United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Region
Western Colorado Area Office
445 West Gunnison Avenue, Suite 221
Grand Junction, CO 81501

IN REPLY REFER TO:

WCG-JWard
ENV-6.00

JAN 29 2015

MEMORANDUM

To: Assistant Field Supervisor, Fish and Wildlife Service, 445 W. Gunnison Ave. Suite 240, Grand Junction, CO 81501-5711

From: Ed Warner
For Area Manager

Subject: 2014 Annual Reports under the Gunnison River Programmatic Biological Opinion-Aspinall Unit, Dolores Project, and Selenium Management Program

The following reports, prepared in response to the Gunnison River Programmatic Biological Opinion, are attached for your information:

- The "Report on Aspinall Unit Operations for Calendar Year 2014 under the Gunnison River Programmatic Biological Opinion"
- Dolores Project Annual Report on Conservation Recommendations
- Selenium Management Program, Gunnison River Basin, Colorado. Annual Progress Report 2014

If you have any questions or concerns in regard to this information, please contact Jenny Ward at 970-248-0651.

Attachment

cc: U.S. Fish and Wildlife Service
Colorado Field Office
P.O. Box 25486
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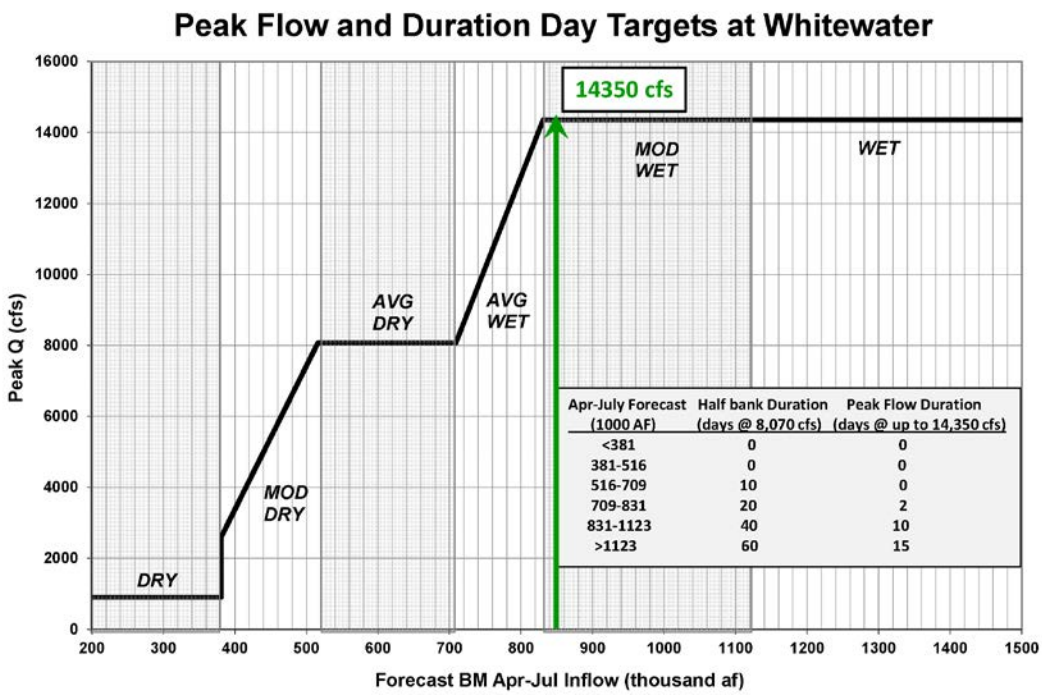
Denver, CO 80225

U.S. Fish and Wildlife Service
Upper Colorado River Endangered
Fish Recovery Program
P.O. Box 25486, DFC
Lakewood, CO 80225 (ea w/att)

Aspinall Unit Operations for Calendar Year 2014 under the Gunnison River PBO

In water year 2014, Western Colorado experienced a return to moderately wet conditions. With the Record of Decision for the Final Aspinall Unit Operations EIS that was signed on May 3, 2012, peak and base flow targets were established for the Whitewater gage near Grand Junction, Colorado to aid in the recovery of four endangered fish; the Humpback Chub, Bonytail Chub, Razorback Sucker, and the Pikeminnow. This report will assess how well the 2014 operations of the Aspinall Unit provided sufficient releases of water at critical times and quantities necessary to avoid unnecessary harm to the endangered fish species and their essential habitat while continuing to meet the authorized purposes of the Aspinall Unit.

Peak Flows As mentioned previously, 2014 was considered a moderately wet year. Year type is determined by the forecasted April through July inflow volume to Blue Mesa Reservoir. Moderately wet years are defined as years where the forecasted inflow volume is greater than 831,000 acre-feet and less than 1,123,000 acre-feet. The April 1st issue of the runoff forecast predicted 850,000 acre-feet of inflow to Blue Mesa Reservoir. The actual April through July inflow volume for 2014 totaled 849,000 acre-feet. The May 1 runoff forecast placed 2014 into a moderately wet year category with a peak flow target of 14,350 cfs at the Whitewater gage.



Apr-July Forecast (1000 AF)	Half bank Duration (days @ 8,070 cfs)	Peak Flow Duration (days @ up to 14,350 cfs)
<381	0	0
381-516	0	0
516-709	10	0
709-831	20	2
831-1123	40	10
>1123	60	15

Figure 1. Peak flow and duration day targets at the Whitewater gage as determined by April-July Forecasted Inflow.

The 14,350 cfs peak target flow was not met in 2014. While spillway releases at the Aspinall Unit were in excess of 2,000 cfs and flows in the Gunnison River through the Black Canyon exceeded 9,000 cfs,

contributing flows from the North Fork of the Gunnison River and other smaller tributaries resulted in a peak on the Gunnison River at the Whitewater gage that only reached 12,500 cfs.

Half Bank and Peak Flow Duration The recommended number of duration days at half-bankfull flows and at the peak flow are also dependent on the forecasted inflow volume to Blue Mesa Reservoir. The table insert in Figure 1 shows the recommended duration of days at peak flow and half bank capacity flows for ranges of forecasted inflow volume to Blue Mesa Reservoir. With the forecasted runoff to Blue Mesa Reservoir setting the year type as moderately wet, the peak flow duration target was 10 days at 14,350 cfs and the half bankfull target was 40 days at 8,070 cfs. The peak flow on the Gunnison River at the Whitewater gage only reached 12,500 cfs and there were 3 days of flows over 12,000 cfs during the time of the peak. Half bankfull flows of 8,070 cfs were achieved for 22 days, short of the 40 day target as tributary flows from the North Fork of the Gunnison River dropped off towards summertime baseflow levels near the end of June.

Base Flows Base flow recommendations were determined by a study conducted by the Fish and Wildlife Service (Figure 2). Year type for base flow is also determined by the April-July forecasted inflow volume to Blue Mesa Reservoir, so 2014 followed the targets for a moderately wet year. Since 2013 was considered a dry year, the dry year baseflow targets are carried over for the January-March time period as the hydrology of these months is more dependent on the previous year's hydrology than the current year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
Mod Wet	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
Avg Wet	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
Avg Dry	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
Mod Dry*	750	750	750/790	750/890	750/890	1050	1050	1050	750/890	750/790	750/790	750
Dry*	750	750	750/790	750/890	750/890	1050	1050	750/890	750/890	750/790	750/790	750

*During March through November in Moderately Dry and Dry type years, additional releases will be made as necessary to provide flows above the 750 cfs anticipated to be diverted by the Redlands Water and Power Company, for the fish ladder and fish screen as shown.

Figure 2. Base flow recommendations to support critical flows and habitat for the endangered fish.

Baseflow targets were exceeded throughout 2014 with the exception of 12 days during the early winter months when the Whitewater gage data was unavailable due to icing impacts. Flows were later estimated to be in the 730 to 740 cfs range, just below the baseflow target of 750 cfs.

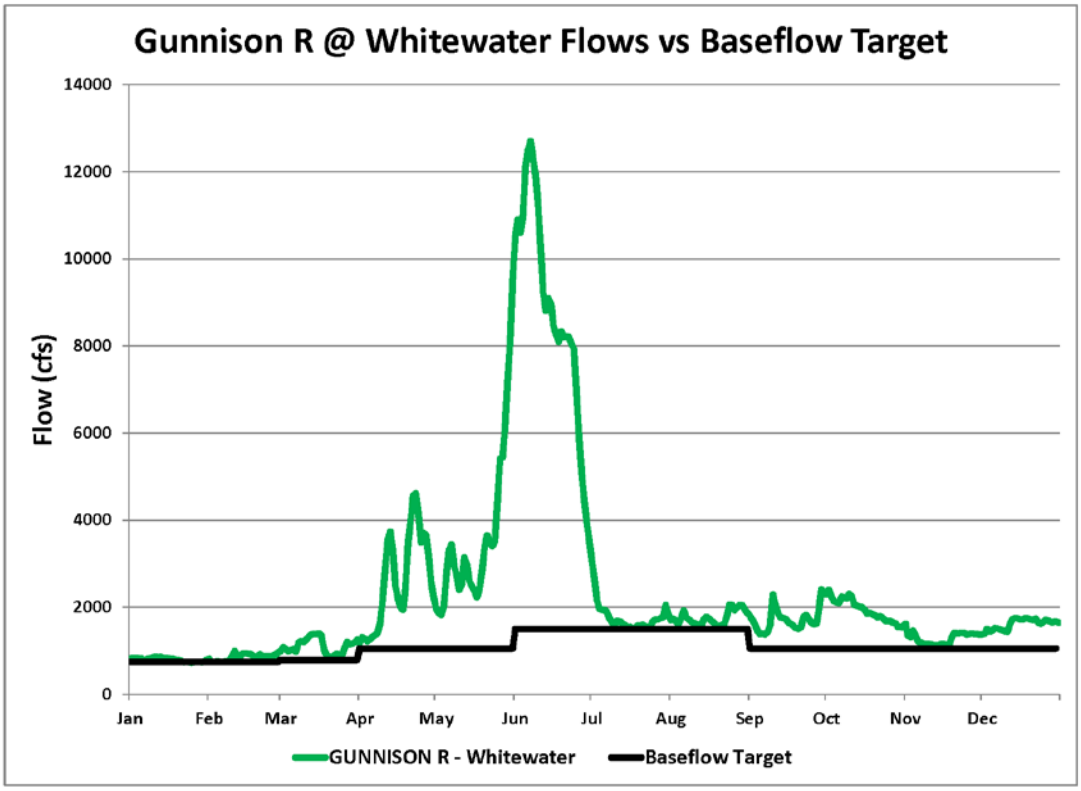


Figure 3. 2014 Base Flow Target vs. Actual Flows at Whitewater Gage.

Gunnison River Flow differences between the Gunnison River at Whitewater and the Gunnison River below the Redlands Diversion Dam are primarily due to the diversion of water to the Redlands Canal. As 2014 was a moderately wet year with more than sufficient streamflow, there were no issues with providing enough water to the Redlands fish ladder and screen during the months of their operation. Figure 4 shows the fluctuations in flow between the Gunnison River at the Whitewater gage and the Gunnison River below the Redlands Diversion Dam.

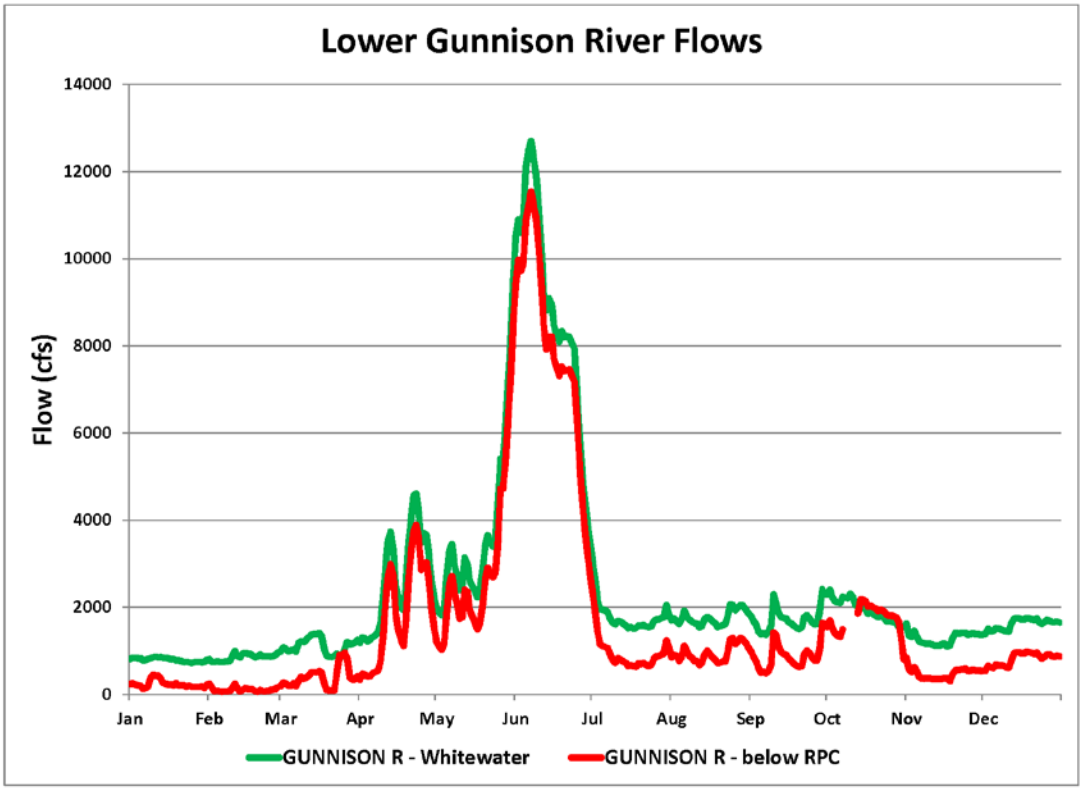


Figure 4. Gunnison River flows as measured at Whitewater and below the Redlands Diversion Dam.

Colorado River Flows at the Colorado/Utah Stateline closely matched the flows at the Cisco, UT gage. Flows tended to range from 2500 cfs up to 37,000 cfs, with both gages experiencing a peak of over 37,000 cfs in the beginning of June. Figure 5 shows the river flows at the Colorado/Utah Stateline gage and the Cisco, UT gage.

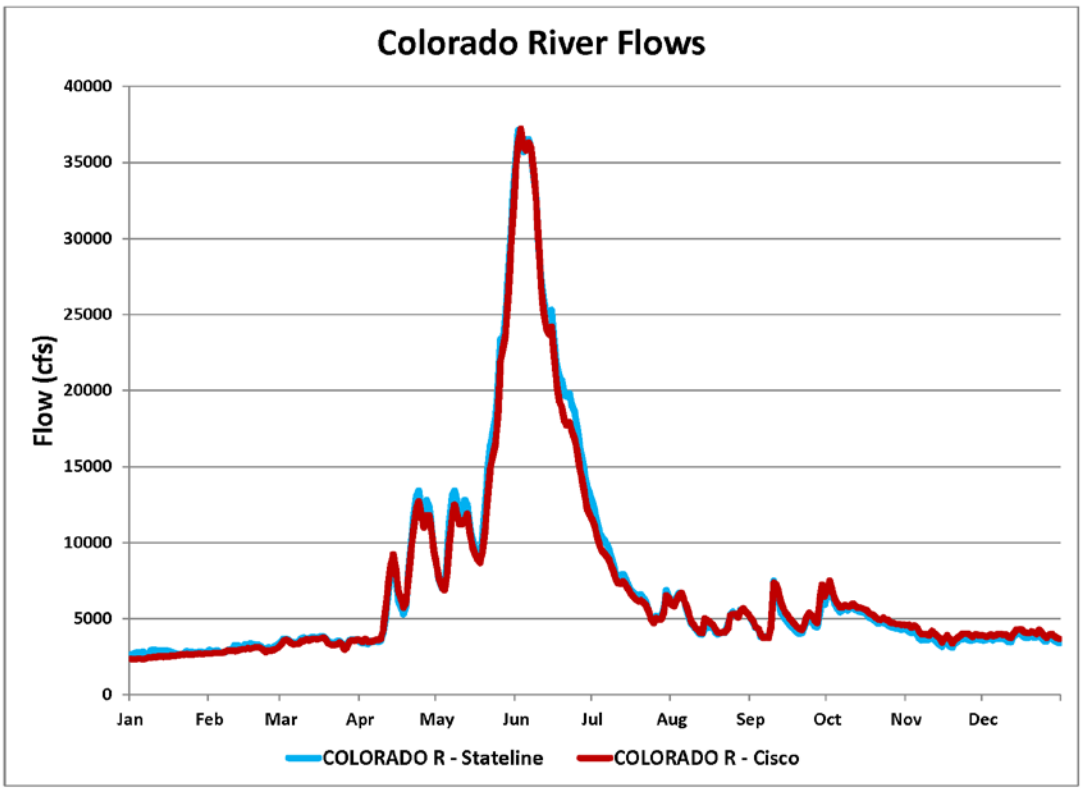


Figure 5. Colorado River flows at the Colorado/Utah Stateline gage and the Cisco, UT gage.

<u>Operational Issues</u> There were no operational issues that impeded flows from the Aspinall Unit to the Whitewater gage during the 2014 water year.

Summary In 2014, hydrologic conditions turned to moderately wet after two consecutive dry years. In an attempt to reach the peak flow and peak duration targets at the Whitewater gage, releases from the Aspinall Unit included a combination of power plants, bypasses and spillways at all three dams. However, declining tributary flows, mainly from the North Fork of the Gunnison River, resulted in the actual peak flow and peak duration falling short of the targets. During this operation the Black Canyon water right peak flow target was met. Baseflow targets were achieved throughout the year with the exception of a short period in early winter when the Whitewater gage was not reading correctly due to icing impacts.

Annual Flow Management of the Dolores River and Status of Conservations Recommendations Water Year 2014

Background: In 1975, the Dolores River was designated as a component of the National System of Wild and Scenic Rivers. Nearly 40-years later the San Juan Public Lands Center (SJPLC) began revising their San Juan National Forest Resource Management Plan. A requirement of the planning process was that all planning area rivers be assessed for their eligibility, classification, and suitability for inclusion in the National Wild and Scenic River System. The San Juan Public Lands Draft Land Management Plan (DLMP) found the Dolores River from the outlet of McPhee Reservoir to Bedrock Colorado to be preliminarily suitable for inclusion in the National Wild and Scenic River System. Outstanding Remarkable Values (ORV's) identified in the DLMP for this section of the Dolores River include fish and wildlife resources, recreation, scenery, and other geological, ecological, and archeological values. Some of the specific ORV's are the roundtail chub, rafting, New Mexico privet, canyon treefrog, and Eastwood's monkeyflower. Since the Dolores River Dialogue (DRD) had been focusing on the lower Dolores River, the SJPLC felt that the DRD had potential to find an alternative to the Wild and Scenic suitability designation that would achieve similar protections for the stream and its ORV's.

In 2008, the SJPLC asked the DRD for assistance in protecting the ORV's and in considering alternatives to Wild and Scenic suitability. The DRD in conjunction with the SJPLC established the Lower Dolores River Working Group (LDWG) and began a process of understanding the human, ecological, and political dynamics at play on the lower Dolores River and how to best address the needs of the ORV's.

As an outcome of the LDWG, a legislative committee was established to consider an alternative to Wild and Scenic designation. A National Conservation Area was considered the best alternative and language is being drafted for legislative consideration. While drafting the language, it was determined that in order to protect the native fish ORV, assistance would be needed from native fishery experts. The "A Way Forward" committee was established and a team of scientists (Bill Miller, Kevin Bestgen, and Phaedra Budy) was hired to review existing data and summarize the status and trends of the three species from McPhee Dam to the confluence with the San Miguel River. The final report presented nine potential management opportunities that may assist with the improvement of the native fish. They are: spill management, base flow management, sediment transport flows, habitat maintenance flows, thermal regime modification, reducing the effects of introduced coldwater species, reducing the effects of introduced warm water species, and supplementing native fishes.

Upon completion of the A Way Forward final report, an Implementation Team (IT) consisting of water managers, NGOs, and State and Federal Agencies was formed to find ways to implement the nine recommendations. The IT, with financial assistance of the Colorado Water Conservation Board, completed its first iteration of "The Lower Dolores River Implementation, Monitoring and Evaluation Plan for Native Fish" in August 2012. Public comments to the plan were received, and the second iteration was published in June 2014.

An electronic version of this plan and appendices can obtained from the Dolores River Dialogue website: http://ocs.fortlewis.edu/drd/pdf/Lower-Dolores-River-Implementation-Monitoring-and-Evaluation-Plan-for-Native-Fish-June%202014.pdf

Downstream Releases: McPhee Reservoir did not spill this year. All downstream releases were made from the managed fishery pool. Project water allocations received a nearly full supply. The downstream releases volume is 26,392 – acre feet for water year 2014.

Downstream releases for water 2014 range from 70 CFS to 25 CFS.

Conservation Recommendation No. 1. *We recommend that Reclamation continue support efforts of the three species conservation strategy on a range-wide basis, including conservation efforts on the Dolores River.*

The Bureau of Reclamation has been an active participant of the Dolores River Dialogue since its inception in 2004, and is currently active in the Implementation Team efforts to manage downstream releases to the lower Dolores River (from McPhee Dam to the confluence of the San Juan Miguel River) for the Native fishes and rafting.

Conservation Recommendation No. 2. *We recommend that Reclamation continue to work with the Biology Committee to consider spill and flow management options to benefit the native fishery in the middle and lower Dolores River while continuing to honor commitments related to downstream rafting.*

The Biology committee was setup as an advisory committee for fishery pool management only. Reclamation and the Dolores Water Conservancy District are actively involved with the DRD and IT in performing spill management.

Reclamation takes an active role with the Biology Committee in identifying base needs and possibilities. Annual base release budgets are drafted by Colorado Parks and Wildlife and agreed upon by all members.

Conservation Recommendation No. 3. *We recommend that Reclamation continue to take an active role in the Dolores River Dialogue, in particular activities related to native fish.*

See background narrative.

RECLAMATION

Managing Water in the West

Selenium Management Program Gunnison River Basin, Colorado Annual Progress Report 2014

Prepared by Selenium Management Program Workgroup
Compiled by Bureau of Reclamation

January 2015

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Introduction

The Gunnison Basin Programmatic Biological Opinion issued by the U.S. Fish and Wildlife Service in 2009 required that "Reclamation develop and implement a Selenium Management Program (SMP), in cooperation with the State of Colorado and Gunnison River basin water users to reduce adverse effects of selenium on endangered fish species in the Gunnison and Colorado rivers…".

A Selenium Program Formulation Document was developed by the Selenium Management Program (SMP) Workgroup and finalized in December 2011. The following report was developed by the SMP Workgroup and details the progress of the SMP.

The SMP Workgroup meets on a quarterly basis or more frequently as needed. Science and Research, Technical, and Outreach subcommittees have been established to support the SMP program. SMP Workgroup ground rules were developed and adopted in July 2013. They are attached as Appendix C. Program progress is reported following the selenium management action plan (SMP Action Plan).

SMP Action Plan

The SMP Action Plan is a living document which continues to evolve as more is learned about selenium fate and transport, as well as, when implementation activities to reduce selenium loading and concentrations in the Gunnison River are identified, initiated and/or completed. The narrative below highlights the SMP progress and activities and corresponds to the most recent revisions to the Program Action Plan, which is attached as Appendix A. A separate table showing only those actions which are underway, ongoing from previous years, or have been completed this year is attached as Appendix B.

Part A - Reduce Existing Selenium Load – These are actions that control or will control selenium loading from existing sources, such as current irrigated agricultural (off- and on-farm) and current non-agricultural water use by municipal, residential and industrial users.

1. Off-farm Projects Completed or Underway – In late 2012, Reclamation issued a Funding Opportunity Announcement for Salinity Control Projects above Hoover Dam. Within the Lower Gunnison Basin, at total of 7 new salinity projects were selected for funding totaling about $14.3 million (A.1.15 to A.1.22). In total, these new projects will pipe approximately 38.33 miles of earthen canals and laterals and is predicted to control an additional 12,281 tons of salts as measured at the Whitewater gage. As of this report, construction is underway on six of the seven projects. Three of the selected projects were referred to the Basin States Program (A.1.20 to A.1.22). These projects are

funded by Reclamation through a contract with the State of Colorado for projects controlling less than 1,000 tons annually. While all of these projects focus on reducing salinity in the Lower Gunnison Basin, there exists the potential for Selenium reduction through the salinity control efforts (USGS 2014). The next Reclamation FOA will occur in FY15, providing an estimated $25 – $35 million in funding. Informational meetings will occur in January 2015. The FOA is planned for release in May 2015, and application selection and awards are planned for August 2015.

2. Off-farm-Future Projects – Planning efforts continued in FY14 supporting the Uncompahgre Eastside Optimization Study (A.2.5.2). A final report entitled *UVWUA Integrated Assessment, Comprehensive Implementation Planning, and System Optimization Analysis* prepared by Irrigation Training and Research Center was submitted in July 2014. Uncompahgre Valley Water Users, Reclamation and ITRC continue to refine concepts and continue advance planning efforts. In FY14, the SMP determined that including the west side of the Uncompahgre Project would be beneficial to selenium reduction efforts. West Side – Uncompahgre Project Optimization Planning at this time includes SCADA analysis (A.2.5.3). Two in-canal headgate automation and SCADA projects were completed on the west side by the UVWUA. There are no other optimization analysis being done at this time, however we did include a request for funding for the west side analysis in the RCPP proposal, and we should hear if this grant has been funded sometime in January 2015.

3. On-farm – Underway and Future Projects – Through the Colorado River Basin Salinity Control Program, a Lower Gunnison Comprehensive Planning effort continued with Basin States funds (A.4.1). The purpose of the study is to identify and prioritize cost effective salinity control opportunities, identify impediments to these opportunities, and to describe how a variety of control measures might be best implemented in a coordinated manner to maximize local and basin-wide benefits in cooperation with other potential funding partners in the Upper Colorado River Basin. The study addresses both on-farm and off-farm. While this study focuses on reducing salinity in the Lower Gunnison Basin, there exists the potential for Selenium reduction through the salinity control efforts (USGS 2014). A draft findings and strategies report dated September 2013 prepared by URS Corporation and presented to the study team and the Salinity Control Workgroup in the fall of 2013. A final report, dated February 2014, was presented at a presentation of findings held in Grand Junction last fall.

4. Identify and Prioritize Target Areas and Potential Projects – The SMP Workgroup continued working with sub-basin level data developed by USGS to

determine where to encourage/support projects that accomplish selenium reduction goals (A.2.4). Based on current information, projects with the largest potential to reduce selenium loading include the Uncompahgre Project's East side and potentially selected drainages in the North Fork of the Gunnison River (USGS 2014).

The SMP continues to work with the USGS on ranking contributing areas of salt and selenium in the Lower Gunnison Basin using multiple linear regression models. In 2013, USGS published the modeling results in a report entitled *Ranking Contributing Areas of Salt and Selenium in the Lower Gunnison Basin, Colorado, Using Multiple Linear Regression Models.* The report is available online at http://pubs.usgs.gov/sir/2013/5075/. A study to develop a water budget for the Bostwick Park was completed in 2014, and the Bostwick Park Systems Optimization Study (A.1.24) is currently underway and expected to be completed in 2015. Findings for the Bostwick Park water budget are being reviewed by the SMP Science subcommittee and are scheduled for publication in 2016. See Action C.1 (Expand Knowledge Base) for additional information on investigations including the USGS led Selenium Science Plan, which is available online at http://www.seleniumtaskforce.org/images/Se_SciencePlan_06302014_Version1.pdf.

5. Encourage/Facilitate Remaining Phases of Piping/Lining East Side Uncompahgre Project Laterals – Through Phase 8, approximately 50.3% of the East Side Laterals (ESL) Project has been completed or is under contract as shown in Appendix A, A.1.2 - A.1.9 and A.1.17. An additional 14.0 miles of piping of eastside laterals is planned for Phase 8. It is anticipated that the remainder of Phase 7 and Phase 8 will be constructed in the Fall of 2015.

   A total of $5 million from the Colorado River Storage Project Memorandum of Agreement (CRSP MOA) funding has been committed for piping and/or lining additional East Side Canals and Laterals (see Appendix A, A.1.14). These funds have been reserved from FY2012 and FY2013 CRSP power revenues. The types of activities that could be funded under the MOA include "costs of environmental compliance for CRSP initial units, including biological opinions or programmatic biological opinions and associated improvements that are necessary to satisfy compliance for continuation of operation of facilities…"

   The SMP continues to support efforts of the Uncompahgre Valley Water Users Association. The UVWUA continues to develop strategies that maximize funding and cost-share opportunities to complete the remaining ESL project. The UVWUA has taken a very aggressive and pro-active approach to securing their own grants for cost share so projects can be maximized and funding leveraged.

6. Encourage/Facilitate Off-Farm Projects in Other High Selenium Loading Areas in the Basin – Some of the water users that submitted for the 2012 FOA (A.1.15-A.1.22) received about $62k in financial assistance from the State of Colorado to help defray the cost of utilizing engineering firms to prepare their applications for submission to Reclamation. (A.2.4.5). The CWCB committed about $45k of Species Preservation funds in FY14 to assist water users in the Lower Gunnison Basin developing projects and proposals.

7. On-Farm EQIP – NRCS continues to promote irrigation efficiency projects aimed towards a long term goal of treating 50 to 60% of the acreage needing treatment (A.3.1). NRCS reported on-farm EQUIP Salinity contracts for FY 2014 totaled 2,145 acres in for the Gunnison River Basin in Delta and Montrose Counties. Approximately $4.85 million dollars was obligated for these projects.

8. On-Farm Basin States Program – In 2012, Reclamation and the State of Colorado finalized an agreement that provided $2 million Basin States Funds to the State for on- and off-farm irrigation improvements. This program replaced the old Parallel Program. In 2014, contracts were written for 40 ac totaling approximately $158k from the Basin State Program (A.3.1).

9. On-Farm Irrigation BMP Demonstration Projects – In 2014, the State of Colorado completed engineering and design of a big gun demonstration project on the Meeker farm (A.4.6), and the project has been implemented. The State plans to make up to $80k available in FY15 to fund demonstration projects. This also includes a private landowner EQIP contract for approximately $128,992. NRCS completed the design and engineering work with input from the landowner. At this time, only the irrigation retention pond construction has been completed. The gun will be installed and running by March 2015.

10. Conduct Public Information and Education Programs – The SMP hosted a table/booth and gave a presentation at the 2014 Soil Health Conference in Delta (A.8.2). The conference is an opportunity to meet with water users and landowners and provide information on selenium activities in the Lower Gunnison Basin. A table/booth and presentation is also planned for the 2015 Soil Health Conference held in January.

    The Gunnison Basin and Grand Valley Selenium Task Force is assisting with the coordination of a presentation at the 2015 Uncompahgre Valley Water Users Association Annual meeting in February 2015 (A.8.3). The SMP Education and Outreach Subcommittee continues to work on planning and coordination activities that include educating the public, county commissioners, and

collaborating with and supporting other outreach efforts occurring in the Lower Gunnison Basin which benefit selenium reduction goals of the SMP.

Part B - Prevent/Minimize/Mitigate New Selenium Loading – These are actions that prevent, minimize or mitigate new selenium loading, primarily from municipal, residential and industrial sources.

1. Refine, Distribute and Promote Best Management Practices –The SMP continues to explore opportunities to address new sources of selenium loading. In 2015, the SMP plans to discuss and develop strategies to minimize new sources using BMPs and other methods (B.1.2). The SMP is also collaborating with entities promoting Soil Health Initiatives, including BMPs (B.2.2). The Soil Health Initiative was supported by an NRCS Cooperative Conservation Partnership Initiative (CCPI) Grant, which has been exhausted. The group is still very active and is moving forward with a 2015 Soil Health Conference. The Selenium Task Force is providing financial support for the conference. While this is not identified with targeting selenium, selenium reduction is a possible indirect impact.

   Participation in the SMP by federal and state agencies and local water users organizations has been good. Additional outreach to local regulatory agencies is planned in FY15 with additional contacts made to county officials.

Part C - Support Activities – These are research and monitoring activities that expand our knowledge base on selenium loading, fate, transport and mitigation.

1. Expanding Knowledge Base – The SMP continues to support expanding the knowledge base as illustrated in C.1 through C.1.5. These investigations are intended to increase our knowledge and ultimately lead to additional or more focused implementation activities. The State of Colorado's Species Conservation Fund has supported a majority of these investigations, which enables USGS and other matching funds.

   In 2013, the State of Colorado and USGS funded the development of a Selenium Science Plan intended to describe and identify data gaps in monitoring and research efforts as needed to more fully understand selenium occurrence and the efforts to mitigate projects in the Lower Gunnison Basin (C.1.5). A draft 5-Year plan was completed in late 2013 and was finalized in 2014. The final Plan was approved by the SMP Workgroup, and the Workgroup will document and approve updates as needed.

Other major accomplishments include the installation of 4 monitoring wells associated with the Wetlands Study (C.1.1.C) and 30 monitoring wells as part of the 30 Well Eastside Groundwater Monitoring Network (C.1.1D).

In 2014, Alisa Mast et al. published their report *Mobilization of selenium from the Mancos Shale and associated soils in the lower Uncompahgre River Basin, Colorado* (C.1.1.A.1). Major findings include the presence of high concentrations of extractable nitrate which appears to be derived from weathered shale. Once selenium is dissolved, the dissolved nitrate appears to inhibit the reduction of the dissolved selenium, leading to elevated concentrations of selenium in groundwater (Mast et al.).

Approximately $1.8M in funding has been expended or committed to assist in expanding the knowledge base. The SMP continues to explore cost-share research and monitoring activities with the on-going Colorado River Salinity Control Program, as well as other funding opportunities in the Lower Gunnison Basin.

2. Monitoring Water Quality – The SMP continues to support surface water quality monitoring as identified in C.2.1 through C.2.3. Approximately $206K has been committed in FY 13/14 for monitoring groundwater quality with the 30-Well Groundwater Network (C.1.1.E). Appendix B lists the water quality monitoring sample sites in 2014 and planned sites in 2015.

3. Monitor Endangered Fish – The Upper Colorado River Endangered Fish Recovery Program continues to conduct population monitoring in the Gunnison River (C.3.1) and the Fish and Wildlife Service and Colorado Parks and Wildlife continue to collect fish tissue plugs to determine selenium concentrations in endangered and native fishes (C.3.2).

4. Report Annual Progress – This annual report represents the annual progress of the Selenium Management Program (C.6). The USGS has completed a preliminary analysis of the Selenium Trend that incorporates data from 2013 (C.6.1). A copy of this draft report is attached for reference as Appendix D. As of FY15, funding has been identified to complete the report. The USGS intends to publish a report every 5 years that incorporates the annual water quality monitoring data collected from the trend sites. In summary, the analysis indicates a continuing downward trend in dissolved selenium at the Whitewater Site.

REFERENCES

(Mast et al.) Mast, M. Alisa, Taylor J. Mills, Suzanne S. Paschke, Gabrielle Keith, and Joshua I. Linard. "Mobilization of Selenium from the Mancos Shale and Associated Soils in the Lower Uncompahgre River Basin, Colorado." *Applied Geochemistry* 48. September 2014 (2014): 16-27. Web. 8 Jan. 2015. http://www.journals.elsevier.com/applied-geochemistry.

(USGS 2014) U.S. Geological Survey, Colorado Water Conservation Board, U.S. Bureau of Reclamation, Colorado River Water Conservation District, U.S. Fish and Wildlife Service, Bureau of Land Management, and Natural Resources Conservation Service. *Science Plan in Support of the Selenium Management Program, Lower Gunnison River Basin, Colorado (Selenium Science Plan)*. U.S. Geological Survey, 2014. Web. 8 Jan. 2015. http://www.seleniumtaskforce.org/images/Se_SciencePlan_06302014_Version1.pdf.

APPENDIX A -- PROGRAM ACTION PLAN

January ςφ, 2015 Version

Current activities for the Selenium Management Program are identified in the following tables. Separate tables are provided for activities that:

A. Reduce existing selenium load from existing sources
B. Prevent, minimize or mitigate potential new selenium loading from new activities
C. Provide for support for the Program or monitoring

Entities cooperating to complete an activity are identified, typically with the lead entity identified first. Schedules are shown where they have been identified by placing an "X" in the appropriate Federal fiscal year (Oct-Sept) column. When funding has not been secured for a specific fiscal year, an "*" will appear below the X. Funding sources are only identified when funding has been committed or assurances have been provided by an organization.

The following acronyms and abbreviations are used in the Action Table:

BR	Bureau of Reclamation
BSP	Basin States Salinity Control Program administered by Colorado Department of Agriculture's State Conservation Board (on- and off-farm projects)
BWP	Basinwide Salinity Control Program administered by Reclamation (off-farm projects)
CDPHE	Colorado Department of Public Health and Environment
CO	State of Colorado
Company	refers to an unidentified irrigation water provider; once contract is signed, a specific entity will be identified
CRSP MOA	Colorado River Storage Project Memorandum of Agreement
CRWCD	Colorado River Water Conservation District (AKA River District)
CWCB	Colorado Water Conservation Board
EQIP	Environmental Quality Incentives Program administered by NRCS (on-farm projects)
ESL	East Side Laterals Project located on the east side of the Uncompahgre Project area near Montrose & Delta
FOA	Funding Opportunity Announcement - Reclamation's Basinwide Salinity Program
LG	Lower Gunnison
NRCS	USDA Natural Resources Conservation Service
NWCC	North Fork River Improvement Association-Western Slope Environmental Resource Council (NFRIA-WSERC) Conservation Center
SCP	Colorado River Basin Salinity Control Program (composite organization including BR, NRCS, BLM, representatives of the 7 Colorado River basin states)
SMP	Gunnison Basin Selenium Management Program
STA	subject to appropriation
STF	Gunnison Basin and Grand Valley Selenium Task Force
TBD	to be determined
USGS	United States Geological Survey
UVWUA	Uncompahgre Valley Water Users Association
UP	Uncompahgre Irrigation Project
WWUC	Lower Gunnison Basin Wise Water Use Council
WNTSC	NRCS West National Technology Support Center, Portland
WS	WaterSmart

ID	Activity	Cooperating entities/programs	Start Date	Current Status	Prior years	FY 12	FY 13	FY 14	FY 15	FY 16	Out years	Est. funding needs	Funding sources	Funds in place?	Comments (with shortcomings highlighted)
	PART A - REDUCE EXISTING SELENIUM LOAD														
	ACCELERATE SE CONTROL PROJECTS FOR IRRIGATED AGRICULTURE														
A.1	**Off-farm – projects completed or underway**														
A.1.1	Uncompahgre Project - Winter Water Program	UVWUA/BR	1992	Completed in 1995	X										Eliminated winter flows in 407 miles of Uncompahgre Project canals & laterals 1992-1995 (controls 41,330 tons of salt annually)
A.1.2	Uncompahgre Project - East Side Laterals Phase 1	UVWUA/BWP/ NIWQP	1998	Completed in 2000	X										Piped 8.5 miles of laterals from 1998-2000; ESL Project is 4.4% complete. (controls 2,295 tons of salt annually)
A.1.3	Uncompahgre Project - East Side Laterals Phase 2	UVWUA/BWP/ NIWQP	2004	Completed in 2007	X										Piped 20.5 miles of laterals from 2004-2009; ESL Project is 14.9% complete. (controls 6,139 tons of salt annually)
A.1.4	Uncompahgre Project - East Side Laterals Phase 3	UVWUA/BWP/ NIWQP	2007	Completed in 2011	X										Piped 10.5 miles of laterals from 2007-2011; ESL Project is 20.3 % complete. (controls 2,292 tons of salt annually)
A.1.5	Uncompahgre Project - East Side Laterals Phase 4	UVWUA/BWP CDPHE	2008	Completed in 2012	X	X						$2.8M	BWP/ CDPHE	Yes	Piping of 11.4 miles is complete; Overall ESL Project is 26.1% complete (controls 3,651 tons of salt annually). Completed in 2012
A.1.6	Lower Grandview Canal & Laterals (North Fork Area)	Grandview Canal & Res. Co/ BWP	2009	Completed in 2011	X							$5.4M	BWP	Yes	10 miles of pipe in Alum Gulch drainage; Construction completed in 2012 & habitat replacement completed in 2013. (controls 4,588 tons of salt annually)
A.1.7	Uncompahgre Project - East Side Laterals Phase 5	UVWUA/BWP	2011	Completed in 2014	X	X	X	X				$4.3M	BWP	Yes	Piping of 19.0 miles of laterals completed in 2014; Overall ESL Project is 35.8% complete (controls 5,037 tons of salt annually)
A.1.8	Uncompahgre Project - East Side Laterals Phase 6A (EC Lateral Lining Demonstration Project)	UVWUA/BR/ CWCB/BSP	2011	Completed in 2013	X	X	X					$2M	CWCB/BSP	Yes	Lining of 2.0 mile project completed in 2013. Overall ESL is 36.7% complete (controls 1,374 tons of salt annually)
A.1.9	Uncompahgre Project - East Side Laterals Phase 7	UVWUA/BSP	2011	Underway, 23% Completed	X	X	X	X	X	X		$3.2M	BSP	Yes	Plan is to pipe 12.7 miles of laterals; Overall ESL will be 43.2% complete (controls 3,029 tons of salt annually)
A.1.10	Lower Stewart Pipeline Project (North Fork area)	Stewart Ditch & Res. Co/ BWP	2012	Underway, 90% Completed		X	X	X	X			$6.0M	BWP	Yes	Plan is to pipe 11.5 miles of lower Stewart Ditch & laterals; (controls 10,920 tons of salt annually); Additional piping & salt reduction to occur under current agreement.
A.1.11	Minnesota Ditch – Phase 1 (North Fork area)	Minnesota Canal & Res. Co/BWP	2011	Completed in 2014	X	X	X	X				$3.9M	BWP	Yes	Piping of 5.2 miles of upper Minnesota Ditch Construction completed in 2013; (controls 3,263 tons of salt annually)
A.1.12	C Ditch/Needle Rock Project (North Fork)	C Ditch Co /BWP	2014	Completed in 2014				X				$1.4M	BWP	Yes	Piped 2.5 miles of the irrigation ditches within the C Ditch/Needle Rock Project; Construction completed in 2014 (controls 1,283 ton salt annually)
A.1.13	Clipper Ditch Project 4 – Spurling & Drake Laterals (North Fork)	Clipper Ditch CO/ BWP	2014	Underway				X	X			$1.2M	BWP	Yes	Plan is to pipe 3.5 miles of the irrigation canals within the Clipper Ditch Project; (controls 1,038 tons of salt annually)
A.1.14	Uncompahgre Project - East Side Laterals Phase TBD (from CRSP MOA)	UVWUA/BR		Planning Phase		X	X	X	X			$5M	BR CRWCD	Yes	Consideration of which laterals or canals to pipe or line and schedule is underway; Funding committed from both FY12 and FY13 CRSP MOA Funding. Funding thru 2025
A.1.15	Minnesota Extension, phase 2 (North Fork)	MC&R C/BWP	2014	Underway			X	X	X			$3.0M	BWP	Yes	Plan is to pipe 3.8 miles of irrigation ditches which serves 950 acres. Is an extension of A.1.11; (controls 2,328 tons of salt annually)
A.1.16	Slack/Patterson Lateral-Roger's Mesa (North Fork)	RMWDA/BWP Association	2014	Underway			X	X	X			$3.3 M	BWP	Yes	Plan is to pipe 9.0 miles of irrigation ditches on Roger's Mesa. (controls 3,345 tons of salt annually)
A.1.17	Uncompahgre Project- Eastside Laterals Phase 8	UVWUA/BWP	2014	Underway				X	X	X	X	$3.5M	BWP	Yes	Plan is to pipe 14.0.miles of laterals; Overall ESL will be 50.3% complete, 98.6 of 196 mi. completed. (controls 3,307 tons of salt annually)
A.1.18	Cattleman's Project (North Fork)	CCISIC/BWP	2015	Construction to start in 2015			X	X	X	X		$2.0M	BWP	Yes	Plan is to pipe 6.0 miles of irrigation ditches (Hart, McLaughlin, Rockwell & Poulsen Ditches); (controls 1,855 tons of salt annually)
A.1.20	2012 FOA BSP Project - Bostwick Park, Siphon Lateral Project (Lower Gunnison)	BPWCD./BSP	2014	Underway			X	X	X			$0.7M	BSP	Yes	Plan is to pipe 1.76 miles of laterals; (controls 413 tons of salt annually)
A.1.21	2012 FOA BSP Project - Zanni Lateral (Crawford)	CWCD./BSP	2014	Underway			X	X	X			$1.0M	BSP	Yes	Plan is to pipe 1.6 miles of the Zanni Lateral. (controls 551 tons of salt annually)

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A.1.22	2012 FOA BSP Project - Forked Tongue-Holman Ditch Company (Lower Gunnison)	FT/HDC/BSP	2014	Underway			X	X	X			$0.7M	BSP	Yes	Plan is to pipe 1.32 miles of multiple user and 0.57 miles of single user ditches. (controls 412 tons of salt annually, 354 tons off-farm & 58 tons on-farm)
A.1.23	M&D and Ironstone Headgate Automation (SCADA)	BOR/SCTF/ UVWUA	2013	Completed in 2014			X	X				$82K	WS/SCTFUVWUA	Yes	Demo use of SCADA that will be applied to the eastside. Complete – Awaiting agreement close-out
A.1.24	Bostwick Park System Optimization	CWCB/BOR	2014	Underway				X	X						Completion expected in 2015
A.2	**Off-farm – future projects**														
A.2.1	Participate in Salinity Control Program - Lower Gunnison Comprehensive Plan effort	CRWCD/ BR/ CWCB/ NRCS/ BSP/SMP	2012	Completed		X	X	X				$150K	BSP	Yes	Study is examining how to best promote & implement future salinity control projects in LG Basin for both On & Off-Farm. Potential selenium reduction benefits. Final report Feb. 2014
A.2.2	2012 Salinity Funding Opportunity Announcement	BWP/BSP	2012	Last agreement signed in 2014		X	X	X				$14.3M	BWP/ BSP	Yes	For projects upstream of Hoover Dam; awarded 7 new projects within the Lower Gunnison Basin in 2013-14. See A.1.15 through A.1.22
A.2.3	2015 Salinity Funding Opportunity Announcement	BWP/BSP	2015	Planning Phase					X	X		~$25-35M	BWP/BSP	Yes (STA)	Pre-FOA planning in winter 2014, FOA anticipated in summer FY15.
A.2.4	Identify & prioritize target areas & potential projects	BR/USGS/SMP		On-going		X	X	X	X			$30K	BR	Yes	Includes examination of influence of Bostwick Park water use on UP loading USGS Study to develop Bostwick Park Water Budget waiting on Interagency Agreement Funding.
A.2.4.3	Formulate proposals for future FOAs and grants	UVWUA/BR/ SMP		Underway		X	X	X	X	X *	X *	~470k	UVWUA / BR	Yes	Reclamation and UVWUA continue to work on advance planning for completing the ESL.
A.2.4.4	RCPP Grant Submittal. System Optimization and modernization.	BPWCD/CWCD/NFWCD/UVWUA/NRCS/CRWD		Underway				X	X			$20M	NRCS	Yes	
A.2.4.5	Technical Assistance Grants to Water Users, 2012 FOA	SMP/CWCB/ DCD	2012	Completed		X	X					$62K	CWCB	Yes	State of Colorado committed up $100K to assist water users in the Lower Gunnison Basin with development of proposals for the FY12 Salinity FOA.
A.2.4.6	Technical Assistance Grants to Water Users, 2015 FOA	SMP/CWCB/ DCD	2014	Underway					X			$150K	CWCB	Yes	Potential Selenium reduction
A.2.4.7	CWCB leading effort planning to identify regional optimization opportunities outside the Uncompahgre Project.	CWCB/Others		Underway			X	X	X			$100K	SCTF	Yes	~10K in FY14, SMP will discuss the merits of include west side of Uncompahgre Project. May include Westside of Uncompahgre Project
A.2.5	**Encourage/facilitate remaining phases of Uncompahgre Project - East Side Laterals**														
A.2.5.1	Step 1 of East Side - Uncompahgre Project optimization planning. Rapid Assessment Study.	CWCB/Cal Poly/UVWUA		Completed in 2010											Rapid Assessment completed in 2010
A.2.5.2	East Side - Uncompahgre Project optimization planning	Cal Poly/CRWCD/ UVWUA/BR/ CWCB/CDPHE	2014	Underway		X	X	X	X			$280K	CDPHE/ CWCB	Yes	Study identified how best to pipe & line east side delivery system & provide more manageable facilities for UVWUA. Currently, final report has not been publically released.
A.2.5.3	West Side - Uncompahgre Project optimization planning, including SCADA	Cal Poly/CRWCD/ UVWUA/BR/ CWCB/CDPHE	2014	Underway					X	X		$35K	CDPHE/ CWCB	partial	Study identified how best to pipe & line west side delivery system & provide more manageable facilities for UVWUA

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A.3	**On-farm -projects completed**														
A.3.1	On-Farm EQIP and Basin States Program Improvements	Landowners/ NRCS/BSP		Ongoing	X	X	X	X	X	X	X				NRCS (2011, 2012 ,2013& 2014) Dollars listed do not include Technical Assistance provided by NRCS funded through EQIP. FY2011 NRCS- 1,803 acres treated in FY10 with cumulative effort totaling 57,588 acres since 1988; figures include all accomplishments of Parallel & Basin States Programs; overall plan is 43% complete FY2012 -Total acres contracted for Gunnison River Basin (Delta and Montrose Counties): 2,163 ac (NRCS EQIP Salinity), 6,635 ac (BSP) -Total dollars obligated for Gunnison River Basin (Delta and Montrose Counties): $3,843,296 (NRCS EQIP Salinity), $496,634 (BSP) FY2013 -Total acres contracted (EQIP Salinity) for Gunnison River Basin (Delta and Montrose Counties): 1,888 ac (NRCS EQIP Salinity, 323 ac (BSP) -Total dollars obligated for Gunnison River Basin (Delta and Montrose Counties): $3,293,604 (NRCS EQIP Salinity), $646,205 (BSP) FY2014 - Total acres contracted (EQIP Salinity) for Gunnison River Basin (Delta and Montrose Counties): 2,145 ac (NRCS EQIP Salinity, 40 ac (BSP) - Total dollars obligated for Lower Gunnison River Basin (Delta and Montrose Counties): $4,851,485 (NRCS EQIP Salinity), $157,681 (BSP)
A.4	**On-farm – underway & future projects**														Plan is to treat 50-60% of remaining acreage
A.4.1	Participate in Salinity Control Program - Lower Gunnison Comprehensive Plan effort	CRWCD/ BR/ CWCB/ NRCS/ BSP/SMP	2012	Completed in 2014		X	X	X				see funding for A.2.1	BSP	Yes	Study is examining how to best promote & implement future salinity control projects in LG Basin for both On & Off-Farm. Potential selenium reduction benefits. Final report Feb. 2014
A.4.2	Implement EQIP-funded irrigation efficiency improvements	Landowners/ NRCS	1988	Underway				X	X *	X *	X *		NRCS	Partial (STA)	
A.4.3	Implement BSP-funded irrigation efficiency improvements	Landowners/ BSP/ CWCB		Underway		X	X	X	X *	X *	X *		Basin Funds	Partial	
A.4.4	Improve Irrigation Water Management	Landowners/ conservation districts		Underway		X	X	X	X *	X *	X *		Basin Funds	Partial	Delta District & Shavano District staff help landowners improve water management
A.4.5	ON-farm Irrigation BMP Demonstration Projects	Landowner/ GBSTF/Cons Districts/CWCB		Underway			X	X	X			~$100K	SCTF/CRWCD/ Landowners/ NRCS		Intended to demonstrate and evaluate practices and improvements that may not be included in the existing programs.
A.4.6	Meaker Big Gun Demo	Landowner/ GBSTF/Cons Districts/CWCB		Underway				X	X			$210K	SCTF/CRWCD/ Landowners/ NRCS	Yes	Demonstrate the feasibility of using Big Gun Sprinkler systems on Adobe soils in irregular shaped parcels.
SE CONTROL PROJECTS FOR EXISTING PONDS															
A.5	**Ponds (recreational, farm, aesthetic)**														
A.5.1	Formulate program to address existing pond seepage	SMP		Not begun										No	Studies (see C.1.) are proposed to examine loading impacts of ponds and develop selenium control concepts.
A5.2	Delineate and inventory ponds using 2011 aerial photos	SCD		Complete			X	X				~$4K	SCTF	yes	Includes perched, size, soils for Lower Uncompahgre, Lower reaches of North Fork to Delta
A5.3	Analyze existing pond data and identify gaps and priority ponds or areas	USGS/NRCS/BR		TBD				X *	X *			~$100K	SCTF/ BR/BSP	No	Include in future modeling in to address pond significance.
SE CONTROL PROJECTS FOR OTHER EXISTING NON-AG SOURCES															
A.6	**Municipal & industrial**														
A.6.1	Explore options for selenium management from sewage treatment plants	Operators/ CDPHE		Not begun										No	SMP to evaluate need and benefits in future
A.6.2	Explore options for selenium management from Individual Sewage Disposal Systems	Operators/ CDPHE		Not begun										No	

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A.6.3	Delineate and inventory septic using GIS	USGS/SCTF/USBR		ongoing				X *	X			$15K	SCTF	partial	19,000+ systems identified. Will look at Tri-county water to estimate annual septic volume
A.6.4	Explore options for selenium management involving gravel pits	Operators/ CDPHE		Not begun										No	Needs to be developed
A.7	Public lands (administered by BLM)	BLM		Ongoing		X	X	X	X				BLM	Yes	BLM to Address selenium in new Resource Management Plans
OUTREACH AND EDUCATION INITIATIVES TO ADDRESS ALL EXISTING SELENIUM SOURCES															
A.8	Conduct public information and education program	SMP		Underway		X *	X *	X *						Partial	Will work with Wise Water Use Council
A.8.1	SMP Education and Outreach Committee	GBSTF/SMP	2013	Underway			X	X	X			~$5K	GBSTF/BR/DCD/SCD/Others	Yes	Each agency cover costs of salaries for participation (in kind services)
A.8.2	Collaborate with the Lower Gunnison Basin Soil Health Team to education the public about selenium reduction and soil health	STF/NRCS	2013	Underway			X	X	X			~$1K	CRWCD	Yes	Table/booth at FY14 Soil Health Conference; STF presentation and booth at FY15Soil Health Conference
A.8.3	Collaborate with local water providers to educate stakeholders about selenium related issues and the importance of on-farm and off-farm selenium reduction activities	STF/SMP		Underway			X	X	X *	X *	X *	~$1K	CRWCD	Yes	STF presentation at February 2014 UVWUA Annual Meeting; Other water providers being contacted to gage interest in selenium presentation to other boards.
A.9	Develop strategies to support, facilitate, encourage LG water users to undertake projects that have Se control benefits	SMP		Not begun		X *								No	
PART B - PREVENT/MINIMIZE/MITIGATE NEW SELENIUM LOADING (primarily for potential municipal, residential & industrial sources)															
B.1	Refine, distribute, & promote Best Management Practices (BMPs)	SMP/STF/ WWUC		Underway		X *	X *	X *	X *	X *	X *		BR/ CRWCD	Partial	Existing BMPs can be found at http://seleniumtaskforce.org/wisewateruseinfo.html
B.1.2	Minimize New Sources using BMPs and other methods (Ponds, Septic system & other sources)	SMP/STF		TBD				X *	X *			Unk	Unk	No	Needs continued discussion by SMP workgroup in 2015. Also being addressed by Education and Outreach committee. See A.8.1
B.2	**Conduct public information & education program**														
B.2.1	Present information/education activities	SMP/ WWUC/STF		Underway		X	X	X *	X *	X *	X *		BR/ CRWCD	Partial	Lower Gunnison Wise Water Use Program underway. Funding through 2012.
B.2.2	Promote Soil Health Initiative	NRCS/DCD/SCD		Ongoing				X	X			UNK	UNK	No	SMP to work with existing and developing Soil Health Initiatives including BMPs Potential to reduce selenium loading
B.3	**Encourage management actions to control loading from proposed actions which involve:**														
B.3.1	Reclamation projects and actions	BOR		Ongoing		X	X	X *	X *	X *	X *		BR	Partial	
B.3.2	BLM managed lands	BLM		Ongoing		X	X	X *	X *	X *	X *		BLM	Partial	
B.3.3	Other Federal actions	USFWS/ TBD		Ongoing		X	X	X *	X *	X *	X *		USFWS/TBD	Partial	
B.3.4	Counties/cities	Counties/ cities		Not begun		X	X	X *	X *	X *	X *				
	PART C - SUPPORT ACTIVITIES														
C.1	**Expand knowledge base**														
C.1.1	**Investigate loading and fate & transport mechanisms**														
C.1.1.A.1	Effects of Recharge and Dissolved Nitrate (Seq. Extract Study aka Column Study) (Phase I)	BR/USGS		Completed		X	X	X				$185K	BR	Yes	Funding from BR Science & Technology Program & USGS Final Report was published in 2014
C.1.1.A.2	Geochemical characterization of selenium in Mancos Shale derived soils and shallow aquifer sediments in the Lower Gunnison River Basin (phase II)	BR/USGS/SCTF/NRCS	2014	Underway				X	X	X		$199K	SCTF/USGS	Yes	
C.1.1.B.1	Characterization of Salinity and Selenium Loading and Land-Use Change in Montrose Arroyo, Western Colorado, from 1992 to 2010, phase 1	USGS/BR		Completed in 2012	X	X						$98K	BR	Yes	Characterization of Salinity and Selenium Loading and Land-Use Change in Montrose Arroyo, Western Colorado, from 1992 to 2010 http://pubs.usgs.gov/sir/2011/5106/

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C.1.1.B.2	Characterization of Salinity and Selenium Loading and Land-Use Change in Montrose Arroyo, Western Colorado, from 1992 to 2013, phase 2	USGS/BR	2011	On-going		X	X	X	X			$98K	BR	Yes	Characterization of Salinity and Selenium Loading and Land-Use Change in Montrose Arroyo, Western Colorado, from 1992 to 2013 Reprt anticipated to be completed in the early part of calendar year 2015.
C.1.1.C	Study of Influence of Water-table Elevated Changes on Selenium Concentrations in Saturated Mancos Shale Derived Soils of the Lower Gunnison River Basin, Colorado (Wetlands Study)	USGS/SCTF/BR		Underway		X	X	X	X			$220K	SCFT/USGS/BR	Yes	4 wells constructed in FY13 using BR Provo Drill Crew, Monitoring being completed by USGS
C.1.1.D	Installation of 30-Well Eastside GW Monitoring Network and Monitoring	USGS/SCTF/BR		Completed		X	X	X *				$434K	SCTF/ USGS/ BR	Partial	10 well installed in FY13 @ ~$190K including BR Provo Drill Crew Costs; ~$144K (SCTF/USGS) & ~$100K (BR) in FY14 for construction of the 20 additional.
C.1.1.E	Monitoring of 30-Well GW Network	USGS/SCTF/BR		Underway			X	X	X	X *	X *	$67K 13 $139K14	SCTF/ USGS	Partial	FY13 Monitoring of 10 wells completed, FY 14-Five Year Proposal to be reviewed by Science Team
C.1.1.F	Real-time Selenium Monitoring, 5 of sites	CRWCD/USGS/BR/BLM		Ongoing		X	X	X	X	X	X	$85k	USGS/BR/BLM	Partial	85k includes 20 salinity stations in CRB
C.1.2	Investigate loading impacts of Non-Ag sources including ponds, ISDS & other point/non-pt. sources	USGS/SMP		Proposed					X	X		$15k	USGS/USBR/SCTF	Partial	ISDS = individual septic disposal systems Part of Model
C.1.3	Investigate solutions & BMPs for Non-Ag sources	SMP		Proposed										No	
C.1.4	Development of soil selenium interpretation	WNTSC		Underway		X	X	X	?				NRCS	Yes	Funding included in NRCS's general Technical Assistance.
C.1.5	Develop 5 Year Science Plan	USGS/SMP		Completed			X	X				$129k	SCTF/ USGS	Yes	Plan was finalized in 2014 approved by the SMP Workgroup. Workgroup to document and approve updates as needed.
C.2	**Monitor water quality**														
C.2.1	Collect periodic samples at core monitoring network (e.g., 6-9/yr.)	CRWCD/ USGS/BR/ CDPHE/ NWCC		Ongoing		X	X	X	X *	X *	X *			Partial	Please see Appendix B
C.2.2	Operate continuous WQ monitors	CRWCD/ USGS/BR		Ongoing		X	X	X	X *	X *	X *			Partial	Please see Appendix B
C.2.3	Collect periodic samples at ancillary sites	USGS,CRWCD, CDPHE, STF, Others		Ongoing		X *	X *	X *	X *	X *	X *			Partial	Please see Appendix B
C.3	**Monitor endangered fish**														
C.3.1	Population Sampling	Recovery Program		Ongoing		X	X	X *	X *	X *	X *		FWS /BR		Funding and investigations provided through UCRRIP
C.3.2	Fish tissue Plugs to determine selenium concentrations	FWS		Ongoing		X	X	X	X *		X *		FWS/ CPW	Partial	In-kind services. August 2014 Fish Population Sampling: 16 Colorado pikeminnow, 1 razorback sucker, and 4 bonytail. 2014 from the Redlands fish ladder: 1 Colorado pikeminnow, 7 razorback suckers, and 3 bonytail.
C.3.2.1	USGS Open-File Report 2013-1104	USGS/FWS		Completed		X	X							Yes	Report entitled "Determination of Selenium in Fish from Designated Critical Habitat in the Gunnison River, Colorado, March through October, 2012"
C.4	Obtain funding for SMP activities	SMP/STF		Underway		X	X	X *	X *	X *	X *			Partial	
C.5	**Develop new technology**														
C.5.1	Investigate canal sealants	BR/ UVWUA		Underway		X							BR	Partial	Working with EPA on application rates. Programmatic NEPA underway. Application of PAM not permitted on Reclamation Projects or with Reclamation funding
C.6	Report annual progress	BR		Due January of each year		X	X	X	X	X *	X *		BR	Partial	Address WQ, updated load/concentration trend plots, biological monitoring, construction progress & outreach/education.
C.6.1	Selenium Trend Analysis	USGS		Ongoing			X	X	X	X	X	$210K	BR	Yes	Draft Selenium Trend Analysis Reports included as part of annual report to FWS

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APPENDIX B – 2014 WATER QUALITY SAMPLE SITES

2013 USGS Water-quality sites in the Lower Gunnison Basin associated with the SMP

09129600 Smith Fork near Lazear, CO
09136100 North Fork Gunnison River above mouth nr Lazear, CO
384624107570701 Gunnison River at 2200 Road Bridge, at Austin, CO
09137500 Gunnison River near Cory, CO
384617108022901 Gunnison R abv Hartland Ditch nr Delta, CO
09144200 Tongue Creek at Cory, CO.
09146200 Uncompahgre R nr Ridgway, CO
09147500 Uncompahgre R at Colona, CO
382802107513301 Montrose Arroyo at East Niagara Street
383041107544201 Cedar Creek near mouth
383946107595301 Loutsenhizer Arroyo at North River Road
384202108032001 Dry Creek at mouth, near Delta
09149500 Uncompahgre R at Delta, CO
09144250 Gunnison R at Delta, CO
384448108070301 Cummings Gulch at mouth
09150500 Roubideau Creek at mouth near Delta, CO
384527108152701 Gunnison River above Escalante Creek, near Delta,CO
385011108225401 Gunnison River bl Dominguez Creek near Whitewater
09152500 Gunnison River near Grand Junction, CO

2014 USGS Water-quality sites in the Lower Gunnison Basin associated with the SMP

09129600 Smith Fork near Lazear, CO
09136100 North Fork Gunnison River above mouth nr Lazear, CO *
384624107570701 Gunnison River at 2200 Road Bridge, at Austin, CO
09137500 Gunnison River near Cory, CO
384617108022901 Gunnison R abv Hartland Ditch nr Delta, CO
09144200 Tongue Creek at Cory, CO.
09146200 Uncompahgre R nr Ridgway, CO
09147500 Uncompahgre R at Colona, CO *
382802107513301 Montrose Arroyo at East Niagara Street
383041107544201 Cedar Creek near mouth
383946107595301 Loutsenhizer Arroyo at North River Road
384202108032001 Dry Creek at mouth, near Delta
09149500 Uncompahgre R at Delta, CO *
09144250 Gunnison R at Delta, CO *
384448108070301 Cummings Gulch at mouth
09150500 Roubideau Creek at mouth near Delta, CO
384527108152701 Gunnison River above Escalante Creek, near Delta,CO
385011108225401 Gunnison River bl Dominguez Creek near Whitewater
09152500 Gunnison River near Grand Junction, CO (aka Whitewater site) *

* *Denotes real-time, continuous monitor sites using linear regression to calculate instantaneous dissolved selenium loads.*

2014 Selenium Task Force Water-quality sites in the Lower Gunnison Basin associated with the SMP

USGS 09146200	Uncompahgre River near Ridgway, CO
USGS 381716107454301	Billy Creek at Mouth
USGS 381933107455101	Onion Creek at County Rd 906A near Colona
USGS 382034107464501	Beaton Creek at Uncompahgre Rd near mouth
USGS 09137050	Currant Creek, near Read, CO (Bridge at mile marker 8 on Hwy 92)
USGS 384812107524501	Oasis Ditch at Hwy 92
USGS 384802107522201	Lawhead Gulch at Hwy 92
USGS 384752107502201	Sulphur Gulch at Hwy 92
USGS 384756107490801	Big Gulch at Hwy 92
USGS 384747107430501	Short Draw west of County Fairgrounds at Hotchkiss
USGS 384915107412101	Jay Creek at Hwy 133 near mouth

APPENDIX C – GUNNISON BASIN SELENIUM MANAGEMENT PROGRAM WORKGROUP GROUND RULES

July 2013

Gunnison Basin Selenium Management Program
Workgroup Ground Rules
July 2013

BACKGROUND:

The Selenium Management Program[1] ("Program" or "SMP") has been developed as part of a broad-based cooperative effort to provide water security, environmental compliance and regulatory certainty for water users in the Gunnison Basin of western Colorado. Developed in response to the 2009 Gunnison Basin Programmatic Biological Opinion ("PBO"), the program guides the efforts of public and private agencies and organization in controlling selenium to meet the dual objectives of:

1) Complying with Clean Water Act requirements, and
2) Assisting in the recovery of several endangered fish species in order to comply with the Endangered Species Act.

The program is designed to benefit water users and regional economies by protecting existing and future water uses through the acceleration of the improvement of irrigation system infrastructure and related on-farm irrigation improvements and practices that reduce selenium (and associated salinity) loading and enhance agricultural productivity. The program also expands efforts to control selenium from non-agricultural sources and to improve scientific understanding of selenium fate and transport.

SMP ORGANIZATION AND STRUCTURE:

Participation is open to all interested parties with a demonstrated stake in the success of the Gunnison Basin SMP and as accepted by the SMP Management Committee. The SMP accomplishes the implementation of selenium control and mitigation activities through a committee and subcommittee structure as follows:

Management Committee:

The SMP Management Committee is comprised of those entities that are specifically recognized in the PBO and/or who later signed the MOU to develop the Program Formulation Document ("PFD") dated December 2009. The Management Committee addresses policy issues, assures that adequate progress is being made, provides resources, provides input and oversight to the Work Group, and selects the preferred strategy. The Area Manager of the Reclamation's Western Colorado Area Office serves as the Management Committee lead. The members of the Management Committee are a representative of the following entities:

[1] See Selenium Management Program, Program Formulation Document, Gunnison River Basin, Colorado dated December 2009, prepared by Selenium Management Program Workgroup and compiled by the Bureau of Reclamation.

-U.S. Bureau of Reclamation

-Colorado Water Conservation Board

-Uncompahgre Valley Water Users Association

-U.S. Bureau of Land Management

-U.S. Fish and Wildlife Service

-Natural Resources Conservation Service

-Gunnison Basin and Grand Valley Selenium Task Force

-Colorado River Water Conservation District

SMP Workgroup:

Members of the Management Committee may designate a staff person to serve and actively participate in the SMP Workgroup. Workgroup meetings will be scheduled quarterly or more frequently as needed throughout the year. With Management Committee concurrence, the Workgroup may be enlarged to include representatives of those entities with a direct interest in the success of the SMP or are uniquely positioned to facilitate implementation of selenium control measures. Reclamation serves as the workgroup lead. The Workgroup is responsible for:

1) Establishing subcommittees, as needed,
2) Directing and reviewing the work performed by subcommittees,
3) Developing SMP priorities and guidance,
4) Identifying and pursuing resources,
5) Coordinating the planning and implementing reduction and prevention measures,
6) Annually updating the SMP Action Plan (approved by the Management Committee)
7) Assisting in preparation of annual progress reports, and
8) Reporting to the Management Committee.

Subcommittees:

Subcommittees are established for specific purposes and work under the general direction of the workgroup. A coordinator for each subcommittee will be designated by the Work Group. Standing subcommittees include the following:

Science and Research Subcommittee: This committee is responsible for identifying the science and research needs of the Program. The Science Subcommittee is also responsible for recommending science and research priorities. Research proposals and requests for funding should be reviewed and recommended by this subcommittee prior to being discussed by the Workgroup. As appropriate, this subcommittee distributes results and publications to the Work Group. This subcommittee also coordinates water quality monitoring activities and manages water quality data. See SMP Action Plan Items listed under C1, C2 & C3 for additional detail.

Technical Subcommittee: This subcommittee is responsible for identification and technical review of potential load reduction measures for existing selenium sources and of prevention measures for potential new sources. The Technical Subcommittee also evaluates technical proposals submitted to the SMP for support and guidance. See SMP Action Plan Items listed under A1-A7, and C5 for additional detail.

Outreach Subcommittee: This subcommittee is responsible for identifying, prioritizing, and implementing public education and outreach needs related to the Program. Activities include developing clear and consistent outreach messages, promoting and encouraging public participation and involvement, developing outreach materials, giving presentations, and organizing and sponsoring outreach events. See SMP Action Plan Items listed under A8, A9, B1 & B2 for additional detail.

SMP WORKGROUP DECISION MAKING

The SMP Workgroup will strive for widespread agreement (informed consensus) and operate under the following guiding principles.

-All workgroup participants should be involved in the process.
-All workgroup participants are expected to participate by contributing opinions and suggestions.
-Each workgroup participant has an equal voice in the final recommendation
-Workgroup participants will collaborate and build upon each other's concerns and suggestions to come up with a decision or solution that best meets the objectives of all participants.
-All workgroup participants will work towards a common solution, despite differences.
-The SMP Workgroup meeting agenda shall clearly identify when a decision is needed.
-Agendas will be provided before the meetings and will be followed. Items not on the agenda will be discussed at the end as time allows.
-Meeting summaries will be prepared and distributed and will include clearly identify action items and decision with supporting rationale made by the SMP Workgroup.

SMP Decision Making Process:

The SMP Workgroup decision making will follow the steps identified below:

Step 1: SMP Decisions process should be initiated at SMP Workgroup Meetings to ensure as much SMP Workgroup member participation as possible. After general discussion, Reclamation will ask if there are any remaining concerns. If there are no additional concerns, the decision will be documented and the workgroup will assign task responsibilities or direct implementation to the appropriate subcommittee.

Step 2: If there are remaining concerns, additional discussion is needed. Then, repeat Step 1.

Step 3: If there are still remaining concerns, the SMP workgroup will decide to do one of the following:

a) Forward it to the Management Committee with a list of unresolved concerns,
b) Adopted the decision with unresolved concerns listed, or
c) Declare that agreement cannot be reach at the meeting and table the proposal for another meeting.

APPENDIX D – LOWER GUNNISON RIVER BASIN WATER-QUALITY MONITORING PROGRAM

Summary, 2013

Selenium Management Program

2013 Annual Summary

Lower Gunnison River Basin Water-Quality Monitoring Program, Colorado

U.S. Geological Survey

Western Colorado Water Science Center

by John Mayo

Introduction

The primary goal of the Selenium Management Program (SMP), as recommended in the U.S. Fish and Wildlife Service Gunnison River Basin Programmatic Biological Opinion (PBO), is to meet the State of Colorado water-quality standard for dissolved selenium of 4.6 micrograms per liter at the U.S. Geological Survey (USGS) streamflow gage number 09152500 Gunnison River near Grand Junction, herein referred to as Whitewater (USFWS, 2009). A parallel goal is to continue implementation of management practices that will maintain or improve the existing downward trend in dissolved-selenium concentration. A downward trend in dissolved selenium from 1986 and 2008 has been documented at the Whitewater gage in the lower Gunnison River basin (Mayo and Leib, 2012). The long term goal of the SMP is to sufficiently improve water-quality conditions by reducing selenium concentrations sufficient to assist in the recovery of the Colorado Pikeminnow and Razorback Sucker. Selenium is a trace element that bio accumulates in aquatic food chains and can cause reproductive failure, deformities, and other adverse effects (Hamilton, 1998; Lemly, 2002).

The SMP has implemented a coordinated water-quality monitoring network in the Lower Gunnison Basin since 2011 (SMP Formulation Document, Part C, 2011). An analysis of dissolved-selenium data at 18 sites (fig.1) has been completed (table 1) and included 4 types of analysis:

A. Annual loading analysis using linear regression models for the five core USGS sites which have continuous streamflow gages;
B. Instantaneous loading analysis for 13 ancillary USGS sites where instantaneous water-quality sampling occurs. Instantaneous dissolved-selenium load can be calculated if the selenium sample was accompanied by a streamflow measurement;
C. 85th percentile analysis for all 18 sites; and

D. Selenium concentration trend analysis for Whitewater.

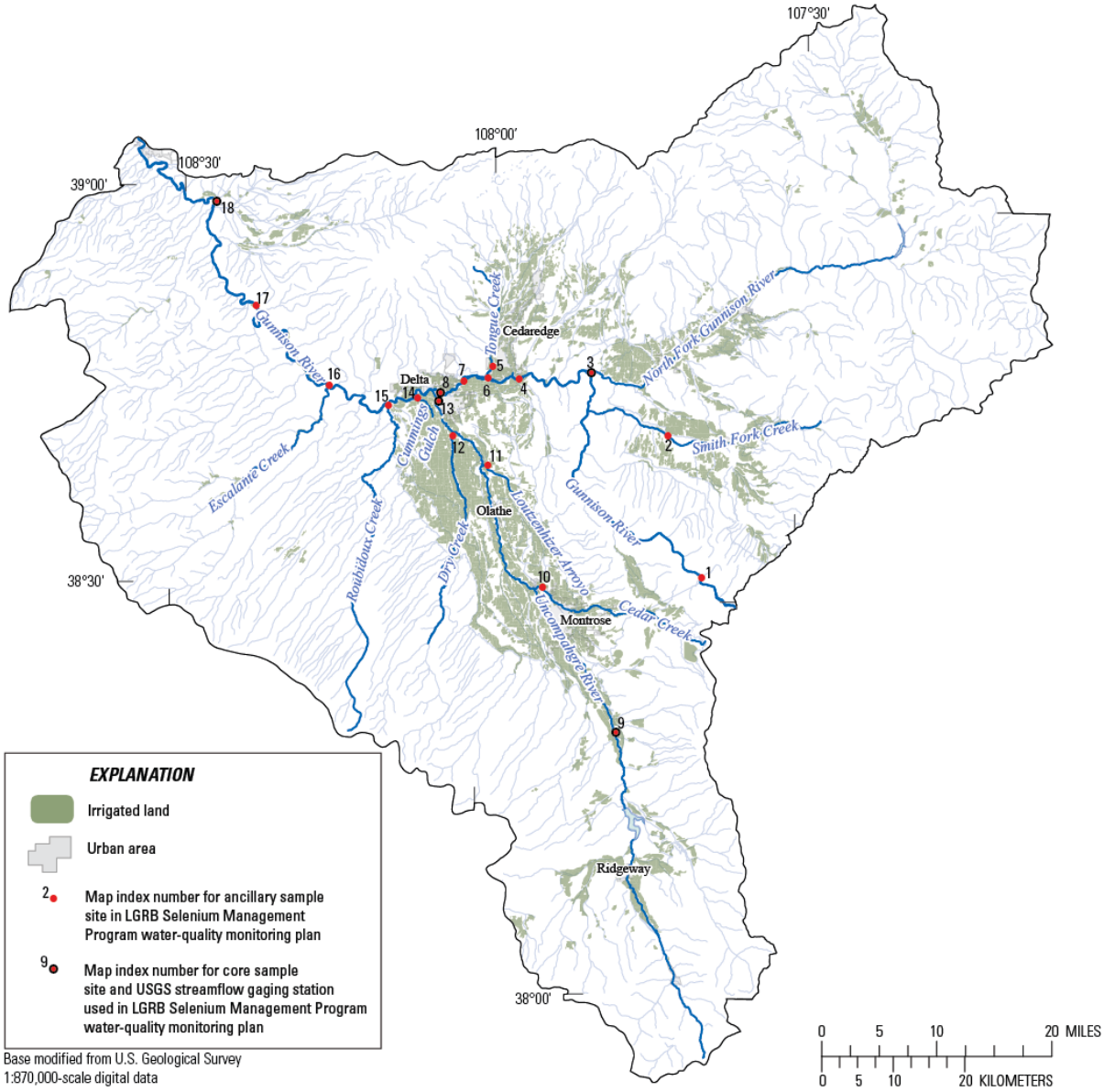

Figure 1. Location of 18 SMP water-quality monitoring sites in lower Gunnison River basin.

Table 1. Summary of tasks completed at 18 Selenium Management Program monitoring sites in the lower Gunnison River basin .

[USGS, U.S. Geological Survey; A) Annual loading analysis; B)Instantaneous loading analysis; C) Annual 85th percentile estimate; D) Instantaneous 85th percentile estimate; E) Trend analysis]

Map Index Number	Station Short Name (USGS Station Number)	Site Type	Analysis Type
1	Gunnison R. blw Gunnison Tunnel (09128000)	Ancillary	B,D
2	Smith Fork near Lazear (09129600)	Ancillary	B,D
3	North Fork Gunnison River near Lazear (09136100)	Core	A,C
4	Gunnison River at Austin (384624107570701)	Ancillary	B,D
5	Tongue Creek at Cory (09144200)	Ancillary	B,D
6	Gunnison River near Cory (09137500)	Ancillary	B,D
7	Gunnison River near Hartland Dam (384617108022901)	Ancillary	B,D
8	Gunnison River at Delta (09144250)	Core	A,C
9	Uncompahgre River at Colona (09147500)	Core	A,C
10	Cedar Creek near Mouth (383041107544201)	Ancillary	B,D
11	Loutzenhizer Arroyo at North River Road (383946107595301)	Ancillary	B,D
12	Dry Creek at mouth nr Delta (384202108032001)	Ancillary	B,D
13	Uncompahgre River at Delta (09149500)	Core	A,C
14	Cummings Gulch at Mouth (384448108070301)	Ancillary	B,D
15	Roubideau Creek near Mouth (09150500)	Ancillary	B,D
16	Gunnison River abv Escalante Creek (384527108152701)	Ancillary	B,D
17	Gunnison R. blw Dominguez Ck. (385011108225401)	Ancillary	B,D
18	Whitewater (09152500)	Core	A,C,E

Dissolved-Selenium Concentrations and Loads

Concentration boxplots for instantaneous dissolved-selenium samples are plotted from left to right in an upstream to downstream order for water years (WY) 2011-2013 in fig. 2. In general, the dissolved-selenium concentration increased from upstream to downstream. Dissolved-selenium concentrations generally range from 0.30 µg/l to 10 µg/l at most sites. Gunnison R. blw Gunnison Tunnel, and Loutzenhizer Arroyo at North River Road represent the lower and upper extremes

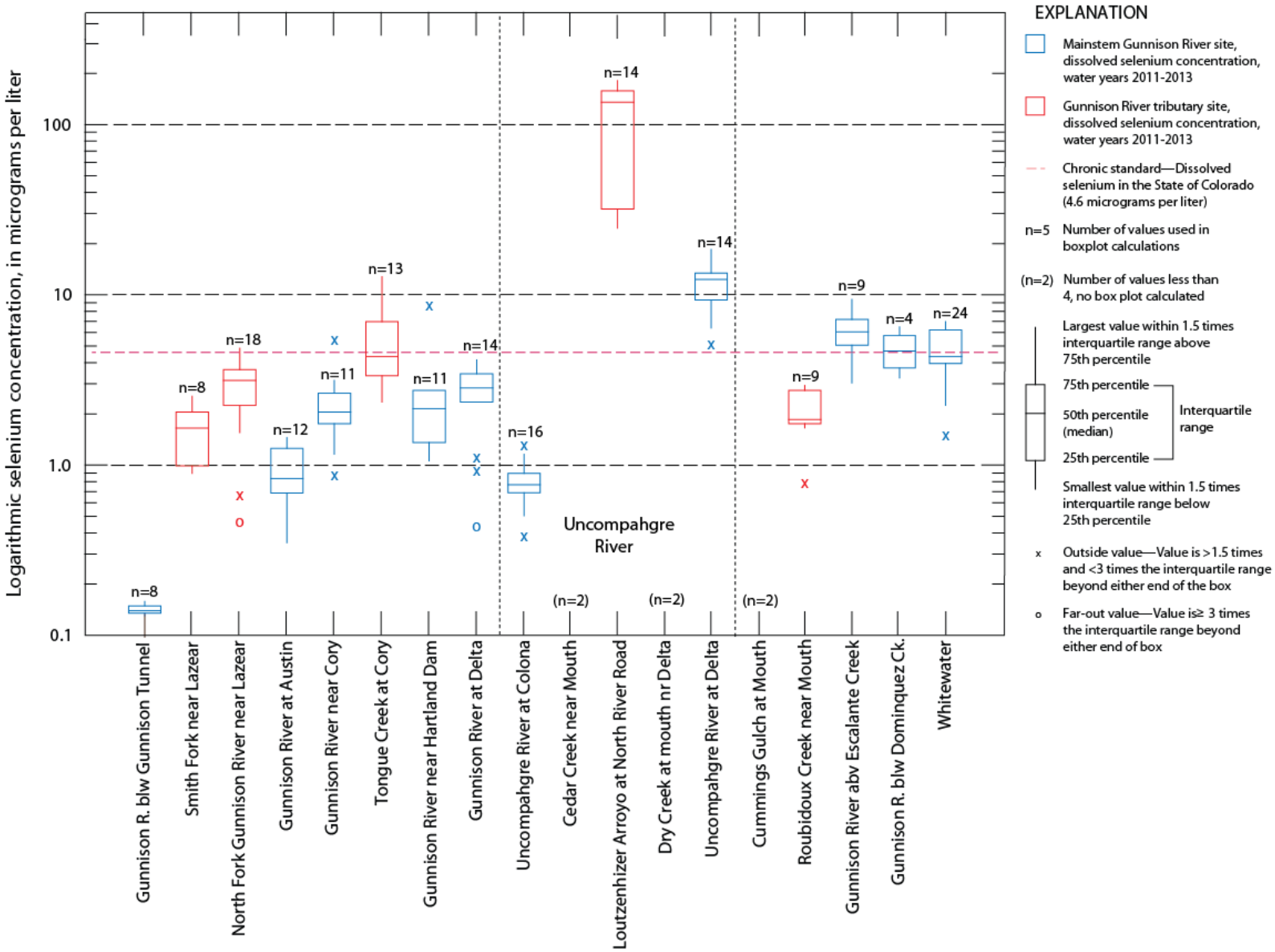

Figure 2. Dissolved-selenium concentration, in micrograms per liter, for instantaneous water-quality samples taken in water years 2011-2013.

respectively. Gunnison R. blw Gunnison Tunnel had instantaneous dissolved-selenium concentrations that were less than 1.00 µg/l for all samples, and Loutzenhizer Arroyo at North River Road had dissolved-selenium concentrations exceeding 100 µg/l.

Annual dissolved-selenium loads were estimated for the five core sites using multiple linear regression techniques in S–LOADEST (Runkel and others, 2004). Mayo and Leib (2012) report the methodology used to perform dissolved-selenium loading analysis. Instantaneous dissolved-selenium loads were calculated for the ancillary sites which do not have a continuous stream gage. These sites only have instantaneous water-quality sampling events which were accompanied by an instantaneous streamflow measurement. No annual loads were estimated at sites where instantaneous loading analysis was performed.

Results from the annual loading analysis for the five core sites in pounds per year are summarized in table 2. Annual load estimates for WY 2013 ranged from 179 pounds per year at Uncompahgre River at Colona to 11,100 pounds per year at Whitewater. Annual estimates for dissolved-selenium loads consistently decreased at all five core sites from 2011 to 2013.

Table 2. Estimated annual dissolved-selenium loads in pounds, using multiple linear regression techniques in S-LOADEST (Runkel and others, 2004) at five core sites with a U.S. Geological Survey gaging station for water years 2011-2013.

[USGS, U.S. Geological Survey; WY, Water year defined as October 1 – September 30]

Index number	USGS station ID	Station short name	Annual dissolved-selenium load, in pounds			
			WY 2011	WY 2012	WY 2013	Total for WY 2011-2013
3	09136100	North Fork Gunnison River near Lazear	1,580	1,050	967	3,600
8	09144250	Gunnison River at Delta	5,880	4,920	4,130	14,900
9	09147500	Uncompahgre River at Colona	391	194	179	764
13	09149500	Uncompahgre River at Delta	7,920	4,860	4,850	17,600
18	09152500	Whitewater	**17,300**	**12,800**	**11,100**	**41,200**

Table 3 shows median and mean daily selenium load in pounds per day for all 18 sites calculated using instantaneous water quality samples. Median daily loads ranged from 0.01 pounds per day for Smith Fork near Lazear to 35.9 pounds per day for Gunnison River abv Escalante Creek. Mean daily loads ranged from 0.06 pounds per day for Smith Fork near Lazear to 37.2 pounds per day for Gunnison River abv Escalante Creek. There were no selenium samples taken in 2013 at Gunnison R. blw Gunnison Tunnel, therefore the median and mean selenium load values for that site are for 2011 and 2012 only. Three sites (Uncompahgre River at Colona, Dry Creek at mouth nr Delta, and Cummings Gulch at Mouth) are new sites, with no samples for 2011 or 2012, and only two samples each for 2013, so instantaneous loads could not be calculated for these three sites.

In general, dissolved-selenium loads at mainstem Gunnison River sites show an increase from upstream to downstream (fig. 3). Most sites analyzed in the basin have a median instantaneous dissolved-selenium load of less than 20.0 pounds per day (lbs/d). Just downstream from the confluence of the Gunnison River and Uncompahgre River at site Gunnison River abv Escalante Creek, median selenium loads increase to over 35 lbs/d. Median values for dissolved-selenium load exceeding 30.0 lbs/d are reasonable based on data from sites Gunnison River at Delta (12.80 lbs/d) and Uncompahgre River at Delta (16.50 lbs/d) (table 3).

Changes in median dissolved-selenium load between sites along the mainstem Gunnison River are reported in table 4. The largest increase in dissolved-selenium load occurs between sites Gunnison River at Delta and Gunnison River abv Escalante Creek resulting from the Uncompahgre River input approximately 23.1 pounds per day. A slight decrease was measured between sites Gunnison River abv Escalante Creek and Whitewater at -2.70 pounds per day. Very little irrigation exists in this reach (fig. 1) that would contribute dissolved-selenium load.

Table 3. Median and mean dissolved-selenium instantaneous daily load, in pounds per day, for all 18 sites for water years 2011-2013.

[USGS, U.S. Geological Survey; WY, water year defined as October 1 – September 30; Site type: C, core; A, ancillary; --, insufficient data to calculate a value]

Index number	USGS station ID	Station short name	Site Type	Number of samples WY 2011	Number of samples WY 2012	Number of samples WY 2013	Median selenium load for sample years, in pounds per day	Mean selenium load for sample years, in pounds per day
1	09128000	Gunnison R. blw Gunnison Tunnel	A	4	4	0	0.57	1.22
2	09129600	Smith Fork near Lazear	A	0	2	6	0.01	0.06
3	09136100	North Fork Gunnison River near Lazear	C	6	7	5	2.84	3.44
4	384624107570701	Gunnison River at Austin	A	2	4	6	3.99	5.11
5	09144200	Tongue Creek at Cory	A	4	4	5	0.41	0.56
6	09137500	Gunnison River near Cory	A	1	4	6	8.30	9.94
7	384617108022901	Gunnison River near Hartland Dam	A	1	4	6	8.63	11.1
8	09144250	Gunnison River at Delta	C	4	5	5	12.8	15.1
9	09147500	Uncompahgre River at Colona	C	6	6	4	0.43	0.64
10	383041107544201	Cedar Creek near Mouth	A	0	0	2	--	--
11	383946107595301	Loutzenhizer Arroyo at North River Road	A	5	3	6	10.9	10.8
12	384202108032001	Dry Creek at mouth nr Delta	A	0	0	2	--	--
13	09149500	Uncompahgre River at Delta	C	4	5	5	16.5	15.2
14	384448108070301	Cummings Gulch at Mouth	A	0	0	2	--	--
15	09150500	Roubidoux Creek near Mouth	A	0	3	6	0.51	0.48
16	384527108152701	Gunnison River abv Escalante Creek	A	0	3	6	35.9	37.2
17	385011108225401	Gunnison R. blw Dominguez Ck.	A	0	0	4	30.9	30.3
18	09152500	Whitewater	C	6	9	9	33.2	36.5

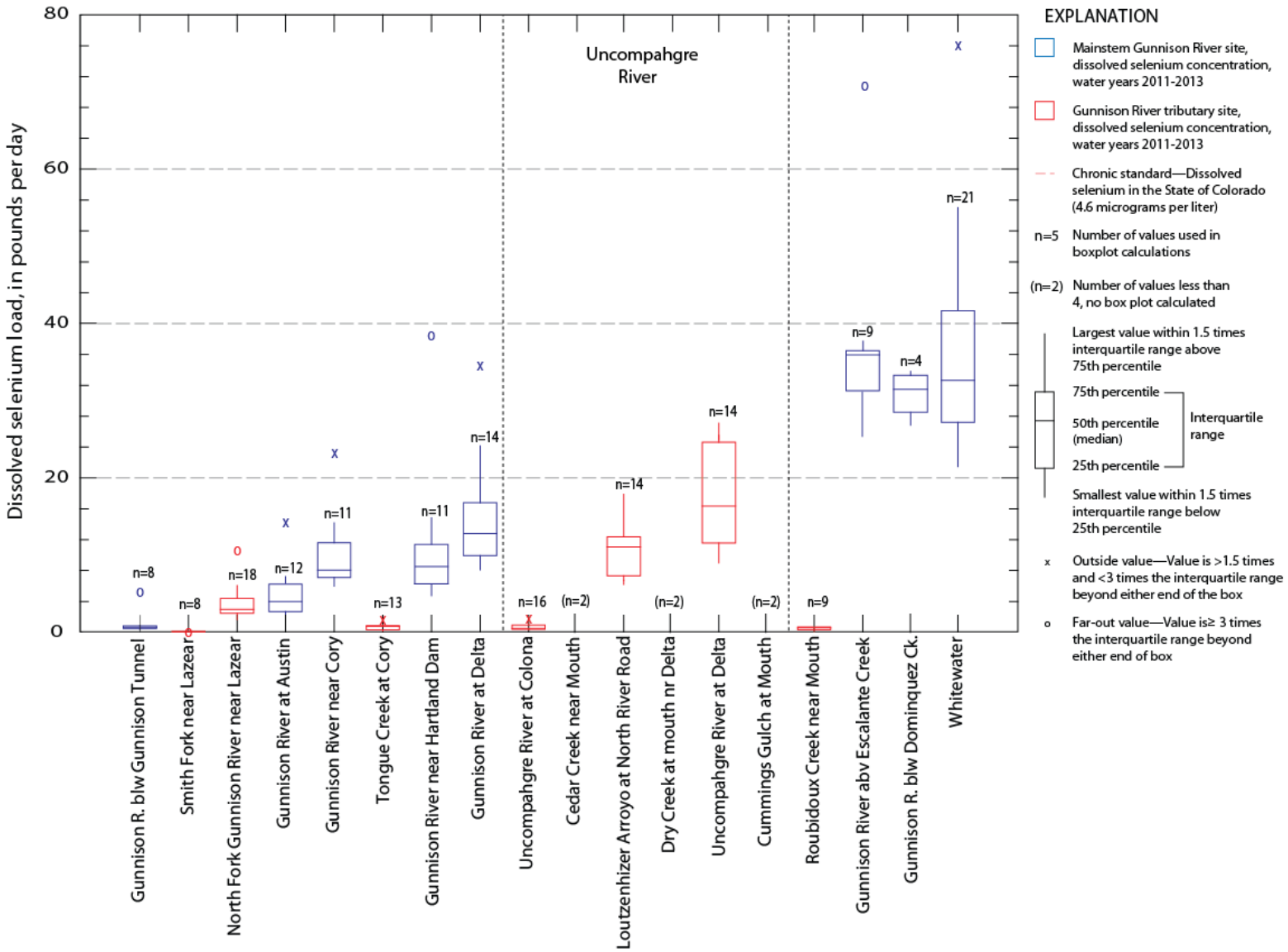

Figure 3. Dissolved-selenium load, in pounds per day, for instantaneous water-quality samples taken in water years 2011-2013.

Table 4. Summary of median dissolved-selenium loads (task B) along the main stem of the Gunnison River based on instantaneous samples in water years 2011-2013.

[USGS, U.S. Geological Survey; WY, water year defined as October 1 – September 30]

Index number	USGS station ID	Station short name	Number of samples WY 2011	Number of samples WY 2012	Number of samples WY 2013	Median selenium load for 2011-2013, in pounds per day	Change in median dissolved-selenium load for 2011-2013, in pounds per day
3	09136100	North Fork Gunnison River near Lazear	6	7	5	2.84	
							1.15
4	384624107570701	Gunnison River at Austin	2	4	6	3.99	
							4.31
6	09137500	Gunnison River near Cory	1	4	6	8.30	
							0.33
7	384617108022901	Gunnison River near Hartland Dam	1	4	6	8.63	
							4.17
8	09144250	Gunnison River at Delta	4	5	5	12.8	
							23.1
16	384527108152701	Gunnison River abv Escalante Creek	0	3	6	35.9	
							-2.70
18	09152500	Whitewater	6	9	9	33.2	

Table 5. Estimated annual 85th-percentile dissolved-selenium concentration (task C) for five core sites, in micrograms per liter, using multiple linear regression techniques in S-LOADEST (Runkel and others, 2004) at sites with a U.S. Geological Survey gaging station for water years 2011-2013.

[USGS, U.S. Geological Survey; WY, water year defined as October 1 – September 30]

Index number	USGS station ID	Station short name	Annual 85th percentile dissolved-selenium concentration, in micrograms per liter			Change in dissolved-selenium concentration, in micrograms per liter, from WY 2011 to 2013
			WY 2011	WY 2012	WY2013	
3	**09136100**	**North Fork Gunnison River near Lazear**	**3.45**	**4.13**	**3.83**	**+.38**
8	**09144250**	**Gunnison River at Delta**	**3.04**	**3.83**	**3.73**	**+.69**
9	**09147500**	**Uncompahgre River at Colona**	**0.91**	**0.87**	**1.10**	**+.19**
13	**09149500**	**Uncompahgre River at Delta**	**18.70**	**15.40**	**15.30**	**-3.34**
18	**09152500**	**Whitewater**	**6.56**	**6.42**	**7.09**	**+.53**

Dissolved-selenium 85th-Percentile Analysis

The dissolved-selenium 85th-percentile concentration (85th-percentile) was calculated for 18 sites. The 85th-percentiles for the five core sites presented in table 5 were calculated using the estimated dissolved-selenium concentration from the multiple linear-regressions techniques as described by Mayo and Leib (2012). The 85th-percentile values at these sites are referred to as the annual values. At the 13 ancillary sites, multiple linear regression was not used due a lack of continuous streamflow data; however, 85th-percentile concentrations were calculated using one WY of instantaneous water quality samples. The instantaneous 85th-percentile concentrations are shown for five core and 13 ancillary sites in table 6 for water year 2011 and 2012.

The annual 85th-percentiles (table 5) for WY 2013 ranged from 1.10 µg/l at Uncompahgre River at Colona to 15.3 µg/l at Uncompahgre River At Delta. The only sites to exceed the state water-quality standard of 4.6 µg/l were Uncompahgre River at Delta and Whitewater.

The instantaneous 85th-percentiles shown in table 6 for samples in WY 2013 ranged from 1.22 µg/l at Uncompahgre River at Colona to 126 µg/l at Loutzenhizer Arroyo at North River Road. There were no selenium samples taken in 2013 at Gunnison R. blw Gunnison Tunnel, and three sites (Uncompahgre River at Colona, Dry Creek at mouth nr Delta, and Cummings Gulch at Mouth) only had two samples each for 2013, so 85th-percentile values could not be calculated for these four sites.

The highest instantaneous 85th-percentile selenium concentrations for WY 2013 occurred at sites Loutzenhizer Arroyo at North River Road and Uncompahgre River at Delta, both of which exceeded the state water-quality standard of 4.6 µg/l. Other sites that exceeded the state water-quality standard in 2013 were Tongue Creek at Cory, Gunnison River abv Escalante Creek, Gunnison R. blw Dominguez Ck, and Whitewater.

The 85th-percentile value can vary, based on the calculation method, and the number and timing of the data points used in the calculation. For example, Whitewater has an annual 85th-percentile for WY 2013 of 7.09 µg/l based on the regression model (table 5), whereas the instantaneous 85th-percentile calculated for Whitewater from WY 2013 is 6.90 µg/l (table 6). The best representations of the actual 85th-percentiles at the five core sites are given in table 5 due to the use of a regression equation approach that estimates a daily value for selenium for each period shown.

Trend Analysis

Using methods described in Mayo and Leib, (2012), a trend analysis was completed at Whitewater. The calibration data set contained all available instantaneous water-quality samples from WY 1986 to WY 2013. This analysis or process ensured all data used for regression model development by Mayo and Leib (2012) was included in the data set used in model development through WY 2013. Another period, WYs 1991-2013, was also used for trend analysis which employed a moving window approach for the period of record. This second approach used the same methods as Mayo and Leib (2012), and is included here to provide more emphasis on the most recently collected data.

Tables 7 and 8 indicate a continuing downward trend in annual selenium load at the Whitewater site. The dissolved-selenium loads were reduced from 23,600 pounds in WY 1986 to 15,700 pounds in WY 2013, which is a decrease of 7,900 pounds per year (table 7). This is a 33.4 percent reduction over the time period, and an additional 4.8 percent reduction from the reported 28.6 percent reduction reported through 2008 in Mayo and Leib (2012).

Table 6. The instantaneous 85th percentile dissolved-selenium concentration (task C) for five core sites and 13 ancillary sites, in micrograms per liter, for water-quality samples collected during water years 2011-2013.

[USGS, U.S. Geological Survey; NA, not applicable; WY, water year defined as October 1 – September 30; --, insufficient data to calculate a value]

Index number	USGS station ID	Station short name	WY 2011		WY 2012		WY 2013	
			Number of samples	Instantaneous 85th percentile	Number of Samples	Instantaneous 85th percentile	Number of samples	Instantaneous 85th percentile
1	09128000	Gunnison R. blw Gunnison Tunnel	4	0.17	4	0.16	0	--
2	09129600	Smith Fork near Lazear	0	--	2	1.97	6	2.30
3	09136100	North Fork Gunnison River near Lazear	6	4.1	7	4.00	5	3.24
4	384624107570701	Gunnison River at Austin	2	0.99	4	1.18	6	1.50
5	09144200	Tongue Creek at Cory	4	3.51	4	10.0	5	9.28
6	09137500	Gunnison River near Cory	1	2.20	4	1.97	4	3.82
7	384617108022901	Gunnison River near Hartland Dam	1	2.40	4	2.16	6	4.38
8	09144250	Gunnison River at Delta	4	2.9	5	3.78	5	3.50
9	09147500	Uncompahgre River at Colona	6	0.98	6	0.85	4	1.22
10	383041107544201	Cedar Creek near Mouth	0	--	0	--	2	--
11	383946107595301	Loutzenhizer Arroyo at North River Road	5	170	3	153	6	126
12	384202108032001	Dry Creek at mouth nr Delta	0	--	0	--	2	--
13	09149500	Uncompahgre River at Delta	4	12.5	5	13.4	5	16.0
14	384448108070301	Cummings Gulch at Mouth	0	--	0	--	2	--
15	09150500	Roubidoux Creek near mouth	0	--	3	2.53	6	2.85
16	384527108152701	Gunnison River abv Escalante Creek	0	--	3	5.80	6	8.13
17	385011108225401	Gunnison R. blw Dominguez Ck.	--	0	--	0	4	5.92
18	09152500	Whitewater	6	4.2	9	6.3	9	6.90

Note, however, that because the predicted loads are based on daily mean flows for each day of the year over the period of record, these dissolved-selenium loads don't represent the actual dissolved-selenium loads that occurred in the beginning and ending years. Instead, the estimated first and last year loads enable the calculation of a relative load difference over the period of the trend analysis.

The 95 percent confidence interval for WY 1986 was 21,800 and 25,500 pounds; for WY 2013, the 95 percent confidence interval was 14,500 and 17,000 pounds (table 7). An annual dissolved-selenium trend was also completed for WYs 1991 to WY 2013 (table 8). The annual dissolved-selenium load was reduced from 21,200 pounds in 1991 to 15,500 pounds in 2013, a decrease of 5,700 pounds, or 26.9 percent (table 8).

To demonstrate the trend in selenium concentration over time, the decimal time component was removed from the regression model and the calibration data set was used to predict concentrations for the sample dates. The measured concentration for each sample date is then subtracted from the predicted concentration, yielding a residual concentration value. These residual concentrations are plotted by date, with a LOcally WEighted Scatterplot Smoothing (LOWESS) fit line in fig. 4 for WYs 1986-2013, and in fig. 5 for WYs 1991-2013. Both fig. 4 and fig.5 confirm a continuing decrease in dissolved selenium over the trend periods.

Table 7. Annual dissolved-selenium trend from water year 1986 to 2013 at U.S. Geological Survey site 09152500, Whitewater.

Water year	Average of the mean daily streamflow for 1986 to 2013, in cubic feet per second	Estimated selenium annual load, in pounds	Lower 95% confidence level for estimated annual selenium load, in pounds	Upper 95% confidence level for estimated annual selenium load, in pounds	Estimated annual selenium load reduction, in percent	Annual 50th percentile of estimated daily selenium concentration, in micrograms per liter	Annual 85th percentile of estimated daily selenium concentration, in micrograms per liter
1986	**2,390**	**23,600**	**21,800**	**25,500**	--	**6.47**	**7.42**

2013	**2,390**	**15,700**	**14,500**	**17,000**	**33.4**	**4.31**	**4.94**
Difference		**7,900**				**2.16**	**2.48**

Table 8. Annual dissolved-selenium trend from water year 1991 to 2013 at U.S. Geological Survey site 09152500, Whitewater.

Water year	Average of the mean daily streamflow for 1991 to 2013, in cubic feet per second	Estimated selenium annual load, in pounds	Lower 95% confidence level for estimated annual selenium load, in pounds	Upper 95% confidence level for estimated annual selenium load, in pounds	Estimated annual selenium load reduction, in percent	Annual 50th percentile of estimated daily selenium concentration, in micrograms per liter	Annual percentile of estimated daily selenium concentration, in micrograms per liter
1991	**2,290**	**21,200**	**19,600**	**23,000**	**--**	**6.22**	**6.89**
2013	**2,290**	**15,500**	**14,200**	**16,900**	**26.9**	**4.54**	**5.03**
Difference		**5,700**				**1.68**	**1.86**

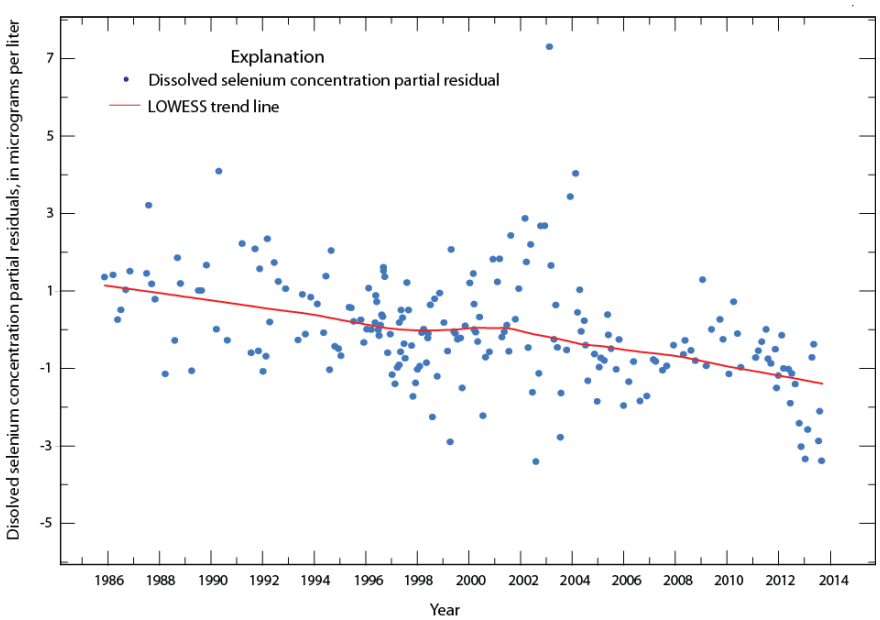

Figure 4. Dissolved-selenium concentration partial residuals and LOcally WEighted Scatterplot Smoothing (LOWESS) fit line for Whitewater (Gunnison River near Grand Junction, 09152500) for water years 1986-2013.

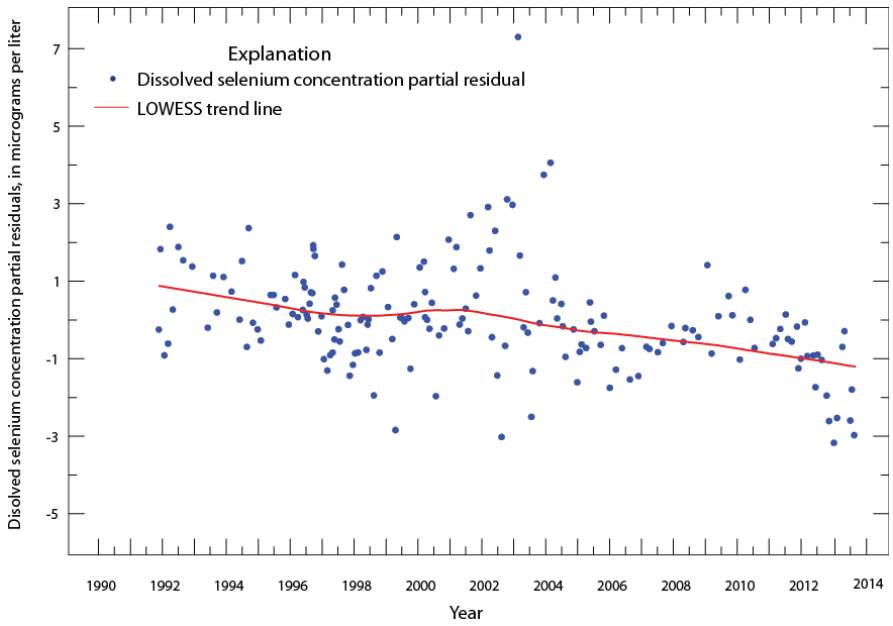

Figure 5. Dissolved-selenium concentration partial residuals and LOcally WEighted Scatterplot Smoothing (LOWESS) fit line for Whitewater (Gunnison River near Grand Junction, 09152500) for water years 1991-2013.

Summary

Dissolved-selenium loading analysis for multiple sites in the lower Gunnison River basin was completed for WY 2013 . Selenium is a trace element that bio accumulates in aquatic food chains and can cause reproductive failure, deformities, and other adverse effects (Hamilton, 1998; Lomly, 2002). Presented in this report are annual dissolved-selenium loads for WYs 2011though 2013 at five USGS sites having continuous streamflow gages (table 2). Annual dissolved-selenium loads for WY 2013 loads ranged from 179 pounds at Uncompahgre River at Colona to 11,100 pounds at Whitewater. Annual loads were not calculated for the remaining thirteen sites, however, instantaneous dissolved-selenium concentrations for water-quality samples were used with instantaneous streamflow measurements to calculate instantaneous loads

(table 3). Most sites analyzed in the basin have a median instantaneous dissolved-selenium load of less than 20 pounds per day (lbs/d).

In general, dissolved-selenium loads at Gunnison River mainstem sites show an increase from upstream to downstream (table 4). To identify how the selected water-quality sites compare to the State of Colorado water-quality standard for dissolved-selenium (4.6 µg/l), the 85th-percentiles for dissolved selenium were calculated. Annual 85th-percentile for dissolved selenium were calculated for the five core USGS sites with streamflow gages using estimated dissolved-selenium concentrations from linear regression models (table 5). The annual 85th-percentiles for five core sites in WY 2013 ranged from 1.10 µg/l at Uncompahgre River at Colona to 15.3 µg/l at Uncompahgre River At Delta. The only core sites to exceed the state water-quality standard of 4.6 µg/l were the Uncompahgre River at Delta and Whitewater.

Instantaneous 85th-percentiles for dissolved selenium were also calculated for all 18 sites using water-quality samples collected during WYs 2011 through 2013 (table 6). The instantaneous 85th-percentiles for samples for WY 2013 ranged from 1.22 µg/l at Uncompahgre River at Colona to 126 µg/l at Loutzenhizer Arroyo at North River Road.

A trend analysis was completed for Whitewater to determine whether selenium loads are increasing or decreasing over time. The trend analysis indicated a decrease of 7,900 pounds per year from WY 1986 to WY 2013 (table 7). This is a 33.4 percent reduction over the time period, and additional 4.8 percent reduction from the reported 28.6 percent reduction reported through 2008 in Mayo and Leib (2012). The trend analysis for WY 1991 to WY 2013 indicated a decrease of 5,700 pounds per year from WY 1991 to WY 2013, or 26.9 percent (table 7).

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