Colorado River Basin Salinity Control Program
Federal Accomplishments Report for Fiscal Year 2020

Presented to

Colorado River Basin Salinity Control
Advisory Council

by

United States Department of Agriculture
Natural Resources Conservation Service
Bureau of Land Management
United States Geological Survey
Environmental Protection Agency
Fish and Wildlife Service (Service)
Bureau of Reclamation

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Colorado River Basin Salinity Control Program
Federal Accomplishments Report for Fiscal Year 2020
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
FA	Financial Assistance
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

Table of Contents

United States Department of Agriculture…...6

Natural Resources Conservation Service…...6

Bureau of Land Management…9

United States Geological Survey….32

Environmental Protection Agency…...50

Fish and Wildlife Service (Service)….54

Bureau of Reclamation….61

List of Tables

Table 1. On-farm/Near-farm Allocations…..7

Table 2. Table 2. The BLM FY20 Salinity Program Funding….10

Table 3. Doppler Radar storm accumulation totals in the study basin (Spring-Fall, 2017-18), Rio Blanco County, Colorado….17

Table 4. Annual mean dissolved solids concentration, flow normalized concentration and discharge in the Colorado River at Cisco, Utah. The black vertical line is when the Colorado River Salinity Control Program began. Data are from USGS streamgage 09180500…..35

Table 5. Basin States Adoption of Salinity Standards & Plan of Implementation Updates…51

Table 6. Tribal Clean Water Act Programs….53

Table 7. Data for Henry's Fork from WY 2020 (May) NRCS M&E Report…...58

Table 8. Table 8. Data from FY2019 NRCS Monitoring and Evaluation Report…...59

Table 9. Data from FY2019 Utah NRCS Monitoring and Evaluation Report.........60

Table 10. Paradox Well Injection History…...64

List of Figures

Figure 1. Linkage of MODFLOW grids to APEX subareas……………..………………………………..15

Figure 2. Map of the Dead Dog Fire extent (outlined in black) and pre-burn survey area (outlined in red), Rio Blanco County, Colorado………………………………………………………..…………..17

Figure 3. Doppler Radar storm accumulation totals in the study basin (Spring-Fall, 2017-18), Rio Blanco County, Colorado……………..…………………………..…………………………...……….19

Figures 4 and 5. Diagram showing a conceptual diagram and image of a sediment/salinity retention pond near Delta, Colorado…………………………………………………………………………..…20

Figure 6. Map showing potential differences in salt accumulations (A) greater-potential salt accumulations downstream of pond, (B) lower-potential salt accumulations downstream of pond, based on geophysical conductance contour…………………………………………………...…21

Figure 7. Graphic depicting processes affecting retention of salinity within salt retention ponds. Observation from the study demonstrates that under most observed conditions, salinity is retained transiently………………………………………………………………………..……….…22

Figure 8. Location of four selected basins in Stinking Water Gulch, Rio Blanco County, Colorado…….24

Figure 9. Aerial photograph showing the target sites for optically stimulated luminescence (OSL) sampling near Rangely, Colorado. Site 1 is located on a former path of Stinking Water Gulch. Site 2 is near the mouth of an unnamed tributary……………………………………………….26

Figure 10. Photograph showing terrace/floodplain remnants (indicated by red arrows) at site 1 looking downstream…………………………………………………………………………..………..26

Figure 11. Photograph showing site 2 with the constructed berm (indicated by red arrow) on the downstream site……………………………………………………………………………….26

Figure 12. Coffee Dam and surrounding Mancos Shale landscape………………………………………28

Figure 13. Upper portion of headcut where water will flow into the now stabilized headcut…………….29

Figure 14. Upper portion of headcut where water will continue to flow downstream……………………29

Figure 15. Terrace Reservoir-Pre-Maintenance, 2020……………………………………………………30
Figure 16. Terrace Reservoir-Post Maintenance, 2020……………………………………………………30
Figure 17. Gould Reservoir-Post Maintenance, 2020……………………………………………………..30
Figure 18. Gould Reservoir-Post Maintenance, 2020……………………………………………………..30
Figure 19. Location of monitoring sites in the 20-station network………………………………………..32
Figure 20. Map of Upper Colorado River Basin, sub-basins and streamgages with pre-1950 water-quality and discharge data……………………………………………………………………………..36
Figure 21. 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…………………………………………………………………37
Figure 22. Pah Tempe Springs, Washington County, Utah……………………………………………….39
Figure 23. Drilling operations near Pah Tempe Hot Springs in January 2018……………………………41
Figure 24. Downhole cameras recorded the injection to evaluate the presence of formation groundwater movement…………………………………………………...…………………………………41
Figure 25. USGS streamgage – Blacks Fork above Smiths Fork…………………………………………43
Figure 26. New priority salinity areas……………………………………………………………………..44
Figure 27. Example of map type provided as part of the review showing various properties of the new priority salinity areas…………………………….…………………………………………45
Figure 28. Paradox Valley………………………………………………………………………………...46
Figure 29. Map of the Dolores River in Paradox Valley showing locations of streamgages and production wells………………………………...………………………………………………………47

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

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 four 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, and most recently (4) PL 115-334, The Agriculture Improvement Act of 2018 enacted on December 20, 2018.

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.

Generally, all three states obligate Salinity funds early enough in the year that statistics are readily available for this report. A number of challenges including Farm Bill, COVID-19, staffing, and technical issues have combined in FY2020 to cause significant delays in obligations. Where salt savings and other pertinent data are available, they are included in this draft of the report. Final figures will be included as the become available in future drafts. Following are present estimates of final Salinity fund obligations for FY2020. At present NRCS leadership teams in the Colorado, Utah, and Wyoming anticipate obligating the majority of the funds allocated to Salinity EQIP in FY2020 with final obligation rates in line with recent years as follows:

Allocation	
Colorado -	$6,500,000
Utah -	$6,674,000
Wyoming -	$250,000
Totals	$13,424,000

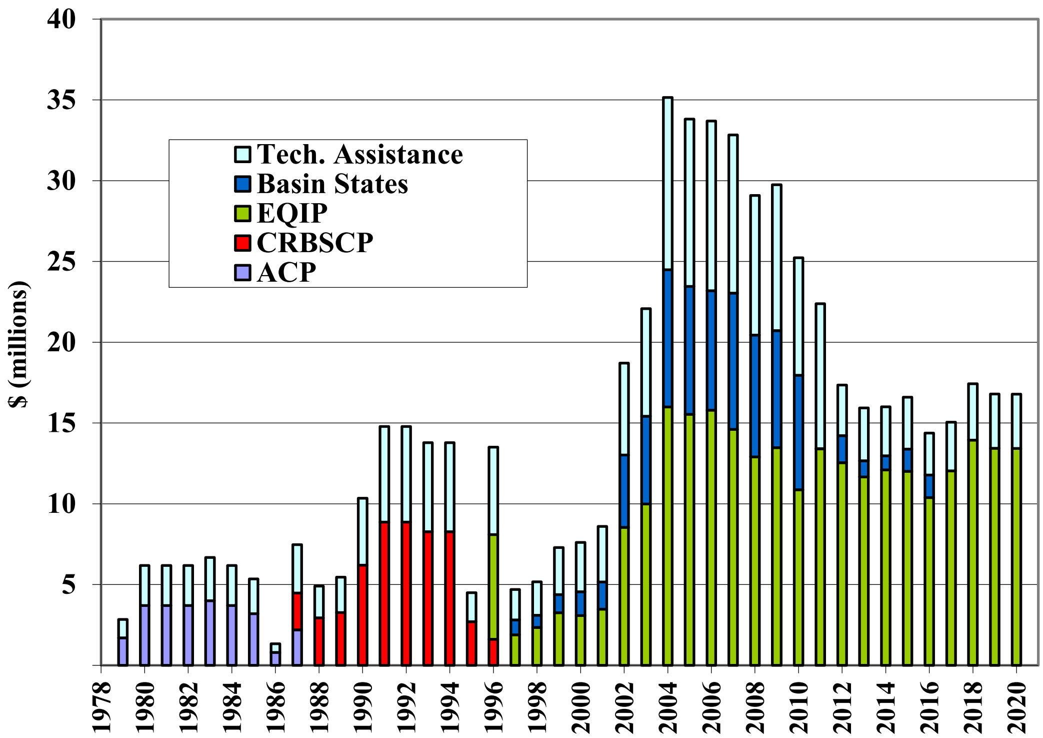
Program History

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 Colorado River Salinity Control Program (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 five consecutive farm bills and is currently authorized through FY 2023.

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

Table 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. FY 2018 Monitoring and Evaluation Reports are not yet available online, but they are available upon request at NRCS, Roosevelt, UT. The Monitoring and Evaluation Reports for FY 2019 can be found at:
www.nrcs.usda.gov/wps/portal/nrcs/detail/co/programs/landscape/?cid=nrcs144p2_062765

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. Data are not yet available to update this section of the report to show FY2020 achievements. It will be updated as data become available.

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. This unit has been designated as complete, but additional implementation continues at a reduced rated. In 2020 two new contracts were obligated on 124 acres to control 699 tons of salt at a cost of $424,538.

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. In 2020 about $4.5M of EQIP was obligated into 47 new contracts to control an additional 2,244 tons of salt on 1,780 acres. Four new wildlife projects on 62 acres were funded in the Lower Gunnison Project area..

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 2020 one new EQIP contract was developed for $6,519 to control 1 ton of salt on 1 acre.

McElmo Creek, Colorado

Implementation was initiated in this unit in 1990. In 2020 17 new contracts were developed for $1,230,973 to control 603 tons of salt on 489 acres.

Silt, Colorado

The Silt Project, authorized in 2006, is Colorado’s newest project. In 2020, two new contracts were developed for $50,674 to control 10 tons of salt on 15 acres.

Green River, Utah

There were no new contracts in the project area in 2020.

Manila-Washam, Utah

There were no new contracts in the project area in 2020.

Muddy Creek, Utah

In 2019, ten new contracts were obligated for $1,064,158. When implemented these projects will control 855 tons on 620 acres. The canals and appurtenant delivery systems to Muddy Creek are currently being piped through various State, Local, and Federal funding sources. Interest for on-farm improvements in Muddy Creek is strong and completion of improvements to the delivery system is expected to facilitate a rapid conversion of the entire unit from flood to sprinkler irrigation. NRCS anticipates completion of the majority of the work in the Muddy Creek Unit within the next five years.

Price-San Rafael, Utah

In 2020, 17 new contracts were obligated for a sum of about $1.27M. When implemented, these measures will control about 2,081 tons on 727 acres.

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. Producer participation has exceeded the original projections. In 2020, 36 new contracts were obligated for a sum of about $2.18M. When implemented, these measures will control about 720 tons on 579 acres. There were four new wildlife habitat contracts obligated on 86 acres in 2020.

Big Sandy River, Wyoming

Implementation has been underway in this unit since 1988. Approximately 13,800 acres of the planned 15,700 acres have been treated (88 percent) and about 71 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. No new contracts were obligated in the Big Sandy Unit. Remaining untreated acres are largely controlled by producers not interested in implementing salinity controls, so salinity funds were not allocated to the Big Sandy Unit in 2020.

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 2020, one new contract was obligated in the Henrys Fork Project Area for a cost of $27,066 that will control 22 tons of salt on 25 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 2020, six contracts were obligated on 338 acres outside of existing project areas to control about 699 tons of salt at a cost of $706,421.

Table 1 - Implementation Status (October 1, 2020)

			Irrigated Acres	Treated Acres	EIS Goal (tons)	On-Farm Controls (tons)	Off-Farm Controls (tons)	[1]Total Tons Controlled	Indexed Initial Cost ($/ton)	Nominal 2020 Cost ($/ton)
Colorado	Grand Valley	1977	44,600	43,449	132,000	137,597	7,134	144,731	55	90
	Lower Gunnison	1982	171,000	73,991	186,000	105,018	23,006	128,024	92	205
	McElmo Creek	1989	29,000	18,970	46,000	29,226	2,895	32,121	105	184
	Mancos Valley	2004	11,700	3,093	11,940	2,574	2,113	4,687	71	608
	Silt	2005	7,400	1,862	3,990	1,497	914	2,411	98	473
Utah	Uintah Basin	1982	226,000	162,451	140,500	142,990	9,957	152,947	187	282
	Price-San Rafael	1997	66,000	38,468	146,900	92,455	1,553	94,008	38	57
	Manila-Washam	2005	8,000	4,076	17,430	8,693	0	8,693	56	0
	Muddy Creek	2004	6,000	1,343	11,677	1,779	6	1,785	101	116
	Green River	2009	2,600	929	6,540	2,860	0	2,860	110	0
Wyoming	Big Sandy River	1988	18,000	13,933	83,700	58,654	114	58,768	42	0
	Henrys Fork	2013	20,700	345	6,540	277	0	277	249	115
Tier II	(all)		0	1,029	0	7,667	1,075	7,568	0	0

United States Department of the Interior
Bureau of Land Management (BLM)

The BLM administers 53 million acres of public lands across seven states within the Colorado River Basin (CRB) above Yuma, Arizona. These public lands are ecologically classified as arid or semiarid rangelands. Most of the public lands have nonpoint sources of salt 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, seeps from marine sedimentary formations, abandoned flowing wells, discharge from abandoned mines, recreation points (ramps), and discharge of waters from authorized activities such as oil and gas production or mining. 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 solution or in conjunction with solids. 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.

Overall runoff volume is low since these rangelands usually experience low precipitation and stream systems are of ephemeral nature; however, large volumes can be episodic. 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 large 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 about 67 percent of BLM-administered lands in the upper basin. Runoff from these areas is estimated to contribute more than half of the annual salt load from BLM-administered lands within the upper basin.

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 reference many of these activities and the BLM is engaged in efforts with partner agencies to improve the ability to quantify salinity reductions. To address these challenges, the BLM is co-developing a system of tools: APEX integration with a groundwater tool, wind tool, salt accounting tool per spatial scale, and complex sedimentation tool based on spatial scale (Agricultural Policy EXtender model; Sharpley and Williams, 1990). 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 with one site sponsoring USDA ARS with Basin States Program funding and BLM funding seven additional rangeland sites.

Program Summary and Administration

Table 2. The BLM FY20 Salinity Program Funding

State	Project Title	Recipient	Field/Research	USD $
CO	Coffey Dam	BLM	Field	125000
CO	Dead Dog Fire	USGS	Research	50000
CO	Verification of Extrapolation of Plot Scale to Watershed Scale Data at Prior Runoff Sites	USGS/BLM	Research	135000
CO	Geormorphic Salinity Analysis	USGS	Research	150000
CO	Ticler Flats Native Plant Res. Site	BLM	Field	60000
CO	Effects of base level lowering on salinity and sediment transport from BLM lands near Rangely, Colorado	USGS	Research	90000
CO	Determining soil erosion rates and potential salinity reductions to the Colorado River in Zone L of the Grand Junction Travel Management Plan	BLM	Field	57000
CO	Deer Creek Structure Repair	BLM	Field	125000
CO	Long-term impacts on salinity and sediment transport to the Colorado River from historic BLM soil-moisture and sediment retention treatment.	USGS	Research	200000
NOC	Enhancement of APEX with MODFLOW for Simulating Sediment & Salt Transport in Groundwater/Surface Water (WY, CO, NM, UT)	BLM/TAMAR	Research	50000
NOC	Enhancement of APEX with multiple tools ongoing: geochemical reactivity, landscape wind erosion, RS automation, PR, etc. (WY, CO, NM, AZ, UT, NV, & CA)	BLM-SC/TAMAR	Research	295000
NOC	Remote Sensing Integration into BLM-APEX model version (WY, CO, NM, AZ, UT, NV, & CA)	BLM-RS-NOC	Research	60000
NM	Simon Watershed Salinity Reduction	BLM	Field	100000
NM	SJRW Salinity Reduction and Maint.	BLM	Field	100000
UT	Kanab Field Office Salinity Control	BLM	Field	65000
UT	Telegraph Flat Head Cut/Gully Restoration for Salinity Reduction	BLM	Field	55000
UT	GSENM/KFO Sediment, erosion, salinity loading rates for sediment retention structures	BLM	Field	74000

UT	Evaluating Land Uses/Trends due 9/13/22	USGS-UT/WO	Research	0
UT	Arid Land Study/Rehabilitation of Soils-Shared Conservation Stewardship (also applied to soils)	BLM	Field	9000
UT	Monsoon Study	USGS	Research	80000
WY	Muddy Creek Habitat Improvement	BLM	Field	100000
WY	Savery Creek stabilization	BLM	Field	50000
First Budget Total	**FY20 BLM Salinity Contribution**			**2,030,000.00**
NOC	QA/QC & compilation of BLM databases/ Salinity Information Management System database*	BLM	Research	(180000) Waiting for final signature as of 9/24/20
	Total BLM Salinity Contribution, FY20		**with SIM database included***	**2,210,000.00***

The 2020 budget included a total allocation of $2,030,000 for BLM Salinity Program approved projects that received funds allocated through the Aquatic Habitat Management (AQM) Program. The salinity coordinator (SC) position that was originally located in Washington, DC (HQ-East) was relocated within the Colorado River basin (CRB) at the request of the Salinity Forum. In FY20, the BLM made many changes resulting in the establishment of a Headquarter's "West" located in Grand Junction, Colorado and the relocation of several employees out west to reduce the number of employees located in Washington, DC. All of the AQM management group will reside together with several of upper management Washington, DC employees at the Colorado State Office. When the NOC accepted the administrative responsibility of the SC position, it was dual-aligned with the Water Quality position and remains active in this capacity currently. Both the Water Resources and AQM Lead permanent positions remain vacant at this time.

The Public Law 98-569, a 1984 Amendment to the Salinity Control Act directs the BLM, and specifically the Salinity Coordinator, to develop a comprehensive program for minimizing salt contributions from lands administered by the Bureau of Land Management (BLM). The BLM accomplishes this objective by implementing best management practices, monitoring, adaptive management, and designing and implementing projects to minimize nonpoint source pollution and salt transport. Partnerships are critical for Colorado to succeed in our multiple use mandate, restoration, and a better understanding of ecosystem processes through science. BLM Colorado Salinity funding allocated to USGS was approximately $550,000, and informed BLM management by improving our understanding of the effects of land uses on salt delivery to the upper Colorado River basin. It's expected the studies will ultimately reduce nonpoint source pollution and more saline soils retained on the landscape.

NATIONAL OPERATION CENTER

The SC plans, conducts, and provides advice for studies and initiatives from field, watershed and the CRB regional level the seven salinity states, their field, district and state offices working with personnel from heavy equipment operators, budget and contract officers, to state directors to Washington, D.C. deputy assistant directors and other federal agency chiefs, directors, and university professors. The current SC provides expertise regarding land use and conservation practice effects and impacts of land use changes on water resources and water quality. The SC also coordinates with the state leads to produce greater project accountability in salinity retention on BLM lands and with the salinity funds.

Through the SC's plans, state leads have submitted 5-year salinity goals. With CRB wildfires dominating the UCRB's landscape at the end of the fiscal year 2020, the SC and WO are quickly adjusting to ensure that FY21 funds are prioritized to meet the debris sediment/salt flow with measurements and abatement projects as best possible.

In addition to assisting field managers and employees, managing a budget, assisting with water quality projects that include sediment collection within the CRB, soil sample collection, other management duties, and writing reports, the current SC is tasked with her own project. This project is all encompassing in trying to quantify the salt that has been retained on BLM public lands and has not entered the Colorado River. Antecedently, the UCRB and other CRB reports have inadequately accounted for BLM contributions of changes in land management practices for the reduction of salinity over time in the Colorado River.

To address the challenge of quantitatively identifying the amount of salt tons being retained on BLM public lands from entering the Colorado River that had previously been unaddressed, the BLM hired a new SC in 2013. This SC began a long-term plan to adeptly answer this complex non-point source response. Several phases needed to occur and only a limited budget would be available for a minimal number of years. The BLM Salinity program invested in a worldwide literature review project and investigational study to improve the current understanding and identify the gaps in knowledge and data available regarding the sources and transport mechanisms in rangeland catchments that deliver total dissolved solids (TDS) to streams in arid and semi-arid lands. With the information gained and the SC's guidance for project planning and implementation, several salinity projects have resulted within the CRB that have directly improve BLM land nonpoint source erosion and sediment and salt transport process knowledge for better quantification and assessment of land use and management practices.

Due to the number of BLM programs that affect sediment and salt transport across the public landscape and potentially into the In addition to co-developing a system of tools: APEX integration with a groundwater tool, wind tool, salt accounting tool per spatial scale, and complex sedimentation tool based on spatial scale (Agricultural Policy/Environmental eXtender model; Sharpley and Williams, 1990). The integration and linking of these tools remains 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 for a total of eight rangeland sites (seven funded by BLM).

The SC, is in progress of co-developing an approach to quantify salinity reductions across BLM's public lands for nonpoint and point sources 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 in which the team is integrating groundwater and wind tools, and salinity equations adjusting for spatial scale and sediment particle size. 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.

Thus far, with the inclusion of specific BLM programs that impact sediment/salt distribution on the landscape and the Colorado River as demonstrated by water quality data and programmatic data and simulated by the BLM-APEX (Agricultural Policy/Environmental eXtender) rangeland model provide evidence of BLM's significant contributions.

This project initiated with a worldwide bibliographic search to identify the knowledge gaps in rangeland data. Next, a rainfall plot experiment occurred at the plot-scale in different soil types with varying vegetation density with three rainfall intensities. That portion took three years to complete and an additional year for water and soil analyses. The adaption of the APEX model requires the development of several modules and rigorous quality assurance and quality control of BLM databases for many programs that impact sediment and salt transport in addition to having access to these data. While some data are easier to obtain, others are taking years to obtain and have yet to be included. Machine learning algorithms have been developed for some and parameter sensitivity analyses have been performed on physical data for which simulations could be conducted. Until all pertinent data can be obtained, the true measure of BLM's contribution to retaining salt from entering the Colorado River cannot be ascertained. Machine learning will continue to analyze large amounts of data.

First, a groundwater model was integrated into APEX so that water could flow off the land into the surface flow, through which it can move laterally, or downward into the groundwater. Through these pathways pollutants such as salts, metals, oil, and microorganisms can also be transported. A scientific publication is in process.

Second, utilizing all experimental plot sediment and runoff data, machine learning algorithms were used in addition to parameter sensitivity analyses to determine the overall salinity equation to be employed for the Colorado River basin rangelands. Originally ____ parameters were being used until fully optimized, ____ parameters ___ number of parameters presented the best equation for salinity with a correlation coefficient of ___. A scientific publication has been written and is in review.

Third, as identified in the worldwide bibliographic search, wind was identified as the dominant transport mechanism of salt. In response, a landscape horizontal aeolian equation was developed based on physical data and was tested with available datasets.

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 all 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. The coupling of MODFLOW to APEX is now complete. The linkage files to map MODFLOW grids to APEX subareas are now developed (Fig. 1). The rainfall-runoff data from Price, UT (Fig. 1) 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. We are generating an indicator for site stability and/or land degradation.

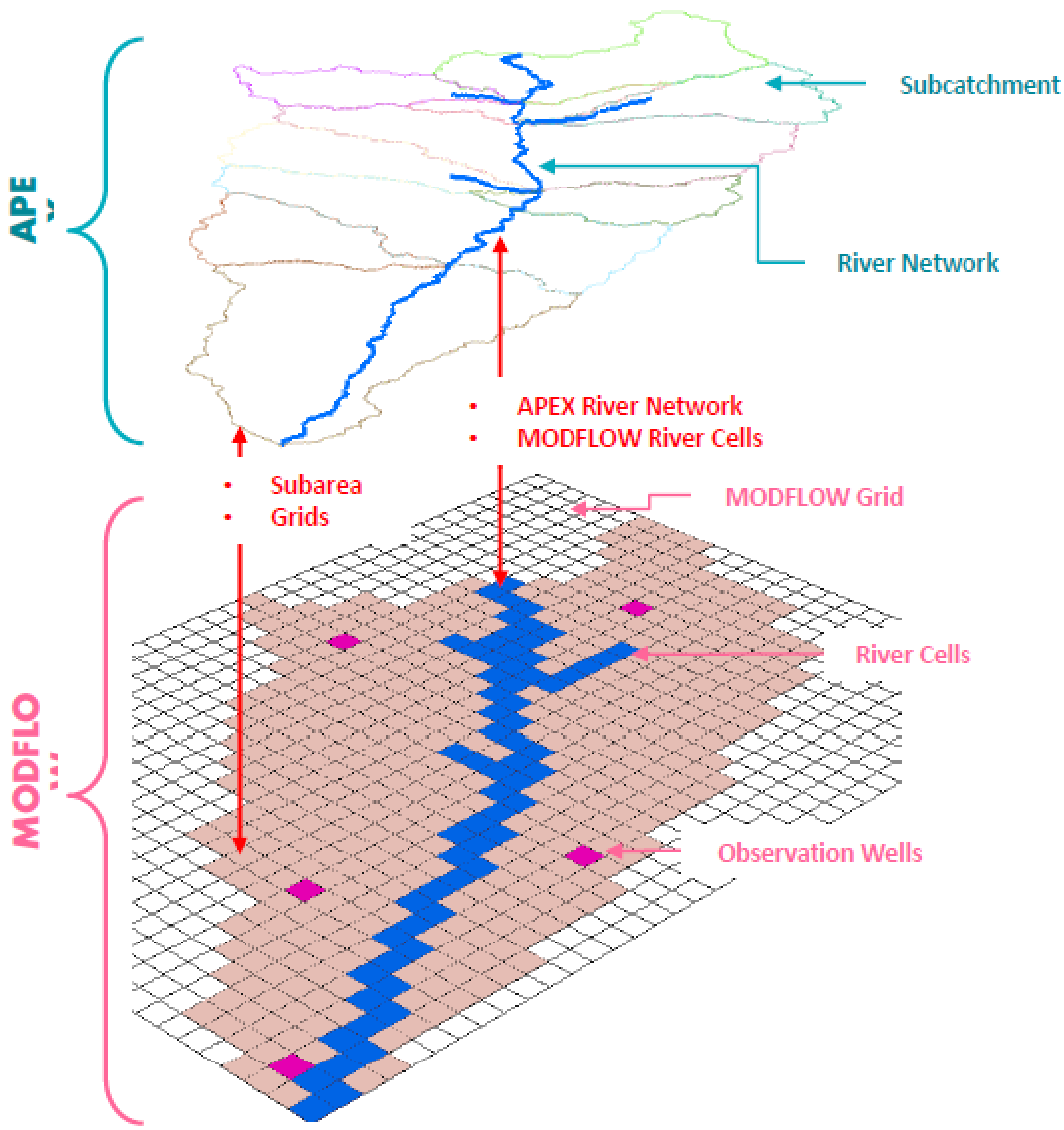


Figure 1. Hydrological Connections-APEXMOD

BLM Colorado Salinity Accomplishments for FY 2020

08/28/2020

I. Introduction

Within Colorado, 8.3 million acres of public lands are managed by the BLM with a predominance on the Western Slope. These lands rise above more than 14,000 feet a.s.l. and dip to steep canyons creating many potentially erosive hillsides that can contribute sediment and salt to the Colorado River and its tributaries. The Mancos Shales is nearly 10,000 feet deep in particular locations constantly providing salts to the surface above. Since Colorado has many practices, both anthropogenic and natural that contribute to point and non-point sources of salt and sediment transport (e.g., wind, animals, OHV trails, energy development).

The Grand Junction and Uncompahgre field offices are located within the Southwest District, and manage approximately 2,178,000 surface acres. The approximate percentages of saline soils within the Grand Junction and Uncompahgre field offices are estimated at 35 and 26%, respectively.

“Dead Dog Fire”: Salinity loading effects from post-fire erosion in a watershed underlain by Cretaceous marine shales near Rangely, CO. U.S. Geological Survey Colorado Water Science Center-Uncompahgre Field Office-30% completed

This project seeks to document post-burn effect on salinity loading in a small watershed near Rangely, Colorado. Erosion rates will be determined from a comparison of pre- and post-burn surveys. Initial pre-burn survey was flown via drone and structure for motion mapping in 2016. Sediment and salinity yield will be directly calculated based on previous soil surveys that documented salinity levels in the tributary basin with net change in sediment volumes detected. Water Erosion Prediction Project (WEPP) modeling has been done for the pre-condition in this area and will be compared to annual post fire estimates. Vegetative surveys of biological soil crust will be completed in post-burn basin. This data sets allows for relations between drone imagery and ground-based vegetation/bio-crust surveys from post-burn to relate pre-burn drone imagery to pre-burn vegetation/bio-crust conditions to better understand the effects of fire in high-desert rangeland areas.

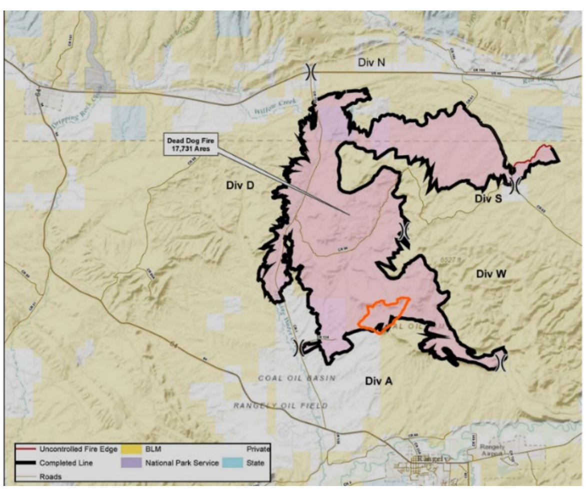


Figure 2. Map of the Dead Dog Fire extent (outlined in black) and pre-burn survey area (outlined in red), Rio Blanco County, Colorado.

An evaluation of post-burn rainfall shows summer thunderstorms with accumulations of 0.5-1.0 inches, covering the basin within the first of 35 days of fire containment. Owing to the dry climate and easily eroded soils in the area, sediment and salinity loading and erosion across the landscape could be substantial.

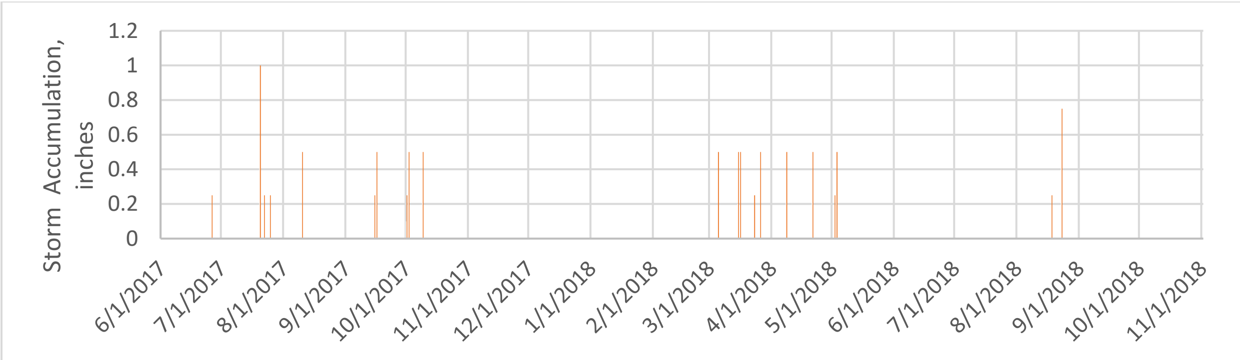


Table 3. Doppler Radar storm accumulation totals in the study basin (Spring-Fall, 2017-18), Rio Blanco County, Colorado.

Reconnaissance evaluations in April and June 2019 were completed to assess erosion and vegetation conditions within the basin, post-burn. Greater than average precipitation in Spring 2019 precluded the completion of data acquisition due to larger, denser stands of annual cover obscuring flight information and ground elevations. Flights and surveys planned for Spring 2020 were grounded because of COVID-19 delays, and denial of the Department of Interior Commercial Off-the-Shelf Unmanned Aircraft System (UAS) Emergency Readiness Waiver. Work began in July and August 2020 to assemble the components needed to do post-burn WEPP modeling. A burn severity map was obtained from the Bureau of Land Management and will be used in to model post-burn erosion using WEPPcloud, a new cloud-based modeling software.

Geomorphic Salinity Analysis (Zone L) – Grand Junction Field Office, 2018-2021—U.S. Geological Survey Colorado Water Science Center-60% completed

Project focuses on understanding releases, targeting remediation locations, and post-remediation monitoring of sediment and salinity loading to the Colorado River near Grand Junction, Colorado, from ephemeral streams in Cretaceous, marine-shale landscapes. Project is in the first phase; the second phase of work will consist of consulting with BLM on best management practices (BMP's) to control sediment and salinity in high salinity zones. Project includes the beginning of the USGS assessment of BMP effectiveness for selected areas in coordination with the BLM SC.

Characterization of dominant erosive processes is needed to assess channel stability and to identify and target locations for remediation. Land-management agencies in Western Colorado are responsible for decision making that regulates the use of these public lands. To address this need, the USGS in cooperation with BLM GJFO will: (1) complete an assessment of channel characteristics and stability in the study area; (2) relate field observations and measurements to mechanisms and processes driving erosion and sediment loading to the Colorado River within a Channel Evolution Model (CEM) and identify geomorphic thresholds; (3) collaborate with BLM staff on implementation of sediment and salinity control treatments or management strategies using improved understanding within the area; and (4) estimate post-remediation effects on sediment and salinity loading to the Colorado River (fig. 3). Due to the limited space for explanation, the USGS will have a science investigations report written in the near future.

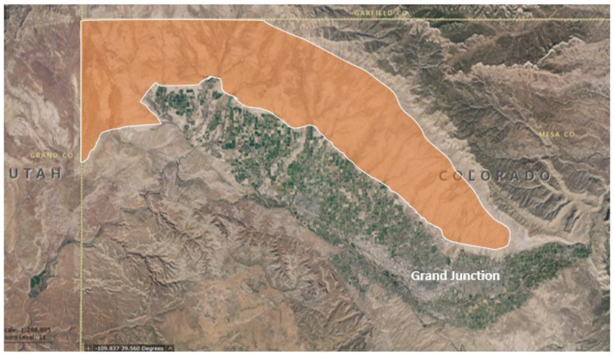


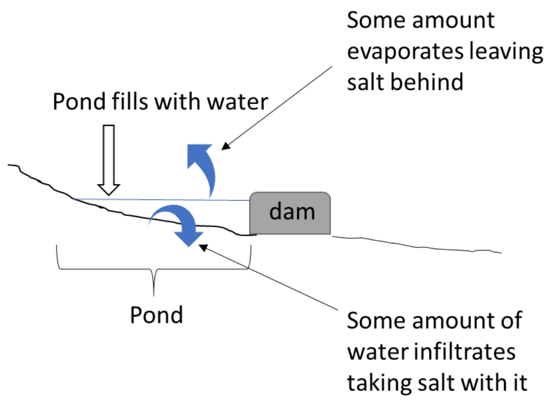
Figure 3. Aerial image showing the study area (orange shading) near Grand Junction, Colorado.

The role of streamflow and sediment delivery into these systems and resulting adjustment of channel form and dominant erosive processes is being evaluated. Evaluation of the role of streamflow will be tested with available hydraulic and channel information to estimate unit stream power based on peak-streamflow predictions from Colorado StreamStats (Capesius and Stephens, 2009; Kircher and others, 1985; Kohn and others, 2016; U.S. Geological Survey, 2014b). Calculations will assess if adjustment of channel slope or unit-stream power correlates with the longitudinal profile, channel cross-section, or incision level of these systems. Aerial images and BLM data are used to evaluate surface disturbances in the study area. These will include construction (for example, roads, pipelines, and well pads) and off-highway vehicles recreation areas, which can potentially affect land resources. Surface disturbances from these activities can affect runoff, soil health, and sediment erodibility on hillslopes and along crossings in fluvial areas.

Sediment Retention Treatments (Ponds)-75% Completed
Long-Term Effectiveness of Sediment-Retention Ponds to Sequester Salts in Cretaceous, Marine Shale Landscapes, Delta and Montrose Counties, Colorado, 2018-2022- USGS Colorado Water Science Center

Preliminary findings indicate there is no discernable difference between salinity levels below or near BLM sediment detention structures and the surrounding landscape. A data release for this work is scheduled for November 2020. The full report is scheduled for completion at the end of fiscal year 2021.
The objective of this project is to assess the long-term effectiveness of sediment-retention ponds to sequester salts. Evaluations of soil salinity around sediment-retention ponds will be used to gage their effectiveness at controlling salt transport. Water entering the impoundment (pond) carry salts from upstream areas and can infiltrate into the soil or concentrate salt in the pond through evaporation and transportation (fig. 5). Comparisons between groups of sediment-retention ponds in different operational states will characterize the working limits of the structures. This information will aid BLM’s prioritization of maintenance and utilization of sediment-retention ponds throughout the landscape. Incorporation of findings from this research

into best management practices may include implementation of alternative approaches to improve the effectiveness of sediment and salt retention while reducing maintenance needs of sediment-retention ponds.



Figures 4 and 5. Diagram showing a conceptual diagram and image of a sediment/salinity retention pond near Delta, Colorado.

Task 1. The USGS Land Treatment Digital Library (https://ltdl.wr.usgs.gov), input from the BLM Salinity Coordinator, and local BLM staff expertise were used to evaluate the merits of each site. The project targeted a representative subset of sediment-retention ponds in the BLM Uncompahgre Field Office Management Area (fig. 4, 5), with planned expansion into additional Management Areas in 2020-22.

Task 2. Soil and vegetation at each sediment-retention pond was characterized to explore the physical and geochemical processes that are occurring. An assessment of the fate and transport of sediment and salts at each sediment-retention pond was made (2020) through statistical correlation and conceptual modeling of observed conditions. Characterization of the soil chemistry and physical conditions includes measuring soil EC, soil moisture, topography, vegetation around the sediment-retention pond, and the physical integrity and function of the sediment-retention pond.

Geophysical surveys utilizing multi-frequency broadband electromagnetic sensors were used to assess the longitudinal changes in resistivity along the pond structures, to aid in targeted sampling and 2-dimenisional geophysical mapping (fig. 6). Geophysical evaluations of 65 target pond structures have been completed and span a range of geologic members within the Mancos Shale Formation. (Smoky Hill and Fort Hays (Niobrara) Members, Storm King Mountain and Juana Lopez Members, Blue Hill Member, Fairport and Bridge Creek Limestone Members, and Hartland and Graneros Members) along with alluvial deposits derived from nearby formations. Sampling concluded in Fall 2019 in this Management Area.

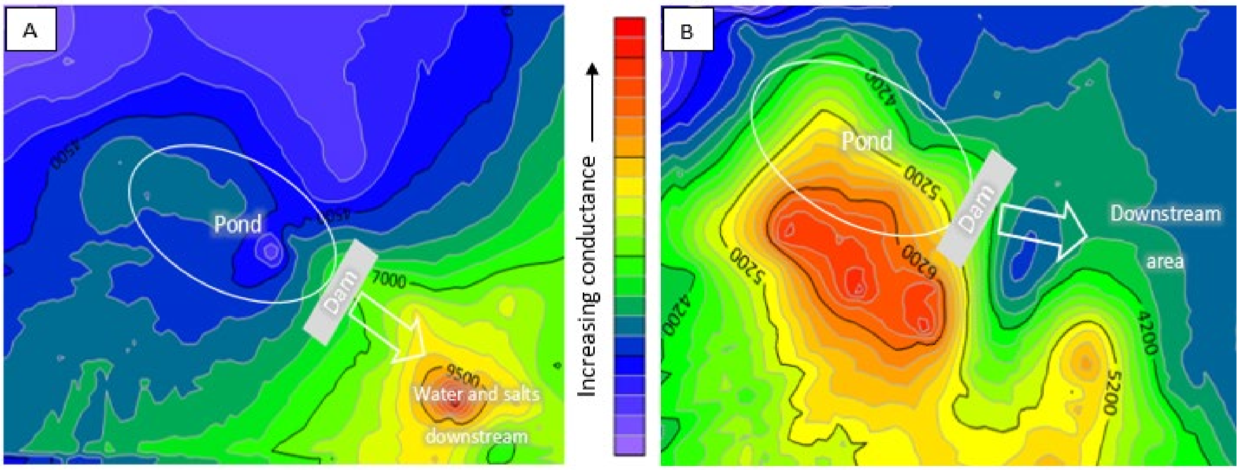


Figure 6. Map showing potential differences in salt accumulations (A) greater-potential salt accumulations downstream of pond, (B) lower-potential salt accumulations downstream of pond, based on geophysical conductance contours.

Evaluation of the parameters, aforementioned, for the sediment-retention pond (21 ponds and 19 in-channel locations) indicates that the impoundments and in-channel areas are similar, and that geological Formation members have stronger correlations to soil conditions than the observable effects of the retention structures. Further details will be described in the USGS reports.

Conceptual models (fig. 7) have been proposed to demonstrate scenarios where salinity is retained by the structures, and when they are more transiently delayed. Permeability of pond substrate and functional status of salt retention ponds dictate which processes are dominant at each location.

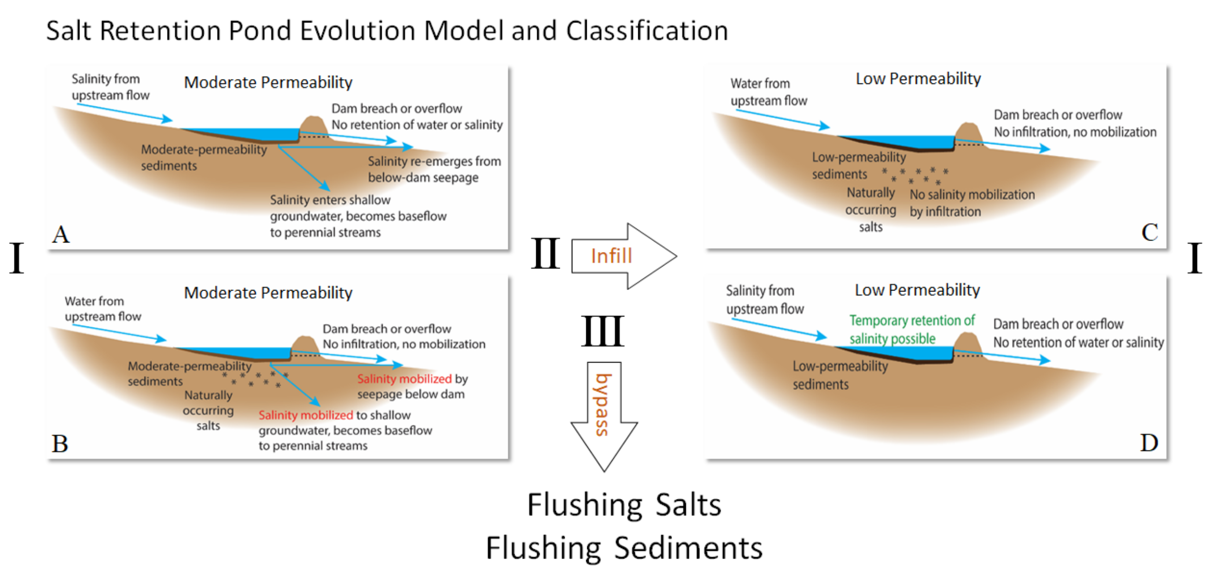


Figure 7. Graphic depicting processes affecting retention of salinity within salt retention ponds. Observation from the study demonstrates that under most observed conditions, salinity is retained transiently.

The findings of the soil sampling and geophysical surveys will be published in U.S. Geological Survey Data Release, in progress 2020; conceptual models and statistical findings will be published in a U.S. Geological Survey Scientific Investigations Report in 2021. These observations span a range of geologic members within the Mancos Shale Formation (Smoky Hill and Fort Hays (Niobrara) Members, Storm King Mountain and Juana Lopez Members, Blue Hill Member, Fairport and Bridge Creek Limestone Members, and Hartland and Graneros Members) along with alluvial deposits derived from nearby formations. Conceptual models of findings will present what is known about the likelihood of salinity sequestering in these structures over longer time periods.

BPS number 17-1980 - Stinking Water Gulch Report (Uncompahgre Field Office)
Project is 75 percent completed, and the final report to be completed in fiscal year 2021. 2021 funding request: $0.00.

Characterization of the distribution and storage of sediments, salinity, and selenium in Stinking Water Gulch near Rangely, Colorado—Progress Update, August 2019. Principle Investigator Cory A. Williams, U.S. Geological Survey Colorado Water Science Center

In many areas of western Colorado, the Cretaceous Mancos Shale Formation is present and a natural source of sediment, salinity, and selenium to surface waters (Presser and others, 1994; Elliott and others, 2008). Anthropogenic activities can change the distribution and storage of sediment, salinity, and selenium in and around channel areas (Butler and others, 1991; 1996; Hamilton, 1998; U.S. Department of the Interior, 1999; Lemly, 2002; U.S. Department of Interior, 2005). Understanding if and how some common land uses affect channel storage of these constituents has important implications to managers facing changing land use on Mancos Shale landscapes. Owing to the large spatial extent, and limited available historical water-quality data, understanding water quality conditions within these landscapes requires novel approaches to estimate historical conditions. Lacking adequate water-quality and streamflow data, estimates of changes to these constituents is done through an assessment of soil chemistry and sediment erosion.

The USGS in cooperation with the BLM are completing a study of four basins on BLM managed lands that are geographically similar and represent different land use histories on areas of Mancos Shale. This study will help resource managers gain insight on how different land uses may affect sediment, salinity, and selenium distribution and storage in Mancos Shale landscapes. 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 study has been described in detail in previous Federal Accomplishment Reports and only the recent progress is presented here.

Task 1. Remote sensing images (1953-2013) have been 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). This information provides 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.

Elevation and location information from 49 ground surveys and photographic control points, using GNSS-RTK survey techniques (Rydlund and Densmore, 2012), were used to convert the digital elevation models into geographic coordinates for sediment volume calculations (bankfull channel and floodplain storage) and final DEM production (with an example shown in figure 8). Comparisons made between the DEM and quality control survey points in Basin B1 at 340 locations showed a mean elevation differences of 0.069 meters, a median difference of 0.021 meters, with 90% of the data within 0.250 meters. Differences in elevation likely reflect vegetative effects and/or averaging of sloped-surface elevations.
Reprocessing of elevation data is underway, utilizing "Classify Ground Points" tool in Metashape. Revisions to land-surface point clouds will be completed in August, allowing refinement of volume estimates and improved accuracy for assessment of channel geometry. Automation in data extraction will increase sample size for statistical comparisons.

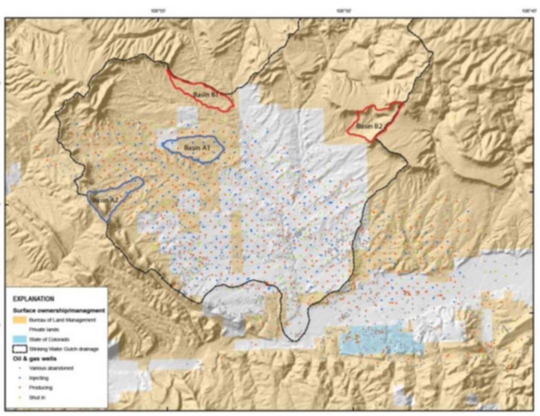


Figure 8. Location of four selected basins in Stinking Water Gulch, Rio Blanco County, Colorado.

Task 5 continues to be completed. A determination of the release rate for sediment, salinity, and selenium is being done through an assessment of volume changes within the channels of each basin in conjunction with annual load estimates from the WEPP analysis in 2017. The cross-section data is used with age dating to estimate channel incision rates and to evaluate total channel volume change through time (inter-basin sediment flux). Geomorphic surface present in the study area were identified, and cross-sectional area at these locations were related to basin morphology to determine the erosional volume. Correlations between cross sectional area and downstream distance in each basin were determined. Volume estimates were related to bulk density of soils in the areas (USDA, 2017) and to samples collected in July 2020. The volumes of each basin and along multiple points within each basin are used to compare sediment storage between basins and basin groups. Revisions of land-surface point clouds have delayed final assessments and statistical comparisons. Completion of this task is pending final approval and publication of data set in a U.S. Geological Survey Data Release slated for release in Fall 2020. Chemical analysis of soil samples collected at locations in each basin along the identified terrace surfaces were used to estimate the salt and selenium mass associated with the sediments that were removed. The solid phase selenium and salinity flux for each basin was estimated based on the determined volumes from the finalized DEMs and incision rate for the range of selenium and salinity concentrations. Using these volumes in conjunction with annual WEPP estimates, the solid phase selenium and salinity loads were estimated for each basin using the range of selenium and salinity from collected samples. Soil chemistry showed varying concentrations of salts at locations sampled within a basin and between basins. Concentrations for salts showed a general decrease in concentration from higher-elevation terrace, lower-elevation terrace, and stream bed samples, whereas selenium concentrations showed a general increase in concertation along this same progression of geomorphic surfaces. Comparisons of concentrations between basins by land use history showed no obvious pattern. A table of selenium and salinity contents at sample sites will be provided and the minimum, median, and maximum will be used as the range of values in load determination in the finalized report.

Task 6 assessed local-scale channel conditions through photographic analysis. Findings suggest that changes to land surface may be more limited in upstream areas where streamflow and sediment transport rates are lower. Task 7 will be completed in 2021 with the **r**elease of final report.

BPS number 17-7653 - Stinking Water Gulch Phase II, Base Level Lowering (Uncompahgre Field Office)-15% completed

This project builds on the work done in four subbasins of Stinking Water Gulch. Because changes to the land surface may be limited in upstream areas where streamflow and sediment transport rates are lower, the analysis has been expanded downstream to a tributary mouth and the main stem of Stinking Water Gulch. Reconnaissance to select sampling sites was completed in summer 2019 and focused on depositional settings where deposited sediments were likely to be preserved. Two target areas for optically stimulated luminescence (OSL) sampling were identified (fig. 10). Site 1 is located on a former path of the main channel and has multiple geomorphic surfaces (terrace/floodplain remnants) where sediments may have been preserved (fig. 9). Site 2 is an abandoned meander at the mouth of a tributary. A berm is present on the downstream side of the meander and may have been constructed to store water in the channel or to prevent erosion of the bluff (fig. 11). Sediment would likely have been deposited when the berm trapped water in the meander. OSL sampling will provide dates for when the sediments were deposited, which will be used to determine incision rates. Sampling is planned for fall 2020. Analysis and report writing will be done in 2021.

Figure 9. Aerial photograph showing the target sites for optically stimulated luminescence (OSL) sampling near Rangely, Colorado. Site 1 is located on a former path of Stinking Water Gulch. Site 2 is near the mouth of an unnamed tributary. Figure 10. Photograph showing terrace/floodplain remnants (indicated by red arrows) at site 1 looking downstream.

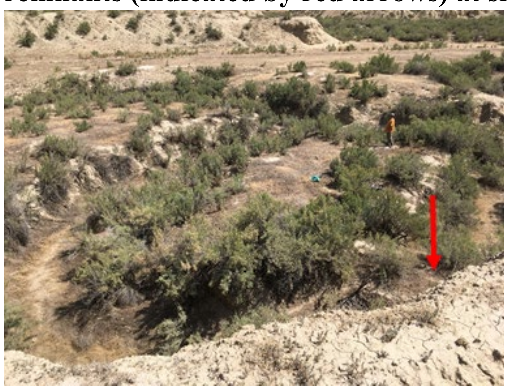


Figure 11. Photograph showing site 2 with the constructed berm (indicated by red arrow) on the downstream site.

Deer Creek Retention Structure Repair-GJFO

In FY2020 archeological surveys were finalized along with all plant surveys. Review by Fish and Wildlife is near complete due to endangered cactus within the project area. Funds were submitted to the contracting process, the project went out for bid in July, and was awarded. The project construction is expected to be delayed due to the Pine Gulch fire until November or early spring and follow up monitoring and seeding will occur one year after construction. The Pine Gulch fire was the largest fire in Colorado's history.

The projects planned for FY 2021 are in downstream drainages of the Pine Gulch fire and an evaluation of completing projects will need to occur.

Determining Soil Erosion Rates in Zone L-GJFO

Fiscal year 2020 was the final year of funding request. Funds were used to complete field data collection. In FY20, the final 100 miles of roads and trails data was collected, as well as over 200 RHEM data points. There were 4 drainages were stream bank stability data were collected. These data were input into WEPP batch models. Stream bank stability data have been entered into River Morph and will be compared to a reference reach north of the field office.

Coffee Dam Breach-Uncompahgre Field Office
The Uncompahgre field office has an abandoned Right of Way (ROW) consisting of a 25-foot high dam designed to hold water for two center pivot irrigation systems on the adjacent private property (fig. 12). The dam was originally built on BLM land in trespass in the early 1970's. The original files on the project indicate at some point the BLM decided to grant a ROW on the structure to remedy the trespass. The structure was maintained through several ownership changes but was abandoned in approximately 2014 when the property was foreclosed on and reverted to bank ownership.

Figure 13. Vicinity map of Coffee Dam.
In 2014 the State of Colorado, Division of Water Resources, placed a Breach Order on Coffee Dam. Alpine Bank was the owner at the time of the breach order and paid a local engineering company to design a breach of the structure and reroute of the two irrigation pipes that run through the structure.

The property changed ownership again in 2017 and the ROW was excepted from the property. In the absence of any alternatives, the BLM pursued salinity funding to breach the dam following the approved design plan.

Figure 12. Coffee Dam and surrounding Mancos Shale landscape.

Breaching the dam would prevent dam failure during a flood event (fig. 12). Such an event would result in *4605 cubic yards* of saline rich Mancos Shale soils from being mobilized downstream and potentially washing out the South Canal, which is owned and operated by the Bureau of Reclamation. Based on the average bulk density of salt in this soil type, <u>308 tons of salt</u> would be retained on-site in the event of an accidental breach of the dam.

UTAH

<u>General Summary</u>

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. BLM-Utah supports projects that capture saline sediment, and encourages studies to monitor and quantify sediment transport using innovative methods 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. In FY20, BLM Utah received $414,000 **(or 828,000)** in salinity funding. This funding was used to maintain and 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.

Grand Escalante Staircase National Monument (GESNM): GESNM received funding for repair and maintenance of salinity control structures including the Telegraph Head Cut Repair project.

Telegraph Head Cut Repair

In 2019 GSENM finished repairing the first phase (phase 1) of a multi-phase project to stabilize active head cutting on Telegraph Flat on the southern border of the Monument. Soil pH levels range from slightly alkaline to strongly alkaline in the immediate area and are influenced by additional salts present in the surrounding geology. Stabilization of the headcuts is needed to prevent further erosion of the surrounding soils as well as the transportation of saline sediment downstream.

In 2017, two structures were installed to stop the head cut. The upper structure failed while the side structure held together. The main headcut was repaired and once again stabilized in 2019 utilizing HDP pond liner, locking cement blocks, and 24-inch basalt rock. Monitoring of the headcut will ensure the use of proper stabilization techniques for use on side headcuts if needed.


Figure 13: Upper portion of headcut where water will flow into the now stabilized headcut.
Figure 14: Upper portion of headcut where water will continue to flow downstream.

<u>GSNEM Continued</u>

Repair and maintenance of sediment retention structures:

Between 2019 and 2020 Grand Staircase-Escalante National Monument cleaned out 10 salinity control structures across the Monument. These structures ranged in size from .03 to .4 acres and are designed to collect and prevent sediment from flowing further downstream. All structures were cleaned out along with two sediment dikes being repaired. Approximately, 6,110 yd^3 of sediment was removed from the structures totaling <u>409 tons of salt</u>.

***St. George Field Office* 2020 Salinity Program Accomplishments**

Salinity funding was used to repair existing structures that were no longer functioning. The Hurricane Fault is within the Gould Wash and Fort Pearce watersheds which drain directly into the Virgin River which is a tributary to the Colorado River. Eleven structures have been completed in 2020. A salt concentration of 3 lbs salt per 100 lbs of soil was assumed. Based on this, the St. George Field Office has removed approximately **14,886 tons** of sediment containing **4,062 tons of salt**. These structures have prevented salt from entering the waterbodies that would transmit sediment loads downstream into the Colorado River.

Below are examples of before and after earth work has been completed for the St.George Field Office

Terrace Reservoir

Removed approximately 50,000 tons of sediment, repaired dike, and reinforced overflow.


Figure 15-Terrace Reservoir-Pre-Maintenance, 2020

Figure 16-Terrace Reservoir-Post Maintenance, 2020


Figure 17-Gould Reservoir-Post Maintenance, 2020

Figure 18-Gould Reservoir-Post Maintenance, 2020

Kanab Field Office (KFO)

In FY20, nine structures were cleaned and repaired. 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 tons of salt were removed from the sediment structures and used to repair or rebuild the dikes.

Vernal Field Office

The Arid Lands Study project was continued and finalized in FY20. This included additional analysis conducted USU. This included reclamation standards for saline soils within the Upper Colorado Basin.

Analysis of long-term landscape and water quality change in the Upper Colorado River Basin , USGS, UT-Water Science Center

Most research to date has focused on private land ownership and has benefitted the Bureau of Reclamation due to data availability including: climate data (1930-2014), temperature, precipitation, snow water equivalence, evapotranspiration, snowmelt rate, snowfall amount/fraction of annual precipitation that is snow, Land cover data (1938-present; including percent shrubland/rangeland, percent grassland, percent forest, and percent bare ground, among other variables), major land use (1945-2012; including cropland, pasture, forest, industrial lands), grazing information (including state-level numbers of grazing animals, per year, for BLM (1947-1994 and 2001-2019) and Forest Service lands (1966-2016)), UCRB specific BLM grazing data which includes the number of AUMs paid for in each grazing allotment (1985-2020) as well as a map of grazing allotments, BLM district grazing information for the Farmington, NM district (1989-2019) that provides the opportunity to do a region-specific analysis if deemed useful, and USDA Livestock Census data, county level (1925-2010)
Work is ongoing until September 13, 2022.

Wyoming

United States Department of the Interior
U.S. Geological Survey

The U.S. Geological Survey (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 19. 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. 19). 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.

The USGS has delivered the 2020 Colorado River Basin 20-Station Monitoring Network update to Reclamation. The packet contains the usual 20-station salinity concentration and load estimates at the pre-established 20 station network in the Colorado River Basin. Also included in the packet are the equations for a given year and site as well as the classifications for each site. The equations are used by USGS and Reclamation to also provide estimates of current salinity conditions as needed for preliminary runs of the CRSS model. Only one site classification, Green River nr Green River decreased in quality from a B to a C. Site classification are applied according to the following criteria:

Classification Criteria

The 20 stations are classified A, B, or C, according to the quantity and quality of available data for the salt-load computations. Optimal data collection at each station includes daily mean streamflow, daily mean SC, and at least 6 water quality samples per WY which include TDS. SC may be monitored continuously with an instrument (daily mean) or sampled once per day by an observer (instantaneous). Continuous monitoring for daily mean SC by instrument is the preferred method.

Types of Specific Conductivity

Specific Conductivity at the sites is classified into several types:

- **Daily – mean daily SC collected by instrumentation. To be considered "daily", the record may have up to 60 missing days of SC per water year which are spread out in small groups over the year.**
- **Intermittent – mean daily SC which has more than 60 missing days per water year spread out over the water year.**
- **Seasonal – mean daily SC has been continuously shut off during the winter (November through March typically), with more than 60 missing days.**
- **Instantaneous – single SC values which have been manually collected by an observer. Usually spaced several days apart and may be missing during winter months.**

CLASS A

For Class A, adequate data must be available for salt-load computation using SLOAD. Site data includes:

- 6 or more QW samples per WY which include some type of TDS (ROE, SOC, or Calculated). SLOAD automatically discards QW records without any type of TDS.
- Daily Q (SLOAD allows no days with missing Q).
- Mean daily SC from instrumentation. The SC record must be "daily" and must have no more than 60 total days of missing values for the WY.

CLASS B

Salt-load computation is possible using SLOAD, but limited data availability could be contributing to error in salt load estimate. Even though the site has daily Q and daily SC, if there are fewer than 6 QW observations, the site will be Class B. Site data includes:

- There are fewer than 6 QW samples per WY which include some type of TDS.

- Daily Q (SLOAD allows no days with missing Q). Missing Q values may be interpolated from surrounding values.
- SC may be mean daily (with up to 60 missing days), seasonal, intermittent (more than 60 missing days), instantaneous from observers, or non-existent.

CLASS C

Inadequate data exists for SLOAD salt-load computation. Site data includes:

- Some QW records may exist, but none have TDS, hence they are not usable.
- SC may or may not exist but is not used.
- Salt concentration and load are calculated from regression analysis of old data (Q and TDS

Literature Cited

Liebermann, T.D., et al. 1987. User's Manual for Estimation of Dissolved-Solids Concentrations and Loads in Surface Water. U.S. Geological Survey, Water Resources Investigations Report 86-4124.

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.

Analysis of long-term landscape and water quality change in the Upper Colorado River Basin

Significant trends in water quality, over a range of time periods, have been observed in UCRB rivers and streams. Multiple agents of change (e.g. agriculture, grazing, wildfire, water development, energy, climate, urbanization, recreation) are active in western river basins including the UCRB and Colorado Plateau; individually and cumulatively impacting landscape processes and water resources. The west has, and continues, to experience large increases in human population, expansion of energy development, changes in agricultural practices and land cover, and substantial climate variability. Landscape-scale change from these drivers can be observed in multi-decadal stream water-quality records, because changes in conditions within source watersheds affects the amount of water coming out of watersheds, and the amount of sediment and solutes carried with the water. It is difficult, however, to determine the amount or degree of impact an individual land-use or water-use change has on water quantity, quality, and availability. A better understanding of the relative contribution of different landscape changes to observed trends in water quality and quantity can be used to assess effects of different drivers of change across space and time and allow for informed resource management toward improved water supply and quality.

A long-term trend in dissolved solids can be observed in annual mean concentration of dissolved solids and flow-normalized concentration in the Colorado River at Cisco, Utah, (table 3). At this site there has been a long-term significant decline in annual mean dissolved-solids concentration from 1940 until 2000. This trend is present prior to the implementation of the Colorado River Salinity Control program when began about 1980. Beginning in 2000, the long-term decline in annual mean concentration ceased and through 2016 there has been a slight increase in annual mean dissolved-solids concentration while the salinity control program has been active.

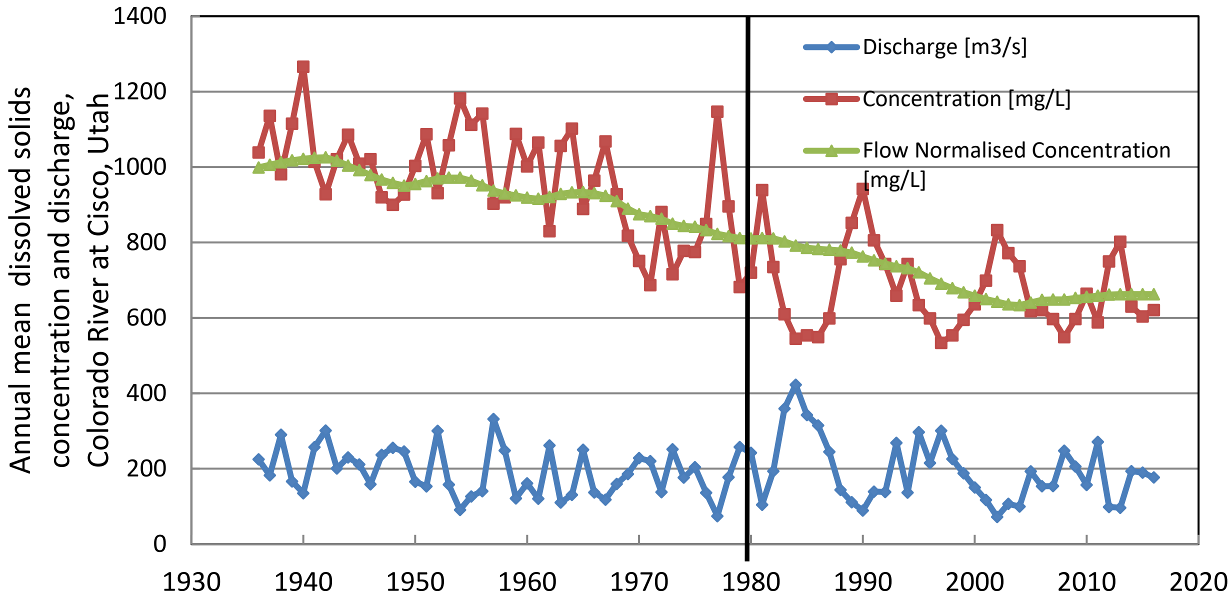


Table 4. Annual mean dissolved solids concentration, flow normalized concentration and discharge in the Colorado River at Cisco, Utah. The black vertical line is when the Colorado River Salinity Control Program began. Data are from USGS streamgage 09180500

The general approach of this study is to assess trends in dissolved solids and specific conductance at USGS streamgages with long-term records. Trend results will be spatially and temporally correlated with trends in land and water use and landscape processes to assess, attribute, and partition long-term causes of change.

<u>Trend analysis of dissolved solids concentrations at USGS gaging stations with long periods of record.</u>

An inventory of USGS streamflow and water quality data in the UCRB yields 20 gaging stations with dissolved solids concentration data beginning prior to 1950, and 36 gaging stations with specific conductance data with periods of record beginning before 1950 (fig. 20). The earliest discharge data were collected in 1894 and water quality data in 1908. This study will also investigate trends in water quality at shorter decadal time scales that may be the result of specific land use or process changes and will assist in explaining the observed long-term trends. This approach allows for the use of streamgages with shorter periods of record that are nested in a watershed and will add approximately 50 streamgage sites to the analysis. The long-term record sites will be supplemented with sites that have only 40-60 years of record to examine the spatial component of trends. Trends at many of these shorter-term sites have been examined previously and this study will leverage and compare with these results and results from other trend studies.

Current completed efforts have examined long-term datasets of dissolved-solids and specific-conductance measurements, collected as early as 1929, were used to explore long-term trends in dissolved solids in streams in the UCRB. A statistical trend analysis using weighted regressions on time, discharge, and season (WRTDS) was used to evaluate changes in dissolved-solids loads and concentrations at 14 sites using data from 1929 to 2017, including time periods prior to the construction of large dams and prior to the implementation of salinity control projects. Long-term trends in streamflow were accounted for using generalized flow-normalization, a newly-developed tool in WRTDS. A completed manuscript was submitted to the Water Resources Research scientific journal in August 2020 with an anticipated publication date of fall 2020.

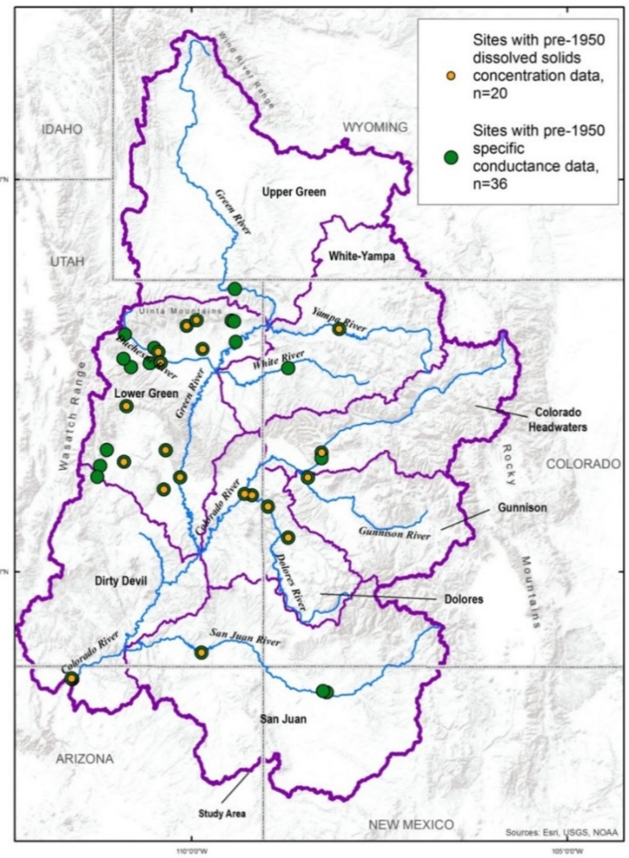


Figure 20. Map of Upper Colorado River Basin, sub-basins and streamgages with pre-1950 water-quality and discharge data

Integrated and cumulative assessment of water quality trends and land use and landscape process trends

Trends observed in stream discharge and water quality will be compared with changes in land-use and landscape processes. The approach will use spatial regression techniques (for example weights of evidence/weighted logistic regression), lagged cross-correlation, multivariate analyses, and structural equation modeling with the objective of assessing and determining the land-use and landscape process(es) responsible for observed trends in stream discharge and water quality. These analyses will provide an understanding of the cumulative impacts of change and highlight land use and landscape processes that have the greatest impact on observed trends streamflow and water quality. Several temporally-variable datasets spanning the UCRB have obtained including: climate data from 1930-2014, land cover data from 1938-present, major land use from 1945-2012, grazing information from BLM and US Forest Service for various time periods and areas, burn summary reports, oil and gas wells, cultivated agricultural lands from 1900-2010, irrigation type from 1982-2012, reservoir storage and dam construction from 1925-2010, and population from 1900-2012. SPARROW modeling techniques are currently under investigation to facilitate development of regression and cross-correlation of the presently known datasets.

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

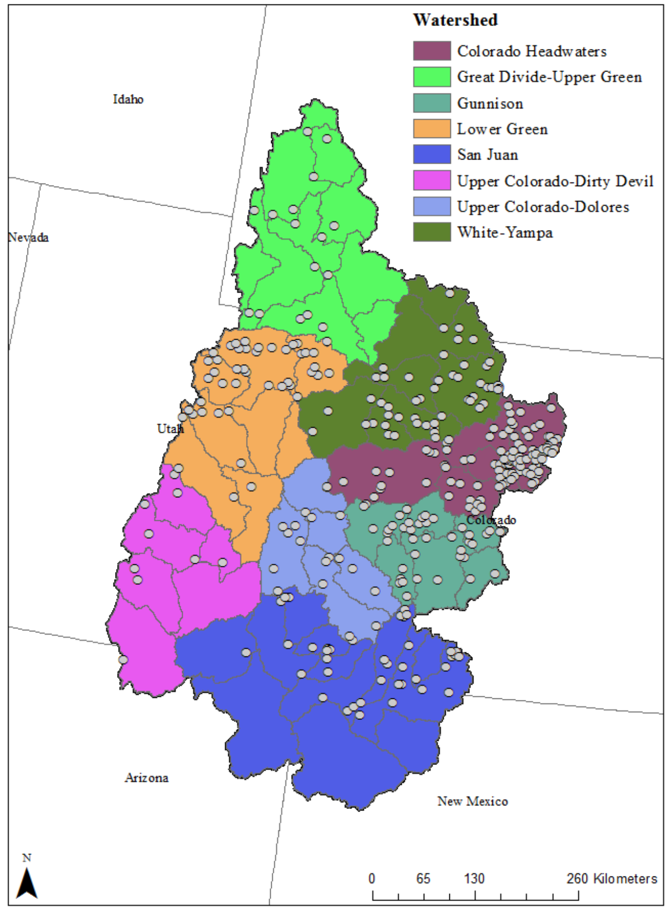


Figure 21. Map of the Upper Colorado River Basin showing the location of major watersheds and 318 monitoring stations (grey points) where salinity loads were estimated and are being used as calibration data in SPARROW 2.0.

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 long-term mean annual salinity loads at 318 sites, and compilation of recent (2010) watershed characteristics data sets, including the updated irrigation dataset (fig 21). 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. A recently approved modification to the existing SPARROW model will investigate historical time-varying salinity loads from irrigated agricultural lands in the UCRB.

Dissolved-solids flux from irrigated lands is related to the quantity of water applied for crop irrigation. Conceptually, the quantity of water applied to agricultural lands is a function of growing season and climate, with less irrigation water needed in cooler and wetter areas with shorter growing seasons. To approximate the spatial variability in the amount of water needed for crop irrigation in the UCRB, mean elevation was used as a landscape transport variable specific to irrigated agricultural land sources in the Miller and others (2017) SPARROW model. While this is adequate for making long-term average estimates of salinity loading to streams, the result is that when time-varying climatic or watershed characteristics, such as precipitation, are used in the model, loads for irrigated agricultural lands are predicted to remain constant over time.

Unlike irrigated agricultural sources in the 2017 SPARROW model, geologic sources are set to interact with a climatic variable (precipitation minus evapotranspiration), which is time-varying, thereby providing an opportunity to estimate time-varying salinity loads from natural (i.e. geologic) sources. However, long-term spatially-distributed estimates of the quantity of irrigated water applied for use in estimating annual salinity loads from irrigation are limited—long-term data exists in some watersheds of the basin but not in others. Considering the limited diversion data set, this study proposes to utilize remotely-sensed data and an energy-balance model to estimate annual irrigated crop consumptive use as a surrogate of irrigation water applied in an enhance SPARROW model. Monthly ET data for the Upper Colorado River Basin from January 1984-December 2015 will be created using the operational USGS Simplified Surface Energy Balance (SSEBop) model to quantify and map ET over irrigated fields using Landsat imagery and associated weather datasets. Where available, historical annual diversion data will be compared to the SSEBop predictions to assess correlation and the level of representation of diverted irrigation water to model-compute irrigated crop consumptive use.

Use of SSEBop model predictions in the SPARROW model will allow for upper basin wide estimates of time-varying irrigation water use. The 1984-2015 date range is appropriate as this corresponds to the date range for which salinity load estimates used to calibrate the 2017 SPARROW model have been made (Tillman and Anning, 2014).

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

Tillman, F.D. and Anning, D.W., 2014, Updated estimates of long-term average dissolved-solids loading in streams and rivers of the Upper Colorado River Basin: U.S. Geological Survey Open-File Report 2014-1148, 11 p.

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

Figure 22. Pah Tempe Springs, Washington County, Utah

Pah Tempe Springs (also known as Dixie Hot Springs) (fig. 22) 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.

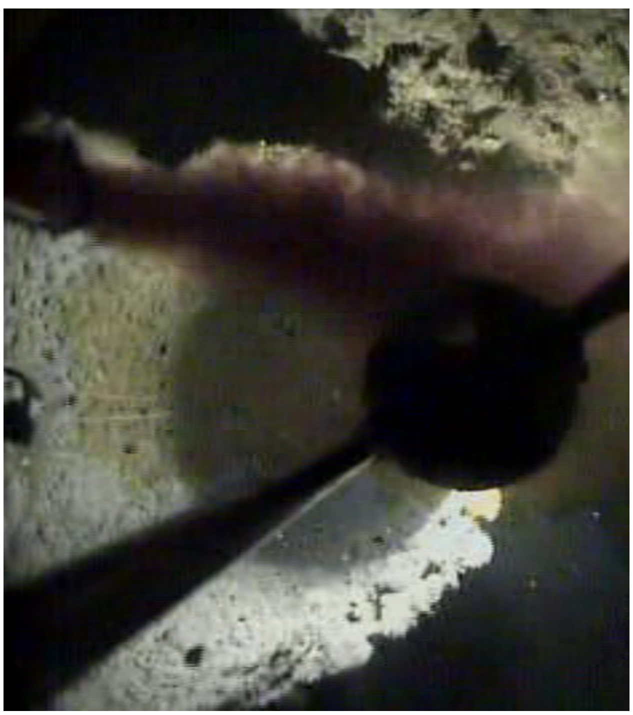
During 2007-08, USGS began a multi-phase investigation of salinity loading in the Virgin River and from Pah Tempe Hot Springs. Phase 1 investigated the transport and fate of salinity in the Virgin River from Pah Tempe Springs downstream to below Littlefield, Arizona. The Phase I investigation concluded 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), has completed the 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. This phase of the study investigated 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. 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).

Figure 23. Drilling operations near Pah Tempe Hot Springs in January 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 has completed drilling on 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 was completed during winter 2017/2018 (fig. 23).



The location of historical well (LV-101) drilled by Reclamation in the 1970s was discovered in 2018 before additional drilling was contracted. Downhole investigations at LV-101 conducted in late 2018/early 2019 indicate that the well is open to its original drilled depth of approximately 500 feet below land surface and water temperatures were relatively constant and comparable to hydrothermal water that discharges at the Pah Tempe Grottos. Sampled geochemistry and isotopic tracers have verified that water sampled from LV-101 is similar to results observed in samples obtained from the Pah Tempe Grottos. Downhole camera imagery revealed a large open interval in the well casing that occurs between 170 to 190 feet below land surface that appears to be the result of hydrothermal corrosion associated with water quality observed in Pah Tempe hot spring water. In the spring of 2020 *Fluorescein* dye was injected into LV-101 in the open interval of the casing that occurs between 170 to 190 feet below land surface. Downhole cameras recorded the injection to evaluate the presence of formation groundwater movement (fig. 24). Water movement within the open interval was readily observable during the injection. Passive activated charcoal samplers placed in the grottos and other streambank spring orifices detected the dye moving through the discharge zone of Pah

Tempe within a week of the injection. A pump test will be conducted in fall 2020 at well LV-101 to investigate discrete intervals of the well for water-quality and water production. A downhole packer will be utilized to isolate sections of the well. Nearby monitoring wells as well as the pumping vault used in Phase III will be instrumented to better understand the connection between LV-101 and the hydrothermal system.

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.

Figure 26. *Fluorescein* dye injection in well LV-101.

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

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

The Blacks Fork is within the Colorado River Basin and is a tributary to the Green River in Wyoming. Previous work by the U.S. Geological Survey (USGS) in the drainage basin at the Blacks Fork near Lyman, Wyoming (USGS station 09222000), estimated 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. 25) 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.

Streamflow and salinity load data had not been collected prior to April 2018 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 for which specific conductance data collection ended in 1998. Additionally, 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. To obtain more accurate estimates of current salinity contributions on an daily basis from Blacks Fork,a streamgage on the Blacks Fork, just upstream of the confluence with the Smiths Fork. began operation in April 2018, collecting streamflow and specific conductance data. The real-time specific conductance data collection concluded in October 2019, however through additional funding from Reclamation, real-time streamflow data are still available online. Streamflows in the basin were different between the 2018 and 2019 irrigation seasons, with the cumulative flow during April through September 2019 calculated as more than 10 times the cumulative flow in 2018. These two different flow regimes will help define the range of expected flow and salinity loading to the system from the site.

Figure 25. USGS streamgage – Blacks Fork above Smiths Fork

Synoptic water-quality sampling for total-dissolved solids at six sites on the mainstem of the Blacks Fork (including the streamgage) and a selected tributary were sampled seven times during the summers of 2018 (three times) and 2019 (four times) to describe the locations and magnitude of water-quality changes in the Blacks Fork. Data show there is a general pattern of increasing total-dissolved solids at many individual sites as the summer progresses, but that increase doesn’t necessarily translate into increased loads (which are the product of total-dissolved solids times streamflow) because the streamflow tends to decrease during this time. These two complementary data sets are being used to characterize the salt loads in the Blacks Fork and can provide water managers with information to evaluate salt-mitigation projects in this area. A USGS Scientific Investigations Report presenting the results of this study will be published in early 2021.

Review of salinity data, estimated loads and data gap analysis for 2017 new priority salinity areas, Colorado River Basin

The Colorado Salinity Control Forum and Reclamation (implementing off farm salinity control) has developed a process to evaluate potential salinity control project areas for future participation in control programs. As part of this assessment, studies are conducted, using available data for an area, to estimate salt loads and partition loading between natural and remediable irrigation-related sources (hydrosalinity study). This work is typically done prior to preparation of a Funding Opportunity Announcement (FOA) to solicit applications for the design and implementation of salinity control projects.

There are currently 12 formally designated USDA NRCS salinity projects areas that encompass many of the lands identified as high salinity loading areas (fig. 26). To aid in prioritizing future salinity control projects, the Colorado Salinity Control Forum's Work Group completed a ranking of watersheds within these 12 project areas. The ranking process and results, described in CRSCF Memorandum 2017-73 (10/10/17), consider salinity loads for selected watersheds estimated in the USGS Upper Colorado River SPARROW II model (Miller and others, 2017), total irrigated acreage, non-treated acreage, water supply, and local-irrigator interest in the program. Numeric scores were applied for each criteria and summed and normalized for scores between 0 and 100. Although suitable for this ranking exercise, the salinity load estimates defined in the Upper-Basin-scale SPARROW II model carry significant uncertainty and are not, in many areas, of sufficient accuracy for Reclamation to define load reduction potential and to conduct cost/benefit analyses. The Forum and Reclamation still required a watershed-specific assessment of salinity, including direct observation of loading in the area, to prepare for program FOA's in priority areas.

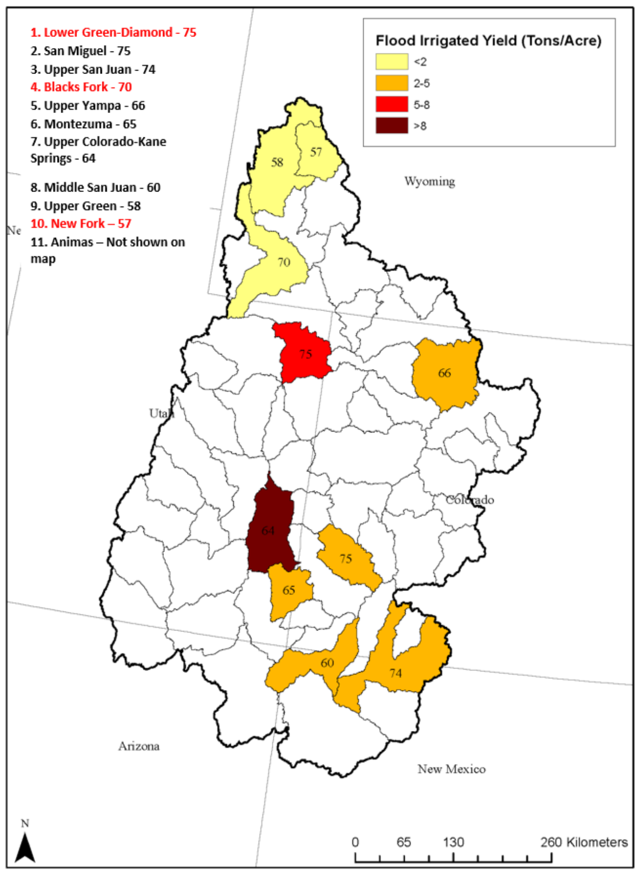


Figure 26. New priority salinity areas

The USGS developed an approach to conduct preliminary work to prepare for and scope hydrosalinity studies in prioritized watersheds (fig. 27). This intermediate step in the assessment process will determine available data for conducting hydrosalinity studies in selected watersheds, assess the utility and sufficiency of those data sets, and define gaps that must be filled prior to conducting further assessment.

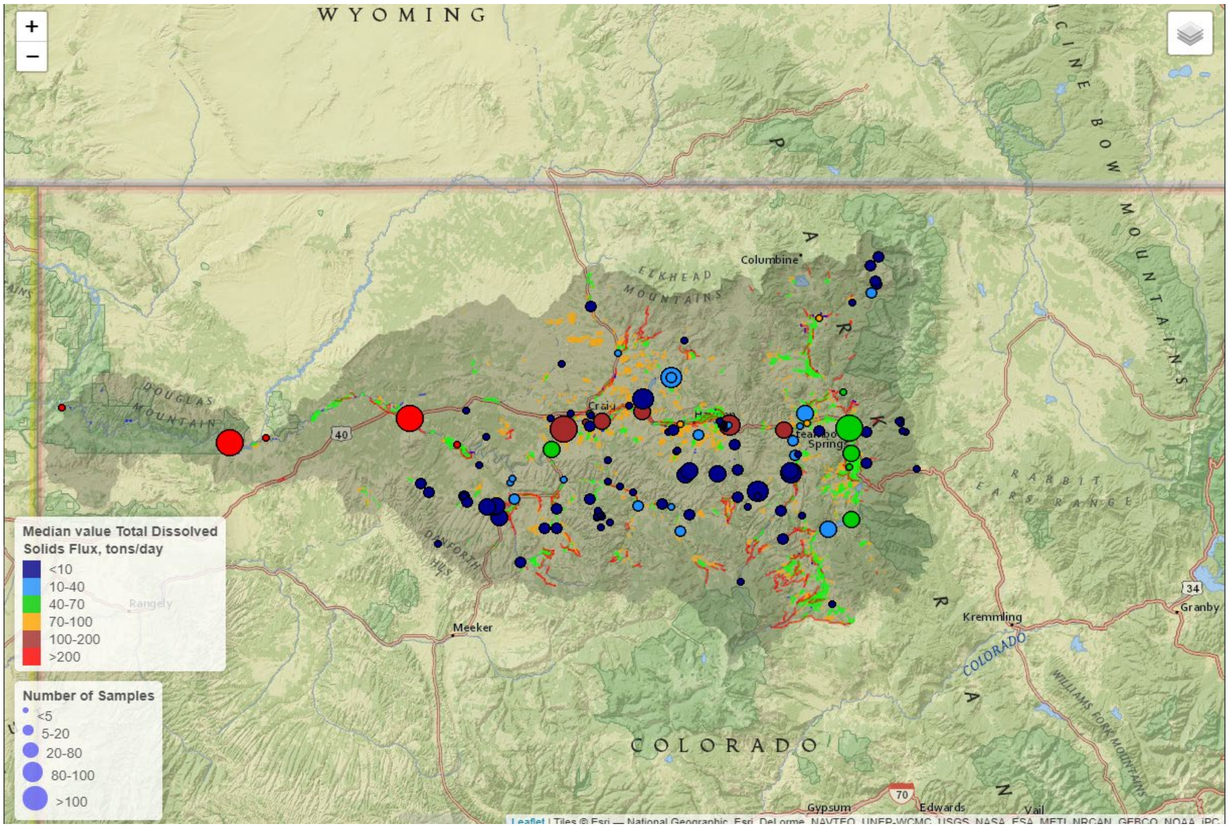


Figure 27. Example of map type provided as part of the review showing various properties of the new priority salinity areas.

In June of 2020, the USGS presented finding for the initial assessment to the Salinity Science Team. Results were presented that broke down the data needs/gaps in each potential study area. Some areas were not recommended for further work, while other areas were recommended for large scale hydrosalinity investigations. Several locations had enough existing salinity data to go forward with a hydrosalinity assessment with minimal or no new data collection required. All results from this review were provided to the Salinity Control Forum Work Group as an Excel spreadsheet for review. Maps are contained within the tabs on each spreadsheet allowing the user to link to live maps of each proposed area. Maps have various feature layers showing salinity levels, canals, sample locations, TDS levels and more. There is also a tab provided for the user to assess the findings of this review for each of the proposed salinity control areas. Findings include a verbal summary of data availability and needs, as well as an estimate of basic study requirements and or initial planning phases that should be considered. Estimates of pricing for each area are provided, but prices are only gross estimates of cost that should be considered if further hydrosalinity investigations are pursued.

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

Figure 28. Paradox Valley

Paradox Valley in western Colorado is a collapsed salt anticline (fig. 28). Tectonic movement and regional groundwater flow since the Tertiary era have led to the exposure and dissolution of salt deposits in the anticline core. Groundwater beneath the central part of the Paradox Valley consists of highly concentrated brine that discharges to the Dolores River, a tributary to the Colorado River, as it flows across the axis of the valley. The Dolores River experiences substantial increases in salinity as it intercepts the brine , with historical (1980-1995) salt loads estimated to range from about 95,000 to 205,000 tons per year (Mast, 2017). 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 alternatives for brine disposal as well as possible strategies to reduce the salinity loads to the Dolores River. Possible future mitigation alternatives include (1) reducing recharge on the valley floor through modification of surface-water impoundments and (or) changing irrigation practices, (2) managing (increasing) the stage of the Dolores River in the valley to decrease the groundwater gradient and thus discharge to the river, and (3) optimization of the current pumping configuration. The USGS has assisted Reclamation in these efforts through: (1) updated estimates of salinity loading (Mast, 2017), (2) geophysical surveys to better characterize the spatial and temporal distributions of brine discharge (Ball and others, 2015; Mast and Terry, 2019), and (3) development of conceptual and numerical groundwater models to support hydrogeologic characterization.

<u>Estimates of Salinity Loading</u>

Updated estimates of salinity loading to the Dolores River for the period 1980-2015 were published by Mast (2017). The report documents regression models developed to relate total dissolved solids (TDS) concentrations to specific conductance (SC) for the Dolores River at Bedrock site (USGS station 09169500) and the Dolores River near Bedrock site (USGS station 09171100) (fig. 30) using available data through 2015. A second-order polynomial provided the best fit of the discrete data for both sites on the river. The largest bias occurred in samples with elevated sulfate concentrations (greater than 500 milligrams per liter), which were associated with short-duration runoff events in late summer and fall. Comparison of regression models from a period of time before operation began at the PVU and three periods after operation began suggests the relation between TDS and specific conductance has not changed over time.

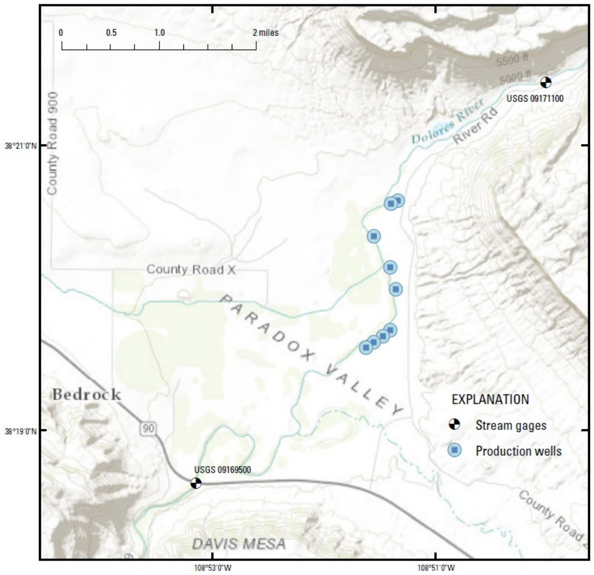


Figure 29. Map of the Dolores River in Paradox Valley showing locations of streamgages and production wells

Net salt gain through the Paradox Valley was estimated as the TDS load at the downstream site minus the load at the upstream site. The mean annual salt gain was 137,900 tons per year prior to operation of the PVU (1980–1993) and 43,300 tons per year after the PVU began operation (1997–2015). The difference in annual salt gain in the river between the pre-PVU and post-PVU periods was 94,600 tons per year, which represents a nearly 70 percent reduction in salt loading to the river.

<u>Spatial Distributions and Temporal Changes of Brine Discharge</u>

The spatial distribution and temporal changes in brine discharge to the Dolores River have been investigated with various geophysical methods since 2011 (Ball and others, 2015; Mast and Terr, 2019). In 2011, an airborne electromagnetic (AEM) survey was conducted across the Paradox Valley to measure subsurface conductivity and locate the brine. About 1,200 kilometers of flight lines were flown using helicopter-mounted instruments with a 150-meter line spacing (Ball and others, 2015). Results of the AEM survey confirmed upwelling brine near the center of the valley and indicated that irrigation along West Paradox Creek might be a source of freshwater recharge to the valley. Results of the AEM survey were used to develop a map showing the elevation of the freshwater-brine interface for October 2011 (Ball and others, 2015) that contributes to the conceptual model of brine discharge. Results show that the interface is shallow and near land surface on the southeast side of the Dolores River near the Paradox salt outcrops. The interface is deepest, and the freshwater lens is thickest, west of the river beneath the irrigated areas along West Paradox Creek.

In 2016, additional site characterization activities were conducted in cooperation with Reclamation to improve the characterization of processes controlling spatial and temporal variations in brine discharge to the Dolores River (Mast and Terry, 2019) For the study, three geophysical surveys were conducted in March, May, and September 2017, and water levels were monitored in selected ponds and groundwater wells from November 2016 to May 2018. The study also utilized streamflow and specific-conductance data from two U.S. Geological Survey streamflow-gaging stations on the Dolores River to estimate salt load to the river. River-based continuous resistivity profiling and frequency domain electromagnetic induction surveys made during low-flow conditions indicated a zone of brine-rich groundwater close to the riverbed along an approximately 4-kilometer reach of the river. Under high-flow conditions, the brine was depressed as much as 2 meters below the riverbed, and brine discharge to the river was reduced to a minimum. Direct current electrical resistivity surveys show that the freshwater lens overlying the brine is much thicker (up to 10 meters) on the west bank than on the east bank (less than 5 meters). A large low-conductivity anomaly at river distance 6,800 meters was observed in all surveys and may represent a freshwater discharge zone or a losing reach of the river. Filling and draining of the wildlife ponds on the west side of the river had a negligible effect on salt loads in the river during the study period. Groundwater monitoring showed there was active exchange of water between the river and the adjacent alluvial aquifer. When river stage was low, groundwater flowed towards the river, and brine discharge to the river increased. When the river stage was high, the gradient was reversed, and fresh surface water recharged the alluvial aquifer minimizing brine discharge. Most of the salt load to the river occurred during the winter and appeared to be enhanced by diurnal stage fluctuations.

Mast and Terry (2019) present a conceptual model of brine discharge to the river at three scales. Groundwater at the regional scale drives dissolution of salt in the Paradox Formation and flow of brine into the base of the alluvial aquifer. Surface water–groundwater interactions at the scale of the alluvial aquifer control brine discharge to the river seasonally and interannually. At the finest scale, diurnal fluctuations in river stage drive exchange of freshwater with saltier pore water in the hyporheic zone, which appears to increase brine discharge to the river during winter.

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

The USGS has developed conceptual and a 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, groundwater-flow directions, and stream-aquifer interactions. A numerical groundwater-flow and transport model was initiated in 2011 to further the conceptual understanding of water and chemical budgets for the Paradox Valley including the PVU. In 2013, the USGS monitored water levels in the PVU extraction wells and nearby monitoring wells to evaluated hydraulic properties of the aquifer. 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.

From 2016-2020 the three-dimensional groundwater-flow and transport model was re-evaluated by: updating the model to the current version of MODFLOW that includes solute transport, refocusing the model area on the central part of the Paradox Valley and the PVU, using updated estimates of salt loading from Mast (2017), and using updated estimates of the spatial and temporal distributions of brine discharge developed by Mast and Terry (2019). 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.

Preliminary modeling results and results from Mast and Terry (2019) indicated that temporal variations in brine discharge to the Dolores River primarily are related to seasonal variations in stage of the Dolores River suggesting 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 updated model is being used 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, although results from Mast and Terry (2019) suggest that surficial water-management activities will likely not affect the long-term discharge of brine from the underlying salt anticline.

Final products from the conceptual and numerical modeling work will be published in 2020. A Scientific Investigations Report (SIR) summarizing the conceptual understanding of groundwater occurrence and flow in the Paradox Valley will present the regional geologic setting, hydrogeologic maps developed for the numerical model, aquifer-test results, and previously collected groundwater age-dating results with respect to the salt loading estimates and geophysical studies. The numerical groundwater-flow and transport model and associated water-management simulations will be published as a groundwater model archive and a USGS Scientific Investigations Report (SIR) describing study methods and results.

Literature Cited

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. and Terry, N., 2019, Controls on brine discharge to the Dolores River in the Paradox Valley, Colorado: U.S. Geological Survey Scientific Investigations Report 2019-####, ## p.

Environmental Protection Agency

During Fiscal Year 2020, 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 19, 2020.

- EPA Water program staff, including permitting staff from the three EPA Regional Offices, provided federal NPDES permit updates and input to the workgroup preparing the 2020 Review of the Water Quality Standards for Salinity in the Colorado River System.

- 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 (PVU). 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 is preparing comments on the PVU Administrative Draft EIS.

- 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.

- The table below 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). Use the State hyperlink to access their current WQS.

COLORADO RIVER BASIN SALINITY CONTROL STANDARDS UPDATE
Basin States Adoption of Salinity Standards & Plan of Implementation Updates

EPA Region – State	2011 Update Adopted 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	In draft	--	Yes 10/18/16	12/23/16		
R9 – California	In draft	--	Yes 5/05/15			
R9 – Nevada	Yes 10/11/12	Yes 2/12/13	In Draft Dec. 2017	Pursuant to the “2017 Review - Water Quality Standards for Salinity, Colorado River System,” as adopted by the Colorado River Basin Salinity Control Forum, the flow weighted annual average concentrations for the calendar year for total dissolved solids in mg/L at the three lower main stem stations of the Colorado River are as follows…….		
R8 – Colorado	Yes 12/12/11	2008 adoption reaffirmed	Yes 12/8/14	--	Reaffirmed Dec. 2017	
R8 – Utah	Yes 4/1/12	Yes 11/20/12	Partial 8/15/14			
R8 – Wyoming	Adopted by reference – Water Quality Rules and Regulations (1982)		Yes 3/23/15	The salinity standards adopted through the Colorado River Basin Salinity Control Forum (Forum) also apply to Wyoming surface waters within the Colorado River Basin.		
R6 – N. Mexico	Earlier version not changed	Previously approved with adoption by reference	…. New Mexico will cooperate with the Colorado River basin states and the federal government to support and implement the salinity policy and program outlined in the most current “review, water quality standards for salinity, Colorado river system” or equivalent report by the Colorado river salinity control forum. 2014 standards referenced.			

September 2020

Table 5.

EPA has approved the applications of nine 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 **San Carlos Apache Tribe** was granted TAS on April 13, 2020. Currently, there are no approved tribal water quality standards, federally proposed or promulgated standards applicable to this tribe.

- The **Gila River Indian Community** received TAS approval on October 30, 2018. EPA Region 9 is working with the Tribe in completing development of their WQS.

- The **Southern Ute Indian Tribe (SUIT)** received TAS approval on March 28, 2018. EPA Region 8 is working with the Tribe in completing development of their WQS. SUIT anticipates holding public/ informational hearings in the future.

- The WQS for the **Ute Mountain Ute Tribe (UMU)** were approved by EPA Region 8 on October 19, 2011. UMU anticipates they'll hold a public hearing sometime in the future. 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 **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 **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 **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 adopted and approved WQS for the Tribes have been published and are available for review on-line at https://www.epa.gov/wqs-tech/epa-actions-tribal-water-quality-standards-and-contacts or by using the table and clicking on the hyperlink for the tribe. Included in the table are other Clean Water Act programs tribes have the authority to implement.

Tribal Clean Water Act Programs					
Colorado River Basin Tribes	**Sec. 106**	**Sec. 319**	**WQS**	**Date Eligible to Administer a WQS Program (TAS)**	**Date Initial WQS Approved by EPA**
Ak-Chin Indian Community	x	x	No		
Camp Verde Yavapai Apache Nation	x	x	No		
Chemehuevi Indian Tribe	x	x	No		
Cocopah Indian Tribe	x	x	No		
Colorado River Indian Tribes	x	x	No		
Fort Mojave Indian Tribe	x	x	No		
Fort McDowell Yavapai Nation	x	x	No		
Gila River Indian Community	x	x	x	10/30/2018	
Havasupai Indian Tribe	x	x	x	4/26/2011	
Hualapai Indian Tribe	x	x	x	7/22/2004	9/17/2004
Hopi Tribe	x	x	x	4/23/2008	7/8/2008
Jicarilla Apache Tribe	x	x	No		
Navajo Nation	x	x	x	1/20/2006 5/23/2019 [Supplemental application]	4/11/2006
Pascua Yaqui Tribe	No	No	No		
Quechan Indian Tribe	x	x	No		
Salt River Pima-Maricopa Community	x	x	No		
San Carlos Apache Tribe	x	x	x	4/13/2020	
Southern Ute Indian Tribe	x	x	x	3/28/2018	
Tohono O'odham Nation	x	No	No		
Tonto Apache Tribe	No	No	No		
Ute Indian Tribe Uintah Ouray	x	No	No		
Ute Mountain Ute Indian Tribe	x	x	x	9/26/2005	10/19/2011
White Mountain Apache Nation	x	x	x	2/3/1997	9/27/2001
Yavapai Prescott Indian Tribe	x	x	No		
Zuni Pueblo	No	No	No		

Table 6 (x = has a program)

United States Department of the Interior
Fish and Wildlife Service (Service)

During Fiscal Year 2020, the U.S. Fish and Wildlife Service (Service) continued to provide coordination and assistance to the Colorado River Basin Salinity Control Forum and Advisory Council involving salinity control activities associated with fish and wildlife habitat. However, due to restrictions implemented for Covid-19, field visits this year have been curtailed, both for the Service and to some extent for agencies we typically work with for wildlife habitat replacement (e.g., Bureau of Reclamation). Creed Clayton continues in his role as Salinity Control Coordinator for the Service.

Summary of FY20 Fish and Wildlife Activities-At a Glance

1) Salinity Control Program Meeting Attendance

    a) Forum, Advisory Council, and Workgroup
        - Phoenix, AZ — 2019.10.22-25
        - Work Group (virtual meeting) — 2020.4.27-29
        - Forum, Advisory Council, & WG (virtual) — 2020.6.1-3
        - Work Group (virtual meeting) — 2020.9.28-30 (planned)

    b) Paradox Salinity Removal Unit Cooperating Agency Meetings for Draft EIS
        - Virtual meeting — 2020.4.16

    c) Lower Gunnison Basin Selenium Management Program meetings
        - Virtual meeting — 2020.7.29
        - Science Team (virtual meeting) — 2020.8.3

2) Environmental Documents, Salinity Control Program

    a) Endangered Species Act Consultations (Western Colorado Field Office)

        - Root and Ratliff Ditch Piping Project (for BOR, Durango Area Office, signed 2020.5.22, TAILS 2020-F-0211)

        - Colorado River Wildlife Area Pond Outlet Culvert Extension (for BOR, Western Colorado Area Office. signed 2020.10.2, TAILS 2019-I-0470)

    b) Response to Salinity Control Advisory Council 2019 Annual Report (2020.7.2, TAILS 2020-CPA-0056)

    c) Review and comment on NRCS Monitoring & Evaluation reports from UT, WY, and CO for status of Wildlife Habitat Replacement progress (2020.4.28, TAILS 2020-CPA-0066)

3) <u>Trainings and Conferences</u>

- Riparian Restoration Conference, Rivers Edge West, Grand Junction, CO 2020.2.4-6
- Introduction to High Tunnels in Organic Systems, NRCS webinar 2020.9.2

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 managed section 7 consultations on salinity control projects that could affect threatened or endangered species in Colorado, including ditch-to-pipeline, canal lining, and wildlife habitat improment projects. Section 7 consultation was completed with Reclamation on a ditch-to-pipe project (Root and Ratliff) near Mancos, Colorado. This project involved consultation on water depletions that are likely to adversely affect two endangered fish found downstream in the San Juan River (Colorado pikeminnow and razorback sucker). Concurrence on a not likely to adversely affect determination was also given for three other listed species that could be found within the project area (southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse). Section 7 consultation was also completed with Reclamation on a culvert replacement project at the Colorado River State Wildlife Area near Grand Junction, which serves as a habitat replacement site in the Grand Valley. This project involved potential effects to the four endangered fish of the Colorado River and associated critical habitats (Colorado pikeminnow, razorback sucker, humpback chub, and bonytail). 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 Upper 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. The Service provided Cooperating Agency comments last year, noting the difficulty of minimizing hazards to migratory birds presented by one of the EIS alternatives. We provided no additional comment this year and await the final decision by DOI.

Wildlife Habitat Replacement Activities.

The Service appreciates the on-going efforts of Reclamation and NRCS staff to replace wildlife habitat values forgone. Due to restrictions relating to Covid-19, field visits were not authorized for nearly all of the field season this year. No field visits to wildlife habitat replacement sites were conducted by the Service in FY20.

Similarly, no requests to review or approve wildlife habitat replacement plans were submitted to the Service this year.

Monitoring and Evaluation Report Review--NRCS Wildlife Habitat Projects.
After review of the NRCS FY19 M&E reports for Wyoming, Colorado, and Utah, the Service Salinity Control Program Coordinator assessed and compiled the progress of NRCS in replacing fish and wildlife habitat forgone as a result of implementing salt control measures. The Coordinator also provided to NRCS suggestions as to how to make future M&E reports more informative regarding wildlife habitat replacement. 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 a 40-60 acre wetland near Eden, Wyoming temporarily dried in 2014 for two years. This incident reinforced the need to assure that acres of habitat replacement are functioning as intended for their 25-year term. The replaced habitat values in the Big Sandy Unit have been in existence for 15+ years. For the first time, no FY19 M&E report was produced by NRCS for the Big Sandy Unit. Apparently the unit is considered to have been completed.

For the Henrys' Fork Salinity Control Unit, due to lack of opportunity for traditional wetland replacement project opportunities, alternative habitat improvement projects have been pursued and scored with a novel habitat replacement calculation tool. Livestock exclusion, nonnative invasive fish exclusion, and increased stream-reach connectivity for native fish populations are all habitat projects that have been completed. Peculiar to the Henrys' Fork Unit, *actual* wetland habitat loss is assessed annually. So far, no wetland acres have dried or otherwise been lost from salinity control projects. Thus, the 241 completed habitat acres/values can be considered in excess of the habitat lost so far. Thus, this unit is proportional and concurrent.

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. The Grand Valley Salinity Control Area met and surpassed its habitat replacement goal this year with the implementation of multiple habitat projects that were under contract, as stated in the Colorado M&E report. The McElmo Creek and Silt Salinity Control Units need further habitat replacement. However, the FY19 M&E report states, "The proximity of this project [Mancos Valley unit] to the McELmo Creek unit could provide additional replacement habitat values for both areas in the future if needed." The NRCS FY19 M&E report also identified the treatment of 100 acres of Tier 2 (Out-of-Project-Area) salt control acres in Colorado. However, no mention was made of associated habitat replacement for these projects. Thus, Tier 2 projects are not incorporated into the table below.

An issue identified with the Lower Gunnison Area (and habitat replacement sites in general), is that only small parcels have been 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, more reliable maintenance, and a longer-term life expectancy. Another issue identified by NRCS in the FY17, FY18, and FY19 M&E reports is a continued staffing shortage 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.

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.

NRCS Wildlife Habitat Replacement Summaries for FY19 follow, by state.

Salinity Control Unit	Habitat Replacement Goal (to be concurrent)	Cumulative Habitat Completed	**Current Status**	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	**Wyoming**
	Acres	Acres	**%**	Acres	Acres	WHR = Wildlife Habitat Replacement
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 were treated for salt control. Habitat/wetland replacement goal was exceeded by approx. 11 acres and was considered complete in 2005.
Henry's Fork	547 habitat values on salt control projects (based on completed salt control projects--but actual wetland habitat loss so far is zero)	241 replacement habitat values generated	**"No replacemement values are needed at this time"**	--	Installed Beaver Creek Fencing estimated at 100-200 future credit s. Interstate Canal Diversion improveme nt should provide 30 future credits	A habitat deficit was shown in past years based on *expected* loss of wetland habitat based on salinity control projects installed (conversion to sprinklers). However, wetland loss is annually assessed and has not occurred yet. Thus, the habitat replacement projects so far resulted in an actual excess of habitat acres of credit. 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.

Table 7. Data for Henry's Fork from WY 2020 (May) NRCS M&E Report

Concurrent and proportional wildlife habitat replacement indicated bygreen shading

Salinity Control Unit	Habitat Replacement Goal (to be concurrent)	Cumulative Habitat Applied	**Current Status**	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	**Colorado**
	Acres	Acres	**%**	Acres	Acres	WHR = Wildlife Habitat Replacement
Grand Valley	1,206	1261	**104%**	55	2	Salt control measures completed. Negotiated total habitat replacement goal of 1,206 acres. 350 habitat improvement acres were recently completed on 5 CPW State Wildlife Areas (Walter Walker SWA, Tilly Bishop SWA, near Corn Lake SWA etc.) finally fulfilling and surpassing the replacement goal.
Lower Gunnison	1,448	1,930	**133%**	482	333	115,000 acres of salt control at full project implementation. This would ultimately require a total of 2,300 acres of WHR (115,000 x 0.02 = 2,300) to be proportional.
McElmo Creek	370	284	**76%**	(86)	23	18,480 salt control acres treated so 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. NRCS has conducted a field analysis to track habitat projects completed so far in this unit, which is laudable (few offices do this). The current habitat acreage reflects WHR projects that are still in place, being maintained, and can be tracked.
Mancos Valley	62	107	**172%**	52	-	3,084 salt control acres as of FY19; 5,400 acres at full project implementation, which would require 108 acres of WHR (5,400 x 0.02 = 108) to be proportional.
Silt	37	25	**67%**	(12)	1	1,847 salt control acres as of FY19; 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.

Table 8. Data from FY2019 NRCS Monitoring and Evaluation Report.

Concurrent and proportional wildlife habitat replacement indicated bygreen shading

Salinity Control Unit	Habitat Replacement Goal (acres to be concurrent)	Cumulative Habitat Applied	**Current Status**	Habitat Surplus/ (Deficit)	Habitat in Active Contracts	**Utah**
	Acres	Acres	**%**	Acres	Acres	WHR = Wildlife Habitat Replacement
Green River	20	0	**0%**	(20)	0	976 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	89	10	**11%**	(79)	32	4,441 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.
Muddy Creek	12	0	**0%**	(12)	0	599 salt control acres thus far; 6,050 acres at full project implementation. This would require a total of 121 acres of WHR 6,050 x 0.02 = 121) at full project implementation.
Price San Rafael Rivers	762	3,446	**452%**	2,684	26	38,122 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)	3,213	21,610	**673%**	18,397	3	160,651 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, which has been exceeded.

Table 9. Data from FY2019 Utah 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

United States Depart of the Interior
Bureau of Reclamation

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 temperature, TDS, and occasionally DO (Dissolved Oxygen). In FY 2020 (WY 2020), the model has been run each month with 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 from the most recent water samples sent to the lab. The resulting modeled TDS of the Glen Canyon Dam (GCD) discharge water is provided to the Lower Colorado region to be used as input for their water quality modeling of Lake Mead.

Colorado River Simulation System (CRSS)

In FY 2020 Reclamation supported the salinity workgroup at the October and June Forum meetings by presenting preliminary and final CRSS salinity modeling data and results under four salinity control scenarios. The salinity control scenarios developed for the 2020 Review include:

1. No additional controls beyond 2020 – 1.22 million tons removed.
2. Controls associated with current projected program funding levels through 2040– 1.59 million tons removed.
3. Controls associated with Plan of Implementation through 2040 – 1.7 million tons removed.
4. Controls associated with controlling maximum potential identified salt load by 2040– 2.35 million tons removed.

In preparation for these Forum meetings Reclamation attended and presented preliminary findings at salinity workgroup meetings in February, April, June, and September. Reclamation preformed additional work to advance the salinity modeling capabilities of the CRSS model and to investigate other scenarios for the salinity workgroup.

Reclamation reviewed and approved a USGS SLOAD update to the historical record for salinity load and concentration that extends the record through calendar year 2019. 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. Reclamation used SLOAD and other data sources to develop a natural flow and salt record at the monitoring locations that extends through calendar year 2018. This record was used as input to in the CRSS model for the 2020 Triennial Review.

Economic Impacts Model

Reclamation maintains a Salinity Economic Impact Model (SEIM) that is used to estimate monetary damages due to salinity in Colorado River water. Damages are estimated in the metropolitan and agricultural areas that receive Colorado River water and presents costs in seven economic sectors including residential, agricultural, commercial, industrial, water and wastewater utilities, groundwater and recycled water use. Economic damages are based on total dissolved solids (TDS) levels greater than 500 mg/L, the Environmental Protection Agency's secondary safe water drinking standard for TDS. The latest SEIM is dated 5/8/20 and was released with prices indexed through 2019 for all sectors except the agriculture sector that are based on 2015-2019 average prices in all regions except the MWD service area region, which is based on 2014-2018 average prices.

This SEIM version was used for the June draft 2020 Triennial Review to estimate quantified damages in the Lower Colorado River Basin. Results from this analysis were presented in the 2020 Review, Appendix F – Salinity Economic Impact Model Description.

In FY 2020, the selected contractor completed work to update the model. The contractor laid out plans to update input data and impact functions. 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. Monthly study meetings were held with the contractor to monitor progress and provide feedback on developments. A training of the revamped model is expected to take place in February 2020.

Reclamation released a final SEIM User Documentation Report that incorporated extensive SEIM committee comments. This final documentation and an update model based on these updates was provided to the contractor selected for the model update. 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. This documentation further discusses and presents the outputs, inputs, and equations included throughout the model.

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.

The following are some of the topics that were addressed by the Science Team during meetings held in January and August 2020:

1. Funding/contract update of approved Research, Studies, and Investigations (SIRs)
2. Results of the 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.
    a. SIR 2020-01 Long Term Trends LC
    b. SIR 2020-02 UCRB High Flows
4. Update on Trends in Ground Water Discharge TDS Loads
5. Pah Tempe Study
6. Report on SIR 2018-02 Review of Salinity Data, Estimated Load and Data Gap Analysis for new priority Salinity areas.
7. Economic Damages Model – awarded in June of 2018 and completed May 31, 2020.
8. Review of Table 3 for the Triennial Review
9. Future science direction, needs, priorities, and funding – Science Team has been asked to look over strategies and update if needed. This will be an ongoing focus in 2021.

Paradox Valley Unit (PVU), Colorado

The PVU 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. The injection pressure has been substantially reduced following injection rate reductions in 2013 and 2017, and seismicity is now the main concern.

On March 4, 2019, a M4.5 earthquake occurred approximately 1.5 km SW of the injection well and the injection operations were immediately suspended. Since the main shock, over 2,000 aftershocks have been recorded and are still occurring as of this writing. Analyses of the earthquake and aftershocks and pore pressure diffusion modeling were conducted to determine the appropriate response to mitigate the frequency and magnitude of induced seismicity.

A six-month injection test at a reduced injection rate was scheduled to start in late April 2020 to determine injection well performance after the extended shut-in. The test would also allow observation of the seismicity response to the reduced injection rate in the area within 5 km of the well. The injection test was started on April 21 at a rate of 113 gpm. The test was suspended on May 29 to allow for the injection test plan to be peer reviewed. The plan was found to be acceptable and appropriate.

Reclamation made the decision to remain shut down and allow the injection formation pressure to further dissipate to potentially extend the service life of the well. The six-month injection test is scheduled to be restarted in mid-November at an injection rate of 113 gpm. At that rate, the PVU will intercept and dispose of approximately 5,300 tons of salt each month.

Table 10 - Paradox Well Injection History

Injection Period	Days of Operation	Pressure Start	High Pressure During Period	Injection Period Net Pressure Change	Tons of Salt[1] Injected	Estimated Tons of Salt[2] Entering the River	No. of Induced Seismic Events ≥ 0.5	Maximum Magnitude of Induced Seismic Events
Jan-May '02	148	1609	4432		52,860	8,945	19	2.7
June-Dec '02	178	929	4593	161	58,953	11,021	38	3.3
Jan-May '03	144	1172	4627	34	53,173	19,545	31	2.4
June-Dec '03	184	1154	4675	48	59,530	12,592	120	2.6
Jan-May '04	140	1201	4640	-35	51,449	21,828	45	2.9
June-Dec '04	160	1091	4541	-99	51,589	8,129	57	3.9
Jan-May '05	140	1038	4736	195	55,024	18,194	52	2.8
June-Dec '05	148	1203	4750	14	46,551	40,762	57	2.9
Jan-June '06	138	375	4680	-70	44,779	53,893	10[3]	2.4
July-Dec '06	162	1084	4797	117	56,920	22,840	16[3]	1.9
Jan-June '07	159	1066	4796	-1	56,068	22,792	6[3]	2.2
July-Dec '07	163	1232	4712	-84	57,395	12,752	26	2.9
Jan-June '08	160	1152	4813	101	54,720	20,936	21	1.3
July-Dec '08	162	1263	4822	9	56,734	17,105	30	2.1
Jan-Mar ‘09	84	1246	4756	-66	29,163	22,353	13	2.6
Apr-Sept '09	160	1157	4891	135	55,083	17,892	42	2.7
Oct ‘09-Mar '10	153	970	4930	39	51,589	32,739	40	2.9
Apr ‘10-Sep '10	162	1347	4990	60	55,747	20,522	25	2.7
Oct ‘10-Mar '11	161	1378	5000	10	55,501	23,410	246	2.9
Apr ‘11-Sep '11	158	1276	5102	102	54,422	15,388	77	2.7
Oct ’11-Mar ‘12	162	1282	5115	6	56,531	21,808	33	2.5
Apr ’12-Sep ‘12	161	1417	5108	-7	55,605	6,392	32	2.1
Oct ‘12-Mar '13	97	3149	5120	12	34,409	6,331	32	4.4
Apr ‘13-Sep '13	162	498	4770	-350	45,769	13,099	11	1.8
Oct'13-Mar '14	181	4059	4788	18	52,194	5,873	11	1.7
Apr ‘14-Sep '14	182	4658	4758	-30	50,539	2,460	5	2.3
Oct ‘14-Mar '15	181	4550	4758	0	50,305	22,856	9	1.1
Apr ‘15-Sep '15	182	4483	4791	33	50,396	7,935	11	1.6
Oct ‘15-Mar '16	180	4581	4758	-33	50,100	24,041	26	2.1
Apr ‘16-Sep '16	182	4633	4789	31	50,748	9,941	17	1.4
Oct ‘16-Mar '17	161	4749	4803	14	44,955	27,652	32	2.9
Apr ‘17-Sep '17	175	1511	4669	-134	46,215	11,548	50	2.6
Oct ‘17-Mar '18	181	4674	4749	80	47,750	35,791	34	2.9
Apr ‘18-Sep '18	179	4710	4814	65	46,764	12,985	29	1.8

Oct '18-Mar '19	154	4704	4788	-26	40,567	20,917	196	4.5
Apr '19-Sep '19	0	1336	1336	-3452	0	29,435	154	3.0
Oct '19-Mar '20	0	49	49	-1287	0	37,212	46	2.5
Apr '20-Aug '20	39	0	3573	3524	6,650	21,490	31	2.7

1 Tons of salt injected based on 260,000 mg/L. Brine concentration varies slightly due to seasonal and environmental fluctuations.
2 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.
3 Seismic data for 2006 and the first half of 2007 is likely incomplete due to seismic network problems.

PVU EIS

A Draft EIS to evaluate the impacts of alternative methods for salinity control at Paradox was prepared with three action alternatives and a "no action" alternative being evaluated. The three action alternatives are a new deep injection well, evaporation ponds, and zero liquid discharge technology. The Draft EIS was released for public review and comment from December 6, 2019 through February 19, 2020. Issuance of a Final EIS is anticipated in the winter of 2020.

Basinwide Salinity Control Program (Basinwide Program)

Funding Opportunity Announcement (FOA) 2019

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 May 31, 2019 and closed on September 20, 2019.

The Application Review Committee met October 9-11, 2019 to evaluate the submitted proposals. A total of 18 application were reviewed, totaling $44.7M, and 12 were approved for award totaling $37.2M in Reclamation funding. Nine new projects were selected for Basinwide funding totaling $33.9M. Eight projects have been awarded for $32.2 and will be detailed below. One Basinwide potential project, for 1.7M, has been placed on hold pending improvement and progress on an existing awarded project.

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 for $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 began construction in the fall of 2020 and is scheduled to be completed in the spring of 2023.

Gunnison Basin, Colorado

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 began in 2018. The pipeline was completed in the spring of 2020, and the habitat mitigation was completed in the summer of 2020. The Crawford Clipper Ditch Company requested and was granted a modification to use the remaining funds to pipe 2400 ft of the Clipper West lateral, to be completed by Spring 2021.

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 began in 2018. It was 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 began in January 2019 and was completed in 2020.

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 began in the fall of 2018 and the first phase was completed. The second phase was 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 began in 2018 and the first and second phases of the project was completed. The last phase of the project will continue to 2021.

Gould Canal Improvement Project A: Selected under the 2017 FOA, Gould Canal A was awarded a $4,294,027 cooperative grant for four stages of work. "Section 1" will be piping approximately 1.17 miles of existing open earth irrigation canal with buried HP Storm or similar pipe. "Upper Tunnel" consists of slip liner construction for the upper tunnel. "Section 3" includes lining approximately 1.41 miles of unlined canal with 30 mil PVC membrane with shotcrete cover. "Section 4" consists of lining approximately 0.76 miles of unlined canal downstream of Section 3 using the same method. All four section will be responsible for controlling approximately 3,137 tons of salt annually. Fruitland Irrigation Company requested and received a modification to change a portion of sections 3 and 4 from a lined canal to a pipeline. Construction of the pipeline is scheduled to begin in the fall of 2020. The project is expected to be completed by the spring of 2023.

Gould Canal Improvement Project B: Selected under the 2017 FOA, Gould Canal B was awarded a $3,545,246 cooperative grant for three stages of work. "Lower Tunnel" consists of slip liner construction for the lower tunnel. Section 2 includes lining approximately 2.10 miles of unlined irrigation canal with 30 mil PVC membrane with shotcrete cover. Section 5 consists of lining roughly 2.30 miles of unlined canal using the same methods as Section 2. These improvements will control 2,564 tons of salt annually. Fruitland Irrigation Company requested and received a modification to change a portion of section 2 from a lined canal to a pipeline. Construction of the pipeline is scheduled to begin in the fall of 2020. The project is expected to be completed by the spring of 2023.

Upper Stewart Ditch: Selected in the 2017 FOA, the Upper Stewart project near Paonia, CO, was selected to be awarded a $2,507,561 cooperative agreement for piping approximately 2.6 miles of existing earthen irrigation canal. The pipe will consist of buried PVC pipe. This project will control 1,622 tons of salt annually with 20 acres of potential on farm improvements. Construction is scheduled to begin in November 2020 and expected to be completed by the end of April 2021.

Needle Rock Ditch: Selected in the 2019 FOA, the Needle Rock Ditch Piping Project near Crawford, CO, was selected to be awarded a $4,238,228 cooperative agreement for piping approximately 6.7 miles of existing earthen irrigation canals and laterals. The pipeline will consist of buried PVC pipe. This project will control 2,952 tons of salt annually. Construction is scheduled to begin in November 2021 and expected to be completed by the end of April 2023.

Tuner/Lone Cabin Ditch: Selected in the 2019 FOA, the Turner and Lone Cabin Ditch project near Paonia, CO, was selected to be awarded a $6,195,859 cooperative agreement for piping approximately 25 miles of existing earthen irrigation canals and laterals. The pipe will consist of buried pipe. This project will control 3,398 tons of salt annually. Construction is scheduled to begin in November 2021 and expected to be completed by December 2022.

Grand Valley, Colorado

Grand Valley Irrigation Company (GVIC) 550 Salinity Control Program: Selected under the 2019 FOA, the GVIC was awarded a $1.2 million cooperative grant to line approximately 1.0

mile of their main irrigation canal within the Grand Valley. This will result in a salt load reduction of approximately 743 tons annually at a cost effectiveness of $62.70 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 July 2020. Construction is scheduled to begin on November 2021 and completed in March 2024.

Grand Valley Water Users Association (GVWUA) Government Highline Canal – Reach 1A Lower: Selected under the 2019 FOA, the GVWUA was awarded a $476 million cooperative grant to line approximately 1.2 miles of their main irrigation canal within the Grand Valley. This will result in a salt load reduction of approximately 3,083 tons annually at a cost effectiveness of $57.75 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 June 2020, and construction began in November of 2020. And is scheduled to be completed by March 2024.

Mancos, Colorado

Webber Ditch Piping Project: Selected under the 2019 FOA, the Webber Ditch Company was awarded a $3.3 million cooperative grant for piping approximately 4.24 miles of existing earthen irrigation canal. The pipeline will consist of buried PVC pipe. This will result in a salt load reduction of approximately 2,066 tons annually at a cost effectiveness of $59.99 per ton. The cooperative agreement was executed in July 2020. Construction is scheduled to begin in November 2020 and to be completed in April 2024.

NEW MEXICO

San Juan Dineh Water Users –

Selected in the 2015 FOA, Reclamation's Upper Colorado Region's Salinity Control Program entered into a cooperative agreement with the San Juan River Dineh Water Users (SWDWU) for $4,835,391 controlling 4,381 tons of salt annual, with a cost effectiveness of $46.00. The SJRDWU's proposal, replacing earthen ditches and canals with enclosed piping and habitat replacement, will reduce the salt load of the Colorado River above Imperial Dam. The water user's proposal plans on converting fifteen secondary laterals into underground pressurized pipelines.

The project will be divided into two areas. The first area located in Shiprock Chapter is served by Hogback Canal and located west of the Hogback monocline. The 26-mile-long Hogback Canal diverts from the San Juan River at the Hogback Diversion and serves 8,830 acres. The project will convert 14 ditches into underground pressurized pipeline serving approximately 240 farmers on 2,077 acres. The total length of the new pipeline is 156,246 ft.

The second area located in Nenahnezad Chapter is served by Fruitland Canal and located east of Hogback monocline. The 22-mile-long Fruitland Canal diverts water from the San Juan River at Fruitland Diversion and serves 2,2224 acres. The project will convert Yellowman Lateral from an earthen ditch into an underground pipeline. Yellowman Lateral serves about 35 farmers on 386 acres. The total length of the new pipeline is approximately 26,671 ft.

Overall, the two sub-projects in Shiprock and Nenahnezad Chapters will total 2,463 acres and convert 182,917 feet of open ditches into underground pressurized pipelines.

San Juan Dineh Water Users – Shiprock Later Conversion Phase II

Selected in the 2019 FOA, a cooperative agreement with the San Juan Dineh Water Users in the amount of $1.2M has been awarded that will control 751 tons of salt annually with a cost effectiveness of $60.64 per ton. The proposed project is to convert 15 laterals from earthen ditches into underground pressurized pipelines and to convert two sections of the Hogback Canal into a pipeline resulting in the elimination of a sluiceway that discharges flow back to the San Juan River via an artificial earthen channel. Overall, the proposed project will convert 6,393 ft of main canal into a pipeline, 47,110 ft of earthen laterals into underground pressurized pipeline, and eliminate a 2,770 ft of earthen sluiceway channel. Total areas served by the proposed project is 1,405 acres.

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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 and replace their diversion structure. 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.

The Antelope and North Laterals Salinity Project was completed during the 2019-2020 winter construction period. Completion of the diversion structure allows the efficient measurement and delivery of irrigation water to the Antelope and North lateral water users. The system is now complete and functioning. All funds were expended.

Rock Point Irrigation Company started construction on their system the fall of 2018 and continued construction through the fall of 2019. The construction was slowed because of weather and substantial completion was delayed until the summer of 2019. There has also been issues with pipe and joint failures which have been repaired. Currently there is an issue with the canal company and contractor to complete project cleanup. Completion of this project is anticipated the fall or early winter of 2020.

UDAF, at the direction of the Advisory Council and Reclamation, continues to employ the Uintah basin salinity coordinator using BSP funds. The work of the coordinator has benefited the salinity control program by creating interest and participation in the program. Because of the competitive nature of the FOA process and minimal salt loading in some of the salinity project areas, other funding has been necessary to reduce the cost per ton. The Coordinator has been effective in finding local funding from diverse sources to help fund projects. This has been a challenge to bring diverse funding sources together and make them fit into the salinity control program. The coordinator has also spoken to this issue at the forum meetings and other meetings in Utah. UDAF feels that using BSP funds for this position has greatly benefited the salinity control program in the Uintah Basin area and other salinity control areas.

<u>Colorado Department of Agriculture - Colorado State Conservation Board (CSCB)</u>

The Colorado Department of Agriculture continues to employ a full-time salinity program field coordinator. His position is funded by the Basin States Program. This makes it possible for the State of Colorado to give input on salinity projects and work that is going on in the state. The salinity coordinator assisted 15 Colorado applicants in the 2019 Reclamation salinity grant cycle (FOA). Ten of these applicants have received notice of award from Reclamation.

The coordinator has now begun working with potential applicants for the next FOA. He helped two potential applicants interact with the Delta Conservation District (DCD). They have secured DCD administered funds to conduct feasibility studies. The studies are expected to help the potential applicants decide whether or not to apply in the next FOA.

The coordinator has also been responding to a wide variety of other inquiries concerning irrigation improvements. Some of the proposed projects may be candidates for the next Reclamation salinity FOA. Others may be a better fit for NRCS funding or other sources of funding. The coordinator tries to engage at least briefly with all who seek his assistance, knowing that doing so creates a good reputation for his position. This reputation may yield more FOA applications in the long run.

The coordinator has been extensively involved in helping Lateral Ditch ML47, one of the remaining BSP passoff projects. He has coached the leadership though the process of applying for a construction loan and a supplemental grant from the Colorado Water Conservation Board. He has assisted the company leadership with other project management skills. Construction of the project is expected to start in November 2020.

The Coronavirus has restricted the coordinator’s travel for the past several months. This has decreased his ability to promote interest in the next Reclamation salinity FOA. However, his travel restrictions are beginning to ease, and he has been able to resume making site visits in some cases.

Progress: BSP Projects:

The following BSP projects are currently being administered by the Colorado Department of Agriculture and conservation districts.

Lateral Ditch ML47 Grand Valley Salinity Project Area ($537,950). The NEPA and design work are completed. The project is expected to start construction in November 2020.

Ward B. Studt Headgate 275 Grand Valley Salinity Project Area ($85,875). The NEPA and design work are completed. The project is available to go to construction in the fall of 2020, but it is unclear if the owners will do so.

Wyoming Water Development Commission (WWDC)

In August 2015, a BSP agreement was put in place with the WWDC that ended September 30, 2020. The agreement had a value of $2,800,000 for construction and salinity studies in Wyoming. Projects were either 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 administered the construction and study components of the Wyoming BSP program.

Progress: BSP Projects:

Eden Valley, Farson/Eden Pipeline Project:

The WWDC has completed one BSP project that came through Reclamation's 2015 FOA process. The project was a canal to pipeline conversion project with the Eden Valley Irrigation and Drainage District (EVIDD). The project converted 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 original project budget was $4,390,413 with funding provided by the WWDC of $2,366,000 and the WY BSP of $2,024,413. It was discovered that the project needed additional funding of $910,000. WWDC has provided EVIDD an additional grant of $700,000 and a loan of $210,000 for an updated project budget of $5,100,413. The project resulted in salt control of 1,619 tons and a cost effectiveness of $52.11/ton. The project was designed, secured the necessary permits, bid and the project awarded by the summer of 2019. The project started construction in the fall of 2019 and was completed by the 2020 irrigation season. The project pipeline connected to a pipeline project completed by Reclamation through the use of MOA funds. The final actual expenditures were; WWDC $2,839,861.93, WY BSP $1,970,954.05 for a total expenditure of $4,810,815.98.

Reclamation

Funding Opportunity Announcement (FOA) 2019

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 May 31, 2019 and closed on September 20, 2019.

The Application Review Committee met October 9-11, 2019 to evaluate the submitted proposals. A total of 18 application were reviewed, totaling $44.7M, and 12 were approved for award totaling $37.2M in Reclamation funding. Three new projects were selected for Basin State program funding totaling $4.9M and are listed below.
In the **2017 FOA**, 4 projects were selected and are being administered by Reclamation.

Muddy Creek Irrigation Company Piping Project Phase III: This project was selected from the 2017 FOA. A cooperative agreement was executed in September 2018 for the amount of $4,583,000. This project, located in Emery County, will replace approximately 37.5 miles of earthen canals with a pressurized pipeline system resulting in the annual reduction of 3,010 reportable tons of salt in the Colorado River, and enabling 3,310 acres of potential on-farm work. This project is in the pre-construction phase with construction expected to begin in the fall of 2020.

Root and Ratliff Salinity Pipeline Project: Selected in the 2017 FOA, the Root & Ratliff ditch Company was awarded a $3.6 million cooperative agreement to pipe approximately 5.5 miles of their main irrigation canal, located near Mancos, Colorado. This will result in a salt load reduction of approximately 2,347 tons annually at a cost effectiveness of $58.21 per ton. Construction is scheduled to begin in the winter of 2020 and the project is expected to be completed by the spring of 2022.

Shinn Park/Waterdog Lateral Salinity Reduction Project: Selected in the 2017 FOA, the Bostwick Park Water Conservancy District was awarded a $4.1 million cooperative agreement to pipe approximately

7.8 miles of unlined irrigation canals, located near Montrose, Colorado. This will result in a salt load reduction of approximately 3,304 tons annually at a cost effectiveness of $47.51 per ton. Construction is scheduled to begin in the fall of 2019 and the project is expected to be completed by the spring of 2021.

Jerdan, West, Hamilton Laterals Pipeline Project: Selected in the 2017 FOA, the Crawford Clipper Ditch Company near Crawford, CO, was selected to be awarded a $3,997,208.60 cooperative agreement for piping approximately 6.7 miles of existing earthen irrigation canal. The pipe will consist of buried PVC pipe. This project will control 2,584 tons of salt annually with 20 acres of potential on farm improvements. Construction is scheduled to begin in November 2021 and expected to be completed by the end of April 2022.

In the **2019 FOA**, 3 projects were selected and are being administered by Reclamation.

Interstate Canal Salinity Reduction project: This project was selected from the 2019 FOA. A cooperative agreement was executed in September 2020 for the amount of $5,284,119. This project, located in Southwestern WY, adjacent to the WY-UT border near McKinnon, WY, will replace approximately 13.1 miles of an unlined earthen canal with a pressurized HDPE pipeline system resulting in the annual reduction of 2,295 reportable tons of salt in the Colorado River. This project is in the pre-construction phase with construction expected to begin in the Spring/Summer of 2021.

Pilot Rock Ditch Piping Project: This project was selected from the 2019 FOA. A cooperative agreement was executed in June 2020 for $940,401. This project, located near Crawford CO. The Pilot Rock Ditch company will replace approximately 1.5 miles of an unlined earthen canal with a pressurized pipeline system resulting in the annual reduction of 665 reportable tons of salt in the Colorado River. This project is in the pre-construction phase with construction expected to begin in the Spring/Summer of 2021.

Short Ditch Extension Piping: This project was selected from the 2019 FOA. A cooperative agreement was executed in July 2020 for $548,687. This project, located near Hotchkiss CO. The Short Ditch Extension Company will replace approximately 1.1 miles of an unlined earthen canal with a pressurized pipeline system resulting in the annual reduction of 419 reportable tons of salt in the Colorado River. This project is in the pre-construction phase with construction expected to begin in the Fall of 2021.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Appropriations and Cost Share from the Basin Funds 1996 thru 2020 and Original Unit Costs

2/22/2021

TOTAL PROGRAM ($1,000)

Unit	1996 to 2014	Unit Cost	2015	2016	2017	2018	2019	2020	Subtotal	2021	2022	2023
Grand Valley O&M	$ 23,372	$ 233,901	$ 2,247	$ 2,312	$ 1,488	$ 1,704	$ 1,596	$ 2,463	$ 275,552	$ 2,800	$ 2,667	$ 2,316
Paradox Valley O&M	$ 48,485	$ 95,740	$ 3,575	$ 4,977	$ 4,439	$ 3,833	$ 5,655	$ 3,803	$ 186,842	$ 5,333	$ 5,333	$ 4,003
Lower Gunnison O&M	$ 2,093	$ 40,386	$ -	$ -	$ -	$ -	$ -		$ 42,479	$ -	$ -	$ -
McElmo Creek (Dolores) O&M	$ 8,851	$ 63,126	$ 576	$ 459	$ 620	$ 481	$ 980	$ 807	$ 78,346	$ 717	$ 717	$ 571
USBR Basinwide Program	$ 237,891	$ -	$ 10,419	$ 13,416	$ 12,210	$ 15,547	$ 11,973	$ 14,721	$ 367,716	$ 8,571	$ 8,571	$ 8,571
Subtotal (USBR Program)	**$ 320,693**	**$ 433,153**	**$ 16,816**	**$ 21,164**	**$ 18,757**	**$ 21,566**	**$ 20,204**	**$ 21,794**	**$ 946,092**	**$ 17,422**	**$ 17,289**	**$ 15,462**
USDA Program	$ 329,753	$ -	$ 21,751	$ 16,844	$ 21,884	$ 24,403	$ 23,548	$ 15,283	$ 551,109	$ 16,488	$ 16,408	$ 15,848
BLM (no Basin Funds)	$ 801	$ -	$ 800	$ 800	$ 800	$ 800	$ 800	$ 800	$ 8,001	$ 800	$ 800	$ 800
Total	$ 651,247	$ 433,153	$ 39,367	$ 38,808	$ 41,441	$ 46,769	$ 44,552	$ 37,877	$ 1,505,202	$ 34,710	$ 34,497	$ 32,110

APPROPRIATIONS EXPENDED ($1,000)

Unit	1996 to 2014	Unit Cost	2015	2016	2017	2018	2019	2020	Subtotal	2021	2022	2023
Grand Valley O&M	$ 17,529	$ 175,426	$ 1,685	$ 1,734	$ 1,116	$ 1,278	$ 1,197	$ 1,848	$ 207,123	$ 2,100	$ 2,000	$ 1,737
Paradox Valley O&M	$ 36,364	$ 71,805	$ 2,681	$ 3,733	$ 3,329	$ 2,875	$ 4,241	$ 2,853	$ 140,845	$ 4,000	$ 4,000	$ 3,002
Lower Gunnison O&M	$ 1,465	$ 28,270	$ -	$ -	$ -	$ -	$ -		$ 29,735	$ -	$ -	$ -
McElmo Creek (Dolores) O&M	$ 6,196	$ 44,188	$ 403	$ 321	$ 434	$ 337	$ 686	$ 565	$ 55,012	$ 502	$ 502	$ 400
USBR Basinwide Program	$ 166,524	$ -	$ 7,293	$ 9,391	$ 8,547	$ 10,883	$ 8,381	$ 10,305	$ 260,493	$ 6,000	$ 6,000	$ 6,000
Subtotal (USBR Program)	$ 228,078	$ 319,689	$ 12,062	$ 15,179	$ 13,426	$ 15,373	$ 14,505	$ 15,571	$ 693,208	$ 12,602	$ 12,502	$ 11,139
USDA Program	$ 230,827	$ -	$ 15,226	$ 11,791	$ 15,319	$ 17,082	$ 16,319	$ 12,974	$ 393,830	$ 12,440	$ 12,383	$ 11,857
Total	$ 458,905	$ 319,689	$ 27,288	$ 26,970	$ 28,745	$ 32,455	$ 30,824	$ 28,545	$ 1,087,038	$ 25,042	$ 24,885	$ 22,996

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

Unit	1996 to 2014	Unit Cost	2015	2016	2017	2018	2019	2020	Subtotal	2021	2022	2023
Grand Valley O&M	$ 876	$ 8,771	$ 84	$ 87	$ 56	$ 64	$ 60	$ 92	$ 10,264	$ 105	$ 100	$ 87
Paradox Valley O&M	$ 1,818	$ 3,590	$ 134	$ 187	$ 166	$ 144	$ 212	$ 142	$ 6,900	$ 200	$ 200	$ 150
Lower Gunnison O&M	$ 94	$ 1,817	$ -	$ -	$ -	$ -	$ -		$ 1,912	$ -	$ -	$ -
McElmo Creek (Dolores) O&M	$ 398	$ 2,841	$ 26	$ 21	$ 28	$ 22	$ 44	$ 36	$ 3,500	$ 32	$ 32	$ 26
USBR Basinwide Program	$ 10,705	$ -	$ 469	$ 604	$ 549	$ 700	$ 539	$ 662	$ 16,084	$ 386	$ 386	$ 386
Subtotal (USBR Program)	$ 13,892	$ 17,020	$ 713	$ 898	$ 800	$ 929	$ 855	$ 932	$ 38,659	$ 723	$ 718	$ 648
USDA Program	$ 14,839	$ -	$ 979	$ 758	$ 985	$ 1,098	$ 1,049	$ 1,052	$ 24,484	$ 800	$ 796	$ 762
Total	$ 28,731	$ 17,020	$ 1,692	$ 1,656	$ 1,784	$ 2,027	$ 1,904	$ 1,984	$ 63,142	$ 1,523	$ 1,514	$ 1,411

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

Unit	1996 to 2014	Unit Cost	2015	2016	2017	2018	2019	2020	Subtotal	2021	2022	2023
Grand Valley O&M	$ 4,967	$ 49,704	$ 477	$ 491	$ 316	$ 362	$ 339	$ 523	$ 58,165	$ 595	$ 567	$ 492
Paradox Valley O&M	$ 10,303	$ 20,345	$ 760	$ 1,058	$ 943	$ 815	$ 1,202	$ 808	$ 39,098	$ 1,133	$ 1,133	$ 851
Lower Gunnison O&M	$ 534	$ 10,298	$ -	$ -	$ -	$ -	$ -		$ 10,832	$ -	$ -	$ -
McElmo Creek (Dolores) O&M	$ 2,257	$ 16,097	$ 147	$ 117	$ 158	$ 123	$ 250	$ 206	$ 19,834	$ 183	$ 183	$ 146
USBR Basinwide Program	$ 60,662	$ -	$ 2,657	$ 3,421	$ 3,114	$ 3,965	$ 3,053	$ 3,754	$ 91,140	$ 2,186	$ 2,186	$ 2,186
Subtotal (USBR Program)	**$ 78,723**	**$ 96,444**	**$ 4,041**	**$ 5,087**	**$ 4,531**	**$ 5,264**	**$ 4,844**	**$ 5,291**	**$ 214,225**	**$ 4,097**	**$ 4,069**	**$ 3,674**
USDA Program	$ 84,087	$ -	$ 5,547	$ 4,295	$ 5,580	$ 6,223	$ 6,180	$ 1,257	$ 132,796	$ 3,248	$ 3,229	$ 3,229
Total	**$ 162,810**	**$ 96,444**	**$ 9,587**	**$ 9,382**	**$ 10,112**	**$ 11,487**	**$ 11,024**	**$ 6,548**	**$ 347,021**	**$ 7,345**	**$ 7,298**	**$ 6,903**

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II
Lower Colorado River Basin Development Fund
Last Revised: 01/22/2021

				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**	**Yearly Accrual**	**Actual**	**Accrual**	**Net**
1996	$ 9,644,684	$ 5,988,526	$ 1,701,433	$ -	$ -	$ 1,701,433	$ 22,546,304	$ (1,701,433)	$ 20,844,871
1997	$ 9,172,879	$ 9,266,475	$ 3,161,340	$ 3,552,000	$ -	$ (390,660)	$ 25,264,033	$ (1,310,774)	$ 23,953,259
1998	$ 10,398,524	$ 16,033,855	$ 5,530,283	$ 4,887,000	$ -	$ 643,283	$ 26,962,764	$ (1,954,056)	$ 25,008,707
1999	$ 10,908,408	$ 21,132,654	$ 7,486,919	$ 6,215,000	$ -	$ 1,271,919	$ 29,745,832	$ (3,225,975)	$ 26,519,857
2000	$ 10,410,325	$ 21,125,130	$ 7,427,599	$ 13,783,000	$ -	$ (6,355,401)	$ 25,338,182	$ 3,129,426	$ 28,467,608
2001	$ 10,255,846	$ 19,786,891	$ 6,998,228	$ 1,100,000	$ -	$ 5,898,228	$ 33,459,054	$ (2,768,802)	$ 30,690,251
2002	$ 8,674,271	$ 25,277,789	$ 8,970,903	$ 6,966,000	$ -	$ 2,004,903	$ 34,137,352	$ (4,773,705)	$ 29,363,647
2003	$ 8,202,777	$ 24,093,372	$ 8,588,644	$ 10,885,000	$ -	$ (2,296,356)	$ 30,422,655	$ (2,477,350)	$ 27,945,305
2004	$ 8,307,425	$ 32,068,003	$ 11,478,096	$ 11,104,000	$ -	$ 374,096	$ 26,593,606	$ (2,851,446)	$ 23,742,161
2005	$ 7,149,125	$ 30,853,131	$ 11,033,011	$ 6,581,000	$ -	$ 4,452,011	$ 26,129,258	$ (7,303,457)	$ 18,825,801
2006	$ 9,636,337	$ 31,458,415	$ 11,238,554	$ 12,399,000	$ -	$ (1,160,446)	$ 18,464,691	$ (6,143,010)	$ 12,321,680
2007	$ 9,426,624	$ 30,737,896	$ 10,956,182	$ 11,544,000	$ -	$ (587,818)	$ 15,567,410	$ (5,555,193)	$ 10,012,217
2008	$ 9,321,072	$ 27,895,702	$ 9,873,866	$ 10,336,000	$ -	$ (462,134)	$ 14,132,889	$ (5,093,059)	$ 9,039,830
2009	$ 9,122,008	$ 37,702,415	$ 13,438,248	$ -	$ -	$ 13,438,248	$ 22,257,725	$ (18,531,307)	$ 3,726,418
2010	$ 8,721,327	$ 25,349,378	$ 8,943,887	$ 5,475,213	$ -	$ 3,468,674	$ 24,506,667	$ (21,999,981)	$ 2,506,686
2011	$ 9,439,846	$ 28,994,153	$ 10,256,560	$ 14,237,779	$ -	$ (3,981,219)	$ 18,711,562	$ (18,018,762)	$ 692,800
2012	$ 9,707,216	$ 27,512,563	$ 9,747,705	$ 13,015,306	$ -	$ (3,267,601)	$ 14,406,300	$ (14,751,161)	$ (344,861)
2013	$ 9,219,567	$ 25,903,460	$ 9,154,800	$ 12,461,662	$ -	$ (3,306,862)	$ 10,167,033	$ (11,444,299)	$ (1,277,266)
2014	$ 9,410,192	$ 25,884,234	$ 9,101,723	$ 8,139,052	$ -	$ 962,671	$ 11,438,173	$ (12,406,970)	$ (968,797)
2015	$ 8,127,546	$ 27,288,103	$ 9,587,195	$ 8,331,242	$ -	$ 1,255,953	$ 11,234,477	$ (13,662,923)	$ (2,428,446)
2016	$ 8,836,212	$ 26,969,736	$ 9,382,164	$ 11,053,052	$ -	$ (1,670,888)	$ 9,017,639	$ (11,992,035)	$ (2,974,396)
2017	$ 8,778,914	$ 28,745,500	$ 10,111,716	$ 9,898,008	$ -	$ 213,708	$ 7,898,545	$ (12,206,243)	$ (4,307,698)
2018	$ 8,102,217	$ 33,387,867	$ 11,768,388	$ 10,619,287	$ -	$ 1,149,101	$ 5,381,475	$ (13,355,343)	$ (7,973,868)
2019	$ 8,379,340	$ 30,825,411	$ 10,789,018	$ 11,024,534	$ -	$ (235,516)	$ 2,736,281	$ (13,119,833)	$ (10,383,552)
2020	$ 8,057,945	$ 31,950,697	$ 11,258,521	$ 6,550,011	$ -	$ 4,708,510	$ 4,244,215	$ (17,828,343)	$ (13,584,128)
2021	$ 8,318,690	$ 29,109,204	$ 9,821,986	$ 12,395,669	$ -	$ (2,573,683)	$ 167,236	$ (15,254,660)	$ (15,087,424)
2022	$ 8,248,042	$ 25,840,000	$ 8,846,476	$ 8,273,091	$ -	$ 573,385	$ 142,187	$ (15,828,045)	$ (15,685,858)
2023	$ 8,261,777	$ 25,783,000	$ 8,825,712	$ 8,286,826	$ -	$ 538,886	$ 117,138	$ (16,366,930)	$ (16,249,793)
2024	$ 8,209,614	$ 25,257,500	$ 8,634,280	$ 8,234,663	$ -	$ 399,617	$ 92,088	$ (16,766,547)	$ (16,674,459)
2025	$ 8,173,438	$ 26,400,000	$ 9,050,476	$ 8,198,487	$ -	$ 851,989	$ 67,039	$ (17,618,536)	$ (17,551,497)
2026	$ 8,285,734	$ 25,400,000	$ 8,686,190	$ 8,310,783	$ -	$ 375,407	$ 41,990	$ (17,993,944)	$ (17,951,954)
2027	$ 8,325,984	$ 25,400,000	$ 8,686,190	$ 8,351,033	$ -	$ 335,157	$ 16,941	$ (18,329,101)	$ (18,312,160)
2028	$ 8,257,532	$ 25,400,000	$ 8,686,190	$ 8,282,581	$ -	$ 403,609	$ (8,108)	$ (18,732,710)	$ (18,740,818)
2029	$ 8,220,077	$ 21,952,000	$ 7,547,352	$ 8,245,126	$ -	$ (697,774)	$ (33,157)	$ (18,034,937)	$ (18,068,094)
2030	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 141,794	$ (17,582,289)	$ (17,440,495)
2031	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 316,744	$ (17,129,641)	$ (16,812,897)
2032	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 491,695	$ (16,676,994)	$ (16,185,298)
2033	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 666,646	$ (16,224,346)	$ (15,557,700)
2034	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 841,597	$ (15,771,698)	$ (14,930,102)
2035	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 1,016,548	$ (15,319,051)	$ (14,302,503)
2036	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 8,000,000	$ -	$ (452,648)	$ 1,191,499	$ (14,866,403)	$ (13,674,905)
2037	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 7,000,000	$ -	$ 547,352	$ 2,366,449	$ (15,413,756)	$ (13,047,306)
2038	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 7,000,000	$ -	$ 547,352	$ 3,541,400	$ (15,961,108)	$ (12,419,708)
2039	$ 8,174,951	$ 21,952,000	$ 7,547,352	$ 7,000,000	$ 4,830,251	$ 547,352	$ (113,900)	$ (16,508,460)	$ (16,622,360)
2040	$ 8,174,951	$ 19,952,000	$ 6,818,781	$ 7,000,000	$ -	$ (181,219)	$ 1,061,051	$ (16,327,241)	$ (15,266,190)
2041	$ 8,174,951	$ 19,952,000	$ 6,818,781	$ 7,000,000	$ -	$ (181,219)	$ 2,236,002	$ (16,146,022)	$ (13,910,020)
2042	$ 8,174,951	$ 19,952,000	$ 6,818,781	$ 7,000,000	$ 1,969,764	$ (181,219)	$ 1,441,189	$ (15,964,803)	$ (14,523,615)
2043	$ 8,174,951	$ 19,952,000	$ 6,818,781	$ 7,000,000	$ 897,906	$ (181,219)	$ 1,718,233	$ (15,783,584)	$ (14,065,351)
2044	$ 11,474,951	$ 19,952,000	$ 6,818,781	$ 13,000,000	$ -	$ (6,181,219)	$ 193,184	$ (9,602,365)	$ (9,409,181)
2045	$ 11,474,951	$ 19,952,000	$ 6,818,781	$ 10,000,000	$ -	$ (3,181,219)	$ 1,668,135	$ (6,421,146)	$ (4,753,011)
2046	$ 11,474,951	$ 19,952,000	$ 6,818,781	$ 6,000,000	$ 6,070,071	$ 818,781	$ 1,073,015	$ (7,239,927)	$ (6,166,912)
2047	$ 11,474,951	$ 19,952,000	$ 6,818,781	$ 5,500,000	$ 7,193,470	$ 1,318,781	$ (145,504)	$ (8,558,708)	$ (8,704,212)
2048	$ 11,474,951	$ 19,952,000	$ 6,818,781	$ 6,000,000	$ 3,684,171	$ 818,781	$ 1,645,276	$ (9,377,489)	$ (7,732,213)
	$ 288,279,582	**$ 781,508,915**	**$ 268,937,212**		**$ 24,645,633**				

Last Revised: 01/22/2021

LOWER BASIN DEVELOPMENT FUND

Year	Projected Revenues	Total Lower Basin Fund Transfer	Basinwide and O&M Cost Share	Basin States Program - Based on NRCS EQIP Expenditures	Balance in LCRBDF	Accrual Amount
1996	$ 9,644,684	$ -	$ -	$ -	$ 22,546,304	$ (1,701,433)
1997	$ 9,172,879	$ 3,552,000	$ 1,260,861	$ 2,291,139	$ 25,264,033	$ (1,310,774)
1998	$ 10,398,524	$ 4,887,000	$ 3,996,311	$ 890,689	$ 26,962,764	$ (1,954,056)
1999	$ 10,908,408	$ 6,215,000	$ 5,414,671	$ 800,329	$ 29,745,832	$ (3,225,975)
2000	$ 10,410,325	$ 13,783,000	$ 5,420,378	$ 8,362,622	$ 25,338,182	$ 3,129,426
2001	$ 10,255,846	$ 1,100,000	$ 4,776,444	$ (3,676,444)	$ 33,459,054	$ (2,768,802)
2002	$ 8,674,271	$ 6,966,000	$ 5,101,075	$ 1,864,925	$ 34,137,352	$ (4,773,705)
2003	$ 8,202,777	$ 10,885,000	$ 3,903,222	$ 6,981,778	$ 30,422,655	$ (2,477,350)
2004	$ 8,307,425	$ 11,104,000	$ 4,314,795	$ 6,789,205	$ 26,593,606	$ (2,851,446)
2005	$ 7,149,125	$ 6,581,000	$ 3,883,882	$ 2,697,118	$ 26,129,258	$ (7,303,457)
2006	$ 9,636,337	$ 12,399,000	$ 4,049,059	$ 8,349,941	$ 18,464,691	$ (6,143,010)
2007	$ 9,426,624	$ 11,544,000	$ 4,207,261	$ 7,336,739	$ 15,567,410	$ (5,555,193)
2008	$ 9,321,072	$ 10,336,000	$ 4,059,162	$ 6,276,838	$ 14,132,889	$ (5,093,059)
2009	$ 9,122,008	$ -	$ 7,485,238	$ (7,485,238)	$ 22,257,725	$ (18,531,307)
2010	$ 8,721,327	$ 5,475,213	$ 3,631,338	$ 1,843,875	$ 24,506,667	$ (21,999,981)
2011	$ 9,439,846	$ 14,237,779	$ 4,289,132	$ 9,948,647	$ 18,711,562	$ (18,018,762)
2012	$ 9,707,216	$ 13,015,306	$ 4,106,774	$ 8,908,532	$ 14,406,300	$ (14,751,161)
2013	$ 9,219,567	$ 12,461,662	$ 4,290,189	$ 8,171,473	$ 10,167,033	$ (11,444,299)
2014	$ 9,410,192	$ 8,139,052	$ 3,823,867	$ 4,315,185	$ 11,438,173	$ (12,406,970)
2015	$ 8,127,546	$ 8,331,242	$ 4,040,402	$ 4,290,840	$ 11,234,477	$ (13,662,923)
2016	$ 8,836,212	$ 11,053,052	$ 5,194,471	$ 5,858,581	$ 9,017,639	$ (11,992,035)
2017	$ 8,778,914	$ 9,898,008	$ 5,204,443	$ 4,693,565	$ 7,898,545	$ (12,206,243)
2018	$ 8,102,217	$ 10,619,287	$ 5,350,247	$ 5,269,040	$ 5,381,475	$ (13,355,343)
2019	$ 8,379,340	$ 11,024,534	$ 4,843,985	$ 6,180,549	$ 2,736,281	$ (13,119,839)
2020	$ 8,057,945	$ 6,550,011	$ 5,292,512	$ 1,257,502	$ 4,244,215	$ (17,828,343)
2021	$ 8,318,690	$ 12,395,669	$ 5,095,669	$ 7,300,000	$ 167,236	$ (15,254,660)
2022	$ 8,248,042	$ 8,273,091	$ 4,314,762	$ 3,958,330	$ 142,187	$ (15,828,045)
2023	$ 8,261,777	$ 8,286,826	$ 4,314,762	$ 3,972,064	$ 117,138	$ (16,366,930)
3 years	$ 16,509,819	$ 27,218,771	$ 14,702,943	$ 12,515,832		

Colorado River Basin Salinity Control Program
Federal Appropriations - Actual/Projected
Last Revised: 01/22/2021

	NRCS - EQIP FA + TA	Basinwide Program	O&M Paradox	O&M Lower Gunn	O&M Grand Valley	O&M Dolores -McElmo Creek	
1996	$ -	$ 500,000	$ 299,816	$ (442,137)	$ 5,630,847	$ -	$ 5,988,526
1997	$ 3,152,673	$ 3,461,188	$ (75,470)	$ 5,329	$ 2,722,755	$ -	$ 9,266,475
1998	$ 3,812,346	$ 7,580,863	$ 1,315,028	$ 398,556	$ 2,522,062	$ 405,000	$ 16,033,855
1999	$ 5,421,047	$ 12,499,405	$ 1,611,223	$ 267,475	$ 1,000,254	$ 333,250	$ 21,132,654
2000	$ 5,190,926	$ 12,027,564	$ 2,450,454	$ 319,096	$ 859,933	$ 277,157	$ 21,125,130
2001	$ 5,784,771	$ 10,789,008	$ 2,083,843	$ 314,247	$ 508,469	$ 306,553	$ 19,786,891
2002	$ 10,451,248	$ 11,490,267	$ 1,944,972	$ 171,808	$ 988,040	$ 231,454	$ 25,277,789
2003	$ 12,864,440	$ 8,544,172	$ 1,467,511	$ (2,497)	$ 857,645	$ 362,101	$ 24,093,372
2004	$ 19,665,355	$ 9,546,243	$ 1,775,762	$ (1,390)	$ 742,009	$ 340,024	$ 32,068,003
2005	$ 19,627,357	$ 8,243,630	$ 1,901,777	$ (2,300)	$ 647,173	$ 435,494	$ 30,853,131
2006	$ 19,735,870	$ 8,472,335	$ 1,816,440	$ -	$ 917,236	$ 516,534	$ 31,458,415
2007	$ 18,526,454	$ 8,939,411	$ 1,974,435	$ -	$ 1,005,020	$ 292,576	$ 30,737,896
2008	$ 15,961,928	$ 7,983,675	$ 2,715,716	$ -	$ 843,661	$ 390,722	$ 27,895,702
2009	$ 16,341,604	$ 17,280,191	$ 2,340,587	$ -	$ 1,318,389	$ 421,644	$ 37,702,415
2010	$ 14,583,462	$ 6,704,185	$ 2,823,333	$ -	$ 765,563	$ 472,835	$ 25,349,378
2011	$ 16,381,998	$ 8,493,155	$ 2,745,000	$ -	$ 1,030,000	$ 344,000	$ 28,994,153
2012	$ 15,484,907	$ 8,298,067	$ 2,427,000	$ -	$ 966,707	$ 335,882	$ 27,512,563
2013	$ 13,353,833	$ 8,678,573	$ 2,343,972	$ -	$ 1,132,895	$ 394,187	$ 25,903,460
2014	$ 14,488,234	$ 7,015,000	$ 2,632,000	$ -	$ 1,414,000	$ 335,000	$ 25,884,234
2015	$ 15,226,488	$ 7,292,705	$ 2,681,205	$ -	$ 1,685,205	$ 402,500	$ 27,288,103
2016	$ 11,791,240	$ 9,391,000	$ 3,732,639	$ -	$ 1,733,857	$ 321,000	$ 26,969,736
2017	$ 15,318,829	$ 8,547,000	$ 3,329,000	$ -	$ 1,116,316	$ 434,355	$ 28,745,500
2018	$ 17,618,425	$ 10,374,000	$ 3,059,141	$ -	$ 1,812,061	$ 524,240	$ 33,387,867
2019	$ 16,319,698	$ 8,380,941	$ 4,241,432	$ -	$ 1,196,817	$ 686,523	$ 30,825,411
2020	$ 16,377,280	$ 10,305,413	$ 2,853,605	$ -	$ 1,848,687	$ 565,712	$ 31,950,697
2021	$ 12,974,204	$ 6,000,000	$ 7,552,000	$ -	$ 2,109,000	$ 474,000	$ 29,109,204
2022	$ 12,440,000	$ 6,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,840,000
2023	$ 12,383,000	$ 6,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,783,000
2024	$ 11,857,500	$ 6,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,257,500
2025	$ 11,000,000	$ 8,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 26,400,000
2026	$ 10,000,000	$ 8,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,400,000
2027	$ 10,000,000	$ 8,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,400,000
2028	$ 10,000,000	$ 8,000,000	$ 5,000,000	$ -	$ 2,000,000	$ 400,000	$ 25,400,000
2029	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2030	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2031	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2032	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2033	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2034	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2035	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2036	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2037	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2038	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2039	$ 10,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 21,952,000
2040	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2041	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2042	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2043	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2044	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2045	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2046	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2047	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000
2048	$ 8,000,000	$ 6,000,000	$ 3,552,000	$ -	$ 2,000,000	$ 400,000	$ 19,952,000

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Lower Colorado River Basin Development Fund

Last Revised: 1/22/2021

	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	2,291,139	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	890,689	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	800,329	6,215,000	$ 29,745,832
2000	10,410,325			1,034,975	694,295	243,648	100,965	237,000	4,381,470	8,362,622	13,783,000	$ 25,338,182
2001	10,255,846			1,034,975	590,422	144,067	111,673	0	3,930,282	(3,676,444)	1,100,000	$ 33,459,054
2002	8,674,271			1,029,973	551,075	279,945	84,315	121,000	4,185,740	1,864,925	6,966,000	$ 34,137,352
2003	8,202,777			1,032,474	415,795	242,999	131,908		3,112,520	6,981,778	10,885,000	$ 30,422,655
2004	8,307,425			1,032,474	503,133	210,236	123,866		3,477,560	6,789,205	11,104,000	$ 26,593,606
2005	6,700,765	448,360		1,032,474	538,836	183,366	158,644		3,003,036	2,697,118	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	7,336,739	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	9,948,647	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	8,171,473	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	866,757	513,417	190,973		3,779,100	5,269,040	10,619,287	$ 5,381,476
2019	6,746,940	1,632,399		0	1,201,739	339,098	250,091		3,053,057	6,180,549	11,024,534	$ 2,736,282
2020	6,582,994	1,474,951		0	808,521	523,795	206,081		3,754,115	1,257,502	6,550,014	$ 4,244,213
Subtotal	271,975,066	23,358,670	27,591,621	53,340,757	15,956,925	7,876,797	3,385,020	619,192	80,720,976	102,217,430	210,157,149	
2021	6,843,739	1,474,951		0	2,139,733	597,550	172,671		2,185,714	7,300,000	12,395,669	$ 167,234
2022	6,773,091	1,474,951		0	1,416,667	566,667	145,714		2,185,714	3,958,330	8,273,091	$ 142,185
2023	6,786,826	1,474,951		0	1,416,667	566,667	145,714		2,185,714	3,972,064	8,286,826	$ 117,135
2024	6,734,663	1,474,951		0	1,416,667	566,667	145,714		2,185,714	3,919,901	8,234,663	$ 92,086
2025	6,698,487	1,474,951		0	1,416,667	566,667	145,714		2,914,286	3,155,154	8,198,487	$ 67,037
2026	6,810,783	1,474,951		0	1,416,667	566,667	145,714		2,914,286	3,267,450	8,310,783	$ 41,988
2027	6,851,033	1,474,951		0	1,416,667	566,667	145,714		2,914,286	3,307,700	8,351,033	$ 16,939
2028	6,782,581	1,474,951		0	1,416,667	566,667	145,714		2,914,286	3,239,248	8,282,581	$ (8,110)
2029	6,745,126	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,340,631	8,245,126	$ (33,159)
2030	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 141,791
2031	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 316,742
2032	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 491,693
2033	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 666,644
2034	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 841,595
2035	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 1,016,546
2036	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	4,095,505	8,000,000	$ 1,191,496
2037	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 2,366,447
2038	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 3,541,398
2039	6,700,000	1,474,951		4,830,251	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ (113,902)
2040	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 1,061,049
2041	6,700,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 2,236,000
2042	6,700,000	1,474,951		1,969,764	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 1,441,186
2043	6,700,000	1,474,951		897,906	1,006,400	566,667	145,714		2,185,714	3,095,505	7,000,000	$ 1,718,231
2044	10,000,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	9,095,505	13,000,000	$ 193,182
2045	10,000,000	1,474,951		0	1,006,400	566,667	145,714		2,185,714	6,095,505	10,000,000	$ 1,668,133
2046	10,000,000	1,474,951		6,070,071	1,006,400	566,667	145,714		2,185,714	2,095,505	6,000,000	$ 1,073,013
2047	10,000,000	1,474,951		7,193,470	1,006,400	566,667	145,714		2,185,714	1,595,505	5,500,000	$ (145,506)
2048	10,000,000	1,474,951		3,684,171	1,006,400	566,667	145,714		2,185,714	2,095,505	6,000,000	$ 1,645,273
Total	762,106,397	91,123,314	55,183,242	131,327,147	64,906,772	32,174,939	11,083,079	1,238,384	229,310,352	313,467,430	650,942,571	

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

2/ $3,850,000 was requested from the LC Region for the Basin States Program; at the end of the fiscal year all Salinity Programs were trued up and an additional $440,840 was collected into the Basin States Program to be used in FY 2016. True up of programs always happen after the fiscal year has ended.

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Lower Colorado River Basin Development Fund

Last Revised: 9/30/2019

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
	Repayment																		
				Grand Valley															
	Paradox Valley Unit			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
2019																		0	2019
2020																		0	2020
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	
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	
	15,890,408	6,070,071	2,925,212	31,436,511	1,969,764	897,906	1,188,406	6,005,064	3,684,171	45,181,822	1,229,102	733,794	12,894,012	934,944	20,829,822	539,870	24,098,090	131,327,147	

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Lower Colorado River Basin Development Fund

Last Revised: 2/22/2021

					LCRBDF Transfers		LCRBDF Fund Balance		
Fiscal Year	Actual/ Projected Fund Revenues	Deficiency Payments	Actual/Projected Federal Expenditure (Basinwide, O&M, EQIP)	Total LCRBDF Required Cost Share	Actual Transfer to UC Region	Repayment to the Treasury	Actual	Accrual	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		$ 28,745,500	$ 10,111,716	$ 9,898,008	$ -	**$ 7,898,545**	**$ (12,206,249)**	**$ (4,307,704)**
2018	$ 8,102,217		$ 33,387,867	$ 11,768,388	$ 10,619,287	$ -	**$ 5,381,477**	**$ (13,355,850)**	**$ (7,974,374)**
2019	$ 8,379,340	$ -	$ 30,825,411	$ 10,789,018	$ 11,024,534	$ -	**$ 2,736,285**	**$ (13,120,835)**	**$ (10,384,550)**
2020	$ 8,057,945		$ 31,950,697	$ 11,258,521	$ 6,550,011	$ -	**$ 4,244,215**	**$ (17,829,846)**	**$ (13,585,631)**
	$ 295,333,737	$ 27,591,621	$ 646,231,356	$ 227,984,983	$ 210,157,146	$ 53,340,757			

Notes: Revenue from values provided by LC (no shortage)

The Federal Expenditure (Appropriations) are from "Appropriations" tab and represent requested funding amounts

Required cost share equals 85% of 30% on EQIP, Basinwide and McElmos O&M and 25% on Grand Valley and Paradox O&M

COLORADO RIVER BASIN SALINITY CONTROL PROGRAM TITLE II

Upper Colorado River Basin Fund

As of 01/22/2021

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	152,957	90,603	30,021		699,612	896,715	1,869,908	0	1,869,908
2019	212,072	59,841	44,134		538,775	1,049,123	1,903,944	0	1,903,944
2020	142,680	92,434	36,367		662,491	1,052,825	1,986,798	0	1,986,798
Subtotal	2,894,054	1,405,994	612,041	94,327	14,448,657	22,122,565	41,609,781	6,868,522	41,833,051
2021	377,600	105,450	30,471		360,000	778,452	1,651,974	0	1,651,974
2022	250,000	100,000	25,714		360,000	746,400	1,482,114	0	1,482,114
2023	250,000	100,000	25,714		360,000	742,980	1,478,694	0	1,478,694
2024	250,000	100,000	25,714		360,000	711,450	1,447,164	0	1,447,164
2025	250,000	100,000	25,714		480,000	660,000	1,515,714	0	1,515,714
2026	250,000	100,000	25,714		480,000	600,000	1,455,714	1,384,314	2,840,028
2027	250,000	100,000	25,714		480,000	600,000	1,455,714	0	1,455,714
2028	250,000	100,000	25,714		480,000	600,000	1,455,714	0	1,455,714
2029	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2030	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2031	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2032	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2033	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2034	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2035	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2036	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2037	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2038	177,600	100,000	25,714		360,000	600,000	1,263,314	0	1,263,314
2039	177,600	100,000	25,714		360,000	600,000	1,263,314	3,200,008	4,463,322
2040	177,600	100,000	25,714		360,000	480,000	1,143,314	64,747	1,208,061
2041	177,600	100,000	25,714		360,000	480,000	1,143,314	0	1,143,314
2042	177,600	100,000	25,714		360,000	480,000	1,143,314	347,605	1,490,919
2043	177,600	100,000	25,714		360,000	480,000	1,143,314	158,454	1,301,768
2044	177,600	100,000	25,714		360,000	480,000	1,143,314	0	1,143,314
2045	177,600	100,000	25,714		360,000	480,000	1,143,314	0	1,143,314
2046	177,600	100,000	25,714		360,000	480,000	1,143,314	1,071,189	2,214,503
2047	177,600	100,000	25,714		360,000	480,000	1,143,314	1,919,584	3,062,898
2048	177,600	100,000	25,714		360,000	480,000	1,143,314	0	1,143,314
Total	8,716,334	4,303,879	1,373,165	94,327	25,671,148	39,534,672	79,725,668	15,014,423	88,094,839

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 2/22/2021

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
	Repayment																		
				Grand Valley											McElmo Creek			**Total**	
Fiscal	Paradox Valley Unit			Construction Completed								Las Vegas	Lower Gunnison		(Dolores Project)		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
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
2019																		0	2019
2020																		0	2020
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	
2021																		0	2021
2022																		0	2022
2023																		0	2023
2024																		0	2024
2025																		0	2025
2026	1,402,063												-421		-17,328			1,384,314	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				3,200,008						3,200,008								3,200,008	2039
2040												64,747						64,747	2040
2041																		0	2041
2042					347,605					347,605								347,605	2042
2043						158,454				158,454								158,454	2043
2044																		0	2044
2045																		0	2045
2046		1,071,189																1,071,189	2046
2047							209,719	1,059,717	650,148	1,919,584								1,919,584	2047
2048																			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	
	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								15,014,423	

FUNDING FORECAST FOR THE BASINWIDE PROGRAM FY 2020

FUNDING FORECAST BASINWIDE PROGRAM — **Date as of** 3/2/2021

Contract Number	Contract Name	Tons of Salt Controlled	End Date	Contract Amount	Obligated to Date	Balance To Obligate	Expended to Date	Balance to Expend	Percent Expended	FY 2020 Appropriations & Cost Share	FY 2021 Appropriations & Cost Share	FY 2022 Appropriations & Cost Share	FY 2023 Appropriations & Cost Share	FY 2024 Appropriations & Cost Share
R18AC00012	Ashley Upper and Highline Canals Project	2,713	**12/31/2023**	$ 3,514,847	$ 3,287,500	$ 227,347	$ 2,919,435	$ 368,065	83%	$ 3,000,000	$ 210,361			
R20AC00011	Government Highline Canal - Reach 1A Project	3,083	**9/30/2025**	$ 4,698,276	$ 3,300,000	$ 1,398,276	$ 869,886	$ 2,430,114	19%	$ 3,300,000	$ 1,398,276			
R20AC00014	Needle/Lone Rock Project	2,952	**9/30/2025**	$ 4,238,228	$ 1,476,657	$ 2,761,571	$ 48,209	$ 1,428,448	1%	$ 1,473,657	$ 1,100,000	$ 1,500,000	$ 164,571	
R20AC00009		1,237	**9/30/2025**	$ 1,786,988	$ -	$ 1,786,988	$ -	$ -	0%	$ -		$ -	$ -	$ -
R20AC00018	Turner and Lone Cabin Ditch Project	3,398	**9/30/2025**	$ 6,165,812	$ 450,000	$ 5,715,812	$ 100,000	$ 350,000	2%	$ 450,000	$ 1,000,000	$ 1,800,000	$ 2,300,000	$ 615,812
R20AC00019	Uncompahgre Phase 10 Project	3,501	**9/30/2025**	$ 5,084,913	$ 1,365,000	$ 3,719,913	$ 56,114	$ 1,308,886	1%	$ 1,365,000	$ 1,150,000	$ 1,400,000	$ 1,169,913	
R20AC00016	Shiprock Lateral Conversion Project – Phase II	751	**9/30/2025**	$ 1,200,000	$ 576,200	$ 623,800	$ -	$ 576,200	0%	$ 576,200	$ 623,800			
R20AC00012	Grandview - Extensions, Diversion, Upper Middle & Lower Projec	3,553	**9/30/2025**	$ 6,360,985	$ 490,755	$ 5,870,230	$ 25,136	$ 465,619	0%	$ 490,755	$ 1,550,000	$ 1,800,000	$ 2,500,000	$ 520,230
R20AC00020	Webber Ditch Pipeline	2,066	**9/30/2025**	$ 3,265,760	$ 850,000	$ 2,415,760	$ -	$ 850,000	0%	$ 850,000	$ 1,000,000	$ 800,000	$ 615,760	
R20AC00010	GVIC - Canal Lining Phase 5 - 550 Project	743	**9/30/2025**	$ 1,231,562	$ 184,544	$ 1,047,018	$ 80,960	$ 103,584	7%	$ 184,544		$ 700,000	$ 347,018	
			TOTALS	**$ 7,851,872**	**$ 11,980,656**	**$ 6,201,253**	**$ 2,699,696**	**$ 15,784,750**	**37%**	**$ 11,690,156**	**$ 8,032,437**	**$ 8,000,000**	**$ 7,097,262**	**$ 1,136,042**
	Projects with Full Obligation													
R16AC00008	Clipper Center Lateral Project - Crawford	2,606	**9/30/2021**	$ 3,153,410	$ 3,153,410	$ -	$ 3,045,656	$ 107,754	97%					
R16AC00010	North Delta Canal - Phase 1	4,383	**9/30/2020**	$ 5,564,809	$ 5,564,809	$ -	$ 5,564,809	$ -	100%					
R18AC00073	Upper Stewart Ditch Pipeline Project	1,622	**12/31/2022**	$ 2,507,561	$ 2,507,561	$ -	$ 1,455,891	$ 503,299	58%					
R16AC00015	San Juan Dineh Project	4,381	**5/21/2021**	$ 4,835,391	$ 4,835,391	$ -	$ 4,524,288	$ 311,103	94%	$ 570,134				
R16AC00016	Uncompahgre East Side Phase 9	6,030	**9/30/2020**	$ 5,363,078	$ 5,363,078	$ -	$ 3,549,707	$ 1,813,371	66%	$ 931,477				
R18AC00074	Gould Canal Improvement Project B	2,564	**12/31/2022**	$ 3,545,246	$ 3,545,246	$ -	$ 1,363,579	$ 2,181,667	38%	$ 656,112				
R18AC00075	Gould Canal Improvement Project A	3,137	**12/31/2022**	$ 4,337,025	$ 4,337,025	$ -	$ 1,623,595	$ 2,713,430	37%	$ 42,998				
				$ 54,278,168	**$ 36,002,663**	**$ -**	**$ 7,049,731**	**$ -**	**20%**	$ 2,200,721				
	CONTRACT COSTS									**$ 13,890,877**	**$ 8,032,437**	**$ 8,000,000**	**$ 7,097,262**	**$ 1,136,042**
	NON-CONTRACT COSTS									**$ 732,190**	**$ 500,000**	**$ 500,000**	**$ 500,000**	**$ 500,000**
	TOTAL OPEN AGREEMENTS						**$ -**	**$ -**	**$ -**	**$ 14,623,067**	**$ 8,532,437**	**$ 8,500,000**	**$ 7,597,262**	**$ 1,636,042**
Funding	**Appropriations S10**									**$ 10,305,413**	**$ 6,000,000**	**$ 6,000,000**	**$ 6,000,000**	**$ 6,000,000**
Funding	**Cost Share X10**									**$ 4,416,606**	**$ 2,571,429**	**$ 2,571,429**	**$ 2,571,429**	**$ 2,571,429**
	TOTAL									**$ 14,722,019**	**$ 8,571,429**	**$ 8,571,429**	**$ 8,571,429**	**$ 8,571,429**
	Final Account Numbers									**$ 98,952**	**$ 38,992**	**$ 71,429**	**$ -**	**$ -**

BASIN STATES PROGRAM FUNDING

Contract Number	Contract Name	Tons of Salt Controlled	End Date	Contract Amount	Obligated to Date	Balance To Obligate	Expended to Date	Balance to Expend	FY 2020 Obligations	FY2021 Obligations	FY2022 Obligations	FY2023 Obligations	FY2024 Obligations
R16AC00001	State of Colorado		**3/1/2021**	$ 6,000,000	$ 2,127,000	$ 3,873,000	$ 518,619	$ 1,608,381	$ 200,000				
R16AC00023	State of Utah		**9/30/2021**	$ 6,237,000	$ 3,712,470	$ 2,524,530	$ 3,439,724	$ 346,906	$ 120,000				
R15AC00054	State of Wyoming		**9/30/2020**	$ 2,800,000	$ 2,460,000	$ 340,000	$ 1,993,523	$ 466,477	$ 75,000				
NEW	State of Colorado (Start Date of 10/01/21)			$ 1,000,000						$ 200,000	$ 200,000	$ 200,000	$ 200,000
NEW	State of Utah (Start Date of 10/01/21)			$ 600,000						$ 120,000	$ 120,000	$ 120,000	$ 120,000
NEW	State of Wyoming			$ 375,000						$ 75,000	$ 75,000	$ 75,000	$ 75,000
R20PG00010	US F&WS		**9/30/2024**	$ 473,762	$ 184,080	$ 289,682	$ 22,630	$ 161,450	$ 91,154	$ 92,926	$ 94,714	$ 96,547	$ 98,420
R16PC00098	Barnett Intermountain - Salinity Consultant		**8/31/2021**	$ 597,900	$ 597,900	$ -	$ 514,436	$ 83,464	$ 125,200	$ 128,956	$ 132,825	$ 135,000	$ 135,000
NEW	Salinity Consultant			$ 600,000									
R17PX00669	University of Colorado		**8/31/2022**	$ 325,137	$ 257,232	$ 67,905	$ 218,523	$ 38,709	$ 14,220	$ 14,551	$ 14,988	$ 15,500	$ 15,500
R18AC00076	Crawford Clipper - Hamilton/Jerdon,	1,511	**12/31/2022**	$ 3,997,208	2,577,239.00	$ 1,419,969	$ 118,448	$ 2,458,791	$ 2,400,000	$ 1,000,000	$ 419,969		
R18AC00094	Muddy Creek, Emery, UT	3,310	**2/28/2022**	$ 4,583,000	$ 2,709,636	$ 1,873,364	$ 1,693,971	$ 1,015,665		$ 1,500,000	$ 373,364		
R18AC00077	Bostwick Park - Shinn Park/Waterdog, Montrose, C	3,304	**5/30/2021**	$ 4,136,490	$ 2,264,735	$ 1,871,755	$ 695,914	$ 1,568,821		$ 1,500,000	$ 371,755		
R18AC00078	Root & Ratliff, Mancos CO	2,347	**5/31/2022**	$ 3,600,021	$ 2,659,906	$ 940,115	$ 530,543	$ 2,129,363		$ 940,115			
R20AC00013	Interstate Irrigation, WY	2,295	**12/31/2022**	$ 3,438,379	$ 350,000	$ 3,088,379	$ 35,000	$ 315,000	$ 350,000	$ 1,262,590	$ 1,376,754	$ 449,035	
R20AC00017	Short Ditch, CO	419	**6/30/2022**	$ 548,687	$ 48,300	$ 500,387	$ 30,750	$ 17,550	$ 48,300	$ 425,387	$ 75,000		
R20AC00015	Pilot Rock Ditch Co, CO	665	**6/30/2022**	$ 61,000	$ 32,656	$ 28,344	$ 22,013	$ 10,643	$ 61,000	$ 598,258	$ 281,143		
R16PG00132	Pah Tempe SIR 5-2016, SIR 2018-05		**9/30/2021**	$ 295,690	$ 295,690	$ -	$ 228,722	$ 66,968					
R17PG00117	SIR 17-03 Blacks Forks Study ($203,978.44)		**9/30/2020**	$ 204,000	$ 203,978	$ 22	$ 192,651	$ 11,328	$ -				
R19PG00068	SIR 2018-01a Analysis of Long-Term Landscape & Water Quality Changes BLM paying half		**3/31/2022**	$ 496,712	$ 250,057	$ -	$ 14,976	$ 235,081					
R19PG00054	SIR 2018-02 Review of Salinity Data, Estimated		**12/31/2020**	$ 45,316	$ 45,316	$ -	$ 45,316	$ -					
R19PG00055	SIR 2018-03 Supplemental Salinity Sampling White River Basin		**9/30/2021**	$ 23,776	$ 23,776	$ -	$ 12,287	$ 11,489					
In House	SIR 2018-04 Huntington Cleveland Chronical		**1/31/2020**	$ 56,600	$ 56,600	$ -	$ 13,200	$ 43,400					
R20PG00013	SIR 2019-02 Sparrow Model		**12/14/2022**	$ 138,732	$ 138,732	$ -	$ 72,856	$ 65,876	$ 138,732				
R20PG00100	SIR 2020-01 Analysis of Long-Term Change in LC		**9/17/2021**	$ 128,751	$ 128,751		$ 19,275	$ 109,476	$ 128,751				
R20PG00101	SIR 2020-02 Salinity Load in UC High Flow		**9/17/2023**	$ 117,751	$ 117,751			$ 117,751	$ 117,751				
	Future SIR									$ 300,000	$ 300,000	$ 300,000	$ 300,000
	Reclamation T/A					$ -		$ -	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
	Advisory Member's Travel					$ -		$ -	$ 11,000	$ 13,000	$ 13,000	$ 13,000	$ 13,000
NEW	RiverWareIDIQ					$ -		$ -	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
	Streamgaging Contracts w/ USGS					$ -		$ -	$ 115,164	$ 118,619	$ 122,177	$ 125,843	$ 129,618
Costs	**ALL COSTS**			**$ 68,257,673**	**$ 45,226,225**	**$ 20,528,792**	**$ 24,574,321**	**$ 7,753,470**	**$ 4,185,707**	**$ 8,450,612**	**$ 4,133,690**	**$ 1,694,764**	**$ 1,251,377**
Funding	**Upper Basin Cost Share Based on NRCS 3 yr plan**								**$ 1,052,825**	**$ 910,980**	**$ 742,980**	**$ 711,450**	**$ 711,450**
Funding	**Lower Basin Cost Share based on NRCS + Accrual**								**$ 1,040,998**	**$ 7,300,000**	**$ 3,958,330**	**$ 3,972,064**	**$ 3,919,901**
Funding	**Carryover Basin Funds**								**$ 2,091,884**	**$ 216,504**	**$ (23,128)**	**$ 544,493**	**$ 3,533,243**
Funding	**Program Year End True-Up**								**$ 216,504**				
Funding	**From Recovery**												
Funding	**From UC Accrual**												
Funding	**ALL FUNDING TOTAL**								**$ 4,402,211**	**$ 8,427,484**	**$ 4,678,183**	**$ 5,228,007**	**$ 8,164,594**
								Carry Over Funding for Next FY	$ 216,504	$ (23,128)	$ 544,493	$ 3,533,243	$ 6,913,217