures allow for their recognition. This increased the possibilities for habitat replacement; finding suitable replacement sites has been a challenge in the past. Ongoing discussions with Reclamation are currently taking place regarding when off-site habitat replacement may be appropriate.

Monitoring and Evaluation Report Review--NRCS Wildlife Habitat Projects.
After review of the NRCS 2017 M&E reports for Wyoming, Colorado, and Utah, the Service Salinity Control Program Coordinator assessed the progress of NRCS in replacing fish and wildlife habitat forgone as a result of implementing salt control measures. The tables below display updated summaries for each state and show whether wildlife habitat replacement is concurrent and proportional with the acres lost due to salt control projects completed to date.

Wyoming. See table below. In 2005, the Big Sandy Salinity Control Unit in Wyoming was determined to be concurrent and proportional with wildlife habitat replacement acres, with the replacement goal exceeded by about 11 acres. However, loss of water in a 40-60 acre wetland near Eden, Wyoming was identified in 2014. This pond remained dry until 2016, when it once again retained water. Loss of this wetland was not identified or analyzed in the EIS. This incident identified a need to assure that acres of habitat replacement are still functioning as intended for their 25-year term.

For the Henrys' Fork Salinity Control Area, due to lack of opportunity for traditional wetland replacement project opportunities, alternative habitat improvement projects have been pursued and scored with a relatively new habitat replacement calculation tool. Livestock exclusion, nonnative invasive fish exclusion, and increased fish population inter-connectivity projects have all been completed and more are under contract. Once the habitat projects under contract are completed, this area should become concurrent and proportional. The Service Salinity Control Program Coordinator plans a site visit to this area with NRCS on September 28 to see and assess these alternative habitat replacement projects.

Colorado. See table below. The largest Salinity Control Area, the Lower Gunnison, is currently exceeding the running habitat replacement goal. The Mancos Valley Salinity Control Area is also ahead of schedule with habitat replacement; in fact, sufficient replacement has been accomplished so far to account for almost all the acres needed at full project implementation. Although the Grand Valley Salinity Control Area is behind schedule in meeting its habitat replacement goal, there are habitat projects under contract that will bring this area up to being proportional and concurrent once implemented. The McElmo Creek and Silt Salinity Control Areas need further habitat replacement.

An issue identified with the Lower Gunnison Area (and habitat replacement sites in general), is that only small parcels are currently available for habitat projects. These small projects are complex in planning and habitat enhancement options, and they provide relatively small replacement acreages per project. A goal of NRCS is to encourage larger habitat replacement projects with better connectivity and a longer-term life expectancy.

Another issue identified by NRCS in the 2017 M&E report is a continued decrease in staffing in Colorado, such that monitoring of habitat replacement sites will be limited and only completed when resources are available. Successful wildlife habitat replacement for salinity control projects depends on the availability of field staff to arrange replacement projects and monitor their success. We are hopeful that NRCS can replace these vacancies quickly.

Utah. See table below. For the state of Utah, the two large salinity control areas—the Uintah Basin and Price-San Rafael--have both exceeded the adopted replacement goal of 2 acres of wildlife replacement habitat per 100 acres of salt control. The smaller units in Utah are not proportional and concurrent with wildlife habitat replacement at this time (Manila-Washam, Green River, Muddy Creek). Very little habitat replacement has been completed for these areas to date. The Service Salinity Control Coordinator has explored the possibility of a habitat replacement project in conjunction with the U.S. Forest Service near Flaming Gorge within the Manila-Washam salinity control area. It is not yet clear whether or not NRCS will partner in this habitat improvement project involving plantings and weed control.

Wildlife Habitat Replacement Summaries for FY17 -- NRCS

Salinity Control Unit	Habitat Replacement Goal (to be concurrent)	Cumulative Habitat Applied	**Current Status**	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	Notes
	Acres	Acres	%	Acres	Acres	WHR = Wildlife Habitat Replacement
Wyoming						
Big Sandy	860	871	**101%**	11	-	At full project implementation, EIS analyzed 15,700 salt control acres to be treated with improved irrigation systems. As of March 2014, 13,077 acres treated for salt control. Habitat/wetland replacement goal was exceeded by approx. 10 acres and was considered complete in 2005. However, due to wetland drying in 2014-2016, additional wetland habitat may be needed to meet replacement goal.
Henry's Fork	320	193	**60%**	(127)	357	Loss and replacement of wetland habitat values associated with irrigation improvement projects is estimated using Montana DOT wetland assessment tool. WHR projects include fish passage, riparian fence to exclude livestock, and a fish barrier to exclude nonnative invasive fish.

Data from FY2017 NRCS Monitoring and Evaluation Report

* CO & UT Habitat Replacement Goal (Habitat Applied = 2% of Improved Irrigation Acres).

Concurrent and proportional wildlife habitat replacement indicated by green shading

Salinity Control Unit	Habitat Replacement Goal (to be concurrent)	Cumulative Habitat Applied	Current Status	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	Notes
	Acres	Acres	%	Acres	Acres	WHR = Wildlife Habitat Replacement
Colorado						
Grand Valley	1,206	774	**64%**	(432)	454	Salt control measures completed. Negotiated total habitat replacement goal of 1,206 acres. 350 of the acres under contract are planned & funded on CPW land. Once the contracts are fully implemented, total WHR will exceed goal by approx. 22 acres.
Lower Gunnison	1,369	1,435	**105%**	66	235	69,942 salt control acres thus far; 115,000 acres at full project implementation. This would require a total of 2,300 acres of WHR (115,000 x 0.02 = 2,300) to be proportional.
McElmo Creek	323	280	**87%**	(43)	13	16,702 salt control acres thus far; 21,550 acres at full project implementation. This would require a total of 431 acres of WHR (21,550 x 0.02 = 431) to be proportional.
Mancos Valley	55	107	**195%**	52	-	2,798 salt control acres thus far; 5,400 acres at full project implementation. This would require a total of 108 acres of WHR (5,400 x 0.02 = 108) to be proportional. Field inventory confirmed 107 acres are still maintained, or 99% of full project implementation.
Silt	32	19	**61%**	(13)	-	1,784 salt control acres thus far; 2,800 acres at full project implementation. The 2/100 acre rate does not apply due to a BE that predicted loss of 10 acres of wetland and 40 acres of riparian/upland habitat losses (=50 acres). The WHR concurrent value is based on the % of the salt treatment goal reached so far, which is 1,784 ac/2,800 ac = 64%. Thus, 0.64 x 50 ac = 32 acres to be concurrent. Actual estimated habitat loss through FY16 was 16 riparian acres.

Data from FY2017 NRCS Monitoring and Evaluation Report.

CO & UT Habitat Replacement Goal (Habitat Applied = 2% of Improved Irrigation Acres).

Concurrent and proportional wildlife habitat replacement indicated by green shading

Salinity Control Unit	Habitat Replacement Goal (to be concurrent)	Cumulative Habitat Applied	**Current Status**	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	Notes
	Acres	Acres	%	Acres	Acres	WHR = Wildlife Habitat Replacement
Utah						
Green River	16	-	**0%**	(16)	-	819 salt control acres thus far; 2,080 acres at full project implementation. This would require a total of 42 acres of WHR (2,080 x 0.02 = 42) at full project implementation.
Manila - Washam	85	10	**12%**	(75)	2	4,236 salt control acres thus far; 7,780 acres at full project implementation. This would require a total of 156 acres of WHR (7,780 x 0.02 = 156) at full project implementation.
MuddyCreek	7	-	**0%**	7	-	329 salt control acres thus far; 6,050 acres at full project implementation. This would require a total of 42 acres of WHR 6,050 x 0.02 = 121) at full project implementation.
Price San Rafael Rivers	722	3,431	**475%**	2,709	20	36,099 salt control acres thus far; 36,050 acres at full project implementation (unit has exceeded goal). Thus, a total of 721 acres of WHR (36,050 x 0.02 = 721) is needed and has been exceed. NRCS will continue to support salinity control.
Uintah Basin (Amended)	3,189	21,504	**674%**	18,315	63	159,454 salt control acres thus far; 160,000 acres at full project implementation. This would require a total of 3,200 acres of WHR (160,000 x 0.02 = 3,200) at full project implementation.

Data from FY2017 NRCS Monitoring and Evaluation Report.

CO & UT Habitat Replacement Goal (Habitat Applied = 2% of Improved Irrigation Acres).

Concurrent and proportional wildlife habitat replacement indicated by green shading

U.S. Geological Survey

Colorado River Basin Salinity Control Program
Accomplishments for Fiscal Year 2018

The USGS conducts a variety of science activities to (1) assess salinity conditions in the Colorado River, (2) guide program management decisions, and (3) determine the effect of salinity control efforts. These activities are conducted in cooperation with the Colorado River Basin Salinity Control Forum and in support of Federal resource management agencies including the Bureau of Land Management (BLM), Bureau of Reclamation (Reclamation), and the Natural Resources Conservation Service (NRCS). In addition, activities and accomplishments in USGS National programs such as the Groundwater and Streamflow Information Program (GSIP) and the National Water-Quality Assessment (NAWQA) Program provide valuable information to Salinity Control Program (SCP) agencies. These SCP science-support activities and relevant USGS National program activities (described below) range from data collection in a basin-wide monitoring network, to research on the fate and transport of salt at various scales.

Colorado River Basin Monitoring Network and Basic-Data Collection: Colorado River Basin 20-Station Monitoring Network

Figure 2 - Location of monitoring sites in the 20-station network.

The USGS currently operates a network of 20 streamflow gaging stations for Reclamation for purposes of tracking and modeling current and future estimates of salinity concentrations and loads in the Colorado River Basin (CRB) (fig. 1). Streamflow and specific-conductance data from this network are used by the USGS to model salinity concentrations and loads (SLOAD output) for use by Reclamation in the Colorado River Simulation System (CRSS) water-supply and salinity projection models. Reclamation depends on the CRSS for midterm and long-term supply and water-quality studies in the CRB. During midterm studies, water-quality results are substantially impacted by initial model conditions, which include salinity concentrations downstream of major reservoirs such as Lakes Powell and Mead.

Hydrogeologic Characterization of Paradox Valley and Evaluation of Alternatives for Salinity Reduction in the Paradox Valley Unit, Montrose County, Colorado

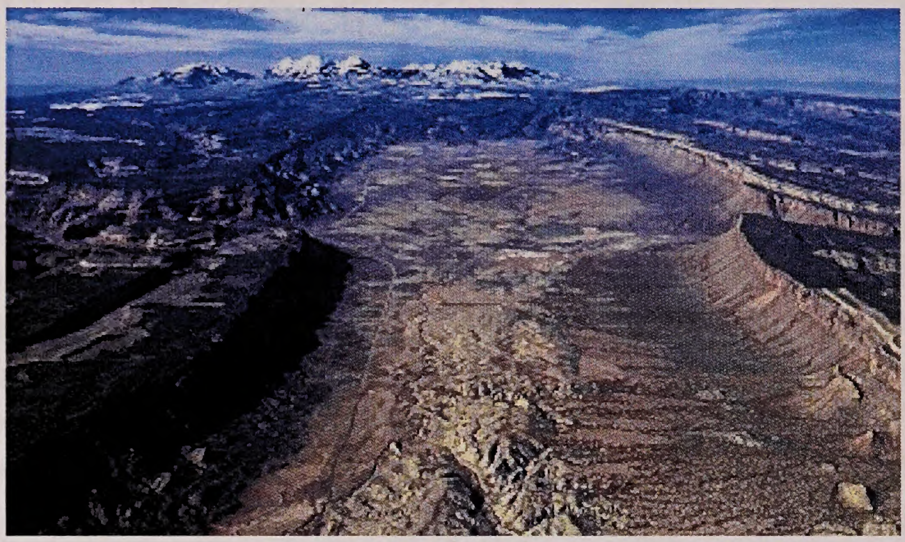


Figure 3 - Paradox Valley

Paradox Valley in western Colorado is a collapsed salt anticline (fig. 2), where groundwater flow has led to the dissolution of salt deposits and the development of a highly concentrated groundwater plume of brine in the central part of the valley. The Dolores River, a tributary to the Colorado River, flows across the axis of Paradox Valley and functions as a groundwater discharge location. Here, the Dolores River experiences substantial increases in salinity as it intercepts the brine, with historical (1988-1995) salt loads estimated to range from about 95,000 to 205,000 tons per year. Under the Colorado River Basin Salinity Control Act, Reclamation constructed and operates a salinity control project, the Paradox Valley Unit (PVU), to reduce salinity loads to the Dolores River. The project consists of a series of shallow pumping wells designed to intercept the brine before it flows into the river and an injection well that disposes of the produced water in deeper geologic formations. The injection well system is nearing the end of its useful life, and Reclamation is exploring alternative strategies to reduce the salinity loads to the Dolores River. Possible future mitigation alternatives to be assessed include (1) reducing recharge on the valley floor through modification of surface-water impoundments and (or) watercourses, and changing irrigation practices, and (2) managing (increasing) the stage of the Dolores River in the valley to decrease the groundwater gradient and flow between the aquifer and the river. The USGS is assisting Reclamation in these efforts through the development of conceptual and numerical groundwater flow and transport models and supporting hydrogeologic characterization.

Groundwater-Flow Modeling and Evaluation of Water-Management Scenarios for Salinity Reduction

The USGS has developed conceptual and numerical models of the Paradox Valley groundwater-flow system to aid in understanding brine movement in the valley and for evaluating the effects of potential water-management scenarios on brine discharge to the Dolores River. A conceptual model of groundwater hydrology and water quality in the Paradox Valley was developed that provides an improved understanding of the hydrogeologic framework, the spatial and temporal distributions of recharge, groundwater-flow directions, salt dissolution, and stream-aquifer interactions. A numerical groundwater-flow and transport model was developed beginning in 2011, which quantifies the water and chemical budgets for the Paradox Valley including the PVU. The numerical model provides a tool for quantitatively assessing groundwater flow and brine movement toward the Dolores River and for evaluating the effect of potential water-management scenarios on brine discharge. In 2013, the USGS conducted a 3- month aquifer test, utilizing existing PVU brine-production wells and nearby monitoring wells, to increase the amount of quantitative data to support modeling. In 2015, the numerical model was updated to include results for the freshwater-brine interface from the AEM survey, and simulations of water-management scenarios were initiated.

Preliminary results of the three-dimensional numerical model indicated that temporal variations in brine discharge to the Dolores River primarily are related to variations in infiltration of water (irrigation return flow and conveyance losses) in the western part of the valley, and to seasonal variations in stage of the Dolores River. These results suggest that water-management operations that increase freshwater heads in the alluvial aquifer could suppress the freshwater-brine interface and reduce brine discharge to the river. The processes and parameters that control these responses, however, are complex. The USGS is currently using the model to evaluate the effects of managing (increasing) the stage of the Dolores River in the valley to decrease the groundwater gradient, flow between the aquifer and the river, and thus brine discharge. Scenarios that increase or decrease recharge on the valley floor through manipulation of irrigation practices or modifications of surface-water impoundments also are being explored.

From 2016-2018, calibration of the three-dimensional groundwater-flow and transport model was reevaluated using additional data on brine injection provided by Reclamation as well as the estimates of salinity loads developed by Mast (2017) and Continuous Resistivity Profiling (CRP) discussed in the following sections. The modeled area was reduced to focus on the Paradox Valley floor, the underlying alluvial aquifer and the PVU pumping wells. The revised model provides an improved representation of the PVU brine pumping and the resulting salinity loads in the Dolores River. In addition, a high-precision GPS survey of PVU pumping wells and Dolores River streamgages was completed in September 2017 that provided absolute elevation information needed for model calibration. A report presenting the conceptual and numerical models underwent revisions in 2017 and 2018. The revised report will be submitted for colleague review and USGS approval in the fall of 2018 with publication expected during the winter of 2018.

Estimates of Salinity Loads for the Dolores River in Paradox Valley, Western Colorado

Reclamation evaluates the effectiveness of the PVU based on differences between the TDS loads computed at two USGS gaging stations on the Dolores River. Dolores River at Bedrock (USGS station 09169500) is located where the river enters the valley (upstream from the PVU), and the Dolores River near Bedrock (USGS station 09171100) is located where the river exits the valley (downstream from the PVU) (fig. 3). Loads are based on continuous measurements (15-minute interval) of specific conductance and discharge at the two gages and monthly water-quality samples, which are used to develop regressions between TDS and specific conductance. The USGS periodically assists Reclamation with updating the regressions and salt-load estimates as new data become available. Two previous USGS publications developed regressions for given time periods. Chafin (2003) developed regression models and computed daily salt loads for January 1988 through September 2001, and Linard and Schaffrath (2014) developed regression models for October 2009 through September 2012.

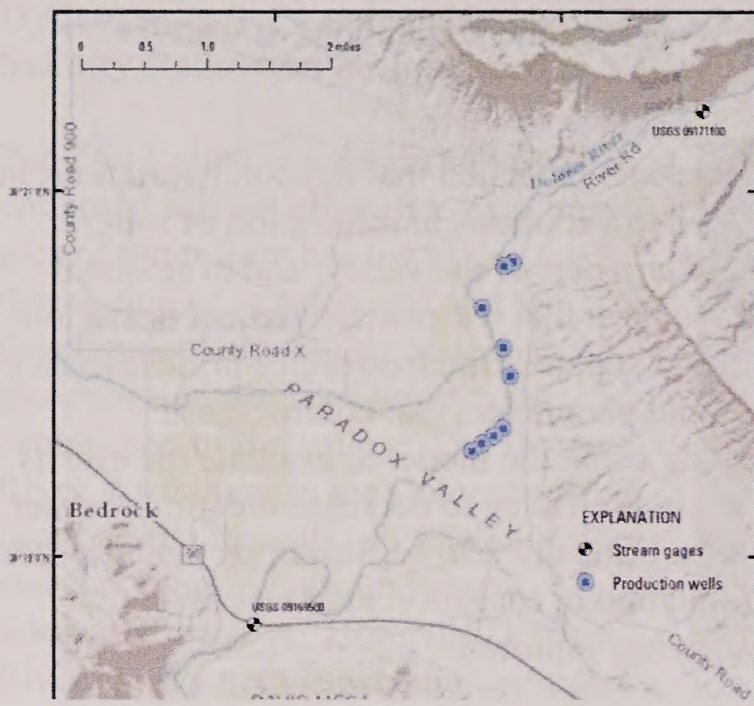


Figure 4 - Map of the Dolores River in Paradox Valley showing locations of streamgages and production wells.

In 2016, the USGS began a new project to develop regression models that relate TDS concentrations to specific conductance for the period of record from 1980 to 2015 for the two Dolores River sites that bracket the PVU in the Paradox Valley. The updated regressions are complete, and a report documenting the regression analysis and loading calculations was published in 2017 (Mast, 2017). Results from the regression analysis were applied to continuous records of specific conductance and discharge to estimate the gain in salt load to the river as it flows across the Paradox Valley for water years 1980 through 2015, and the estimates are being used as calibration targets for the revised groundwater-flow and transport model. The new regression equations also are being utilized by the USGS NRTWQ website (https://nrtwq.usgs.gov/co/), which provides real-time computed concentrations of TDS for the Dolores River sites.

<u>Literature Cited</u>

Chafin, D.T., 2003, Effect of the Paradox Valley Unit on the dissolved-solids load of the Dolores River near Bedrock, Colorado, 1988–2001: U.S. Geological Survey Water-Resources Investigations Report 02-4275, 6 p.

Linard, J.I., and Schaffrath, K.R., 2014, Regression models for estimating salinity and selenium concentrations at selected sites in the Upper Colorado River Basin, Colorado, 2009–2012: U.S. Geological Survey Open-File Report 2014–1015, 28 p., *http://dx.doi.org/10.3133/ofr20141015.*

Mast, M.A., 2017, Estimation of salt loads for the Dolores River in the Paradox Valley, Colorado, 1980–2015: U.S. Geological Survey Scientific Investigations Report 2017–5059, 20 p., https://doi.org/10.3133/sir20175059.

<u>Use of Continuous Resistivity Profiling to Characterize Brine Discharge Zones along the Dolores River, Paradox Valley, Colorado</u>

Although operation of the PVU in the Paradox Valley has reduced salt loads in the Dolores River by about 80,000 tons per year, upwards of 40,000 tons per year of excess salt is still exiting the valley indicating additional sources of brine to the river that are not captured by the current PVU well field. In 2017, the USGS began river- and ground-based geophysical surveys to better define the spatial extent and temporal variability of brine-discharge zones along the river. This information is needed by Reclamation to aid in the selection of optimal locations for new brine-collection wells. A secondary objective is to improve understanding of the effect of recharge from managed ponds and wetlands west of the river on the rate and location of brine discharge to the river. This information is needed to inform mitigation strategies for reducing salt load through water management alternatives in the Paradox Valley.

Continuous Resistivity Profiling (CRP) is being used to characterize sub-surface structure in the salt plume and delineate potential areas of enhanced brine discharge to the river. Saline groundwater has a low electrical resistivity (high conductivity) compared to the river water and the fresh water lens in the alluvial aquifer, which both have high electrical resistivity (low conductivity). The CRP method uses floating electrodes towed behind a small inflatable boat so that resistivity beneath the entire valley reach of the Dolores River can be measured. Electrical current is injected and extracted at two electrodes, while voltages are measured using the other electrodes. Location (GPS) and bathymetry data are collected concurrently with resistivity measurements to georeference the geophysical results. Specific-conductance profiles along the river also are collected from the boat to provide a longitudinal map of dissolved solids in the river.

The CRP and conductance profiles were conducted over the 7-mile reach of the river between the USGS stream gages. The first CRP survey took place during early-spring baseflow conditions in March of 2017 when the ponds/wetlands are filled but before snowmelt began, and a second CRP survey took place during spring runoff high flow in May of 2017. A third CRP survey was conducted in September 2017 during fall baseflow conditions. In addition to the CRP surveys, ground-based electromagnetic surveys were conducted in March of 2017 to characterize the extent of brine in the alluvial aquifer adjacent to the river. Results from CRP will provide two-dimensional vertical cross sections of electrical resistivity along the boat tracks oriented parallel to the river. Results from ground-based geophysical methods will provide plan-view maps of electrical resistivity (and interpreted depth to the freshwater-brine interface) for the surveyed areas. Study results will be published as USGS data releases in 2018.

As part of the CRP study, pressure transducers and continuous data loggers were installed to measure stage in wildlife ponds adjacent to the PVU. Water-level data collected at the ponds and adjacent PVU observation wells were being published as part of the project data release, and the results are being incorporated into the groundwater-flow and transport model. Seasonal water-level data for the ponds are being used to inform the simulation of freshwater recharge to the alluvial aquifer in the PVU and to develop management scenario that simulate the effects of increases and decreases of recharge to the alluvial aquifer.

Statistical Modeling (SPARROW and LowGunS) Applied to Assessing the Distribution of Salinity Loads and Load Sources in Stream of the Upper Colorado River Basin

The USGS has developed two models to assess the distribution of salinity loads in surface waters and sources of those loads in the Upper Colorado River Basin (UCRB): (1) The UCRB SPARROW (Spatially Referenced Regressions on Watershed) attributes model and (2) The Lower Gunnison River Basin Water-Quality model (LowGunS). These models represent the surface-water flow system at basin and sub-basin scales and are based on conceptual models that relate observed loads in UCRB streams to up-basin physical characteristics including elevation, precipitation, geology, land cover, and land and water use. Both models estimate salinity load and load sources and can be used to improve SCP managers' and planners' understanding of the salinity-load balance and to prioritize and optimize SCP resources toward efficient and cost-effective control projects.

Model estimates are currently being used by SCP participating agencies to meet a variety of information needs. Work continues, however, to enhance the accuracy and utility of these models as part of SCP science planning.

Upper Colorado River Basin Salinity Modeling – Updated and Enhanced SPARROW Model (SPARROW 2.0)

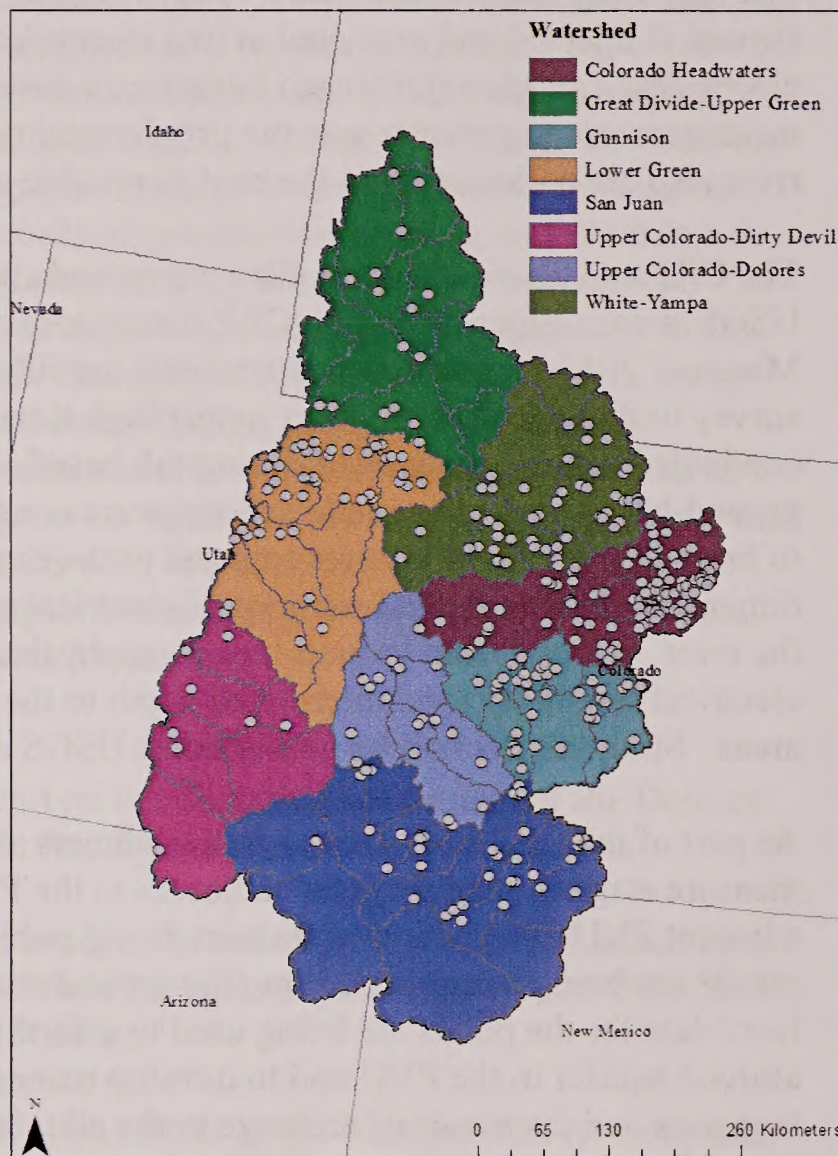


Figure 5 - Map of the Upper Colorado River Basin showing the location of major watersheds and 318 monitoring stations (grey points) where salinity loads were estimated and are being used as calibration data in SPARROW 2.0.

The UCRB SPARROW model (UCRB SPARROW 1.0) was developed by the USGS in 2009 to provide improved understanding of the spatial distribution of salinity sources, load accumulations, and transport mechanisms in the UCRB. This model relates observed salinity loads in UCRB streams to up-basin physical characteristics including elevation, precipitation, geology, land cover, and land and water use, and routes those loads through the stream network to estimate loads in more than 10,000 unmonitored stream reaches.

In 2014 and 2015, the USGS began development of an updated UCRB model referred to as SPARROW 2.0. The updated model builds on the geospatial basin characteristic data sets and modeling approaches developed for the SPARROW 1.0 model with emphasis on providing estimates of salinity load in the UCRB that reflect the current level of salinity control on irrigated lands under long-term streamflow conditions. Work to update the model included construction of the UCRB stream network, calibration to the aforementioned long-term mean annual salinity loads at 318 sites, and compilation of recent (2010) watershed characteristics data sets, including the updated irrigation dataset (fig 4). The updated model is complete, and the report documenting the model and simulations was published in 2017 (Miller and others, 2017). Model-estimated loads and load sources (e.g. natural vs. agricultural sources) allow managers to better understand and estimate load distribution and yield to streams in any area of interest, even if little or no data are available for that area. In turn, this information can be used to prioritize and optimize SCP resources toward efficient and cost-effective control projects.

The USGS continues to work closely with Reclamation scientists and engineers to maximize the SPARROW model utility toward the enhancement of future Reclamation salinity transport models, including providing estimates and predictions of agricultural and natural salinity loading to the CRSS model.

Literature Cited:

Miller, M.P., Buto, S.G., Lambert, P.M., and Rumsey, C.A., 2017, Enhanced and updated spatially referenced statistical assessment of dissolved-solids load sources and transport in streams of the Upper Colorado River Basin: U.S. Geological Survey Scientific Investigations Report 2017–5009, 23 p., https://doi.org/10.3133/sir20175009

Investigation of Transport of Dissolved Solids Discharged from Pah Tempe Springs, Southern Utah, and Possible Remediation of Salinity Load to the Virgin River

Figure 6 - Pah Tempe Springs, Washington County, Utah

Pah Tempe Springs (also known as Dixie Hot Springs) (fig. 5) discharge substantial amounts of dissolved solids (salt) to the Virgin River, which are then transported downstream and contribute to the salinity of the Colorado River. Consequently, these salts affect the suitability of water in the Lower Colorado River Basin for agricultural, industrial, and domestic uses. Studies conducted in the 1970s and 80s determined that desalinization of the water discharged from Pah Tempe Springs is technically feasible. However, the reduction in dissolved solids that would have been realized in the Colorado River from this type of project was less economical, at the time, than other proposed projects and involved more uncertainties. Consequently, the project was not implemented.

During 2007-08, USGS began a multi-phase investigation of salinity loading in the Virgin River and from Pah Tempe Hot Springs. Phase 1 investigated the transport and fate of salinity in the Virgin River from Pah Tempe Springs downstream to below Littlefield, Arizona. The Phase I investigation concluded that removal of salts discharged from Pah Tempe Springs could result in a larger reduction in dissolved-solids loads in the river at Littlefield, Arizona, than was previously estimated by Reclamation.

On the basis of these results, SCP managers determined to move forward with a comprehensive investigation (Phase II). The scope of work for this second phase was defined by recommendations resulting from Phase I and included an additional assessment of salinity load lost as seepage from the Virgin River and whether that load was returned to the river via Littlefield Springs. The results of Phase II have been documented in the USGS Scientific Investigations Report "Hydrosalinity studies of the Virgin River, Dixie Hot Springs, and Littlefield Springs, Utah, Arizona, and Nevada", which was published in 2014 and is available at *http://pubs.usgs.gov/sir/2014/5093/*. The results imply that a hypothetical reduction in dissolved-solids load in the Virgin River below Littlefield Springs, if Pah Tempe Springs salts were restricted, may be from about 67,500 or 71,500 tons/year immediately and as high as 90,000 tons/year within 30 years of restriction.

The USGS, in cooperation with SCP, Reclamation, and the Washington County Water Conservancy District (WCWCD), is currently completing two study tasks as part of a third study phase (Phase III), exploring the feasibility of Pah Tempe Springs load mitigation scenarios and the effects of mitigation on downstream Virgin River flow, chemistry, and ecology. Specifically, the current study phase is assessing the a potential of approach to reducing the Pah Tempe Springs salinity load to the Virgin River. The study is investigating pumping thermal water from within the Hurricane Fault damage zone to lower the groundwater pressure head at spring discharge locations and reduce or eliminate discharge from the springs to the river. The USGS designed experiments to assess the effects of groundwater withdrawals from the Hurricane Fault zone on discharge of saline water from Pah Tempe Springs, and on the flow and quality of water in the receiving Virgin River (figs. 8 and 9). Test results showed that pumping to capture thermal saline water is nearly 100 percent efficient with low flow in the Virgin River upstream of the study reach, and that unwanted freshwater capture can occur when the background river stage is higher. Drawdown and spring discharge reduction observed during pumping showed that the near-surface bedrock aquifer is extremely permeable. Groundwater temperature data indicate that the source of thermal water occurs several hundred feet upstream of the Hurricane Fault. The study report for Phase III was published early in 2018 (Gardner, 2018).

A groundwater flow model of the fault damage zone has been constructed for use in assessing test results and for evaluating future diversion and treatment scenarios. The subsurface characteristics of the Hurricane Fault zone are unknown and is a limitation of the model. To learn more about geothermal flow in the fault zone, a fourth phase (Phase IV) was added to the investigation. This phase, which is currently being conducted in cooperation with the WCWCD involves drilling two test wells into and adjacent to the fault zone to investigate the hydraulic properties and geochemistry and fluid flow. These data will then be incorporated into the model. Test well drilling is being funded cooperatively by the WCWCD and SCP and began during winter 2017/2018 (fig. 6). Additional drilling and sampling activities are scheduled to begin fall of 2018.

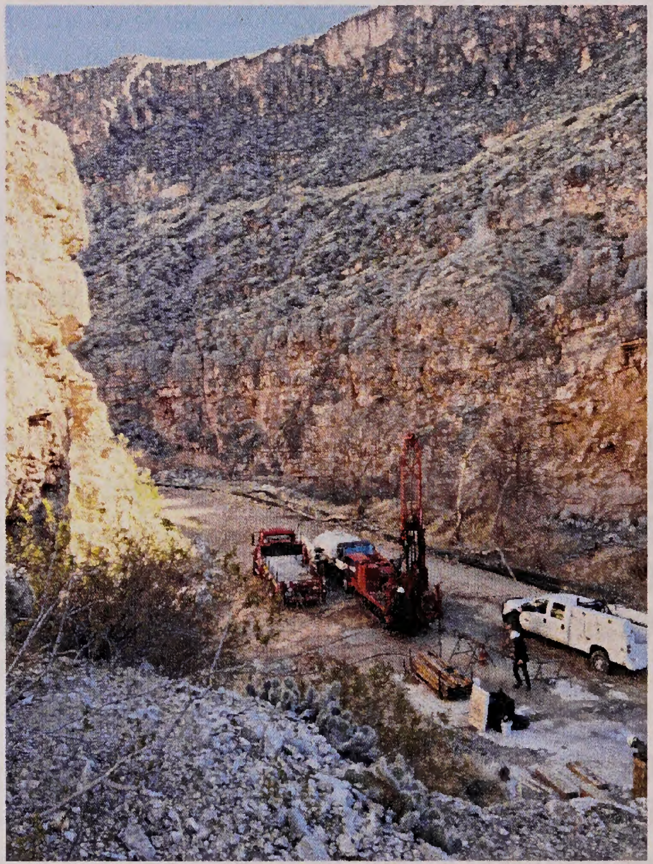


Figure 7 - Drilling operations near Pah Tempe Hot Springs in January 2018.

Study results aid in understanding the general hydraulic characteristics and properties of the fault zone and will allow for assessment of the feasibility and effectiveness of a range of possible pumping scenarios to reduce salinity load to the river. In particular, the groundwater flow model will aid in optimization of well placement and pumping schedules should a salt load mitigation project be developed. This will allow

Reclamation and SCP managers to assess the scope and cost of Pah Tempe Springs salt load mitigation approaches that incorporate groundwater pump-and-treat techniques.

References

Gardner, P.M. 2018, Effects of groundwater withdrawals from the Hurricane Fault zone on discharge of saline water from Pah Tempe Hot Springs, Washington County, Utah: U.S. Geological Scientific Investigations Report 2018-5040, 41 p., https://doi.org/10.3133/sir2018-5040

Rangeland Sources of Salinity – Evaluation of the Effects of Selected Rangeland Conditions on the Sources and Transport of Dissolved Solids Delivered to Streams in the Upper Colorado River Basin

The USGS, USDA Agricultural Research Service (ARS), Reclamation, and other member agencies of the Colorado Salinity Control Forum have been working together to further the understanding of dissolved-solids sources and transport processes in the UCRB since the 1970s. While many past studies have focused on irrigated agricultural lands, the overall objective of this study is to improve the understanding of sources and transport mechanisms in rangeland catchments that deliver dissolved solids to streams in the UCRB. An important goal is to gain knowledge about how certain land management practices or land conditions may be affecting dissolved-solids yields to streams, such that changes in these practices and conditions could be made to reduce dissolved-solids yields.

The study consists of six phases, including: (1) a literature review on sources and transport of dissolved solids in rangelands (completed), (2) a synthesis of the literature review (completed), (3) a GIS reconnaissance of the effects of rangeland conditions on dissolved-solids yields (completed), (4) an evaluation of the potential to improve an existing dissolved-solids source and transport model for the UCRB by better accounting for relevant factors in rangelands, including development of a SPARROW II (completed)and watershed scale model simulation of salinity loading at various scales (USGS report in review, BLM/ARS work ongoing), and (5) an analysis of the relation between dissolved solids and suspended sediment in streams in the UCRB (completed).

Relations between the health of rangelands (i.e. state within an Ecological Site) and transport potential of salts identified in this study may be used to investigate where conservation practices can be applied to cost-effectively reduce dissolved-solids yields to UCRB streams.

As part of the investigation of salinity sources from natural landscapes, the USGS is testing a model for simulating salinity mobilization and transport at a watershed scale using the same models that the USDA ARS and BLM are going to be using across the UCRB. The second study is examining how stream chemistry can be used to assess the source of salinity from a natural landscape.

Modeling Rangeland Dissolved-Solids Sources in Muddy Creek and Molen Seep Wash, Utah

The SCP has been working to further understand dissolved-solids sources and the associated transport processes in rangelands in the UCRB. Rangeland management has operated under the presumption that changes in land cover result in changes in watershed conditions and load response. However, these correlations are masked by transient fluctuations in precipitation, surface runoff, or irrigation practices. The overall objective of this study is to develop a conceptual model to assess scaling-up hydrologic parameters estimated from rainfall plot-scale experiments to the watershed scale. In addition, the conceptual model will be used to assess how different scenarios of land use and climate might affect dissolved-solids loads.

The plot-scale rainfall-runoff experiments were completed by the USDA ARS at the Molen Seep (Dry X) study area. An APEX model incorporating salinity is being developed for parts of the Muddy Creek and Molen Seep (HUC12) watersheds. Land use, soil distribution, and topographic characteristics are used to construct the model domain. In addition, long-term meteorological parameters (air temperature, precipitation, wind, solar radiation, and relative humidity) from 11 stations in and around the watersheds are used (fig. 7). Four USGS streamflow gages in the watersheds were used for salinity load calculations. At the Upper Muddy Creek, the Lower Muddy Creek, the Molen Seep Wash, and the Molen Seep tributary streamgages, continuous stage, discharge, and specific conductance were monitored with periodic analyses of event water quality.

Figure 8 - Study watersheds showing the modeled sub-catchments, meteorological stations, and streamgages. The photograph is of USGS streamgage 385202111121601, Muddy Creek below Miller Canyon near Emery, UT.

The watershed model has been constructed and the weather, land use, and soil databases have been populated. The model was used to simulate the distributed discharge and dissolved-solids loads at locations throughout the model domain as well as the four stream gages. Simulated model loads are compared to observed discharge and dissolved-solids loads for overall consistency.

The model was used to conceptually investigate various scenarios of land use and vegetation changes on dissolved-solids loading in the watersheds. The precipitation volume, event length, and temporal distribution of events also were varied to better understand the effects on dissolved-solids loading to the streams. A draft report describing the model and simulations is ready for review with publication expected in early FY2019. Results indicate that simulation of distributed precipitation hourly is critical for simulating transient storm loads that are common from arid lands in the UCRB. The model scenarios can be used to assess where conservation practices can potentially be applied to cost-effectively reduce dissolved-solids yields to UCRB streams.

Use of Stream Chemistry as an Integrator of Watershed and Landscape Processes to Assess Salinity Sources and Loads and their Relation to Natural Landscapes

The SCP is conducting studies to develop modeling tools to estimate salinity loading and to assess approaches to synthesizing and scaling-up rain-simulation plot-scale experiment results to develop conceptual and numerical sub-watershed scale models of salinity transport in selected areas in the UCRB. Additionally, there is a need for data from streams to connect source material to the stream salinity loading that is occurring. A more detailed understanding of the geochemical fingerprints of waters received by streams draining natural landscapes allows us to trace those waters to their sources and to constrain and refine future conceptual or simulation assessment models, as well as assess the accuracy and utility of their projections of the effects of management practices at various scales. Streams integrate the effects of all the hydrologic flow paths, processes, and surface activities in a watershed. As a result, stream chemistry will also reflect this integrated signal and has been used to forensically investigate sources, transport, and the fate of chemical constituents including salinity.

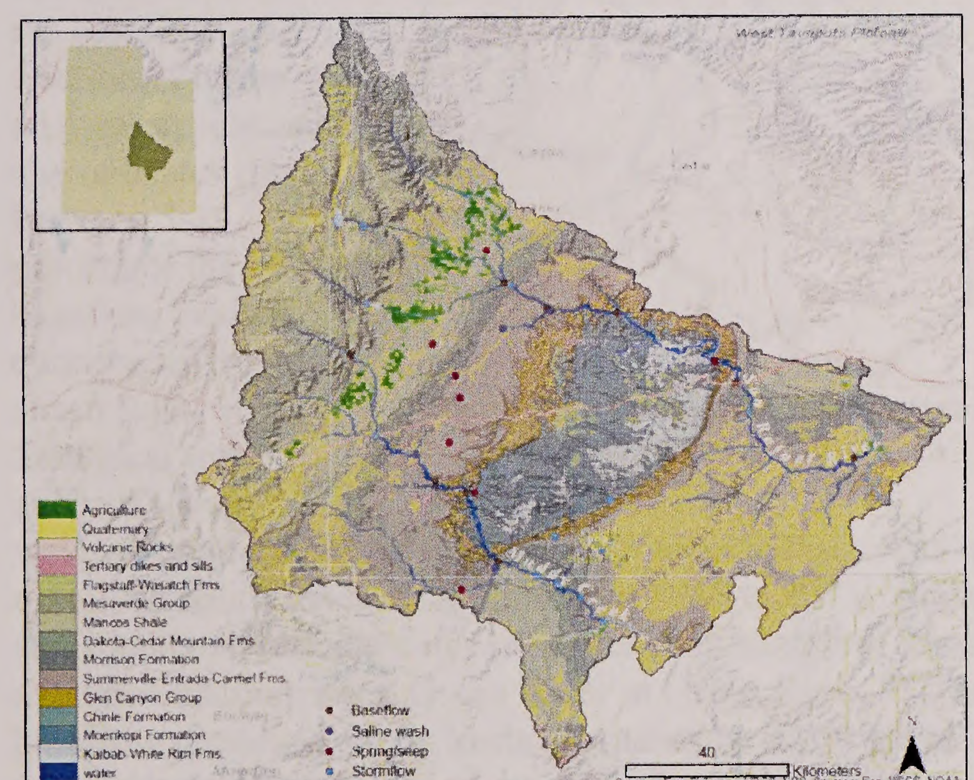


Figure 9 - Synoptic sampling sites on Muddy Creek and the San Rafael River.

This study is using integrated stream chemistry to assess sources of salinity from natural landscapes and provide the data required to assess transport mechanisms in future modeling and land-management decision support tools. Synoptic sample sets have been collected in 2016 on Muddy Creek and the San Rafael River in central Utah (figs. 7, 8, and 9) from the headwaters to their confluence with the Dirty Devil and Green Rivers under low flow conditions. These sample sets represent the sources and chemistry of baseflow loads. Additional samples were collected during runoff events that represent the surface component of loading in September of 2016.

Results from the baseflow sample sets indicate that there are distinct chemical signatures to the salinity loading from the Mancos Shale and the Carmel Formation, a Jurassic-age interbedded gypsiferous sandstone/limestone/siltstone. Storm flow samples have geochemical signatures of multiple formations and the source of solutes evolve over a storm event. For example, the source of solutes in Muddy Creek in baseflow conditions is the San Rafael Group while the San Rafael River solutes are predominantly from the Mancos Shale. Samples collected over a storm event on the San Rafael River indicate much of the storm solute load is derived from the San Rafael Group while Mancos provides the baseflow load. The implications for of these results for salinity control are that multiple sources of load that are active at different times which needs to be considered in the design of control projects.

Figure 10 - - Water sample collection along the San Rafael River.

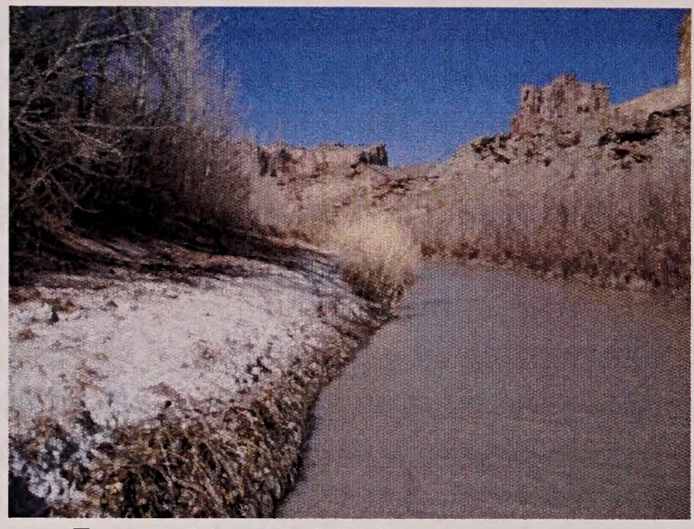


Figure 11 - Muddy Creek under baseflow conditions with effervescence salts on the stream bank

Analysis of Baseflow Salinity Loads and Trends in Loads

Across the UCRB baseflow on average accounts for about 50 percent of the annual streamflow yet because of high salinity concentrations in baseflow it accounts for a larger percentage of the salinity load. This study begun in 2017 assesses the baseflow component of load and trends in that load in the UCRB building on USGS funded work on determining baseflow component of streamflow in the UCRB. Chemical hydrograph separation was used to estimate baseflow discharge and baseflow dissolved solids loads at 69 stream gages across the UCRB. On average, it is estimated that 89 percent of dissolved solids loads originate from the baseflow fraction of streamflow. We believe that this method overestimates baseflow loads because it lumps summer and fall storm loads in to the baseflow load fraction. Further analysis at selected site indicates that between 5-15 percent of the baseflow loads is contributed by storm flow. Statistical trend analysis using weighted regressions on time, discharge, and season was used to evaluate changes in baseflow dissolved solids loads at 29 sites from 1987 to 2011. Sixth-two percent of sites showed statistically significant decreasing trends in baseflow dissolved solids loads (fig. 10). At the two most downstream sites, Green River at Green River, UT and Colorado River at Cisco, UT, baseflow dissolved solids loads decreased by a combined 780,000 metric tons, which is approximately 60 percent of estimated basin-scale decreases in total dissolved solids loads as a result of salinity control efforts (Rumsey and others, 2017).

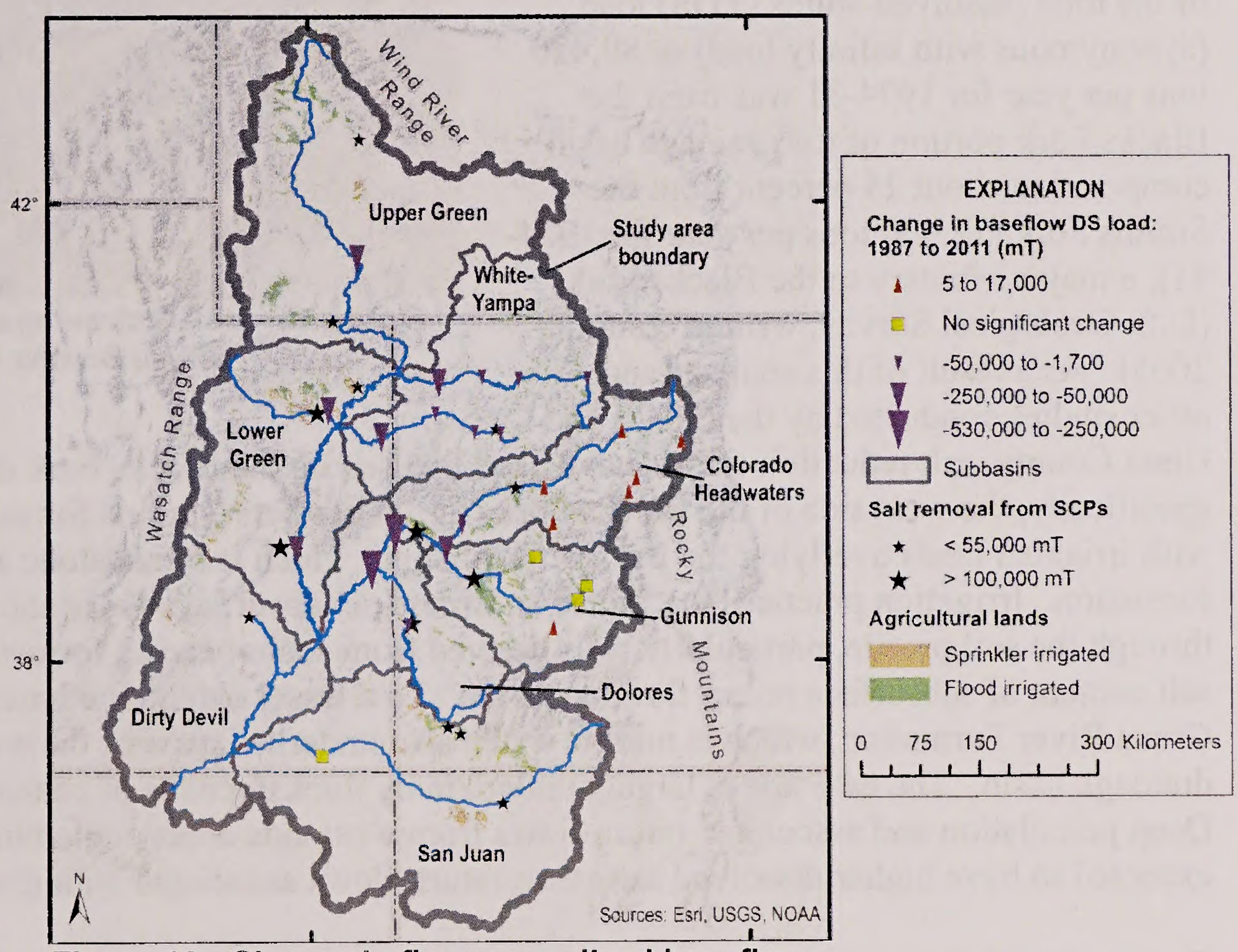


Figure 12 - Change in flow-normalized baseflow dissolved solids load from 1981-2011

Rumsey, C.A., Miller, M.P., Schwarz, C.E., Hirsch, R.M., Susong, D.D., 2017, The role of baseflow in dissolved solids delivery to streams in the Upper Colorado River Basin. Hydrological Processes v.31 p. 4705-4718 https://doi.org/10.1002/hyp.11390

Characterization and Quantification of Salinity Loads from the Blacks Fork above Smiths Fork near Lyman, Wyoming


Figure 13 - USGS streamgage – Blacks Fork above Smiths Fork

The Blacks Fork is within the Colorado River Basin and is a tributary to the Green River in Wyoming. Previous work by USGS in the drainage basin at the Blacks Fork near Lyman, Wyoming (USGS station 09222000), determined that about 75 percent of the total dissolved-solids (TDS) load (synonymous with salinity load) or 89,420 tons per year for 1974-81 was from the Blacks Fork portion of the drainage basin compared to about 25 percent from the Smiths Fork (22,400 tons per year for 1974-81), a major tributary to the Blacks Fork (U.S. Geological Survey, written commun., 2005). As a result of this analysis and other studies conducted by the NRCS and Uinta County, salt reduction efforts have been focused on the Blacks Fork drainage basin. More specifically, the west side of the Blacks Fork (fig. 1) has been studied for salt loading associated with irrigated lands overlying the Bridger Formation, which is a sandstone and shale-bearing formation. Irrigation practices that cause an excess of subsurface water and deep percolation through the soil profile, particularly soils derived from shale-bearing formations, can increase salt content of subsurface return flows to rivers. To a lesser extent, the Laney Member of the Green River Formation, which is marine shale, also underlies parts of the west side of the drainage basin. The east side is largely underlain by thick deposits of coarse alluvial gravels. Deep percolation and associated return flows from west-side areas containing shale would be expected to have higher dissolved salts than return flows associated with gravel deposits.

Current (2016) streamflow and salinity load data are not available for the Blacks Fork near Lyman, either above or below Smiths Fork, therefore calculations of salinity contributions from Blacks Fork to the Colorado River Basin are based on the data from the USGS streamgage Blacks Fork near Little America. However, the streamgage Blacks Fork near Little America has a drainage area of 3,100 square miles, which is much larger than the drainage area of streamgage Blacks Fork near Lyman (downstream of the Smiths Fork confluence at inactive USGS streamgage 09222000) of 821 square miles, so current salinity contributions attributed to the Blacks Fork drainage basin are likely not as accurate as possible. More accurate estimates of current salinity contributions on an annual basis from this area of interest could be obtained by installing a streamgage on the Blacks Fork, just upstream of the confluence with the Smiths Fork, to isolate the contributions from the Blacks Fork prior to the diluting effects of the Smiths Fork. Unpublished data indicate that average salt concentrations from seeps are higher on the west side of Blacks Fork than from seeps on the east side of the river. Synoptic water-quality sampling along the mainstem of the Blacks Fork and selected tributary and return flow inputs would help describe the locations and magnitude of water-quality changes in the Blacks Fork. These data could be used to characterize the salt loads in the Blacks Fork and its inputs and would provide water managers with information to evaluate salt-mitigation projects in this area. Operation of existing and installation of new streamgages and synoptic sampling began in Spring 2018.

Bureau of Land Management (BLM)

Colorado River Basin Salinity Control Program Accomplishments for Fiscal Year 2018

The BLM administers 53 million acres of public lands across seven states within the Colorado River Basin (CRB) above Yuma, Arizona. Most of these arid and semi-arid public rangelands have nonpoint salt sources including surface runoff, soil erosion (fires, grazing, embankments, incising channels, gully formation, wind, off-highway vehicle roads), channel sediments, and groundwater discharge to streams. Point sources of salt on public lands include saline springs, marine sedimentary formation seeps, abandoned flowing wells, abandoned mine discharge, recreation points (ramps), and discharge of waters from authorized activities such as oil and gas production or mining. Global semi-arid and arid rangeland studies have documented that salt loading is closely associated with sediment loading and that wind transport is the dominant mechanism of sediment movement. Salts can be transported in aqueous solution or with other solids as precipitates. Salt concentration on public lands tends to be highest in areas underlain by marine sedimentary rocks such as shales and mudstones that receive less than eight inches of annual precipitation. Areas within the Colorado River Basin (CRB) are underlain with nearly 10,000 feet deep of Mancos Shale providing a continuous supply of salt when exposed.

Overall runoff volume within these rangelands is low due to a minimal precipitation gradient and stream systems of ephemeral nature; however, large volumes can be episodic and create maximum sediment displacement. The greatest volume of salt contributed from BLM-administered lands is sourced from areas with moderate to low salt concentrations in soils that receive greater than 12-inches of annual precipitation commonly from these flashy storm events. Although salt concentrations in runoff from these lands are low, total loading is relatively large because of higher water yields. These areas comprise approximately 67 percent of BLM-administered lands in the upper basin where runoff is estimated to contribute more than half of the annual salt load.

The BLM reduces detrimental land impacts by utilizing best-management practices; including terms, conditions, and stipulations in land-use authorizations and by requiring actions to restore lands upon completion of authorized activities. The BLM engages in many activities to restore degraded ecosystems that contribute excessive sediment and salts to CRB watersheds. These activities include constructing and maintaining grade-control structures, spreader dikes, and retention structures; emergency stabilization and restoration efforts following wildfires; removal of invasive plant species, channel stabilization, and other riparian enhancements; maintaining road surfaces and culverts; remediation of abandoned mine lands, and; fire fuels reduction treatments.

Salinity reductions for these activities are confounding due to the inherent complexity of BLM lands and the salts (and sediments) contained being predominantly from nonpoint sources and the mechanisms of salt (and sediment) mobilization and transport are still being understood. Due to the inability to conduct effectiveness monitoring for all projects, the increased understanding of processes will take time and will be reported accordingly. Reports from BLM State Offices, and from gathering timely information within the databases, reference many of these activities and the BLM is engaged in efforts with collaborating agencies to improve the ability to quantify salinity reductions. To address these challenges, the BLM is co-developing a system of tools: APEX (Agricultural Policy EXtender model; Sharpley and Williams, 1990) integration with a groundwater tool, wind-dust salt distribution tool, salt (solution/precipitation/sorption accounting tool per spatial scale, and complex sedimentation tool based on spatial scale. The integration and linking of these tools is in progress as additional physical data continues to be collected throughout the CRB and then calibrated and validated within APEX. The collection of physical data to model parameter value justification was completed August 2018. That 5-year project was conducted on BLM rangelands within the CRB boundaries.

Program Summary and Administration

The 2018 budget included a total allocation of $1,900,000 for Colorado River Basin Salinity Control projects funded through the Soil, Water & Air Management (SWA) Program. The current Salinity Coordinator (SC) position was filled in January 2013 and is placed administratively at the National Operation Center (NOC). The Water Resource Specialist and SWA program lead positions were filled at the Washington Office in fall, 2016. State Soil, Water, and Air program leads assist BLM field offices with support for salinity control projects and reporting.

NATIONAL OPERATION CENTER

With the hiring of the SC, BLM invested in a literature review project and investigational study to improve the current understanding and identify the gaps in knowledge and data regarding the sources and transport mechanisms in rangeland catchments that deliver total dissolved solids (TDS) to streams in arid and semi-arid lands. Guidance for project planning and implementation have resulted in several salinity projects within the CRB to improve BLM land nonpoint source erosion and sediment and salt transport process knowledge for better quantification and assessment of land use and management practices. One of the first projects funded that remains active is the dynamic bibliography. New salinity literature is added as it is released from many sources and citations can be viewed online based on relevant search terms.

The SC, is in progress of co-developing an approach to quantify salinity reductions across BLM's public lands for nonpoint and point sources (per priority salinity impacted areas listed in the introduction) with Texas A&M AgriLife Research (TAMAR) in Temple, TX. The BLM-TAMAR team (led by Dr. Jaehak Jeong) is co-developing a system of tools centered on the APEX (Agricultural Policy EXtender model; Sharpley and Williams, 1990) in which the team is integrating groundwater and wind tools, and salinity equations adjusting for spatial scale and sediment particle size (based on physical data). The APEX tool will be used to detect sediment deposition and soil erosion from wind and water through a less expensive method than intensive and pervasive field sampling, to answer the public's questions and BLM's quantification's reductions and transport from land to the Colorado River regarding salinity.

BLM funded a multi-year baseline project to collect runoff, sediment, vegetation, and salinity data from a variety of saline soil sites (FY14-FY18). Physical and chemical data were collected from seven identified saline sites varying in vegetation, soil- salinity levels, and soil types in

Utah, Colorado, and New Mexico. The respective BLM field offices assisted with the required NEPA documentation. The USDA-ARS utilized their rainfall event simulator to conduct the experiment. Data are still being received and are undergoing quality review by the BLM SC. A final report will be submitted to the BLM by December 2019. The data are being used for determining if equations and processes can be extrapolated to the watershed-scale by the BLM-TAMAR team and the data will be used as the baseline for two additional projects with the BLM-USGS. The complete BLM-APEX tool can eventually be utilized for quantifying BLM land use and management actions and salinity transport contributions across the 53 million acres and for prioritization of funding, management, and future projects.

In FY2018, the NOC SC and TAMAR continue to work on the adaptation of the APEX model to meet BLM's needs to quantify sediment and salt transport. Wind erosion modules from the Aerolian EROsion tool (AERO; Webb et al., 2013) and ground water flow model MODFLOW (USGS) are being linked to APEX. Scripts are being produced to couple APEX-MODFLOW. The linkage files to map MODFLOW grids to APEX subareas are now developed (Fig. 1). The rainfall-runoff data from Price, UT (Fig. 2) is being used as the example watershed to discern the salt loads and test the new equations established in the adapted APEX model along with the other six rainfall runoff rangeland sites. The final APEX-MODFLOW version is integrated with an unsaturated flow tool and a salt transport 3D tool to estimate salt loading to streams to predict site vulnerability related to salt mobility and groundwater transport (MODFLOW-UFZ-RT3D; Bailey, et al., 2013). We are generating an indicator for site stability and/or land degradation.

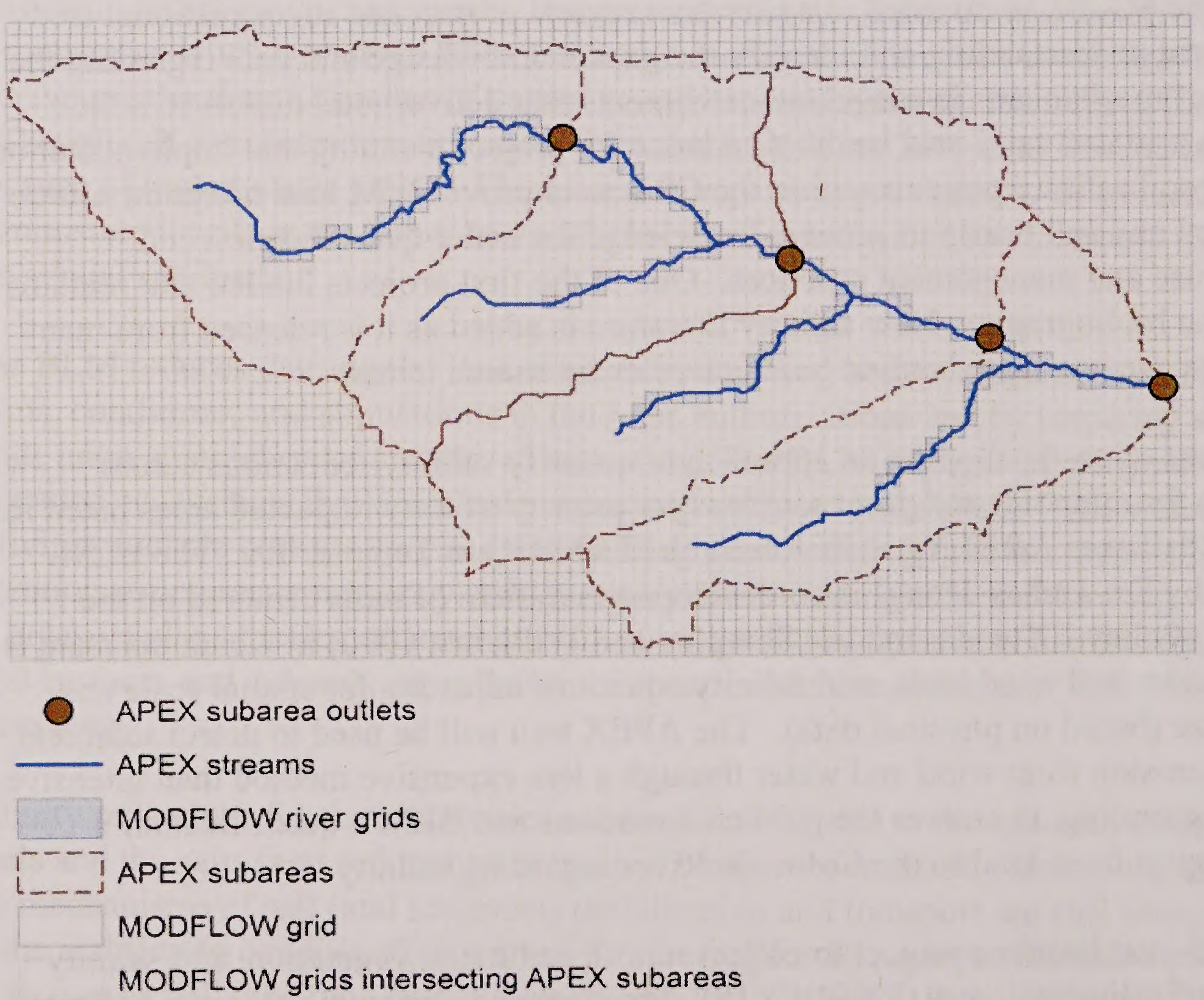


Figure 14 - Linkage of MODFLOW grids to APEX subareas

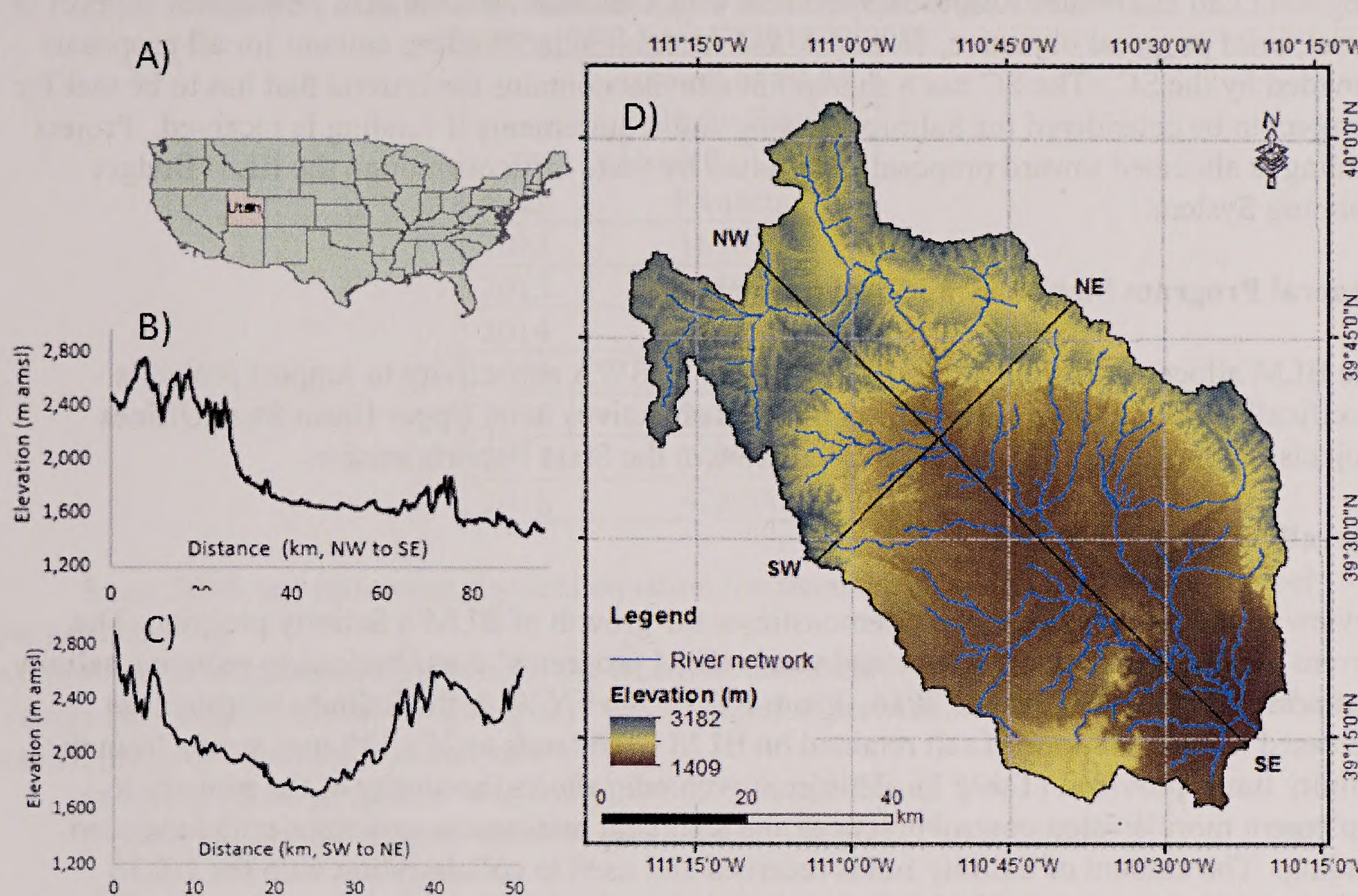


Figure 15 - A. USA and Price, UT watershed location; B. and C. Elevation profile of cross section NW to SE and SW to NE; D) Price watershed river network with 30-m digital elevation model in the background

With the Price watershed established, the runoff data utilizes a regression model formulated using a Machine Learning technique for plot-scale salt transport simulation. The salt loads to the Price River are then evaluated with the APEX-MODFLOW tool to test the scaling up application of the regression model. There are 72 rainfall-runoff plots and over 1,000 data points collected from the seven BLM saline rangeland sites. The Price, UT model will be used to test the other watersheds with the equations and adaptations made to APEX. The National Resources Inventory survey data for vegetation was used and updated the Price watershed to include an additional 234 plant species.

In January 2018, BLM released “A Framework for Improving the Effectiveness of the Colorado River Basin Salinity Control Program, 2018-2023.” All salinity efforts fit within this framework and continue to meet BLM’s mission.

STATE REPORTS

In FY2018, $1.9 million was allocated for BLM’s salinity-control program from its SWA subactivity to support projects that met the criteria for determining projects eligible for BLM’s salinity program objectives within the CRB. Project funding is allocated toward proposals submitted by State Offices and the National Operations Center (AZ, CA, CO, NM, NV, UT, WY) through the BLM Budget Planning System (BPSS) and prioritized for the WO SWA

Program Lead and Water Resource Specialist with a recommendation list, reasons for support or denial, brief proposal objective, concerns, and recommended funding amount for all proposals provided by the SC. The SC has a sharepoint site that contains the criteria that has to be met for a project to be considered for Salinity funding and requirements if funding is received. Project funding is allocated toward proposals submitted by State Offices through the BLM Budget Planning System.

General Program Summary and Administration

The BLM allocated $1,900,000 in FY2018 from its SWA subactivity to support project's specifically relating to salinity control program objectives in its Upper Basin State Offices. Projects funded in FY2018 are described below in the State Reports section.

Overall Summary FY2018:

Review of the previous five years demonstrates the growth of BLM's Salinity program. The current SC has been able to review and verify BLM programs' contributions to reducing salinity transport within the CRB since 2014. From FY2015 to FY2018, the Salinity program has increased from 1,248 tons of salt retained on BLM CRB lands to 173,119 tons solely from the Salinity funds provided (Table 1). This improvement reflects the ability of the projects to implement more erosion control practices and sediment retainment structures with increased funding. The amount of Salinity funds received and used in collaboration with the USGS projects in alignment with BLM Salinity objectives and BLM's mission is presented in Table 2.

Table 1 - Salt tons retained on BLM CRB lands and funds received from FY2014-FY2018

Fiscal Year	Salt Tons Retained	Salinity Funds Received (M)
2014	--	1.26
2015	1,248	1.125
2016	74,086	1.5
2017	111,743	1.5
2018	173,119	1.9

Table 2 - BLM Salinity funds used for USGS projects (CO, UT, WY) within the CRB from FY2012-FY2018

Year	Amount of BLM Salinity Funds Used for USGS Projects
2012	165000
2013	175000
2014	225000
2015	170000
2016	268000
2017	245000
2018	428000

Since 2014, the following physical equation has been used to calculate tons of salt per year per area:
Assumptions throughout calculations in the BLM section include: % salt = 3% by weight; Average bulk density of soils = 2.65 g cm^{-3} unless stated otherwise and the principal tons of salt retained per year equation is as follows:

$$[x \text{ miles} * 2 \text{ cu yd mile}^{-1} * 4467 \text{ lb yd}^{-3} * 0.03 \text{ lb salt lb soil}^{-1}] =$$
$$[13{,}401 \text{ lb salt lb} * x \text{ miles mile}^{-1}] = [6.7 \text{ tons of salt year}^{-1} * x \text{ mile mile}^{-1}] \qquad \text{eqn. 1}$$

Fuels Treatment Effectiveness Monitoring Program (FTEM)
Utah has 171 records where there is 90 days to report it into the FTEM database. The records for Utah account for 21 percent of all of BLM's records. Since 2003, BLM has accomplished millions of acres of fuels management treatments including prescribed fire, seeding, thinning, mastication, and lop and scatter. Vegetation left on the ground from treatments such as lop and scatter, inhibits the transport of sediment and salts. Initially there may be increased erosion; however, overall per acre burned there is 1 cubic yard of sediment retained. Central to the success of the program is assessing the efficacy of those treatments. Since 2010, the FTEM has treated 1,164 acres (mastication and reseeding) within the CRB (AZ, CO, NM, UT) resulting in the reduction of **125,830 salt tons** transported.

Emergency Stabilization and Rehabilitation Program (ES&R)
Emergency Stabilization and Rehabilitation is a BLM program that reduces sediment and salinity transport. The ES&R reports provide detail of areas and treatments, success rates of treatments, monitoring durations, and additional efforts, as well as the related costs. The information is used by the SC to combine with existing vegetation, land use, soil, slope and climate data to compare pre-burn conditions to post-burn and post-rehabilitation conditions and establish solutions to questions about the impacts of fire on salinity availability over time. Larger and more recent fires that have been treated on BLM lands that impact salinity and sediment retention will be added for more coverage throughout the CRB. The ES&R Table 3 presents several fires where more than 10,000 acres were burned. The information contained is conservative in that no area is accounted for spatially more than once nor treated more than once to minimize double accounting. From these 12 Utah fires, the ES&R treatment reduced **8,945,237 salt tons** from being transported across BLM CRB lands.

Table 3 - The BLM Emergency Stabilization and Rehabilitation Program area treatments and salt retained per fire event

Event Name	Location	Year	ES&R FY Treatment Years	BLM Acres Treated	Salt Tons Reduced	Treatment
Bryson Wash	West Desert District	2006	2007, 2008	424	48,835	Seeding
Columbia Fire	Price, UT	2009	2009, 2010	1,322	142,910	Seeding
Rattle Fire Complex	Moab, UT	2002	2002-2005	28,544	3,085,640	Cleanout Washes; Seeding
Little Baullie Mesa Treatment	Moab/ Monticello, UT	2009	2009, 2010	1,653	178,691	Seeding; Remove PJ
West Coal Creek Fire	West Coal Creek	Grazing Area since 1960s	2007, 2008	2,002	216,419	Remove PJ; Seeding
Westwater II Fire	Moab, UT	2006		1,128	121,938	Seeding
Lakeside Fire	Tooele County, UT	2011	2012, 2013	15,964	1,725,727	Seeding, Noxious weed Control
Dallas Canyon Fire	Central Tooele Country, UT (>30% slopes)	2012	2012, 2013	1,308 success ful (5,317 treated)	141,396	Seeding, noxious weed treatment, closures, other treatment
Patch Springs Fire	Terra, UT and nearby Tribal Lands (area with high potential flash flooding and sediment transport)	2013	2013-2015	6,497	702,333	Seeding, soil stability structures, cattleguards, fencing,
Faust Fire	Vernon, UT	2012	2012-2014	11,658	1,260,244	Seeding, closures,

						soil stability
Grease Fire	Fillmore area. UT	2012	2012-2014	2,435	263,226	Seeding, closures, cattle guard
Clay Springs Fire	Canyon Mountain Range, UT	2012	2012-2014	9,786	1,057,878	Seeding, erosion control structures, closures, fences

Recreation-OHV (Off Highway Vehicle) Program

Within the entire CRB, we have calculated that the Recreation-OHV Program contains 89,700 miles of dirt roads that contribute to sediment and salt transport (Figure 3.) Based on a pound of soil having an average of 3 percent salt and that an average of 2 cubic yards are retained per mile of road maintained; it is assumed that at least one time since a BLM OHV road was maintained since it was built. Thus, it reasons that a minimum of **20,560 salt tons** have been retained on BLM land due to road maintenance on OHV dirt roads (Fig. 16).

Figure 16 - BLM Recreation-OHV Program dirt roads that contribute to salt transport within the CRB

All salinity-related data will be updated and accounted for as it becomes available per BLM databases and reports. **The total number of salt tons retained by FY18 funded Salinity Program accomplishments are 173,119 (Table 4).** The calculated contributions from Recreation-OHV for Roads for overall miles (**20,560 salt tons**); FTEM [(approximately **125,830 salt tons** (AZ, CO, UT, WY)] from FY2010 to FY2018; and the ES&R Program for 12 selected BLM fires in UT (**8,945,237 salt tons** retained) totaling 9,264,746 tons of salt retained on BLM lands without area duplication (Table 4). ***The total of salt retained on BLM lands for the programs included in this report is 9,264,746 tons, including Salinity (without area duplication).***

Table 4 - Salinity states and their contributions to retaining sediment/salts on BLM lands

State	Salt Tons retained from FY2018 Salinity funded projects	§*Carryover of tons of salt retained since FY2004 (as applicable)	Cumulative salt tons retained from Salinity funded projects	Final Salt tons retained on BLM lands from Salinity funded projects	Final Cumulative Salt Tons Retained from Multiple BLM Programs including Salinity
AZ	0	7747	7747	**173,119**	**9,264,746**
CO	0	6000	6000		
NM	23,871	41675	65,546		
UT	8,116	27829	35,945		
WY	52,399	5482	57,881		

*Numbers reported are subject to the updating of BLM data
§Deamoritization was not taken for salt tons carryover in FY18.

STATE REPORTS

BLM State Offices submitted the following reports describing activities related to salinity control programs on BLM-administered lands. State reports include descriptions of projects conducted with designated Salinity Program funding through the SWA subactivity as well as summaries of activities conducted through other programs and permitted users that reduce the transport of salt to the Colorado River.

ARIZONA

Across the Arizona Strip Field Office there are hundreds of erosion control structures which have been built to slow erosional runoff, salinity, and valuable soil loss which could eventually reach the Colorado River system via wind or water. There are 243 of these structures in the 1,000-acre Fort Pearce flood and salinity control subbasin that are in progress of being maintained.

COLORADO

USGS Yellow Creek Streamflow Site

Continued funding occurs for USGS streamflow site above Crooked Wash to bracket an area on the White River (White River Dome and Piceance and Yellow Creeks) known to be responsible for increasing salinity loads in the White River. Summary of all data available and funded by BLM is available at
http://waterdata.usgs.gov/nwis/nwisman/?site_no=09306224&agency_cd=USGS.

Stinking Water Gulch-Grand Junction- UFO & USGS

Project Tasks and Progress: The study includes four basins in Stinking Water Gulch near Rangely, Colorado. Two basins are dominated by energy development (Basin A1 and A2) and the other two basins are dominated by rangeland grazing (Basin B1 and B2). The basins in each basin group (A and B) include basins of similar size, aspects, soils, and slope. A comparison of sediment, salinity, and selenium storage characteristics between these two basin groups is used to evaluate the homogeneity of each system as well as to test for significant differences between the two groups. This approach aims to provide insight into how different land uses affect the distribution, storage, and release of sediment, salinity, and selenium in surface-water systems. Results will be presented as part of a peer reviewed publication in 2019. The objectives of the project are to (1) characterize sediment, salinity, and selenium distribution and storage in four basins in Stinking Water Gulch under differing land uses (energy development and rangeland grazing); and (2) to evaluate the role of land use (energy development and rangeland grazing) and watershed processes that may increase sediment, salinity, or selenium inter-basin flux.

This project began in 2015 and is nearly complete. The methods and tasks are described in the 2016 FAR. With remote sensing images (1953-2013) used to evaluate the land use history of each basin and provide the timing and occurrence of changes in land use and channel morphology (channel width, sinuosity, and drainage density), the temporal context of any observed changes in large-scale channel form that may be associated with land use changes or other disturbances within the surface-water system. Surveying was completed for each basin to understand differences in channel geometry to facilitate assessment of storage of sediment, salinity, and selenium for each basin. Surveying efforts included 20 cross-sections in each of the basins in conjunction with an unmanned aircraft systems (UAS) equipped with a high-resolution digital camera. Utilizing Structure from Motion (SfM) topography mapping techniques, approximately 13,000 overlapping images from the UAS were combined using available processing software to produce Digital Elevation Models (DEMs) of each of the four basins (Clark and others, 2013).

An assessment of hillslope erosion potential began December 2015, using the Water Erosion Prediction Project (WEPP) model (USDA, 1995). The WEPP model is a process-based, distributed parameter, continuous simulation, erosion prediction model that is applicable to evaluate hillslope erosion processes (sheet and rill erosion). Comparison of these basins can aid in understanding potential sediment inputs and erosion attributable to road and well pad disturbances associated with land uses in the area. Final correlations are being identified between erosional value and basin morphology and cross-sectional area amongst other pertinent factors and will be presented in the final report.

Groundwater Chemistry and Water-Level Elevations of the Piceance and Yellow Creek Watersheds, Rio Blanco County, Colorado-BLM & USGS
Groundwater is one of the many resources that BLM must consider when managing our public lands. In some locations in western Colorado, saline groundwater is a source of salinity to surface waters. In the Piceance and Yellow Creek Watersheds, saline groundwater is present in the freshwater aquifer and is a known contributor of salinity to Piceance and Yellow Creek. For example, a study conducted in Alkali Flats located in the northern part of the study area, found that groundwater only needed to contribute five percent of the flow to Piceance Creek to result in observed increases in salinity. Anthropogenic activities such as nahcolite mining, gas development, or oil shale development could change the amount of saline groundwater that contributes to surface water. Monitoring water-level elevation and groundwater chemistry in bedrock aquifers in the Piceance and Yellow Creek provides BLM with data on which to base sound management decision regarding groundwater resources.

The BLM and USGS are collaborating to conduct monitoring for understanding groundwater chemistry and water-level elevations in bedrock aquifers of the Piceance and Yellow Creek watersheds in Rio Blanco County, CO.

NEW MEXICO

San Juan River Basin Erosion Reduction
Focus is on noxious weed removal that threatens native riparian habitat, cutting trees, and showing lack of understory plant growth leading to loss of top soils due to rain/snowmelt events that lead to surface products in the stream. Sediment fences are being built, Youth Conservation Corps are involved to restore native vegetation and soil erosion and salinity will be reduced. Work is progressing.

La Manga Canyon Watershed Improvement
Degraded rangelands including sagebrush grasslands and P/J woodlands are on steep hillsides. The trees have minimal understory and excessive soil erosion. Sediment retention dams are being built with an estimated salt savings of **13.5 salt tons per year** with life expectancy of 10-

12 years (17 structures x 13.5 tons =) **229.5 tons** of salt retained in 2018.

Road Improvements – Roads have been regularly maintained and reconstructed to meet road standards. The BLM's Civil Engineering technician developed the San Juan Public Roads Committee. This committee includes oil and gas producers, members of the local ranching community, and the Forest Service. The Committee has greatly improved the conditions of the local unpaved roads and has helped reduce the amount of sediment reaching the river systems from the road network. The Surface Protection staff at the BLM-FFO improved over 32 miles of road, built 12 engineer approved sediment retention structures, cleaned five retention structures, installed 28 culverts and built eight sediment ponds resulting in a carryover of **162 salt tons** retained near the Farmington, NM area.

Vegetation Treatments – Sagebrush treatments with Tebuthiuron were applied to 13,270 acres of sagebrush/grassland that had become unhealthy due to excessive densities of sagebrush. Sagebrush in high densities tends to dominate the available soil moisture causing a loss of grass species and an increase in bare ground resulting in increased soil erosion. Tebuthiuron is applied at an appropriate rate to thin the sagebrush but not to eliminate it. Reducing sagebrush densities generally results in increased water availability for grass and forb species which typically increase ground cover and reduce soil erosion. Pinyon/Juniper lop and scatter projects are beneficial to salinity reduction on the landscape. Reestablishing a grass understory in project area increases infiltration rates and decrease runoff and erosion during high flow precipitation events. Slash created by the project is used to protect seeded areas and decrease sheet runoff in the project areas. Seed mixes used include a wildlife forb component.

Silt Traps – Eighty-three Applications for Permit to Drill (APDs) have been approved this year with exemptions provided to Oil and gas operators granted with an exemption from storm water runoff by the EPA. A common Best Management Practice (BMP) associated with the building of these well pads is the construction of silt traps to contain sediment runoff associated within the disturbance from the well pad. Each location generally had a minimum of one silt trap associated with it. For this FY, 83 silt traps were constructed, assuming 1 silt trap per well pad. Approximately 640 silt traps have been built to help curtail sediment and salt loading and improve water quality in the San Juan Basin has resulted in about **19 salt tons** retained. This is an aggregate estimation from road improvements and well pad construction projects.

San Juan River Watershed Salinity Reduction and Vegetation Management
Rangeland areas have been identified for vegetation treatments to increase native understory recovery. The funding for this project has been allocated through an agreement with NMACD to conduct aerial treatment of 13,270 acres of sagebrush communities lacking sufficient understories. The estimated salt yield for this project is **19,260 salt tons.** Approximately 35 acres of P/J encroachment have been thinned and seeded; an approximate 500 acres of P/J encroachment in the Simon Canyon Watershed and Middle Mesa have been treated using heavy equipment and the areas have been reseeded yielding an approximate **3,100 salt tons** retained.

Approximately 40 acres of thinning projects in La Manga Canyon were reseeded to ensure project success. The mowing of approximately 300 acres of Tamarix within Gobernador Canyon occurred. NEPA compliance for the project is in the final stages. The salt cedar leaf beetle biocontrol has eliminated most of the salt cedar communities in the canyon, and this project is designed to seek and eradicate the remaining clusters with small equipment. This project yields approximately **1100 salt tons** retained.

San Juan River Watershed Integrated Salinity Reduction
Funding for this project has been allocated to purchase materials used for sediment capture fences. Two major structures in Largo Canyon and La Manga Canyon are planned to have maintenance and upgrades.

Figure 17 - Recently Installed Silt Trap

Figure 18 - Previous Bradley Road Figure (completely impassible-eroded by Carrizo Wash)

UTAH

General Summary
The BLM-Utah's salinity program is focused on reducing sediment and salinity loads transported across the landscape and within streams and washes, with the overall goal of ultimately reducing salinity loading from BLM managed lands to the Colorado River. The BLM-Utah supports projects that capture saline sediment and encourages studies to monitor and quantify sediment transport using innovative method that identify saline soils (particularly where soil survey data is limited or non-existent), estimate sediment and salt loading rates, and prioritize areas to focus salinity reduction efforts. Salinity funding was used to repair erosion control structures, implement new stabilization projects to reduce erosion on saline soils, and fund interagency research agreements to identify sources of salinity and quantify loading rates.

Projects
Repair and maintenance of sediment retention structures:

Kanab Field Office (KFO): Repair and maintenance of salinity control structures. In 2017 (FY18) the Kanab Field Office began large scale maintenance on the Dry Wash salinity control structure. The Dry Wash control structure has been in a non-functioning state since the mid 1990's because it was full of sediment and unable to retain any more. The sediment was excavated by heavy equipment and used to repair the existing dam. Excavation was 75 percent complete before a large thunderstorm filled the structure with water and washed through part of the spillway. The BLM was able to go back in September and fix the spillway but was unable to remove more sediment due to the presence of a large amount of water. Approximately 3,440 yd^3 (**231 salt tons**) of salt-laden sediment was excavated from the control structure's primary settling pond and moved to the control dike to restore and stabilize the dike and increase the holding capacity of the reservoir.

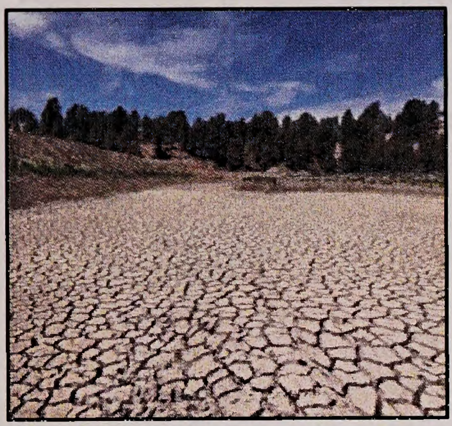


Figure 19 - Dry Wash Structure FY2018

The Thompson Draw salinity structure has been washed out and in a non-functioning state for a number of years. Salt-laden sediment was removed from the bottom and sides of the structure and used to enhance the strength of the dam. The structure was returned to its original size and an overflow was put in place to help stabilize the structure and improve function through intense storm events. Approximately 1,500 yd^3 (**101 salt tons**) of salt-laden sediment was excavated from the Thompson Draw structure. The Thompson Draw structure is now capable of holding 4,190 yd^3 (281 salt tons) of sediment.

Figure 20 - Thompson Draw before (left) and after (right) maintenance.

The West Canyon salinity control structure has been in a non-functioning state for a number of years. The BLM excavated sediment from the bottom of the structure and used it to reinforce the large breech in the dam. Approximately 1,100 yd^3 (**74 salt tons**) of salt laden sediment was excavated from the West Canyon salinity control structure. The West canyon structure is now capable of holding 3,896 yd^3 (261 salt tons) of sediment.

Figure 21 - West Canyon before (left) and after (right) maintenance.

The Black Rock Flat salinity control structure was nearly unrecognizable in 2015 because of the amount of sediment it collected in the last 30 plus years. The BLM excavated sediment from the bottom of the structure and reformed the control dike. Approximately 1,017 yd^3 (**68 salt tons**) of salt-laden sediment was excavated from the Blackrock Flat salinity control structure and added to the dike to allow for more sediment to be trapped in the structure.

Figure 22 - Black Rock Flat before (left) and after (right) maintenance.

The Black Rock salinity control structure was constructed in the 1970's and had filled to capacity as of 2017. Salt-laden sediment was excavated from the bottom of the structure to recreate the dike. As can be seen in the preceding pictures the Black Rock salinity control structure is a large structure. Approximately 2572 yd^3 (**170 salt tons**) of salt-laden sediment were excavated from the Blackrock Flat salinity control structure and used to rebuild the dike.

The Yellow Canyon salinity control structure was originally constructed in the 1990's. Large storm events completely washed out the structure. The structure and salt laden sediments were excavated from the Yellow Canyon salinity control structure and used to rebuild the breached dike. The Yellow Canyon salinity structure now has a capacity of 2,992 yd^3 (**200 salt tons**).

The Upper Sink Valley salinity control structures were two structures that were completely full of sediment. Flood waters carrying sediment were running over the structures and contributing to large floods that carry salts into the Colorado River system. In total, 1,256 yd^3 (**38 salt tons**) of salt-laden sediment were excavated from the Upper Sink Valley salinity control structures.

Figure 23 - Upper Sink Valley structures 1 (left) & 2 (right) after catching water and sediment.

The Adams Wash salinity control structure was constructed in the 1980's and appears to have been maintained once since that time. The BLM performed maintenance on the structure and 604 yd^3 (**40 salt tons**) of salt-laden sediment were excavated from the Adams Wash salinity control structure.

Kanab Field Office Salinity Work 2018

In summary, nine structures were cleaned and repaired on the KFO. A total of 14,481 yd^3 of sediment was removed from these structures and used to repair and maintain the dams. An estimated **970 salt tons** were removed from the sediment structures and used to repair or rebuild the dikes.

<u>Grand Staircase-Escalante National Monument (GSENM)</u> – Repair and maintenance of 37 salinity control structures. These structures ranged in size from 0.03 to 0.5 acres. Most of the work focused on removing sediments to increase storage capacity in functioning structures. Breaches in several dams and gully plugs were also repaired and/or reinforced. Approximately 65,524 yd^3 of sediment was removed from the structures and used to maintain and repair the adjacent dams. The last clean-out dates are unknown, but salt captured over the life of these structures was approximately **4,390 salt tons**. Fence posts were placed in the bottom of these structures to track sediment accumulation over the next several years.

In addition, funding was used to repair the dam at the Eight Mile salinity control structure and to move and lower the overflow spillway. In 2013 and 2014, BLM received salinity funding to extend the dam approximately 150 feet, repair and stabilize the spillway, and excavate sediment from the control structure's primary settling pond to restore the holding capacity of the reservoir. The top of the spillway was too high, and it was necessary to move and lower it for proper function.

Figure 24 - Large salinity control structure near the Wolverine Loop Road in the Circle Cliffs. This structure was cleaned in August 2017. The structure captures saline sediments from Chinle Formation outcrops to the west.

During the summer of 2017, fence posts were placed in the bottoms of 23 structures cleaned from FY14 to FY16 to monitor annual sediment accumulations. From August 2017 to July 1, 2018 these structures captured 27,384 yd^3 of sediment, resulting in **1,834 salt tons reduced**. Two salinity control structures in the House Rock Valley Road area were almost completely filled with sediment during a monsoon storm at the end of July 2017. Both structures retained approximately 4-ft of sediment resulting in 858 salt tons reduced (encompassed in the 1,834 salt tons noted above).

High resolution surveys were conducted using a georeferenced laser range finder to determine the geometry of KFO salinity control structures. Total cubic yards of sediment were determined from these surveys.

Headcut stabilization:
Grand Staircase-Escalante National Monument – Headcut repair and soil stabilization in a deep gully formed in Telegraph Flat, near the southern boundary of the Monument. In November 2017 GSENM begin the first phase of a multi-phase project to stabilize active headcutting on Telegraph Flat, near the southern border of the Monument. During phase 1, contractors installed two rock mulch rundown structures to stabilize two wide, incised headcuts. The rock mulch rundowns were constructed by building a slope through the headcuts and reinforcing the slopes with geotextile webbing filled with rock and soil. Collector structures were built at the top of the rundowns to direct water onto the rundown structures. These structures are designed to reduce the energy of water causing headcutting and prevent the headcuts from migrating further upstream.

Reducing grazing pressure on saline soils:
Moab Field Office: The Big Flat Grazing Allotment has a new grazing strategy due to the recent permit renewal process. In order to better manage a large area of moderately saline soils, a new grazing pasture has been delineated allowing a shorter period of use on these soils. Construction of a multiple mile fence is necessary to divert grazing and reduce erosion of highly saline soils. Total tons of salt reduced has not been assessed.

Monitoring stream flows and salinity concentrations:
San Juan River Monitoring: Monitored for flow, sediment (as turbidity) and salt (as specific

conductance) concentrations in the San Juan River near Bluff, UT. The station is being maintained by the USGS. Data collected from this gage will be used to correlate salt concentrations with suspended sediment concentrations in the river. This relationship combined with flow data will allow near-real-time sediment and salt loads to be calculated and can be used for a variety of monitoring and modeling purposes for BLM, USGS, BOR, and other agencies. Data for this site are available at https://waterdata.usgs.gov/ut/nwis/uv?site_no=09379500.

Assessment of erosion, sediment yield, and salinity loading on BLM-administered lands: Grand Staircase-Escalante National Monument (GSENM) and Kanab Field Office (KFO): A collaborative project between the USGS and BLM is in progress to quantify sediment and salinity loading rates. This study will determine sediment yields in watersheds above sediment retention basins using repeat topographic surveys and derived Digital Elevation Models (DEMs) of differences. Topographic data will be processed using an emerging photogrammetric technique referred to as Structure from Motion (SfM) photogrammetry. The method employs classic photogrammetric principles to derive topography from photography but utilizes advances in computer visionization to substantially relax photo quality and acquisition requirements and increase the ease of use while maintaining high accuracy.

Structures were allowed to dry over the winter and surveys began in May 2018. In FY18, 17 salinity control structures on the GSENM and KFO were surveyed using SfM technology. These structures will be surveyed annually for several years to determine sedimentation rates for GSENM and KFO areas.

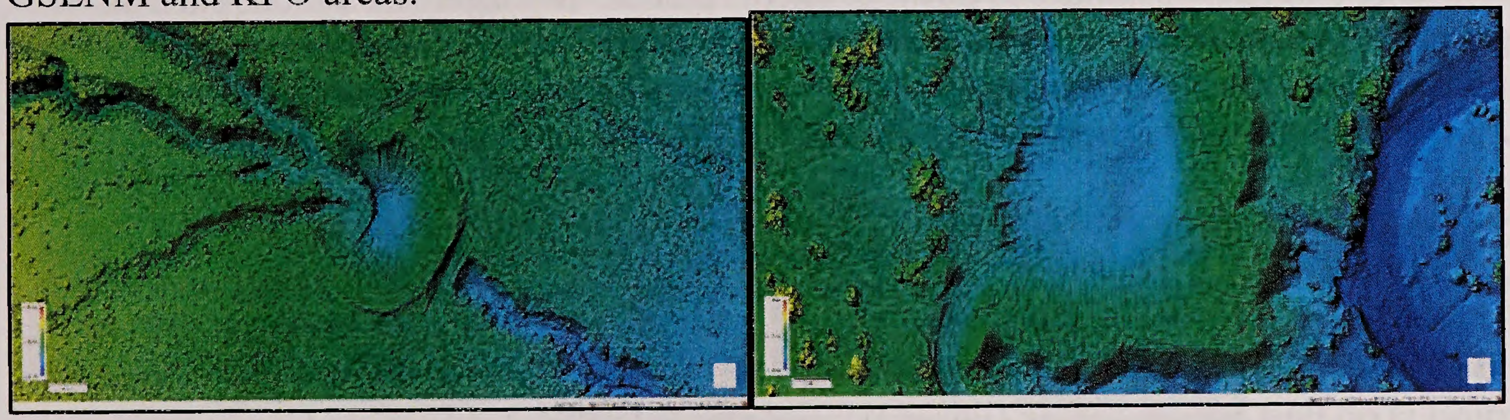


Figure 25 - Screenshots of DEMs produced from SfM assessments of Thompson Pond on the KFO (left) and Wolverine 2 on the GSENM (right) in May 2018

WYOMING

The following information is an estimate of the amount of salt retained on the landscape because of actions taken by the Rock Springs, Rawlins, Kemmerer, and Pinedale Field Offices in FY2018.

Nonpoint Sources

Nonpoint sources are addressed through regular maintenance of BLM roads and facilities as well as reclamation of well pads and other disturbances. Salt savings from nonpoint sources are estimates only. The exact amount, location, and duration of surface disturbance and the associated sediment and salt concentrations are unknown. With the increase in soil data availability and improvements in GIS mapping, more accurate estimates are anticipated but as of this time are unavailable.

There have been increased levels of stream bank erosion associated with rain events. At the same time, broad scale vegetation cover has improved, which reduces nonpoint erosion and aids in grazing distribution. It is unknown which process dominates. The Wyoming Lands Conservation Initiative (WLCI) http://www.wlci.gov/ and Jonah Interagency Office (JIO) http://www.wy.blm.gov/jio-papo/index.htm provided funding for several projects http://www.wy.blm.gov/jio-papo/whatsgoingon.htm in the area that, while not focused on direct salt reductions, have the potential to reduce salt volumes by improving wildlife habitat and thus focus primarily on vegetation, which also benefits salinity. The volume and cost savings of these projects is unknown.

The standard practices of road maintenance and grazing management help to reduce potential erosion. The costs and salt savings vary widely. Though not specific to salt savings, these practices are key to broad scale erosion reduction and salt retention. The following assumptions were made for the calculations below:

Cottonwood Creek Headcut Repair

This project plans to stabilize a headcut on Cottonwood Creek, which is an intermittent tributary to Lower Muddy Creek. In 2011, this reach of Cottonwood Creek failed PFC Assessments due to channel instability. A headcut is located in Section 6 of T13, R91 and is actively moving at an approximate rate of 10 feet per year. As the headcut migrates up gradient, it continues to contribute large amounts of salinity to down gradient reaches. Management actions such as grazing rotations, are currently in-place to allow for better growth of stabilizing riparian vegetation; however, the headcut is continuing to migrate. Efforts to repair or stabilize the headcut involve installing gradient control structures at the current headcut location.

Muddy Creek Watershed Stabilization

Muddy Creek is a major tributary to the Little Snake River within the CRB. Cooperative efforts by BLM, WGFD, TU, USFWS, local conservation districts and landowners began in 2010 to restore degraded stream channels and improve riparian and aquatic habitat across the watershed. One project is on East Muddy Creek (Phase II) while the other is on Littlefield Creek; both streams are tributaries to Muddy Creek. Engineered stream restoration designs are being implemented on both stream channels to restore natural channel stability, and reduce in-channel erosion. Implementation of these projects will reduce in-channel erosion, which will in turn reduce sediment and salinity loadings to Muddy Creek. The Muddy Creek watershed encompasses 471 km^2 and is a major tributary to the Little Snake River within the CRB.

Savery Creek Project

The Savery Creek project is a multi-year project (approximately 4 stream miles) that will be completed in three to four phases. Reaches of Savery Creek below High Savery Reservoir exhibit unstable channel characteristics including mass wasting on outside bends, excessive in-channel erosion and sedimentation and large width to depth ratios. All of these factors are contributing large amounts of sediment to downstream water bodies in the CRB. Savery Creek is a major tributary to the Little Snake River, located within the Upper Colorado River watershed.

This project proposes to implement natural channel design techniques on the target reaches that would reduce in-channel erosion, sedimentation and salinity loadings. Construction of Phase 1 has begun. Conceptual plans have been completed which allows for the fund raising and permitting phases to begin.

WY Pierotto Drop Structure

As part of the Big Piney La Barge Project effort, the BLM Pinedale Field Office has joined efforts with the University of Wyoming to develop a greater understanding of erosion prediction models. Sampling equipment has been installed to measure actual changes in sediment and salinity in a watershed. This data will be used for modeling purposes. This project contributes water quality to the Green River.

The project area is located within an existing 100-year-old oil and gas field with more than 1,800 active wells, primarily on BLM lands. Erosion has reached excessive levels in the project area caused by the removal of topsoil and vegetation from constructing well pads for oil and gas extraction, concentration and redirection of overland flows by access and recreational roads, and livestock grazing. These types of activities have combined to expose underlying soils and bedrock to increased rates of erosion.

Locally, this has resulted in incised stream channels, reduced soil moisture, increased erosive surface runoff, and increased sediment and salt transport. The existing natural erosive conditions of this landscape include steep slopes, rugged terrain, vulnerable soils, and loss of soil-stabilizing vegetation from years of drought. Minimizing salt and sediment transport is immediately pertinent to this basin.

Figure 26 - The Pierotto Drop structure

The Sweetwater County Conservation District (SWCCD) is the lead agency that is coordinating between the BLM, Sweetwater County, Anadarko Petroleum, Black Butte Coal Mine, Bridger Coal Mind, the town of Rock Springs, and the State of Wyoming. Although the original structure and its replacement are not on BLM managed lands, BLM participates, to address the potential of degradation to adjacent BLM managed lands per the Wyden Amendment. The purpose of the project is to maintain the existing location of the headcut, prevent future degradation of the stream channel, maintain existing water tables, and retain salts within geologic deposits. The final project has been successful.

Height of drop 20 ft; Width of drop 200 ft; Potential advancement of drop (post failure) in one year 1 mile (5280 ft) (This is an estimate for calculation only. There is much more soil and salt upstream from this location.)

20-ft High * 200-ft wide * 5280-ft * 165.4 lb soil/ft^3 * 0.03lb salt/lb soil * 1 Ton/2000 lb = **52,399 salt tons** retained on the landscape. (This calculation assumes advancement of the full width of the headcut and does not take into account the potential additional salts that could be introduced through tributaries and the reductions in water table elevations). Eqn. 2

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Bureau of Reclamation

Colorado River Basin Salinity Control Program Accomplishments for Fiscal Year 2018

Desert Lakes Monitoring

The Huntington Cleveland salinity project and monitoring is complete. The monitoring of surface waters and groundwaters was reduced to once per quarter and ended completely in calendar year 2016. A report of the monitoring of the area and the progress made by the project was completed, sent out for review, and revisions are currently being included. The report will be finished by the end of 2018.

TDS Forecast Modeling

The Water Operations Group of Reclamation publishes a 24 month forecast for Lake Powell. This forecast includes a minimum, most likely, and maximum hydrology scenarios for the next 24 month period of time. The three scenarios (min, most, and max) are published in January, April, August, and October. The remaining months consist of a most likely hydrology scenario.

The Water Quality Group takes the forecasts and uses them to run the 2 dimensional model, Ce-Qual W2. This model is used to forecast temperatures, TDS, and occasionally DO (Dissolved Oxygen). In FY 2018 (WY 2018), the model has been run each month. The model continues to be done in version 4.1 and the standardized Meteorological data file has been updated with each run. The various regressions (EC to TDS) used for the inflows to Lake Powell have also been updated for the most recent samples sent to the lab.

Colorado River Simulation System (CRSS)

In FY 2018 Reclamation supported the salinity workgroup at the October 2017 Forum meeting while presenting final CRSS salinity modeling results under four salinity control scenarios. The final salinity control scenarios reported in the 2017 Review included:

1. No additional controls beyond 2017 – 1.33 million tons removed
2. No additional controls beyond 2020 – 1.39 million tons removed
3. Controls based on recent available funding by 2035 – 1.66 million tons removed
4. Controls based on expanded funding by 2035 – 1.79 million tons removed

A process has begun to verify, and as necessary update the remaining potential salinity control estimates reported in Table 3 of the 2017 Triennial Review. This effort continues to verify the off farm and on farm salinity control estimates as reported in existing agreements and identifies what portion of these controls have been implemented through 2018. Another component of this effort is to ensure the historical Environmental Impact Statements, Hydro-Salinity studies, and Environmental Assessments support our reported potential control estimates.

Reclamation reviewed and approved a USGS SLOAD update to the historical record for salinity load and concentration that extends the record through calendar year 2017. This flow and salinity concentration record comprises the 20-gauge monitoring network including the 3 numeric criteria locations, below Hoover and Parker Dams, and above Imperial Dam.

CADSWES worked, under Reclamation's direction, to further enhance the CRSS salinity algorithms. CADSWES improved salinity methods in RiverWare to model the movement of salt through the groundwater lenses below the Navajo Indian Irrigation Project (NIIP) irrigated lands. CADSWES has also addressed minor flow and salinity mass balance issues that required some minor source code modifications to the RiverWare software.

Economic Impacts Model

A request for proposals was made available to choose a contractor to update Reclamation's Salinity Economic Impact Model (SEIM). The model is a Microsoft Office Excel workbook used to estimate monetary damages that are incurred in the metropolitan and agricultural areas in the lower Colorado Basin resulting from usage of Colorado River water. The SEIM estimates damages to seven economic sectors including residential, agricultural, commercial, industrial, water and wastewater utilities, groundwater and recycled water use sectors. The latest SEIM was released and dated 07/30/18 with only minor formatting changes.

The SEIM consists of input data, impact functions, and output summary results. The input data includes water supply, water use, demographic data, and other data pertaining to each region in the lower Colorado Basin. The impact functions estimate damages for specific items corresponding to each sector or the impact on crop yields for the agricultural sector.

A group of Reclamation personnel and a representative from the SEIM committee reviewed submitted proposals for the project and selected Daniel B. Stevens and Associates as the contractor to update the model. The contractor is expected to update existing damage impact functions - including costs and other input values, and identify and create new impact functions that could estimate damages not already captured in the model. The contract is set to run through May 2020 when Reclamation will be provided an updated model.

Reclamation incorporated SEIM committee comments on the SEIM User Documentation Report and is seeking to resolve remaining comments than release the report to the workgroup. A draft – not for distribution version was provided to the contractors chosen for the SEIM update to further help familiarize them with the design and operation of the SEIM model interface. The User Documentation presents individual sheets in the SEIM Excel interface to aid users in understanding how the SEIM is structured, and how it operates. The documentation discusses and presents the outputs, inputs, and equations included the SEIM.

The 2017 Triennial Review for Water Quality Standards for Salinity in the Colorado River System was published by the Colorado River Basin Salinity Control Forum in October. The SEIM was utilized in this study to estimate monetary damages under four salinity control scenarios:

1. No additional controls beyond 2017 – 1.33 million tons removed
2. No additional controls beyond 2020 – 1.39 million tons removed
3. Controls based on recent available funding by 2035 – 1.66 million tons removed
4. Controls based on expanded funding by 2035 – 1.79 million tons removed

Estimated Annual Damage Reductions under each alternative were derived by subtracting the Total Quantified Damages from the baseline of 1.33 million tons removed, or $574.2 million.

Alternative	Salinity Reduction at Imperial Dam in 2035 (mg/L)	Total Quantified Damages (2014 Dollars)	Annual Damage Reductions as Compared to No Additional Future Controls Beyond 2017
1.33M tons removed	--	$574.2M	--
1.39M tons removed	6	$558.1M	$16.1M
1.66M tons removed	28	$500.4M	$73.8M
1.79M tons removed	37	$477.4M	$96.8M

The model also estimated damages under each alternative for salinity concentrations estimated for the year 2035 at three diversion points along the mainstem Lower Colorado River: Hoover, Parker, and Imperial Dams.

Alternative	Average Annual Concentration (mg/L)			Average Annual Quantified Damages ($millions – 2014 Dollars)			
	Hoover	Parker	Imperial	Hoover	Parker	Imperial	Total
1.33M tons removed	641	660	797	$78.361	$222.814	$273.013	$574.188
1.39M tons removed	636	655	791	$75.583	$215.347	$267.124	$558.054
1.66M tons removed	619	637	769	$66.120	$188.775	$245.541	$500.436
1.79M tons removed	611	630	760	$61.665	$179.040	$236.710	$477.415

Reclamation presented these results and the model in its current form at the Multi-State Salinity Coalition Annual Salinity Summit held February 8 in Las Vegas, NV.

Science Team

To further improve and expand our knowledge of salinity control methods, data, and modeling within the Colorado River basin, the Salinity Science Team was created. This team incorporates technical experts and coordinators from each Federal agency (Reclamation, USDA, NRCS, BLM, and USGS) that provides salinity data and/or modeling and the Forum's Executive Director. For more information on the Science Team, please refer to the last section of the USGS Chapter in the 2006 FAR.

The following are some of the topics that were addressed by the Science Team during meetings held in January and August 2018:

1. Funding/contract update of approved Research, Studies, and Investigations (SIRs)
2. Upcoming 2019 FOA
3. Review of SIR proposals for funding and recommending to the Advisory Council's Technical Advisory Group (TAG) which proposals should receive funding.
4. Update on Paradox Valley Unit Groundwater model and simulations
5. Update on Trends in Ground Water Discharge TDS Loads
6. Pah Tempe Study
7. New areas for salinity studies
8. Economic Damages Model – awarded in June of 2018, kick-off took place August 1, 2018.
9. Review of Table 3 for the Triennial Review
10. Future science direction, needs, priorities, and funding

Basinwide Salinity Control Program (Basinwide Program)

Funding Opportunity Announcement (FOA) 2017

Applications to reduce salinity contributions to the Colorado River were solicited through a FOA for both the Basinwide Program and Basin States Program (BSP). The FOA was released on August 4, 2017 and closed on November 14, 2017.

There were 3 Applications that were selected for the Basinwide Program through a competitive process under the evaluation criteria set forth in the FOA. Applications were evaluated and ranked by an Application Review Committee (ARC) in December of 2017.

In September of 2018, the following applications were awarded in the Basinwide Program:

1) Upper Stewart Ditch, Paonia, Colorado, for $2,507561, controlling 1,622 tons of salt annually with 20 acres of potential on farm.
2) Gould Canal A in Montrose, Colorado, for $4,294,027, and controlling 3,137 tons of salt annually.
3) Gould Canal B in Montrose, Colorado, for $3,545,246, and controlling 2,564 tons of salt annually.

Uintah Basin, Utah
Ashley Upper and Highline Canals Rehabilitation Project: This project is located in Uintah County in the vicinity of Vernal, Utah. It was selected from the applications received in the 2015 FOA and was submitted by the Ashley Upper Irrigation Company in conjunction with the

Ashley Highline Irrigation Company. A cooperative agreement was executed in September of 2016. However, the recipient did not have their funding in place and that agreement was closed. The recipient now has their funding in place and a new agreement was executed in August of 2018, for the amount of $3,514,847 as a 25 percent Federal cost share. This project will replace approximately 21.9 miles of earthen canal and laterals with irrigation pipe resulting in the annual reduction of 2,713 reportable tons of salt in the Colorado River at an anticipated cost of approximately $54.00 per ton of salt. The project is expected to begin construction in the spring of 2019 and be completed and in the spring of 2020.

Gunnison Basin, Colorado

UVWUA Phase 8 – ESL: As a result of the 2012 FOA, the UVWUA was selected to be awarded a $3.5 million cooperative agreement for Phase 8 of the ESL. This phase involves piping an additional 14.1 miles of laterals off of the South Canal, East Canal and Loutzenhizer, resulting in an expected annual salt reduction of 3,307 tons, at a cost effectiveness of $49.86 per ton. The cooperative agreement was executed in FY 2014. Construction began in the summer of 2015 and will be completed by the end of 2018.

Cattleman's Harts, Hart/McLaughlin, Rockwell, Poulsen Ditches: Selected in the 2012 FOA, this project involves piping a portion of the Cattleman's Ditch, operated by the Cedar Canon Iron Springs Ditch and Reservoir Company. The ditch is supplied by Crystal Creek, a tributary to the Gunnison River near Crawford, Colorado. In July 2013, Reclamation entered into an agreement to provide up to $2.01 million to pipe 6.3 miles of existing laterals with an expected salt load reduction of about 1,855 tons/year, at a cost effectiveness of $47.72 per ton. Construction began in the fall of 2015 and was completed in the spring of 2018.

Cattleman's Ditch Salinity Control – Phase 2: Selected under the 2015 FOA, the Cedar Canon Iron Springs Ditch and Reservoir Company was awarded a $2.67 million cooperative grant to pipe approximately 6.0 miles of existing, unlined earthen irrigation canal and laterals located near Crawford, Colorado and along Alkali Creek, a tributary to the Gunnison River. This will result in an annual salt load reduction of approximately 2,183 tons to the Colorado River, at a cost effectiveness of $51.00 per ton. The piping project will consist of buried HDPE, PVC, and gravity flow pipe. The cooperative agreement was executed in April 2016, and construction began in October of 2017. It is expected to be completed in the spring of 2019.

Clipper Center Lateral Pipeline Project: Selected under the 2015 FOA, the Crawford Clipper Ditch Company was awarded a $3.15 million cooperative grant to pipe approximately 4.3 miles of existing, unlined earthen irrigation canals located near Crawford, Colorado and along Cottonwood Creek, a tributary to the Gunnison River. This will result in an annual salt load reduction of approximately 2,606 tons to the Colorado River, at a cost effectiveness of $50.43 per ton. The piping project will consist of buried PVC and HDPE pipe. The cooperative agreement was executed in March 2016, and construction will begin in 2018. It is expected to be completed in 2019 or spring of 2020.

North Delta Canal – Phase 1: Selected under the 2015 FOA, the North Delta Irrigation Company was awarded a $5.56 million cooperative grant to pipe approximately 5.97 miles of existing, unlined earthen irrigation canals located near Delta, Colorado and along the north side of the Gunnison River. This will result in an annual salt load reduction of approximately 4,383 tons to the Colorado River, at a cost effectiveness of $52.92 per ton. The piping project will consist of 1.41 miles of buried HDPE pipe and 3.02 miles of gravity flow pipe (piping is providing a 1.54 mile shortcut). The cooperative agreement was executed in April 2016, and construction will begin in 2018. It is expected to be completed in the spring of 2020.

Orchard Ranch Ditch Piping Project: Selected under the 2015 FOA, the Orchard Ranch Ditch Company was awarded a $1.28 million cooperative grant to pipe approximately 2.0 miles of existing, unlined earthen irrigation canals located near Orchard City, Colorado and along Surface Creek, a tributary to the Gunnison River. This will result in an annual salt load reduction of approximately 1,004 tons to the Colorado River, at a cost effectiveness of $53.16 per ton. The piping project will consist of buried HDPE pipe. The cooperative agreement was executed in April 2016, and construction will begin in 2018. It is expected to be completed in 2019.

Fire Mtn. Canal Salinity Reduction Piping Project: Selected under the 2015 FOA, the Fire Mountain Canal and Reservoir Company was awarded a $2.95 million cooperative grant to pipe or abandon approximately 4.24 miles of existing, unlined earthen irrigation canals located near Hotchkiss, Colorado and along the north side of the North Fork of the Gunnison River. This will result in an annual salt load reduction of approximately 2,365 tons to the Colorado River, at a cost effectiveness of $52.07 per ton. A portion of the project is funded by the USDA, NRCS, through the Regional Conservation Partnership Program (RCPP) in the amount of $1.32 M. The cooperative agreement was executed in September 2017, and construction will begin in 2018. It is expected to be completed in the spring of 2020.

UVWUA Phase 9 – ESL: As a result of the 2015 FOA, the UVWUA was selected to be awarded a $5.4 million cooperative agreement for Phase 9 of the ESL. This phase involves piping or abandoning an additional 21.6 miles of laterals off of the Selig and East Canals, resulting in an expected annual salt reduction of 6,030 tons, at a cost effectiveness of $37.07 per ton. A portion of the project is funded by the USDA, NRCS, through the RCPP. The cooperative agreement was executed in September 2017. Construction is expected to begin in 2018 and will continue to 2021.

Grand Valley, Colorado

Grand Valley Irrigation Company (GVIC) Canal Improvement Grant 2012: As a result of selection under the 2012 FOA, the GVIC was selected to be awarded a $4.9 million cooperative grant to line about 2.4 miles of their main canal within the Grand Valley. A salt loading reduction of approximately 4,001 tons annually is expected, at a cost effectiveness of $53.31 per ton. The canal lining will consist of a PVC membrane with a shotcrete cover. The cooperative agreement was executed in FY 2014 and construction began in December 2014. It is expected to be completed by the end of 2018.

Grand Valley Irrigation Company (GVIC) Canal Improvement Grant 2015: Selected under the 2015 FOA, the GVIC was awarded a $2.8 million cooperative grant to line approximately 1.65 miles of their main irrigation canal within the Grand Valley. This will result in a salt load reduction of approximately 2,363 tons annually at a cost effectiveness of $49.64 per ton. The canal lining will consist of a 30-mil PVC membrane with 3-4 inches of shotcrete cover. The cooperative agreement was executed in August 2016, and construction will begin in January 2018. It is expected to be completed in the spring of 2020.

Grand Valley Water Users Association (GVWUA) Government Highline Canal – Reach 1A Middle: Selected under the 2015 FOA, the GVWUA was awarded a $3.6 million cooperative grant to line approximately 0.97 miles of their main irrigation canal within the Grand Valley. This will result in a salt load reduction of approximately 2,583 tons annually at a cost effectiveness of $58.63 per ton. The canal lining will consist of a 30-mil PVC membrane with 3-4 inches of shotcrete cover. The cooperative agreement was executed in April 2016, and construction began in November of 2016. It is expected to be completed in the spring of 2019.

Paradox Valley Unit (PVU), Colorado

This project intercepts extremely saline brine (260,000 mg/l total dissolved solids) before it reaches the Dolores River and disposes of the brine by deep well injection (injection interval about 14,000 feet below ground surface).

Induced seismicity and the pressure necessary to inject the brine into the disposal formation at 14,000' have been the limiting factors of the project. Since injection rate reductions in 2013 and 2017 have substantially reduced the injection pressure, seismicity is now the main concern. Although the projected life of the well was estimated to be 3 to 5 years, new geomechanical and flow modeling is now being conducted to determine the injection well life based on seismicity and well performance.

The project continues to intercept and dispose of 95,000+ tons of salt annually.

Alternatives Study
An Alternatives Study/EIS process to evaluate alternative methods for salt disposal at Paradox is continuing with three alternatives and a "no action" alternative being evaluated. The three action alternatives are a second injection well, evaporation ponds, and zero liquid discharge technologies. As these alternatives are being developed, Reclamation continues to have related meetings and discussions with the BLM, EPA, Colorado Department of Public Health and Environment, and other stakeholders. A draft Alternatives EIS is scheduled to be completed by the end of FY19 with a ROD scheduled to be issued in FY20.

Table 1 – Paradox Well Injection Evaluation

Injection Period	Operational Days[1]	Pressure Start	High Pressure During Period	Injection Period Net Pressure Change	Tons of Salt Injected[2]	No. of Induced Seismic Events	Maximum Magnitude of Induced Seismic Events	Estimated Tons of Salt Entering the River[3]
Jan-May '02[4]	148	1609	4432		52,860	25	2.9	8,469
June-Dec '02[5]	178	929	4593	161	58,953	34	2.2	8,333
Jan-May '03[5]	144	1172	4627	34	53,173	27	2.1	18,037
June-Dec '03[5]	184	1154	4675	48	59,530	106	2.3	11,185
Jan-May '04[6]	140	1201	4640	-35	51,449	47	2.4	20,225
June-Dec '04[7]	160	1091	4541	-99	51,589	57	3.9	6,442
Jan-May '05[5]	140	1038	4736	195	55,024	69	2.4	14,011
June-Dec '05[8]	148	1203	4750	14	46,551	31	2.6	38,582
Jan-June '06[9]	138	375	4680	-70	44,779	10[10]	2.4	53,039
July-Dec '06[5]	162	1084	4797	117	56,920	13[10]	2.1	18,605
Jan-June '07[5]	159	1066	4796	-1	56,068	7[10]	1.1	19,728
July-Dec '07[5]	163	1232	4712	-84	57,395	31	2.6	11,279
Jan-June '08[11]	160	1152	4813	101	54,720	47	1.3	15,305
July-Dec '08[5]	162	1263	4822	9	56,734	61	2.1	16,378
*Jan-Mar '09[5]	84	1246	4756	-66	29,163	20	2.6	22,029
Apr-Sept '09[12]	160	1157	4891	135	55,083	70	2.7	16,507
Oct '09-Mar '10[5]	153	970	4930	39	51,589	91	2.9	32,876
Apr '10-Sep '10[5]	162	1347	4990	60	55,747	75	2.7	17,223
Oct '10-Mar '11[5]	161	1378	5000	10	55,501	43	2.9	22,916
Apr '11-Sep '11[13]	158	1276	5102	102	54,422	63	2.7	11,591
Oct '11-Mar '12	162	1282	5115	6	56,531	59	2.5	21,003
Apr '12-Sep '12	161	1417	5108	-7	55,605	116	1.9	5,507

1 Operational days include partial days of operation which accounts for variations in tons of salt injected
2 Tons of salt injected based on 260,000 mg/L. Brine concentration varies slightly due to seasonal and environmental fluctuations.
3 Tons of salt entering the river based on regression equations (Ken Watts, USGS Administrative Report – "Estimates of Dissolved Solids Load of the Dolores River in Paradox Valley, Montrose County, CO, 1988-2009, August 5, 2010"). The 2010 FAR contained erroneous estimated tons of salt entering the river.
4 Begin 100% brine injection
5 No problems
6 Down from 3/1/04 through 3/7/04 for mechanical problems
7 Implemented quarterly 10-day shutdown schedule from 9/22 to 10/22; M3.9 earthquake on 11/7; plant shut down until 11/18; discontinued 10-day shutdown schedule
8 Down from 11/13/05 through 12/31/05 for mechanical problems
9 Down from 1/1/06 through 1/19/06 and 2/16/06 through 3/2/06 for mechanical problems
10 Seismic data for 2006 and the first half of 2007 is likely incomplete due to seismic network problems
10 Seismic data for 2006 and the first half of 2007 is likely incomplete due to seismic network problems
10 Seismic data for 2006 and the first half of 2007 is likely incomplete due to seismic network problems
11 Down from 4/16-17/08 for mechanical problems
12 Down from 5/18-19/09 for mechanical problems
13 Down from 9/18-9/20 for communication link failure.

* Biannual shutdown schedule changed from winter/summer to spring/fal

Injection Month	Min Injection Pressure	Max Injection Pressure	Monthly Pressure Change	Tons of Salt Injected[1]	Estimated Salt Load in tons[2]	# of Induced Seismic Events M ≥ 0.5[3]	Max Mag of Seismic Events	No. of Seismic Events in Past 12 Months, M ≥ 0.5	Comments
Jan-13	2,733	5,111		8,115	263	15	4.4	69	January 23 M4.4 Earthquake - Shut Plant Down 1/23/13 - 2200 hours; Injection rate prior to earthquake was 230 gpm, shut down schedule was two twenty day shut downs annually
Feb-13	893	2,733	-2,378	0	1,324	3	1.7	70	Plant Down
Mar-13	500	893	-1,840	0	2,600	1	1.2	64	Plant Down
Apr-13	390	4,250	3,357	4,064	3,351	4	0.7	60	Start up on April 17 after January 23 M4.4 earthquake. Begin 33 hour weekly shut down schedule and continue to use 2.125" plungers until new 2" plungers are installed.
May-13	3,290	4,452	202	8,752	1,535	3	1.8	58	33 hour weekly shut down schedule, 2.125" plungers
Jun-13	3,948	4,685	233	8,311	2,089	2	0.8	52	Continued 2.125" plungers to June 5 - Installed 2" plungers on June 5, began 18 hour shut down schedule on June 11
Jul-13	4,143	4,740	55	8,457	1,823	1	1.2	47	No significant down time
Aug-13	4,218	4,722	-18	8,629	289	1	0.5	47	No significant down time
Sep-13	3,513	4,770	48	7,557	659	0	0.3	43	PLC problems - plant down from 9/19 through 9/22. 18 hour weekly shut downs suspended from 9/22 to 11/12
Oct-13	3,683	4,770	0	9,610	195	1	1.2	35	No significant down time

Nov-13	4,208	4,803	33	8,814	577	2	0.7	36	No significant down time
Dec-13	4,195	4,758	-45	8,713	778	1	0.8	34	No significant down time
Jan-14	4,202	4,739	-19	8,584	681	0	0.3	19	No significant down time
Feb-14	4,187	4,745	6	7,760	925	4	1.7	20	No significant down time
Mar-14	4,193	4,757	12	8,713	1,275	3	1.5	22	No significant down time
Apr-14	4,206	4,772	15	8,159	675	1	0.9	19	No significant down time
May-14	4,215	4,775	3	8,711	258	2	1.2	18	No significant down time
Jun-14	4,217	4,769	-6	8,381	186	0	N/A	16	No significant down time
Jul-14	4,218	4,778	9	8,428	236	2	2.3	17	No significant down time
Aug-14	4,212	4,781	3	8,645	-300	0	N/A	16	No significant down time
Sep-14	4,206	4,772	-9	8,215	-832	0	1.8	16	No significant down time
Oct-14	4,215	4,776	4	8,773	758	2	1.0	17	No significant down time
Nov-14	4,223	4,773	-3	8,297	2,992	3	1.1	18	No significant down time
Dec-14	4,205	4,778	5	8,272	4,202	0	0.4	17	No significant down time
Jan-15	4,202	4,766	-12	8,731	3,246	2	1.0	19	No significant down time
Feb-15	4,202	4,754	-12	7,775	4,353	2	1.1	17	No significant down time
Mar-15	4,228	4,766	12	8,457	6,282	0	N/A	14	No significant down time
Apr-15	4,196	4,760	-6	8,230	3,959	2	0.6	15	No significant down time
May-15	4,190	4,763	3	8,512	1,708	1	0.7	14	No significant down time
Jun-15	4,209	4,761	-2	8,279	174	2	0.9	16	No significant down time
Jul-15	4,227	4,777	16	8,637	-336	1	1.1	15	No significant down time
Aug-15	4,164	4,797	20	8,614	-478	3	1.6	18	No significant down time
Sep-15	4,239	4,787	-10	8,124	810	2	1.0	20	No significant down time
Oct-15	3,598	4,767	-20	7,863	733	3	0.9	21	SCADA upgrade 10/26-10/29; plant down for 76 hours
Nov-15	4,206	4,737	-30	8,594	2,358	4	1.0	22	No significant down time
Dec-15	4,195	4,754	17	8,494	2,589	1	0.8	23	No significant down time
Jan-16	4,194	4,762	8	8,671	3,227	4	1.6	25	No significant down time
Feb-16	4,133	4,749	-13	7,824	8,965	9	2.1	32	No significant down time

Mar-16	4,214	4,766	17	8,655	5,070	5	1.5	37	No significant down time
Apr-16	4,228	4,773	7	8,367	3,380	2	1.1	37	No significant down time
May-16	4,060	4,774	1	8,655	2,551	4	1.4	40	No significant down time
Jun-16	4,204	4,785	11	8,163	855	3	1.4	41	No significant down time
Jul-16	4,233	4,771	-14	8,704	990	4	1.4	44	No significant down time
Aug-16	4,242	4,791	20	8,485	-1,780	2	0.7	43	Seismic event count for August may be under-represented
Sep-16	4,269	4,797	6	8,376	793	2	1.2	43	Seismic event count for September may be under-represented
Oct-16	4,250	4,807	10	8,844	1,072	3	1.1	43	No significant down time
Nov-16	4,283	4,815	8	8,225	1,827	8	1.3	47	No significant down time
Dec-16	4,220	4,805	-10	8,540	4,478	8	1.6	54	PLC problems - plant down 4 hours
Jan-17	4,254	4,822	17	8,566	8,969	5	1.1	55	No significant down time
Feb-17	4,300	4,820	-2	7,760	8,029	1	0.3	47	No significant down time
Mar-17	1,515	4,801	-19	3,021	3,706	7	2.9	49	Plant down from 3/12 to 3/31 for M 2.9 earthquake
Apr-17	1,196	4,447	-354	6,088	-64	11	1.8	58	Plant down from 4/1 to 4/7 for M 2.9 earthquake; Injection resumed on 4/7 at 176 gpm and 6 hour weekly shutdowns
May-17	4,196	4,603	156	8,182	633	4	1.4	58	No significant down time
Jun-17	4,311	4,634	31	7,848	820	3	1.5	58	No significant down time
Jul-17	4,368	4,677	43	8,103	884	2	0.6	56	No significant down time
Aug-17	4,380	4,649	-28	8,144	1,424	15	2.5	69	No significant down time
Previous 12 Months			-148	91,697	32,571	69	2.9		
Previous 24 Months			-138	192,296	62,319	112	2.9		

[1]Tons of salt injected based on 260,000 mg/l. PVB density varies slightly due to seasonal and environmental fluctuations.
[2] Salt load is estimated based on regression equations developed by USGS (Ken Watts, USGS Administrative Report - "Estimates of Dissolved Solids Load of the Dolores River in Paradox Valley, Montrose County, Colorado, 1988 through 2009, dated August 5, 2010") and provisional data provided by USGS. Some daily EC and streamflow discharge values are estimates. See Salt Load Notes tab.
[3]See Seismicity Notes tab

Basin States Program (BSP)

Public Law 110-246 amended the Act creating the BSP to be implemented by the Secretary of the Interior through Reclamation. Section 205(f) of the Act was amended to provide that cost share obligations be met through an up-front cost share from the Basin Funds. The amendment also authorizes Reclamation to expend the required cost share funds through the BSP for salinity control activities established under Section 202(a)(7) of the Act.

Reclamation has determined that agencies within the upper Basin states to be appropriate partners and has executed cooperative agreements to utilize the services of these state agencies to assist in seeking and funding cost-effective activities to reduce salinity in the Colorado River system. Activities will also benefit the upper Basin states by improving water management and increasing irrigation efficiencies.

<u>Utah Department of Agriculture and Food (UDAF)</u>

The Utah Department of Agriculture and Food received two projects from Reclamation's 2015 FOA. One project is with Sheep Creek Irrigation Company, Manila, Utah and is a canal piping project that will retain 1,474 tons of salt per year at a cost of $1,947,929.99. The project is titled "Antelope and North Laterals Salinity Project" and will pipe two laterals of the Sheep Creek Canal. The other project is in the Vernal area and will pipe the Rock Point Canal retaining 740 tons of salt with a total project cost of $1,422,849.00, with $976,549.00 coming from Basin States Program funds.

During the 2017-2018 winter construction season, Sheep Creek Irrigation Company substantially completed the piping of the Antelope and North laterals. Both of these new pipelines were put in use during the 2017 irrigation season. During the 2017 irrigation season, a storm event washed significant debris into the system resulting in overflows. Since the original project came in under budget, Sheep Creek Irrigation Company proposed and was approved to use the remaining funding to rebuild the diversion structure to eliminate large debris inflows. This work is expected to be completed in the Fall of 2018.

Rock Point Irrigation Company has hired an engineering firm, procured final design, and purchased pipe for their project. The pipe is stored at previously approved storage sites not requiring Cultural Resource or NEPA clearance. Rock Point Irrigation Company has obtained all easements and is awaiting NEPA clearance to begin construction. They intend to start construction late fall of 2018. Because Steinaker Dam will be drained, Rock Point Irrigation Company will need to adjust their construction time line and method of water delivery until Steinaker is refilled.

UDAF, at the direction of the Advisory Council and Reclamation, continues to employ the Uintah basin salinity coordinator using BSP funds. The value of this coordinator has been demonstrated by the success of obtaining four 2015 FOA projects. These projects were competitive because of the coordinator's efforts to confederate historically opposing companies into accepting unified systems that improve each company and the significant cost share match being provided by local funding sources to buy down the cost per ton of salt control. Improvements with the Ute Tribe have also been made and it is anticipated that in future FOA's the tribe will submit applications. UDAF feels that using BSP funds for this position has greatly benefited the salinity control program in the Uintah Basin area. The coordinator has also been successful in helping entities submit applications with the NRCS Regional Conservation Partnership Program.

Colorado Department of Agriculture - Colorado State Conservation Board (CSCB)

In Colorado, the Basin States Program (BSP) has been delivered through six local Conservation Districts that operate within the boundaries of the approved salinity control areas in the state. These salinity control areas include the Silt Mesa, Grand Valley, Lower Gunnison, McElmo Creek and Mancos River salinity areas. The Bookcliff, Mesa, Delta, Shavano, High Desert (formerly Dolores), and Mancos Conservation districts receive funds from the Colorado Department of Agriculture (CDA) which, prior to 2017, had received projects to implement based upon the agreement with Reclamation. There is an active agreement in place, however, due to no new BSP projects being assigned to CDA, administrative funding for a CDA salinity coordinator was insufficient so this position remained vacant. The Lower Gunnison Field Coordinator position, Beth Karberg, has been vacant since April 13, 2018. A vacancy announcement to hire a Salinity Field Coordinator will be advertised by October 1 with start date estimated at December 1, 2018. This position is a hybrid of the two vacant position local duties. All administration of agreements between Reclamation and CDA and CDA and partnering Conservation Districts is performed at the CDA home office in Broomfield, CO.

The Lower Gunnison Field Coordinator assisted 14 prospective 2018 FOA applicants with basic initial planning, supplemental state funding and wildlife habitat replacement options. This includes 2 applicants from the Mancos River Salinity Area. Ms. Karberg has performed basic planning with 9 ditch companies that were not ready to apply in the 2018 FOA process. The Coordinator helped 11 Lower Gunnison basin ditch associations with interest in working on FOA projects by describing preliminary activities required to organize and develop a proposal.

Progress:

BSP Projects:

Through its partnership with Conservation Districts, CDA remains equipped to administer BSP FOA projects for the Salinity Control Program.

The USDA tracked NEPA progress, design, and cost estimate updates for the following 2015 BSP projects in the Grand Valley Salinity Project Area: Ward B. Studt Headgate 275, Lateral Ditch ML47 and Duke Ditch. The drawings are presently awaiting review by the (NRCS) State Engineer and expected to be ready for contracting in November. The contracted amount obligated for these projects is $1,088,564. CDA and the Delta Conservation District oversaw completion, certification and final payment ($104,363.00) for the Water Users of Lateral Ditch # 110. The Michael Johnson ditch piping project ($221,586) in the Silt Mesa Salinity Project Area is ready for construction and the Bookcliff Conservation District is presently moving forward with contracting for completion during the 2018-19 winter season.

The Sanchez wildlife habitat improvement project ($25,762) in the Lower Gunnison Salinity Project Area is nearly complete. Brush management will continue into Fall 2018 and Summer 2019, followed by riparian tree plantings in Spring 2019. It will require continued monitoring and management by the Shavano Conservation District through 2020.

Wyoming Water Development Commission (WWDC)

In August 2015, a new BSP agreement was put in place with the WWDC that will end in 2020. The new BSP agreement is similar to the agreements with Utah and Colorado. The agreement has a value of $2,800,000 for construction and salinity studies in Wyoming. Projects can either be a FOA pass-off, EQIP pass-off or through a solicitation that meets Reclamation's requirements.

The WWDC provides state funding through grants and loans for water studies, master plans, and construction projects across Wyoming. WWDC project funding is provided to a public entity for projects including, but limited to, transmission pipelines, storage, reservoirs, irrigation improvements, canal to pipe conversions, and system improvements. Day-to-day operations are managed by the Wyoming Water Development Office (WWDO) staff. The WWDO construction division will be administering the construction and study components of the Wyoming BSP program.

Progress:

BSP Projects:

Eden Valley, Farson/Eden Pipeline Project:

Currently, WWDC has one BSP project that came through Reclamation's 2015 FOA process. The project is for a canal to pipeline conversion project with the Eden Valley Irrigation and Drainage District (EVIDD). The project will convert approximately 6 miles of irrigation canal to pipeline. The project includes piping the Farson F-2, F-3, F-4, and F-5 laterals. The project budget is $4,390,413 with funding provided by the WWDC of $2,366,000 and the WY BSP of $2,024,413. The project will result in salt control of 1,619 tons and a cost effectiveness of $52.11/ton.

Currently, the project has secured the services of an engineer and has entered the design phase of the project. The project is currently finalizing the design, securing necessary permits, and conducting necessary reviews. The project is anticipated to go to construction in the fall of 2018.

The project will connect to a project being managed by Reclamation through the use of MOA funds. Reclamation's MOA project has experienced delays, resulting in delays for the WY BSP and WWDC project.

Reclamation
In the 2015 FOA, two projects were selected for BSP funding that are being administered by Reclamation. The two projects are:

Minnesota L-75 Lateral Salinity Control Project: Selected under the 2015 FOA, the Minnesota L-75 Lateral Company was awarded a $153,412 cooperative grant to pipe approximately 3,100 feet of existing, unlined earthen irrigation ditch located near Paonia, Colorado and along the south side of the North Fork of the Gunnison River. This will result in an annual salt load reduction of approximately 129 tons to the Colorado River, at a cost effectiveness of $49.57 per ton. The piping project will consist of buried PVC pipe. The cooperative agreement was executed in March 2016, and construction will begin in the winter of 2017-18. It was completed in the spring of 2018.

Whiterocks and Mosby Canals Rehabilitation Project: This project was selected from the 2015 FOA. A cooperative agreement was executed in September 2016 for the amount of $2,412,462. This project, located in Uintah County, will replace approximately 13.7 miles of earthen canals with a pressurized pipeline system resulting in the annual reduction of 1,635 reportable tons of salt in the Colorado River. The project is approximately 65 percent complete with the final phase of construction anticipated to begin in the fall of 2018.

In the **2017 FOA**, 4 projects were selected and are being administered by Reclamation. One is yet to be awarded and no information will be released until award. The other three are: (1) Muddy Creek in Emery County, Utah for $4,583,000, controlling 3,010 tons of salt per year and with 3,310 acres of potential on-farm work; (2) Root & Ratliff in Mancos, Colorado for $3,600,027, controlling 2,347 tons of salt per year and with 2,347 acres of potential on-farm work; and (3) Shinn Park/Waterdog in Montrose, Colorado for $4,136,490, controlling 3,304 tons of salt per year and with 331 acres of potential on-farm work.

Summary Data

Colorado River Basin Salinity Control Program

The Summary Tables of Reclamation's Salinity Control Programs, presented in the Advisory Council Meeting, are in the following pages.

Last Revised: 10/20/2018

LOWER BASIN DEVELOPMENT FUND

Year	Projected Revenues	Total Lower Basin Fund Transfer	Basinwide and O&M Cost Share	Basin States Program	Balance in LCRBDF	Accrual Amount	
					$ 7,898,546	$ (12,206,248)	Ending FY 2017
2018	$ 8,102,217	$ 10,619,287	$ 5,263,955	$ 5,355,332	$ 5,381,476	$ (13,073,770)	Ending FY 2018
2019	$ 8,821,265	$ 13,000,000	$ 4,326,176	$ 8,673,824	$ 1,202,740	$ (10,369,733)	Ending FY 2019
2020	$ 8,797,677	$ 9,000,000	$ 4,670,871	$ 4,329,129	$ 1,000,418	$ (11,667,203)	Ending FY 2020
2021	$ 8,830,137	$ 8,500,000	$ 4,457,521	$ 4,042,479	$ 1,330,555	$ (13,366,786)	
3 YR TOTAL	$ 25,721,159	$ 32,619,287	$ 14,261,003	$ 18,358,284	$ 1,000,418	$ (11,667,203)	

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Lower Colorado River Basin Development Fund

Last Revised: 10/20/2018

	Revenues				Up-front Cost Sharing							
Year	Hoover	Parker & Davis	Deficiency Payments	Repayment Transfer to Treasury	Paradox Valley O&M	Grand Valley O&M	McElmo Creek O&M	Lower Gunnison O&M	Basinwide SCP	BSP SCP	Actual and Projected Transfer to UC Region	Actual LCRBDF Balance Available
1987	1,540,705											$ 1,540,705
1988	9,359,325		1,532,868	56,609								$ 9,310,553
1989	8,442,385		1,532,868	671,012								$ 15,549,058
1990	8,899,348		1,532,868	967,576								$ 21,947,962
1991	8,055,138		11,532,868	2,424,156								$ 16,046,075
1992	7,622,748		1,532,868	3,341,252								$ 18,794,703
1993	6,960,422		1,532,868	5,502,160								$ 18,720,097
1994	8,830,220		1,532,868	7,853,582								$ 18,163,867
1995	8,212,818		1,532,868	5,833,699								$ 19,010,118
1996	9,644,684		1,532,868	4,575,630								$ 22,546,304
1997	9,172,879		1,532,868	1,370,282					1,260,861	1,369,996	3,552,000	$ 25,264,033
1998	10,398,524		1,532,868	2,279,925	372,591	714,585	$147,535	145,192	2,761,600	745,497	4,887,000	$ 26,962,764
1999	10,908,408		730,073	1,180,267	456,513	283,405	121,398	116,000	4,553,355	702,891	6,215,000	$ 29,745,832
2000	10,410,325			1,034,975	694,295	243,648	100,965	237,000	4,381,470	8,246,380	13,783,000	$ 25,338,182
2001	10,255,846			1,034,975	590,422	144,067	111,673	0	3,930,282	(3,790,919)	1,100,000	$ 33,459,054
2002	8,674,271			1,029,973	551,075	279,945	84,315	121,000	4,185,740	1,802,338	6,966,000	$ 34,137,352
2003	8,202,777			1,032,474	415,795	242,999	131,908		3,112,520	6,982,687	10,885,000	$ 30,422,655
2004	8,307,425			1,032,474	503,133	210,236	123,866		3,477,560	6,789,712	11,104,000	$ 26,593,606
2005	6,700,765	448,360		1,032,474	538,836	183,366	158,644		3,003,036	2,697,956	6,581,000	$ 26,129,258
2006	8,174,033	1,462,305		4,901,904	514,658	259,884	188,166		3,086,351	8,349,941	12,399,000	$ 18,464,691
2007	8,008,373	1,418,252		779,905	559,423	284,756	106,582		3,256,500	6,464,739	11,544,000	$ 15,567,410
2008	7,842,785	1,478,287		419,593	769,452	239,037	142,334		2,908,339	6,276,838	10,336,000	$ 14,132,889
2009	7,574,720	1,547,288		997,172	1/ 663,166	1/ 373,546	1/ 153,600		1/ 6,294,926	1/ (7,485,238)	1/ 0	$ 22,257,725
2010	7,201,523	1,519,805		997,172	799,944	216,909	172,247		2,442,238	1,843,875	5,475,213	$ 24,506,669
2011	7,846,225	1,593,621		997,172	777,750	291,833	125,615		3,093,934	9,948,947	14,237,779	$ 18,711,564
2012	8,154,241	1,552,976		997,172	687,650	273,901	122,357		3,022,866	8,908,532	13,015,306	$ 14,406,303
2013	7,657,120	1,562,447		997,172	664,125	320,988	143,596		3,161,480	8,746,278	12,461,662	$ 10,167,037
2014	7,840,925	1,569,267		0	745,733	400,634	122,035		2,555,465	4,315,185	8,139,052	$ 11,438,178
2015	6,567,522	1,560,024		0	759,674	477,475	146,625		2,656,628	2/ 4,290,840	8,331,242	$ 11,234,482
2016	7,260,300	1,575,912		0	1,072,456	640,900	175,950		3,305,165	5,858,581	11,053,052	$ 9,017,643
2017	7,328,063	1,450,851		0	943,217	418,373	158,465		3,684,388	4,693,565	9,898,008	$ 7,898,546
2018	6,590,291	1,511,926		0	814,502	362,071	122,914		3,964,468	5,355,332	10,619,287	$ 5,381,476
Subtotal	252,054,841	18,739,394	27,591,621	53,340,757	13,079,908	6,500,487	2,737,876	619,192	70,134,704	87,758,621	181,963,314	
2019	7,309,338	1,511,926		0	1,201,333	714,000	225,129		2,185,714	8,673,824	13,000,000	$ 1,202,740
2020	7,285,751	1,511,926		0	1,272,733	665,267	182,871		2,550,000	4,329,129	9,000,000	$ 1,000,417
2021	7,318,211	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,141,645	8,599,167	$ 1,231,387
2022	7,341,567	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,341,645	8,799,167	$ 1,285,713
2023	7,287,012	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,341,645	8,799,167	$ 1,285,485
2024	7,352,471	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,441,645	8,899,167	$ 1,250,716
2025	7,425,349	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,341,645	8,799,167	$ 1,388,825
2026	7,381,461	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,341,645	8,799,167	$ 1,483,045
2027	7,341,618	1,511,926		0	1,201,333	566,667	139,521		2,550,000	4,441,645	8,899,167	$ 1,437,422
2028	7,326,712	1,511,926		0	1,201,333	566,667	139,521		2,550,000	3,641,645	8,099,167	$ 2,176,894
2029	6,943,644	1,511,926		0	1,201,333	566,667	139,521		2,550,000	3,641,645	8,099,167	$ 2,533,298
2030	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 2,988,868
2031	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 3,444,438
2032	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 3,900,008
2033	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 4,355,579
2034	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 4,811,149
2035	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 5,266,719
2036	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 5,722,289
2037	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 6,177,860
2038	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 6,633,430
2039	6,943,644	1,511,926		4,830,251	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 2,258,749
2040	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 2,714,319
2041	6,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 3,169,890
2042	6,943,644	1,511,926		1,969,764	1,201,333	467,500	139,521		2,550,000	2,641,645	7,000,000	$ 2,655,696
2043	6,943,644	1,511,926		897,906	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 2,213,360
2044	9,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 5,668,930
2045	9,943,644	1,511,926		0	1,201,333	467,500	139,521		2,550,000	2,641,645	7,000,000	$ 10,124,501
2046	9,943,644	1,511,926		6,070,071	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 7,510,000
2047	9,943,644	1,511,926		7,193,470	1,201,333	467,500	139,521		2,550,000	3,641,645	8,000,000	$ 3,772,100
2048	9,943,644	1,511,926		3,684,171	1,201,333	467,500	139,521		2,550,000	2,641,645	7,000,000	$ 4,543,499
Total	479,297,210	64,097,182	27,591,621	77,986,390	0 49,191,308	0 21,862,254	0 7,052,476	619,192	0 146,270,418	0 204,627,641		

1/ Upfront cost sharing was created but not requested by the UC Region this year.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Lower Colorado River Basin Development Fund

Last Revised: 10/20/2018

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
	Repayment																		
	Paradox Valley Unit			Grand Valley Construction Completed								Las Vegas	Lower Gunnison		McElmo Creek		USDA	Transfer to	
Year	Well	Facilities	O&M	Sep-89	Sep-92	Sep-93	Sep-97	Sep-98	Sep-99	Total	O&M	Wash	Construction	O&M	Construction	O&M	NRCS	Treasury	Year
1988											11,410				17,402		27,797	56,609	1988
1989			5,511								14,424				160,515		490,562	671,012	1989
1990			25,242	165,039						165,039	5,178				176,194		595,923	967,576	1990
1991			40,744	165,366						165,366	20,826		683,908		685,579		827,733	2,424,156	1991
1992			54,736	167,566						167,566	24,461		1,018,031		1,022,056	12,857	1,041,545	3,341,252	1992
1993			100,304	201,706						201,706	25,037		1,800,250	58,374	1,791,857	13,151	1,511,481	5,502,160	1993
1994			90,727	269,810						269,810	62,403	36,690	1,481,236	62,335	3,508,286	29,635	2,312,460	7,853,582	1994
1995			104,588	271,061						271,061	12,198	7,338	1,265,024	89,901	2,263,383	10,861	1,809,345	5,833,699	1995
1996			523,452	419,128						419,128	172,501	11,439	151,911	150,538	407,689	97,918	2,641,054	4,575,630	1996
1997			156,978	125,241						125,241	51,373	3,237	45,361	45,222	122,133	29,592	791,145	1,370,282	1997
1998			307,790	720,642						720,642	108,753	7,338	382,343	61,102	616,036	75,921		2,279,925	1998
1999			52,534	961,841						961,841	105,987	7,338	-256		52,823			1,180,267	1999
2000				1,025,136						1,025,136		7,338	1,362		1,139			1,034,975	2000
2001				1,025,136						1,025,136		7,338	1,362		1,139			1,034,975	2001
2002				1,029,973						1,029,973								1,029,973	2002
2003				1,025,136						1,025,136		7,338						1,032,474	2003
2004				1,025,136						1,025,136		7,338						1,032,474	2004
2005				1,025,136						1,025,136		7,338						1,032,474	2005
2006	4,901,904																	4,901,904	2006
2007	740,345											256,827	-383,526		166,259			779,905	2007
2008	997,172														-577,579			419,593	2008
2009	997,172																	997,172	2009
2010	308,611			688,561						688,561								997,172	2010
2011				997,172						997,172								997,172	2011
2012				997,172						997,172								997,172	2012
2013				997,172						997,172								997,172	2013
2014																		0	2014
2015																		0	2015
2016																		0	2016
2017																		0	2017
2018																		0	2018
Subtotal	7,945,204	0	1,462,606	13,303,130	0	0	0	0	0	13,303,130	614,551	366,897	6,447,006	467,472	10,414,911	269,935	12,049,045	53,340,757	
2019																		0	2019
2020																		0	2020
2021																		0	2021
2022																		0	2022
2023																		0	2023
2024																		0	2024
2025																		0	2025
2026																		0	2026
2027																		0	2027
2028																		0	2028
2029																		0	2029
2030																		0	2030
2031																		0	2031
2032																		0	2032
2033																		0	2033
2034																		0	2034
2035																		0	2035
2036																		0	2036
2037																		0	2037
2038																		0	2038
2039				4,830,251						4,830,251								4,830,251	2039
2040																		0	2040
2041																		0	2041
2042					1,969,764					1,969,764								1,969,764	2042
2043						897,906				897,906								897,906	2043
2044																		0	2044
2045																		0	2045
2046		6,070,071																6,070,071	2046
2047							1,188,406	6,005,064		7,193,470								7,193,470	2047
2048									3,684,171	3,684,171								3,684,171	2048
Total	7,945,204	6,070,071	1,462,606	18,133,381	1,969,764	897,906	1,188,406	6,005,064	3,684,171	31,878,692	614,551	366,897	6,447,006	467,472	10,414,911	269,935	12,049,045	131,327,147	

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Upper Colorado River Basin Fund

As of 9/30/2017

A	B	C	D	E	F		G	H		I	J
	Up-front Cost Sharing										
Fiscal Year	Paradox Valley O&M	Grand Valley O&M	McElmo Creek (Dolores) O&M	Lower Gunnison O&M	Basinwide SCP		USDA NRCS BSP	**Total Transfer to UC Region**		**Total Repayment Transfer to Treasury**	**Total Annual Requirement**
1987										6,918	6,918
1988										90,088	90,088
1989										110,531	110,531
1990										156,936	156,936
1991										200,047	200,047
1992										301,475	301,475
1993										451,325	451,325
1994										357,687	357,687
1995										1,934,454	1,934,454
1996										2,750,148	2,750,148
1997					222,505		(254,648)	0		285,643	253,500
1998	65,752	126,103	$26,036	25,622	487,341		131,146	862,000		135,666	997,666
1999	80,561	50,013	21,423	17,195	803,533		244,275	1,217,000		87,604	1,304,604
2000	122,523	42,997	17,817	20,513	773,201		1,611,949	2,589,000		0	2,589,000
2001	104,192	25,425	19,707	20,202	693,579		(863,105)	0		0	0
2002	97,249	49,402	14,879	11,045	738,660		318,765	1,230,000		0	1,230,000
2003	73,375	42,882	23,278	(161)	549,268		271,358	960,000		0	960,000
2004	88,788	37,100	21,859	(89)	613,687		1,200,655	1,962,000		0	1,962,000
2005	95,089	32,359	27,996		529,948		1,256,756	1,942,148		0	1,942,148
2006	90,822	45,863	33,206		544,650		1,469,355	2,183,896		0	2,183,896
2007	98,721	50,252	18,809		574,676	1/	3,274,556	4,017,014	2/	0	4,017,014
2008	135,786	42,183	25,118		513,236		(2,541,323)	(1,825,000)		0	(1,825,000)
2009	117,029	65,919	27,105		1,110,870		4,725,077	6,046,000		0	6,046,000
2010	141,167	38,278	30,396		430,984		1,289,302	1,930,127		0	1,930,127
2011	137,250	51,500	22,114		545,989		801,982	1,558,835		0	1,558,835
2012	121,350	48,336	21,592		533,448		861,682	1,586,408		0	1,586,408
2013	117,199	56,644	25,341		557,908		930,508	1,687,600		0	1,687,600
2014	131,600	70,700	21,536		450,964		1,603,400	2,278,200		0	2,278,200
2015	212,622	94,100	44,293		639,793		1,009,181	1,999,989		0	1,999,989
2016	188,820	119,230	31,050		583,265		1,005,454	1,927,819		0	1,927,819
2017	166,450	73,831	27,964		650,274		777,577	1,696,096		0	1,696,096
2018	143,736	63,895	21,691		699,612		896,715	1,825,649		0	1,825,649
Subtotal	2,386,345	1,163,116	501,519	94,327	12,547,779		19,123,902	35,816,988		6,868,522	42,685,510
2019	212,000	126,000	25,000		300,000		819,383	1,482,383		0	1,482,383
2020	224,600	117,400	25,000		350,000		772,278	1,489,278		0	1,489,278
2021	212,000	100,000	25,000		350,000		788,126	1,475,126		0	1,475,126
2022	212,000	100,000	25,000		350,000		625,000	1,312,000		0	1,312,000
2023	212,000	100,000	25,000		350,000		625,000	1,312,000		0	1,312,000
2024	212,000	100,000	25,000		350,000		625,000	1,312,000		0	1,312,000
2025	212,000	100,000	25,000		350,000		625,000	1,312,000		0	1,312,000
2026	212,000	100,000	25,000		350,000		625,000	1,312,000		1,384,314	2,696,314
2027	212,000	100,000	25,000		350,000		600,000	1,287,000		0	1,287,000
2028	212,000	100,000	25,000		350,000		600,000	1,287,000		0	1,287,000
2029	212,000	100,000	25,000		350,000		600,000	1,287,000		0	1,287,000
2030	212,000	82,500	25,000		350,000		600,000	1,269,500		0	1,269,500
2031	212,000	82,500	25,000		350,000		575,000	1,244,500		0	1,244,500
2032	212,000	82,500	25,000		350,000		575,000	1,244,500		0	1,244,500
2033	212,000	82,500	25,000		350,000		575,000	1,244,500		0	1,244,500
2034	212,000	82,500	25,000		350,000		550,000	1,219,500		0	1,219,500
2035	212,000	82,500	25,000		350,000		550,000	1,219,500		0	1,219,500
2036	212,000	82,500	25,000		350,000		550,000	1,219,500		0	1,219,500
2037	212,000	82,500	25,000		350,000		500,000	1,169,500		0	1,169,500
2038	212,000	82,500	25,000		350,000		500,000	1,169,500		0	1,169,500
2039	212,000	82,500	25,000		350,000		500,000	1,169,500		3,200,008	4,369,508
2040	212,000	82,500	25,000		350,000		400,000	1,069,500		64,747	1,134,247
2041	212,000	82,500	25,000		350,000		400,000	1,069,500		0	1,069,500
2042	212,000	82,500	25,000		350,000		400,000	1,069,500		347,605	1,417,105
2043	212,000	82,500	25,000		350,000		400,000	1,069,500		158,454	1,227,954
2044	212,000	82,500	25,000		350,000		400,000	1,069,500		0	1,069,500
2045	212,000	82,500	25,000		350,000		400,000	1,069,500		0	1,069,500
2046	212,000	82,500	25,000		350,000		400,000	1,069,500		1,071,189	2,140,689
2047	212,000	82,500	25,000		350,000		400,000	1,069,500		1,919,584	2,989,084
2048	212,000	82,500	25,000		350,000		400,000	1,069,500		0	1,069,500
Total	6,372,600	2,710,900	750,000	0	10,450,000	0	16,379,787	36,663,287		8,145,901	133,701,953

1/ In FY2003 $1,103,000 was transferred from the Upper Basin Fund, but was not transferred into the Salinity Program until FY 2007. The total amount was accounted for in the Basinwide Program portion.

2/ The actual amount transferred from the Upper Basin Fund to the UC Region for the Salinity Program was $2,038,000, of which $573,000 was for the Basinwide Program. Please see footnote 1/ for the explanation of the difference.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Upper Colorado River Basin Fund

As of 9/30/2017

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
	Repayment																		
	Paradox Valley Unit			Grand Valley Construction Completed								Las Vegas Wash	Lower Gunnison		McElmo Creek (Dolores Project)		USDA NRCS	Total Transfer to Treasury	
Fiscal Year	Well	Facilities	O&M	Sep-89	Sep-92	Sep-93	Sep-97	Sep-98	Sep-99	Total	O&M		Construction	O&M	Construction	O&M			Year
1987											2,013						4,905	6,918	1987
1988			973								2,545						86,570	90,088	1988
1989			4,454								914						105,163	110,531	1989
1990			7,190								3,675						146,071	156,936	1990
1991			9,659								4,317					2,269	183,802	200,047	1991
1992			17,701								4,418			10,301		2,321	266,734	301,475	1992
1993			16,011								11,012			11,000		5,230	408,072	451,325	1993
1994			18,457								2,152			15,865		1,917	319,296	357,687	1994
1995			29,749								14,647		1,405,078	16,021		8,845	460,114	1,934,454	1995
1996			90,326								24,860		-7,680	18,525	2,464,892	13,657	145,568	2,750,148	1996
1997			80,337								22,645		675	18,774	21,829	12,613	128,770	285,643	1997
1998			70,676								18,704		-43	19,188	10,658	16,483		135,666	1998
1999													59,331		28,273			87,604	1999
2000																		0	2000
2001																		0	2001
2002																		0	2002
2003																		0	2003
2004																		0	2004
2005																		0	2005
2006																		0	2006
2007																		0	2007
2008																		0	2008
2009																		0	2009
2010																		0	2010
2011																		0	2011
2012																		0	2012
2013																		0	2013
2014																		0	2014
2015																		0	2015
2016																		0	2016
2017																		0	2017
2018																		0	2018
Subtotal	0	0	345,533	0	0	0	0	0	0	0	111,902	0	1,457,361	109,674	2,525,652	63,335	2,255,065	6,868,522	
2019	0	0		0	0	0	0	0	0	0								0	2019
2020	0	0		0	0	0	0	0	0	0								0	2020
2021	0	0		0	0	0	0	0	0	0								0	2021
2022	0	0		0	0	0	0	0	0	0								0	2022
2023	0	0		0	0	0	0	0	0	0								0	2023
2024	0	0		0	0	0	0	0	0	0								0	2024
2025	0	0		0	0	0	0	0	0	0								0	2025
2026	1,402,063	0		0	0	0	0	0	0	0			-421		-17,328			1,384,314	2026
2027		0		0	0	0	0	0	0	0								0	2027
2028		0		0	0	0	0	0	0	0								0	2028
2029		0		0	0	0	0	0	0	0								0	2029
2030		0		0	0	0	0	0	0	0								0	2030
2031		0		0	0	0	0	0	0	0								0	2031
2032		0		0	0	0	0	0	0	0								0	2032
2033		0		0	0	0	0	0	0	0								0	2033
2034		0		0	0	0	0	0	0	0								0	2034
2035		0		0	0	0	0	0	0	0								0	2035
2036		0		0	0	0	0	0	0	0								0	2036
2037		0		0	0	0	0	0	0	0								0	2037
2038		0		0	0	0	0	0	0	0								0	2038
2039		0		3,200,008	0	0	0	0	0	3,200,008								3,200,008	2039
2040		0		0	0	0	0	0	0	0		64,747						64,747	2040
2041		0			0	0	0	0	0	0								0	2041
2042		0			347,605	0	0	0	0	347,605								347,605	2042
2043		0				158,454	0	0	0	158,454								158,454	2043
2044		0					0	0	0	0								0	2044
2045		0					0	0	0	0								0	2045
2046		1,071,189					0	0	0	0								1,071,189	2046
2047							209,719	1,059,717	650,148	1,919,584								1,919,584	2047
2048										0									2048
Total	1,402,063	1,071,189	345,533	3,200,008	347,605	158,454	209,719	1,059,717	650,148	5,625,651	111,902	64,747	1,456,940	109,674	2,508,324	63,335	2,255,065	15,014,423	

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II
Lower Colorado River Basin Development Fund
Last Revised: 10/18/2017

Fiscal Year	Actual/ Projected Fund Revenues	Deficiency Payments	Actual/Projected Federal Expenditure (Basinwide, O&M, EQIP)	Total LCRBDF Required Cost Share	LCRBDF Transfers: Actual Transfer to UC Region	LCRBDF Transfers: Repayment to the Treasury	LCRBDF Fund Balance: Actual	LCRBDF Fund Balance: Accrual	LCRBDF Fund Balance: Net
1987	$ 1,540,705						$ 1,540,705	$ -	$ 1,540,705
1988	$ 9,359,325	$ 1,532,868				$ 56,609	$ 9,310,553		$ 9,310,553
1989	$ 8,442,385	$ 1,532,868				$ 671,012	$ 15,549,058		$ 15,549,058
1990	$ 8,899,348	$ 1,532,868				$ 967,576	$ 21,947,961		$ 21,947,961
1991	$ 8,055,138	$ 11,532,868				$ 2,424,156	$ 16,046,075		$ 16,046,075
1992	$ 7,622,748	$ 1,532,868				$ 3,341,252	$ 18,794,702		$ 18,794,702
1993	$ 6,960,422	$ 1,532,868				$ 5,502,160	$ 18,720,096		$ 18,720,096
1994	$ 8,830,220	$ 1,532,868				$ 7,853,582	$ 18,163,866		$ 18,163,866
1995	$ 8,212,818	$ 1,532,868				$ 5,833,699	$ 19,010,118		$ 19,010,118
1996	$ 9,644,684	$ 1,532,868	$ 5,988,526	$ 1,701,433	$ -	$ 4,575,630	$ 22,546,304	$ (1,701,433)	$ 20,844,871
1997	$ 9,172,879	$ 1,532,868	$ 9,266,475	$ 3,161,340	$ 3,552,000	$ 1,370,282	$ 25,264,033	$ (1,310,774)	$ 23,953,259
1998	$ 10,398,524	$ 1,532,868	$ 16,033,855	$ 5,530,283	$ 4,887,000	$ 2,279,925	$ 26,962,764	$ (1,954,056)	$ 25,008,707
1999	$ 10,908,408	$ 730,073	$ 21,132,654	$ 7,486,919	$ 6,215,000	$ 1,180,267	$ 29,745,832	$ (3,225,975)	$ 26,519,857
2000	$ 10,410,325		$ 21,125,130	$ 7,427,599	$ 13,783,000	$ 1,034,975	$ 25,338,182	$ 3,129,426	$ 28,467,608
2001	$ 10,255,846		$ 19,786,891	$ 6,998,228	$ 1,100,000	$ 1,034,975	$ 33,459,054	$ (2,768,802)	$ 30,690,251
2002	$ 8,674,271		$ 25,277,789	$ 8,970,903	$ 6,966,000	$ 1,029,973	$ 34,137,352	$ (4,773,705)	$ 29,363,647
2003	$ 8,202,777		$ 24,093,372	$ 8,588,644	$ 10,885,000	$ 1,032,474	$ 30,422,655	$ (2,477,350)	$ 27,945,305
2004	$ 8,307,425		$ 32,068,003	$ 11,478,096	$ 11,104,000	$ 1,032,474	$ 26,593,606	$ (2,851,446)	$ 23,742,161
2005	$ 7,149,125		$ 30,853,131	$ 11,033,011	$ 6,581,000	$ 1,032,474	$ 26,129,258	$ (7,303,457)	$ 18,825,801
2006	$ 9,636,337		$ 31,458,415	$ 11,238,554	$ 12,399,000	$ 4,901,904	$ 18,464,691	$ (6,143,010)	$ 12,321,680
2007	$ 9,426,624		$ 30,737,896	$ 10,956,182	$ 11,544,000	$ 779,905	$ 15,567,410	$ (5,555,193)	$ 10,012,217
2008	$ 9,321,072		$ 27,895,702	$ 9,873,866	$ 10,336,000	$ 419,593	$ 14,132,889	$ (5,093,059)	$ 9,039,830
2009	$ 9,122,008		$ 37,702,415	$ 13,438,248	$ -	$ 997,172	$ 22,257,725	$ (18,531,307)	$ 3,726,418
2010	$ 8,721,327		$ 25,349,378	$ 8,943,887	$ 5,475,213	$ 997,172	$ 24,506,667	$ (21,999,981)	$ 2,506,686
2011	$ 9,439,846		$ 28,994,153	$ 10,256,560	$ 14,237,779	$ 997,172	$ 18,711,562	$ (18,018,762)	$ 692,800
2012	$ 9,707,216		$ 27,512,563	$ 9,747,705	$ 13,015,306	$ 997,172	$ 14,406,300	$ (14,751,161)	$ (344,861)
2013	$ 9,219,567		$ 25,903,460	$ 9,154,800	$ 12,461,662	$ 997,172	$ 10,167,033	$ (11,444,299)	$ (1,277,266)
2014	$ 9,410,192		$ 25,884,234	$ 9,101,723	$ 8,139,052	$ -	$ 11,438,173	$ (12,406,970)	$ (968,797)
2015	$ 8,127,546		$ 27,288,103	$ 9,587,195	$ 8,331,242	$ -	$ 11,234,477	$ (13,662,923)	$ (2,428,446)
2016	$ 8,836,212		$ 26,969,736	$ 9,382,164	$ 11,053,052	$ -	$ 9,017,637	$ (11,992,040)	$ (2,974,403)
2017	$ 8,778,914	$ -	$ 28,387,000	$ 10,111,716	$ 9,898,008	$ -	$ 7,898,545	$ (12,206,249)	$ (4,307,704)
2018	$ 8,102,218	$ -	$ 28,903,750	$ 11,486,809	$ 10,619,287	$ -	$ 5,381,477	$ (13,074,271)	$ (7,692,794)
	$ 278,896,452	$ 27,591,621	$ 549,708,881	$ 194,169,057	$ 181,963,314	$ 53,340,757			

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II
Lower Colorado River Basin Development Fund
Last Revised: 10/20/2018

				LCRBDF Transfers		LCRBDF Fund Balance		
Fiscal Year	**Actual/ Projected Fund Revenues**	**Actual/Projected Federal Expenditure (Basinwide, O&M, EQIP)**	**Total LCRBDF Required Cost Share**	**Actual/ Projected Transfer to UC Region**	**Repayment to the Treasury**	**Actual**	**Accrual**	Net
2016	$ 8,836,212	$ 26,969,736	$ 9,382,164	$ 11,053,052	$ -	$ 9,017,639	$ (11,992,040)	$ (2,974,401)
2017	$ 8,778,914	$ 28,745,500	$ 10,111,716	$ 9,898,008	$ -	$ 7,898,545	$ (12,206,248)	$ (4,307,703)
2018	$ 8,102,217	$ 32,455,218	$ 11,486,809	$ 10,619,287	$ -	$ 5,381,475	$ (13,073,770)	$ (7,692,295)
2019	$ 8,821,265	$ 29,765,650	$ 10,295,963	$ 13,000,000	$ -	$ 1,202,740	$ (10,369,733)	$ (9,166,993)
2020	$ 8,797,677	$ 29,787,566	$ 10,297,470	$ 9,000,000	$ -	$ 1,000,417	$ (11,667,203)	$ (10,666,786)
2021	$ 8,830,137	$ 29,385,522	$ 10,199,583	$ 8,500,000	$ -	$ 1,330,554	$ (13,366,786)	$ (12,036,232)
2022	$ 8,853,493	$ 26,123,000	$ 9,011,093	$ 8,900,000	$ -	$ 1,284,047	$ (13,477,879)	$ (12,193,832)
2023	$ 8,798,938	$ 26,123,000	$ 9,011,093	$ 8,900,000	$ -	$ 1,182,985	$ (13,588,972)	$ (12,405,987)
2024	$ 8,864,398	$ 26,123,000	$ 9,011,093	$ 8,900,000	$ -	$ 1,147,383	$ (13,700,065)	$ (12,552,682)
2025	$ 8,937,276	$ 26,123,000	$ 9,011,093	$ 8,900,000	$ -	$ 1,184,658	$ (13,811,158)	$ (12,626,500)
2026	$ 8,893,387	$ 26,123,000	$ 9,011,093	$ 8,700,000	$ -	$ 1,378,045	$ (14,122,250)	$ (12,744,206)
2027	$ 8,853,544	$ 25,623,000	$ 8,828,950	$ 8,700,000	$ -	$ 1,531,589	$ (14,251,200)	$ (12,719,612)
2028	$ 8,838,639	$ 25,623,000	$ 8,828,950	$ 8,700,000	$ -	$ 1,670,227	$ (14,380,150)	$ (12,709,923)
2029	$ 8,455,570	$ 25,623,000	$ 8,828,950	$ 8,500,000	$ -	$ 1,625,798	$ (14,709,100)	$ (13,083,303)
2030	$ 8,455,570	$ 25,273,000	$ 8,729,783	$ 8,000,000	$ -	$ 2,081,368	$ (15,438,884)	$ (13,357,516)
2031	$ 8,455,570	$ 24,773,000	$ 8,547,640	$ 8,000,000	$ -	$ 2,536,938	$ (15,986,524)	$ (13,449,586)
2032	$ 8,455,570	$ 24,773,000	$ 8,547,640	$ 8,000,000	$ -	$ 2,992,508	$ (16,534,165)	$ (13,541,656)
2033	$ 8,455,570	$ 24,773,000	$ 8,547,640	$ 8,000,000	$ -	$ 3,448,079	$ (17,081,805)	$ (13,633,727)
2034	$ 8,455,570	$ 24,273,000	$ 8,365,498	$ 8,000,000	$ -	$ 3,903,649	$ (17,447,303)	$ (13,543,654)
2035	$ 8,455,570	$ 24,273,000	$ 8,365,498	$ 8,000,000	$ -	$ 4,359,219	$ (17,812,800)	$ (13,453,581)
2036	$ 8,455,570	$ 24,273,000	$ 8,365,498	$ 8,000,000	$ -	$ 4,814,789	$ (18,178,298)	$ (13,363,509)
2037	$ 8,455,570	$ 23,273,000	$ 8,001,212	$ 8,000,000	$ -	$ 5,270,360	$ (18,179,510)	$ (12,909,150)
2038	$ 8,455,570	$ 23,273,000	$ 8,001,212	$ 8,000,000	$ -	$ 5,725,930	$ (18,180,722)	$ (12,454,792)
2039	$ 8,455,570	$ 23,273,000	$ 8,001,212	$ 8,000,000	$ 4,830,251	$ 1,351,249	$ (18,181,934)	$ (16,830,685)
2040	$ 8,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ -	$ 1,806,819	$ (17,454,574)	$ (15,647,755)
2041	$ 8,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ -	$ 2,262,390	$ (16,727,215)	$ (14,464,825)
2042	$ 8,455,570	$ 21,273,000	$ 7,272,640	$ 7,000,000	$ 1,969,764	$ 1,748,196	$ (16,999,855)	$ (15,251,659)
2043	$ 8,455,570	$ 21,273,000	$ 7,272,640	$ 7,000,000	$ 897,906	$ 2,305,860	$ (17,272,496)	$ (14,966,636)
2044	$ 11,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ -	$ 5,761,430	$ (16,545,136)	$ (10,783,706)
2045	$ 11,455,570	$ 21,273,000	$ 7,272,640	$ 7,000,000	$ -	$ 10,217,001	$ (16,817,777)	$ (6,600,776)
2046	$ 11,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ 6,070,071	$ 7,602,500	$ (16,090,417)	$ (8,487,917)
2047	$ 11,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ 7,193,470	$ 3,864,600	$ (15,363,058)	$ (11,498,457)
2048	$ 11,455,570	$ 21,273,000	$ 7,272,640	$ 8,000,000	$ 3,684,171	$ 3,635,999	$ (14,635,698)	$ (10,999,699)
	$ 298,317,500	$ 818,280,192.25	$ 282,242,616.73	$ 11,000,000.00	$ 24,645,633			

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Appropriations and Cost Share from the Basin Funds 1996 thru 2018 and Original Unit Costs

9/30/2018

TOTAL PROGRAM ($1,000)

Unit	Unit Cost	1996-2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Subtotal	2019	2020	2021
Grand Valley O&M	233,901	16,292	1,021	1,373	1,289	1,515	1,885	2,247	2,312	1,488	1,704	265,028	3,360	2,015	2,015
Paradox Valley O&M	95,740	31,200	3,764	3,660	3,236	3,124	3,501	3,575	4,977	4,439	3,833	161,049	5,653	4,000	4,000
Lower Gunnison O&M	37,693	0	0	0	0	0	0	0	0	0	0	37,693	0	0	0
McElmo Creek (Dolores) O&M	63,126	6,163	676	491	480	563	479	576	459	620	481	74,113	883	883	883
USBR Basinwide Program	0	181,936	9,577	12,104	11,854	12,399	10,021	10,419	13,416	12,210	15,547	289,483	8,571	10,000	11,857
Subtotal (USBR Program)	430,460	235,591	15,038	17,629	16,860	17,600	15,887	16,816	21,164	18,757	21,566	827,366	18,468	16,898	18,755
USDA Program	0	223,621	20,833	23,403	22,121	19,077	20,697	21,751	16,844	21,884	24,403	414,636	19,190	18,000	18,457
BLM (no Basin Funds)		800	800	800	800	800	800	800	800	800	800	8,000	800	800	800
Total	430,460	460,012	36,671	41,832	39,781	37,477	37,384	39,367	38,808	41,441	46,769	1,250,002	38,458	35,698	38,012

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APPROPRIATIONS EXPENDED ($1,000)

Unit	Unit Cost	1996-2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Subtotal	2019	2020	2021
Grand Valley O&M	175,426	12,219	766	1,030	967	1,133	1,414	1,685	1,734	1,116	1,278	198,768	2,520	1,511	1,511
Paradox Valley O&M	71,805	23,400	2,823	2,745	2,427	2,343	2,626	2,681	3,733	3,329	2,875	120,787	4,240	3,000	3,000
Lower Gunnison O&M	28,270	1,465	0	0	0	0	0	0	0	0	0	29,735	0	0	0
McElmo Creek (Dolores) O&M	44,188	4,314	473	344	336	394	335	403	321	434	337	51,879	618	618	618
USBR Basinwide Program	0	127,355	6,704	8,473	8,298	8,679	7,015	7,293	9,391	8,547	10,883	202,638	6,000	7,000	8,300
Subtotal (USBR Program)	147,392	168,753	10,766	12,592	12,028	12,549	11,390	12,062	15,179	13,426	15,373	431,510	13,378	12,129	13,429
USDA Program	0	156,535	14,583	16,382	15,485	13,354	14,488	15,226	11,791	15,319	17,082	290,245	13,433	12,600	12,920
Total	287,585	325,288	25,349	28,974	27,513	25,903	25,878	27,288	26,970	28,745	32,455	861,948	26,811	24,729	26,349

UPPER BASIN FUND COST SHARE PAYMENTS ($1,000)

Unit	Unit Cost	1996-2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Subtotal	2019	2020	2021
Grand Valley O&M	8,771	611	38	52	48	57	71	84	87	56	64	9,938	126	76	76
Paradox Valley O&M	3,590	1,170	141	137	121	117	131	134	187	166	144	6,039	212	150	150
Lower Gunnison O&M	1,414	0	0	0	0	0	0	0	0	0	0	1,414	0	0	0
McElmo Creek (Dolores) O&M	2,841	277	30	22	22	25	22	26	21	28	22	3,335	40	40	40
USBR Basinwide Program	0	8,187	431	545	533	558	451	469	604	549	700	13,027	386	450	534
Subtotal (USBR Program)	16,616	10,245	641	756	725	757	675	713	898	800	929	33,753	763	715	799
USDA Projects	0	10,063	937	1,053	995	858	931	979	758	985	1,098	18,659	864	810	831
Total Payment	16,616	20,308	1,578	1,809	1,720	1,616	1,606	1,692	1,656	1,784	2,027	52,412	1,627	1,525	1,629

LOWER BASIN FUND COST SHARE PAYMENTS ($1,000)

Unit	Unit Cost	1996-2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Subtotal	2019	2020	2021
Grand Valley O&M	49,704	3,462	217	292	274	325	401	477	491	316	362	56,322	714	428	428
Paradox Valley O&M	20,345	6,630	800	778	688	664	744	760	1,058	943	815	33,408	1,201	850	850
Lower Gunnison O&M	8,010	0	0	0	0	0	0	0	0	0	0	8,010	0	0	0
McElmo Creek (Dolores) O&M	16,097	1,572	172	125	122	144	122	147	117	158	123	18,776	225	225	225
USBR Basinwide Program	0	46,394	2,442	3,087	3,023	3,162	2,555	2,657	3,421	3,114	3,965	69,854	2,186	2,550	3,024
Subtotal (USBR Program)	94,156	58,057	3,631	4,281	4,107	4,294	3,822	4,041	5,087	4,531	5,264	186,007	4,326	4,053	4,527
USDA Projects	0	57,023	5,312	5,968	5,641	4,865	5,278	5,547	4,295	5,580	6,223	99,509	4,893	4,590	4,707
Total	94,156	115,081	8,944	10,249	9,748	9,159	9,100	9,587	9,382	10,112	11,487	285,517	9,220	8,643	9,233

BASINWIDE

Contract Name	End Date	Contract Amount	Obligated to Date	Balance To Obligate	Expended to Date	Balance to Expend	FY 2018 Apporopriations & Cost Share	FY 2019 Apporopriations & Cost Share	FY 2020 Apporopriations & Cost Share
Clipper Center Lateral Project - Crawford	9/30/2020	$ 3,153,410	$ 1,910,551	$ 1,242,859	$ 410,095	$ 1,500,456	$ -	$ 942,000	$ 300,859
Cattleman's Ditch Phase 2 - Cedar Canyon	9/30/2020	$ 2,671,305	$ 2,671,305	$ 0	$ 1,808,916	$ 862,389	$ 1,495,304		
North Delta Canal - Phase 1	9/30/2020	$ 5,564,809	$ 4,957,668	$ 607,141	$ 267,610	$ 4,690,058	$ 2,942,951	$ 607,141	
Government Highline Canal – Reach 1A Middle - GVWU	9/30/2020	$ 3,634,242	$ 3,634,242	$ -	$ 2,682,625	$ 951,617	$ 165,267		
GVIC - Canal Lining Phase 4	4/1/2021	$ 2,814,499	$ 2,214,857	$ 599,642	$ 692,015	$ 1,522,842	$ 1,736,071	$ 599,642	
San Juan Dineh Project	5/21/2021	$ 4,835,391	$ 4,265,257	$ 570,134	$ 1,147,011	$ 3,118,246	$ 500,000	$ 570,134	
Uncompahgre East Side Phase 9	9/30/2020	$ 5,363,078	$ 2,181,601	$ 3,181,477	$ 82,966	$ 2,098,635	$ 1,661,100	$ 2,000,000	$ 1,181,477
Fire Mountain Canal Project	9/30/2021	$ 2,954,512	$ 2,954,512	$ -	$ 100,000	$ 2,854,512	$ 1,894,512	$ -	
Ashley Upper and Highline Canals Project		$ 3,514,847	$ 287,500	$ 3,227,347	$ 69,250	$ 218,250	$ 287,500	$ 2,000,000	$ 1,227,347
Upper Stewart Ditch Pipeline Project		$ 2,507,561	$ 1,021,210	$ 1,486,351	$ -	$ 1,021,210	$ 1,021,210	$ 1,000,000	$ 486,351
Gould Canal Improvement Project A		$ 4,294,027	$ 1,000,000	$ 3,294,027	$ -	$ 1,000,000	$ 1,000,000	$ 2,000,000	$ 1,294,027
Gould Canal Improvement Project B		$ 3,545,246	$ 1,119,000	$ 2,426,246	$ -	$ 1,092,397	$ 1,119,000	$ 1,200,000	$ 1,226,246
		$ 30,991,246	$ -	$ 6,201,253	$ 7,191,237	$ 17,598,755	$ 14,110,415	$ 10,918,917	$ 5,716,307
Cattleman's Ditch Phase 1	4/1/2018	$ 1,991,798	$ 1,991,798	$ -	$ 1,991,798	$ -			
South Valley Lateral Salinity Project - Sheep Creek	4/30/2018	$ 4,026,265	$ 4,026,265	$ -	$ 4,026,199	$ 66			
GVIC Canal Improvement 2012	9/30/2017	$ 4,581,825	$ 4,581,825	$ -	$ 4,449,841	$ 131,984			
UVWUA East Side Laterals Project Phase 8	12/31/2018	$ 3,542,157	$ 3,542,157	$ -	$ 3,477,391	$ 64,766			
Orchard Ranch Ditch Piping Project	9/30/2020	$ 1,280,720	$ 1,280,720	$ -	$ 121,987	$ 1,158,733			
		$ 14,142,045	$ 14,142,045	$ -	$ 13,945,229	$ 196,816			
CONTRACT COSTS							$ 14,110,415	$ 10,918,917	$ 5,716,307
NON-CONTRACT COSTS							$ 1,398,396	$ 450,000	$ 500,000
TOTAL OPEN AGREEMENTS			$ 14,142,045	$ 6,201,253	$ 21,136,467	$ 17,795,571	$ 15,508,811	$ 11,368,917	$ 6,216,307
Appropriations S10							$ 10,374,000	$ 6,000,000	$ 7,000,000
Recoveries S10							$ 508,853		
Cost Share X10							$ 4,664,080	$ 2,571,429	$ 3,000,000
TOTAL							$ 15,546,933	$ 8,571,429	$ 10,000,000
Appropriations/Cost Share Totals							$ 15,546,933	$ 8,571,429	$ 10,000,000
Contract/Non Contract Totals							$ 15,508,811	$ 11,368,917	$ 6,216,307
END OF YEAR CARRY OVER									
Final Account Numbers							$ 38,122	$ (2,797,488)	$ 3,783,693

Date as of 10/26/2018

BASIN STATES PROGRAM FUNDING

Contract Number	Contract Name	End Date	Contract Amount	Obligated to Date	Balance To Obligate	Expended to Date	Balance to Expend	FY 2018 Obligations	FY 2019 Obligations	FY 2020 Obligations	FY2021 Obligations	FY2022 Obligations
R15PG00008	NRCS COLORADO	9/30/2019	$ 4,926,760	$ 1,959,228	$ 2,967,532	$ 1,958,731	$ 497					
R13PG40026	NRCS UTAH	3/31/2018	$ 5,146,031	$ 4,597,477	$ 548,554	$ 4,489,432	$ 108,045					
R15PG00011	NRCS WYOMING	3/2/2020	$ 121,434	$ 79,106	$ 42,328	$ -	$ 79,106					
R16AC00001	State of Colorado	3/1/2021	$ 6,000,000	$ 1,727,000	$ 4,273,000	$ 295,275	$ 1,431,725	$ 300,000	$ 200,000	$ 200,000	$ 200,000	
R16AC00023	State of Utah	4/30/2021	$ 6,237,000	$ 3,472,470	$ 2,764,530	$ 2,607,802	$ 864,668	$ 150,000	$ 120,000	$ 120,000	$ 120,000	
R15AC00054	State of Wyoming	5/30/2020	$ 2,800,000	$ 2,310,000	$ 490,000	$ 209,590	$ 2,100,410	$ 900,000	$ 75,000	$ 75,000	$ 75,000	
R14PG00069	US F&WS	9/7/2019	$ 567,374	$ 441,041	$ 126,333	$ 348,766	$ 92,275			$ 50,000	$ 50,000	
R16PC00098	Barnett Intermountain - Salinity Consultant	8/31/2021	$ 597,900	$ 350,600	$ 247,300	$ 230,600	$ 110,000	$ 120,000	$ 122,100	$ 125,200	$ 127,000	
R17PX00669	University of Colorado -Prairie	8/31/2022	$ 325,137	$ 126,007	$ 199,130	$ 67,867	$ 58,141	$ 13,591	$ 13,900	$ 14,220	$ 14,551	
R16AC00019	Minnesota L-75	9/30/2020	$ 186,412	$ 188,412	$ -	$ 187,412	$ 1,000					
R16AC00046	Uinta - White Rocks/Mosby	12/31/2018	$ 2,412,463	$ 2,412,463	$ -	$ 1,595,000	$ 817,463	$ 817,463				
NEW	2017 FOA 1		$ 3,997,208		$ 3,997,208	$ -		$ 177,239	$ 1,164,599	$ 2,000,000	$ 655,369	
R18AC00094	Muddy Creek, Emery, UT	2/28/2022	$ 4,583,000	$ 209,636	$ 4,373,364	$ -		$ 209,636	$ 1,164,739	$ 1,779,371	$ 1,429,254	
R18AC00077	Bostwick Park - Shinn Park/Waterdog, Montrose, CO	5/30/2021	$ 4,136,490	$ 464,735	$ 3,671,755	$ 30,000	$ 434,735	$ 464,735	$ 1,805,090	$ 1,866,665		
R18AC00078	Root & Ratliff, Mancos CO	5/31/2020	$ 3,600,021	$ 159,906	$ 3,440,115	$ -		$ 159,906	$ 1,500,874	$ 1,500,000	$ 439,247	
R3018C0017	SIR Salinity Economic Impact Model (SEIM)	5/31/2020	$ 319,758	$ 319,378	$ 319,378	$ 14,261	$ 305,117	$ 169,758				
	TSC agreement to work on SEIM/Triennial Review		$ 92,000	$ 92,000		$ 89,700	$ 2,300					
R16PG00132	Pah Tempe SIR 5-2016, SIR 2018-05	9/14/2018	$ 295,690	$ 295,690	$ -	$ 133,782	$ 161,908	$ 75,000	$ 32,000			
R17PG00117	SIR 17-03 Blacks Forks Study ($203,978.44)	9/30/2020	$ 204,000	$ 142,867	$ 61,133	$ 44,495	$ 98,371		$ 61,133	$ -		
NEW	SIR 2018-01a Analysis of Long-Term Landscape & Water Quality Changes BLM paying half or more		$ 496,712						$ 250,000			
NEW	SIR 2018-02 Review of Salinity Data, Estimated		$ 45,000						$ 45,000			
NEW	SIR 2018-03 Supplemental Salinity Sampling White River Basin		$ 24,050						$ 24,050			
In House	SIR 2018-04 Huntington Cleveland Chronical		$ 56,600					$ 56,600				
	Future SIR								$ 300,000	$ 300,000		
	Reclamation T/A				$ -		$ -	$ 100,000	$ 50,000	$ 50,000	$ 50,000	
	Advisory Member's Travel				$ -		$ -	$ 9,000	$ 11,000	$ 11,000	$ 13,000	
NEW	RiverWareIDIQ				$ -		$ -	$ 18,000	$ 20,000	$ 20,000	$ 22,000	
	Streamgaging Contracts w/ USGS				$ -		$ -	$ 113,300	$ 94,952	$ 105,000	$ 110,000	
Costs	**ALL COSTS**		$ 60,745,571	$ 33,215,948	$ 27,226,259	$ 24,574,321	$ 7,753,470	$ 3,854,228	$ 7,054,437	$ 8,216,456	$ 3,305,421	$ -
Funding	**Upper Basin Cost Share Based on NRCS 3 yr plan**							$ 896,715	$ 663,215	$ 632,415	$ 625,000	$ 625,000
Funding	**Lower Basin Cost Share based on NRCS + Accrual**							$ 5,355,332	$ 8,673,823	$ 4,329,129	$ 4,141,645	$ 4,341,645
Funding	**Carryover Basin Funds**							$ 446,502	$ 4,018,590	$ 7,138,342	$ 3,883,430	$ 5,344,654
Funding	**Program Year End True-Up**							$ 650,000	$ 650,000			
Funding	**From Recovery**								$ 187,151			
Funding	**From UC Accrual**							$ 134,138				
Funding	**ALL FUNDING TOTAL**							$ 7,482,687	$ 14,192,779	$ 12,099,886	$ 8,650,075	$ 10,311,299
							Carry Over Funding for Next FY	$ 3,628,459	$ 7,138,342	$ 3,883,430	$ 5,344,654	$ 10,311,299