TMDL for Selenium in the Colorado River Watershed

Utah Water Quality Board Approval Date:
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Water Quality Protection Section

Colorado River Selenium TMDL

EPA Approval Date:

Waterbody ID	UT14010005-001_00 Colorado River-6, UT14030001-005_00 Colorado River-5, UT14030005-004_00 Colorado River-4, UT14030005-003_00 Colorado River-3
Location	Grand & San Juan Counties, Utah
Pollutants of Concern	Selenium (Se)
Impaired Beneficial Uses	3B: Protected for warm water species of game fish and other warm water aquatic life including the necessary aquatic organisms in their food chain
Current Loading	31.06 Kg/day average during low flow conditions
Loading Allocation (TMDL)	21.349 Kg/day average during low flow conditions
Load Reduction	9.685 Kg/day during low flow conditions
Wasteload Allocation *(Moab WWTP Permit ID UT0020419)* Moab WWTP current load	Not to exceed 4.6 µg/L or 26.1 grams/day Selenium Less than 4.04 grams/day (based on detection limit of 1 µg/L)
Margin of Safety	10% explicit 2.375 Kg/day during low flow conditions
Defined Targets/Endpoints	1) Total maximum load as a daily average of less than 21.375 Kg/day 2) Load reduction of 9.69 Kg/day
Implementation Strategies	1) Colorado River Basin Salinity Control Program 2) Selenium Management Program 3) Landowner participation
This document is identified as a TMDL for waters in the Colorado River drainage and is submitted under §303d of the Clean Water Act to U.S. EPA for review and approval.	

Table of Contents

1.0 Introduction

Section 303(d) of the Clean Water Act and US Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting applicable water quality standards or designated uses under technology-based controls. TMDLs specify the maximum amount of a pollutant which a waterbody can assimilate and still meet water quality standards. Based upon calculation of the total load that can be assimilated, TMDLs allocate pollutant loads to sources and a margin of safety (MOS). This study determines allowable limits for pollutant loading to meet the water quality standard and designated uses for the Colorado River from the confluence with the Green River upstream to the Utah/Colorado state line.

This document presents a TMDL for two assessment units on the Colorado River;
1. Colorado River from Green River Confluence to Moab,
2. Colorado River from Moab to HUC unit (14030005) boundary of the Colorado River.
These units were listed on Utah's 2006 303(d) list for impairment associated with excess concentrations of selenium (Se) (UDEQ 2006). At high concentrations selenium is toxic to aquatic life and increases the risk of deformities and decreased reproduction in fish and aquatic birds.

The Colorado River will be listed on subsequent 303(d) lists for selenium until the TMDL has been approved by EPA. It is important to note that data collection in support of this TMDL is an ongoing effort and that as new data are collected the TMDL may be revised accordingly. The table below presents the 2006 303(d) list information for the Colorado River.

Table 1.1 - Impairment listing for the Colorado River above the confluence with the Green River

<table>
<tr><th>Site ID's</th><th>Description</th><th>Impaired Designated Use</th><th>Pollutants of Concern</th><th>Primary Source of Impairment</th></tr>
<tr><td>Site 4952400</td><td>Colorado River AB CNFL / Green River</td><td rowspan="4">Warm water aquatic life</td><td rowspan="4">Selenium</td><td rowspan="4">Natural geologic formations, subsurface flows.</td></tr>
<tr><td>Site 4956290</td><td>Colorado River at Potash Boat Ramp</td></tr>
<tr><td>Site 4957000</td><td>Colorado River at US191 xing near Moab</td></tr>
<tr><td>Site 4958490</td><td>Colorado River at Dewey Bridge</td></tr>
</table>

The Colorado River from the Utah/Colorado Stateline down to the confluence with the Green River is known for scenic landscapes, whitewater rafting, outdoor recreation, and multiple other uses. The State of Utah has designated the beneficial uses of the Colorado River as protected for culinary use, recreational use, aquatic life use and agricultural use (1C, 2A, 3B, 4).

2.0 Identification of Waterbody, Pollutant of Concern, Pollutant Sources

Land Use, Cover, Ownership and Topography

General land use, cover, ownership and topography data were gathered from the Automated Geographic Reference Center (AGRC) for the State of Utah.

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary drastically by elevation. Dry conditions make irrigation necessary for nearly all crops grown in the watershed. If irrigation water is applied in excess of plant requirements that excess amount will percolate below the rooting zone where it picks up TDS and Se, and returns with elevated concentrations to watershed streams either as surface runoff or groundwater base flow. Tables 2.1 & 2.2 show landownership and water related landuse respectively for the Colorado River study area above the confluence with the Green River and below the UT/CO Stateline. Figure 2.1 shows the impaired section of the Colorado River in Utah (yellow) and the surrounding geography.

Table 2.1 Land Ownership

Ownership	Acres	Percent of Total Study Area	Detail
Bureau of Land Management	1,585,322	61.7	BLM
National Forest	231,370	9.0	Moab Ranger District and north slope of Monticello Ranger District
National Parks, Monuments & Historic Sites	217,100	8.5	Arches and Canyonlands
National Wilderness Area (near Jones Canyon)	5,101	0.2	Near Jones Canyon confluence with Westwater Canyon, Colorado River
Other State (UDOT)	139	0.0	road right-of-ways
Private	239,549	9.3	
State Parks and Recreation	4377	0.2	Utah State Parks (DNR)
State Sovereign Land	12,170	0.5	Utah Forestry, Fire, and State Lands (DNR)
State Trust Lands (SITLA)	271,146	10.6	SITLA: School and Institutional Trust Lands Administration
State Wildlife Reserve/Management Area	1,646	0.1	Utah Wildlife Resources (DNR)
Tribal Lands	177	0.0	Uintah/Ouray Reservation: headwaters of Left Hand Nash Wash
Total	2,568,097	100	

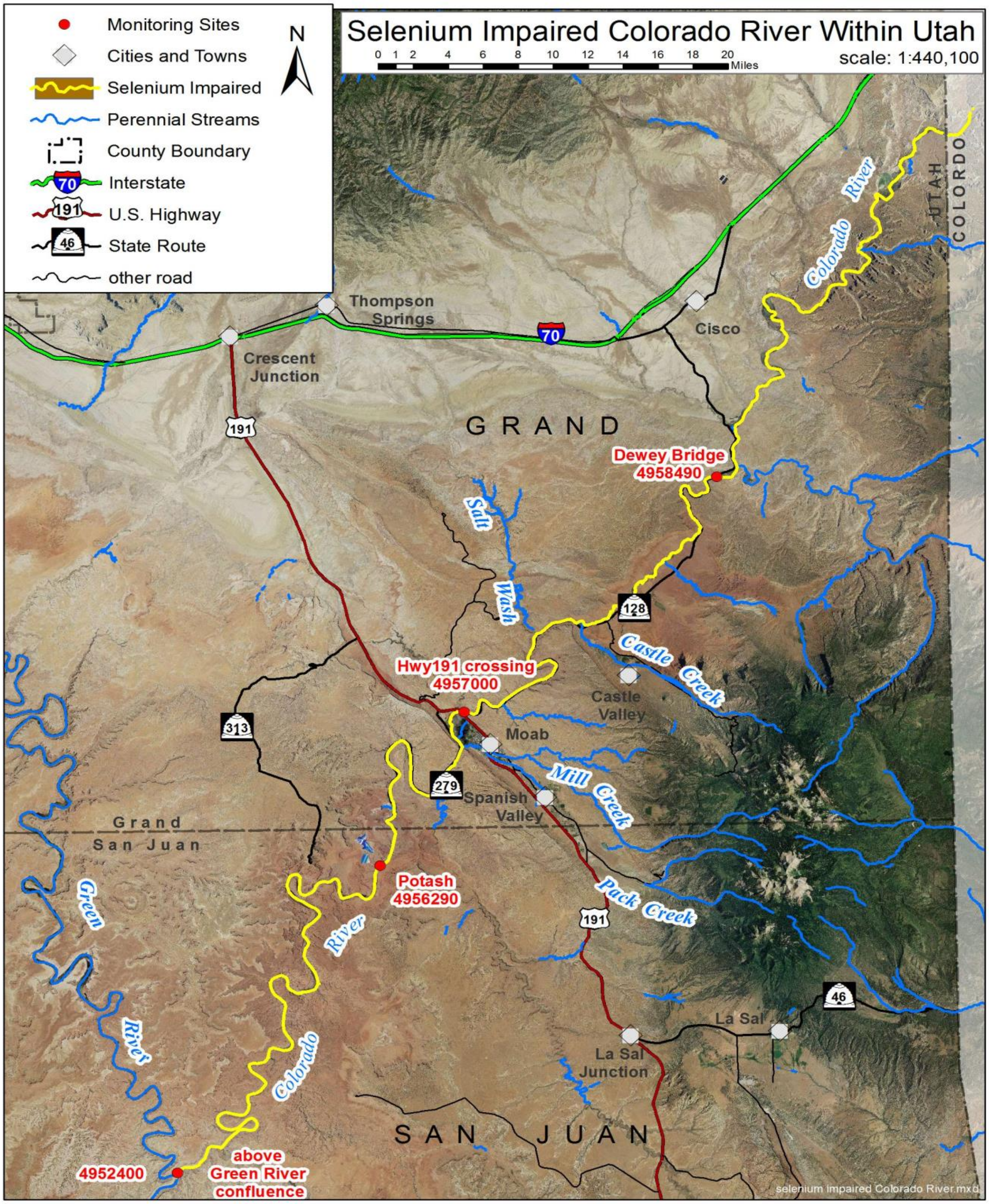
Table 2.2 Water Related Landuse

Landuse	Acres	Percent of Total Study Area	Detail
All Agricultural Land	66,895.6	2.60	Includes irrigated, fallow, and dry farms
Riparian	5,017.7	0.20	Stream/lake associated habitat

Urban Grass	315.5	0.01	Urban Parks and Golf Courses
Urban	8,908.3	0.35	Urban (homes, yards, roads, businesses, schools)
Water	10,058.6	0.39	Surface Water: rivers, lakes, ponds
Total	91,195.6	3.55	3.55% of total drainage area

As can be seen in Table 2.2 the irrigated lands in the watershed total less than 3% of the drainage basin. The majority of the irrigated land in Utah is located in Spanish Valley and Castle Valley where Mill Creek and Castle Creek drain to the Colorado River. These two tributaries have negligible loads of selenium to the Colorado River. Mill Creek contributes an average of 0.02 kg/day and Castle Creek contributes an average of 0.03 kg/day. Neither tributary shows concentrations that exceed the 4.6 μg/L standard at the watershed outlets. Loading averages were calculated from 9 data points on Mill Creek and 11 data points on Castle Creek collected since 2002.

Figure 2.1 Colorado River Area



Threatened & Endangered Species

The Colorado and Green Rivers are designated critical habitat for the four endangered fish species with Westwater Canyon being identified as one of the best remaining habitats for humpback chub. Several thousand bonytail have been experimentally released into the Colorado River in the last decade. Selenium is hypothesized as contributing to the decline of endangered fish species within the upper Colorado River Basin because it may inhibit reproduction and recruitment.

The BLM's program for T&E species consists of inventory and monitoring, habitat management, and compliance with the Endangered Species Act through Section 7 consultations with U.S. Fish and Wildlife Service. The Moab Field Office has active inventory and monitoring programs for listed species. Endangered fish studies are conducted by the Utah Division of Wildlife Resources and U.S. Fish and Wildlife Service. The BLM is also working with other agencies on conservation agreements to restore Colorado cutthroat trout, bluehead sucker, roundtail chub and flannel mouth sucker, all of which are Utah sensitive species.

All implementation activities associated with the TMDL will take into consideration any T&E species present.

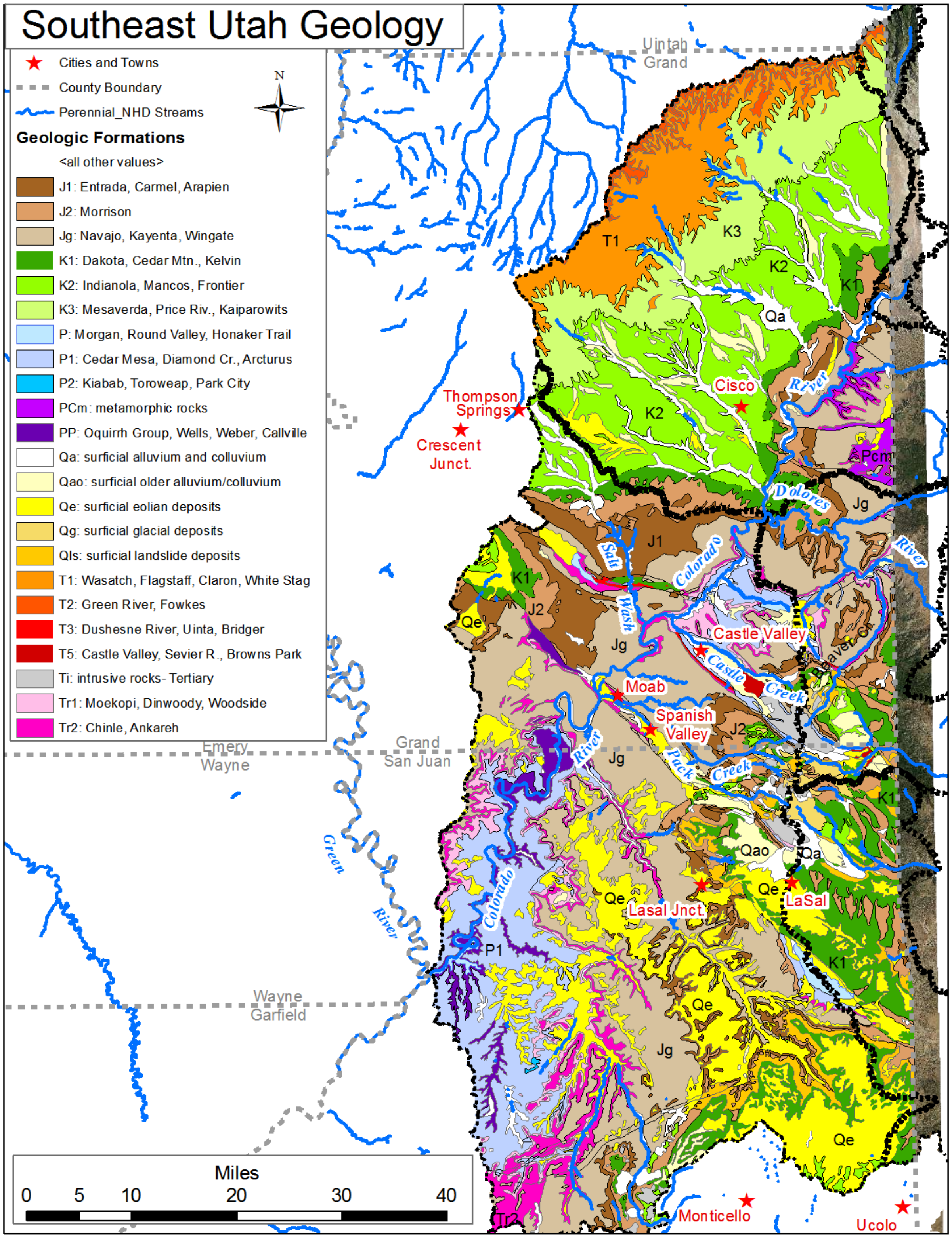
Pollutant of Concern

Selenium is an essential micro-nutrient but is toxic in high concentrations. It is relatively abundant in Mancos shale derived soils and landscapes. In elevated concentrations, selenium has been proven to cause mortality, deformity, and reproductive failure in fish and aquatic birds (USEPA 1998). The toxicity of selenium depends on its chemical form. Selenium becomes bioavailable to aquatic biota through surface and groundwater interactions with surrounding geology. In alkaline soils and in oxidizing conditions selenium uptake is increased because it is in its biologically active form.

Mancos shale is comprised of organic-rich, fine-grained sedimentary rock deposited in very low oxygen conditions (see figure 2.2, formation K2). This type of shale is also a probable source of metals found in some mineral deposits. Many shale formations are sources for pollutants such as Se (USGS 2004). In addition, soils in proximity to volcanic activity contain elevated selenium concentrations. Selenium is also found in coal.

Natural processes, enhanced by seepage from irrigated agriculture in the upper watershed (in the state of Colorado above the study area), are capable of transporting the naturally-occurring Se in the sediments in the watershed to the stream system.

Figure 2.2 – Geology of the Colorado River Watershed

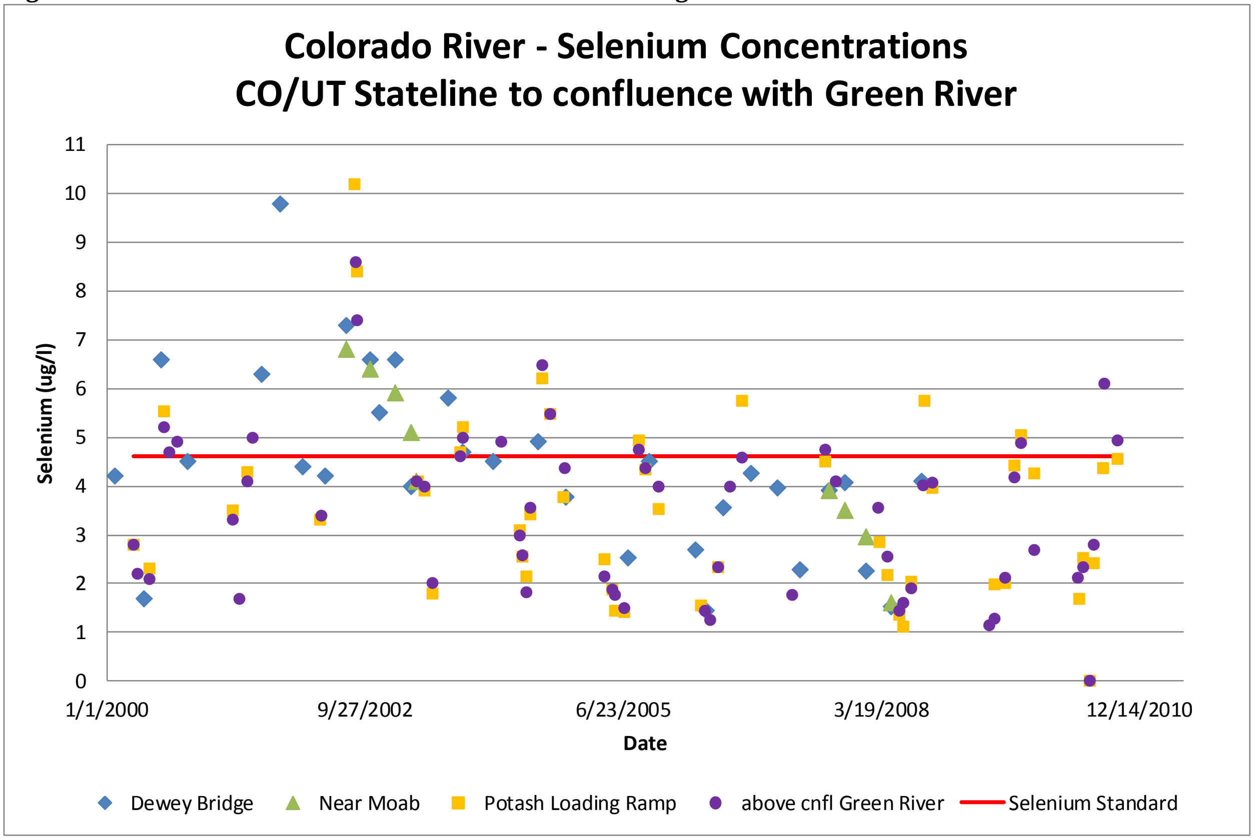


Pollutant loads of selenium in this TMDL were calculated from data collected at four monitoring locations along the Colorado River in Utah.

- 4958490 COLO R AT DEWEY BRIDGE
- 4957000 COLORADO R AT US191 XING NEAR MOAB
- 4956290 COLORADO RIVER AT POTASH BOAT RAMP
- 4952400 COLORADO R AB CNFL / GREEN R

Between 2000 and 2010 the Utah Division of Water Quality collected a total of 149 samples from these stations (see table 3.2). Of these 149 samples 40 exceeded state standards for selenium (figure 2.3). All samples were collected under the supervision of the Utah Division of Water Quality and analyzed at the Utah Public Health Lab.

Figure 2.3 – Selenium concentration data at four monitoring locations



Pollutant Sources

Selenium exists naturally in the Mancos Shale derived soils common to the Colorado River Basin. Studies suggest that selenium mobilization occurs primarily in shallow aquifers, which can be influenced by irrigation and water delivery through unlined canal networks. Water in shallow aquifers is a diffuse source of return flows to tributaries and the Colorado River, thus making it difficult to determine where specific sources of selenium loading occur. Irrigation is common in the upper basin in both agricultural and urban settings. Irrigation practices have been noted to concentrate selenium through dissolution and mobilization of the soluble fraction into receiving waters. Other anthropogenic sources of selenium include the combustion of coal, petroleum fuels and smelting metals.

In the publication ‘Salinity and Selenium, an Internal Report to the Colorado River Basin Salinity Control Forum’ (2003) the Technical Subcommittee concluded that the majority of selenium loading to Lake Powell comes from two principle sources in Colorado, the Grand Valley and the Gunnison River Basin (30% and 31% respectively). The report further identifies 25% as coming from the Green River and 8% from the San Juan River. The majority of the remaining 6% is attributed to the Dolores River and the Colorado River above Grand Valley. The major source of loading in these areas is irrigation of Mancos shale-derived soils (Engberg, 1999).

3.0 Water Quality Standards and TMDL Target

The Clean Water Act requires every state to adopt water quality standards to protect, maintain, and improve the quality of surface waters. Water quality standards consist of three major components:

- Beneficial uses reflect how humans and wildlife can potentially use the water. Examples of beneficial uses include aquatic life support, agriculture, drinking water supply, and recreation. Every waterbody in Utah has designated uses; however, not all uses apply to all waters.
- Criteria define the condition of the water that is necessary to support the beneficial uses. Numeric criteria represent the maximum concentration of a pollutant that can be in the water and still protect the beneficial use of the waterbody. Narrative criteria state that all waters must be free from sludge, floating debris, oil/scum, color and odor producing materials, substances that are harmful to human, animal, or aquatic life, and nutrients in concentrations that may cause algal blooms.
- The Antidegradation policy establishes situations under which the state may allow new or increased discharges of pollutants, and requires those seeking to discharge additional pollutants to demonstrate an important social or economic need.

The Utah Water Quality Board (UWQB) is responsible for establishing water quality standards that are then administered by the Utah Department of Environmental Quality, Division of Water Quality. These standards are found in the Utah Administrative Code, Standards of Quality for Waters of the State R317-2 and vary based on the beneficial use assignment of the waterbody (UDWQ 2010). The table below summarizes the selenium standards pertaining to the 303(d) listed segment in the Colorado River.

Table 3.1 Colorado River Designated Uses and associated Selenium Standards

Designated Use	Description	Selenium
1C	Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.	50 μg/l (max)
2B	Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.	N/A
3B	Protected for warm water species of game fish and other warm water aquatic life including the necessary aquatic organisms in their food chain.	4-day avg: 4.6 μg/L 1-hour max: 18.4 μg/L
4	Protected for agricultural uses including irrigation of crops and stock watering.	50 μg/l (max)

Utah's Listing Methodology and 303(d) Status

The beneficial use support status for streams in Utah is determined by comparing the results of analyzed samples to water quality standards. Utah has defined guidelines for assessing each beneficial use. To be in full beneficial use support for any pollutant, no more than one violation of the criterion can be observed in a three year period. For any pollutant, greater than 2 violations of the criterion in a 3-year period will cause the Beneficial Use to be assessed as Non-supporting.

Of the samples analyzed, 32% exceed the 4.6 μg/L standard at Dewey Bridge and 25% exceed the standard above the confluence with the Green River (see Table 3.2).

Table 3.2 - Percent exceedance & number of observations

Colorado River at Dewey Bridge - 4958490				
From	**To**	**# Observations**	**# Exceedances**	**% Exceedance**
2000	**2010**	**31**	**10**	**32%**
Colorado River at US 191 crossing near Moab - 4957000				
From	**To**	**# Observations**	**# Exceedances**	**% Exceedance**
2000	**2010**	**9**	**4**	**44%**
Colorado River at the Potash Boat Ramp - 4956290				
From	**To**	**# Observations**	**# Exceedances**	**% Exceedance**
2000	**2010**	**49**	**11**	**22%**
Colorado River above confluence with Green River - 4952400				
From	**To**	**# Observations**	**# Exceedances**	**% Exceedance**
2000	**2010**	**60**	**15**	**25%**

As can be seen in Figures 3.1 to 3.4 selenium concentration varies widely even within the same year although the trend at each site indicates a decrease in concentrations. Several high concentrations were observed in 2002 and 2003. This explains the high percent of exceedances at the site near Moab where 5 of the 9 samples were collected in 2002-2003. Analysis of the data using load duration curves was selected because of the high temporal variability seen in the concentration data at all sites.

Figure 3.1 - Selenium concentration at Dewey Bridge

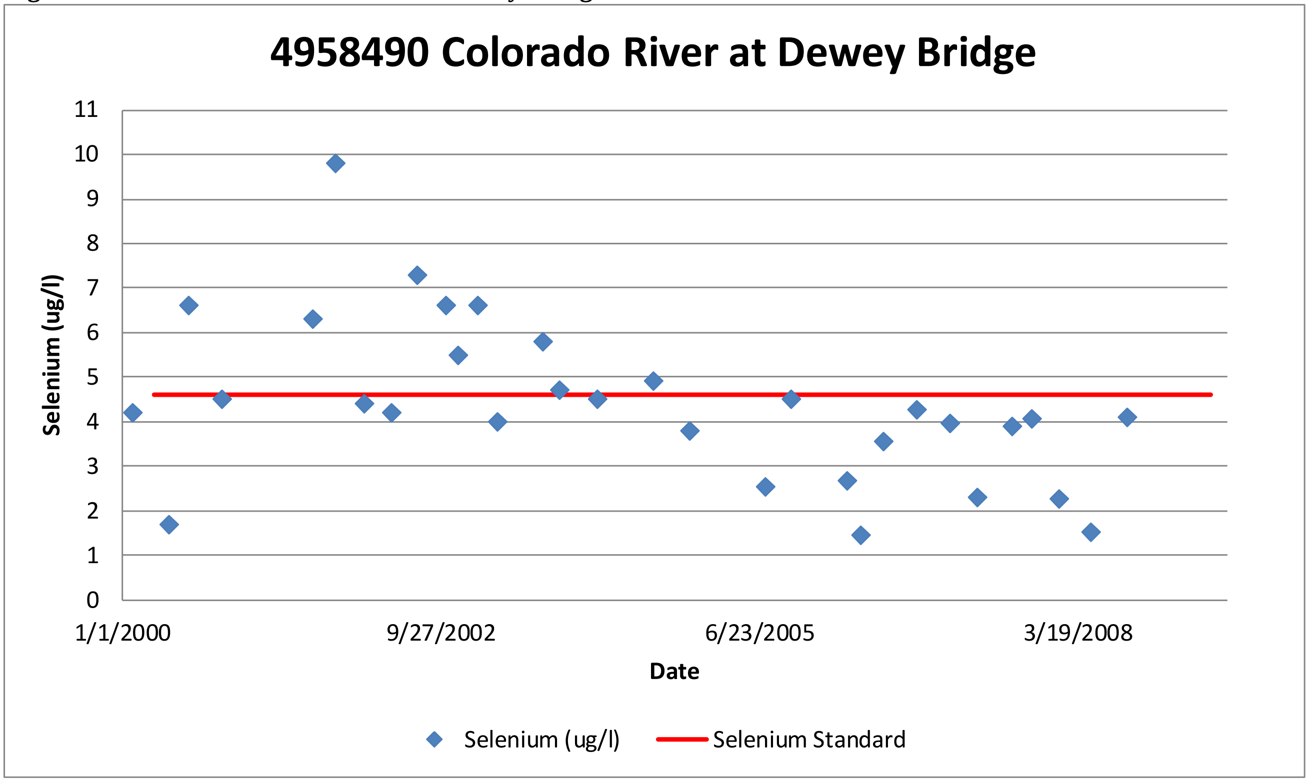


Figure 3.2 - Selenium concentration near Moab

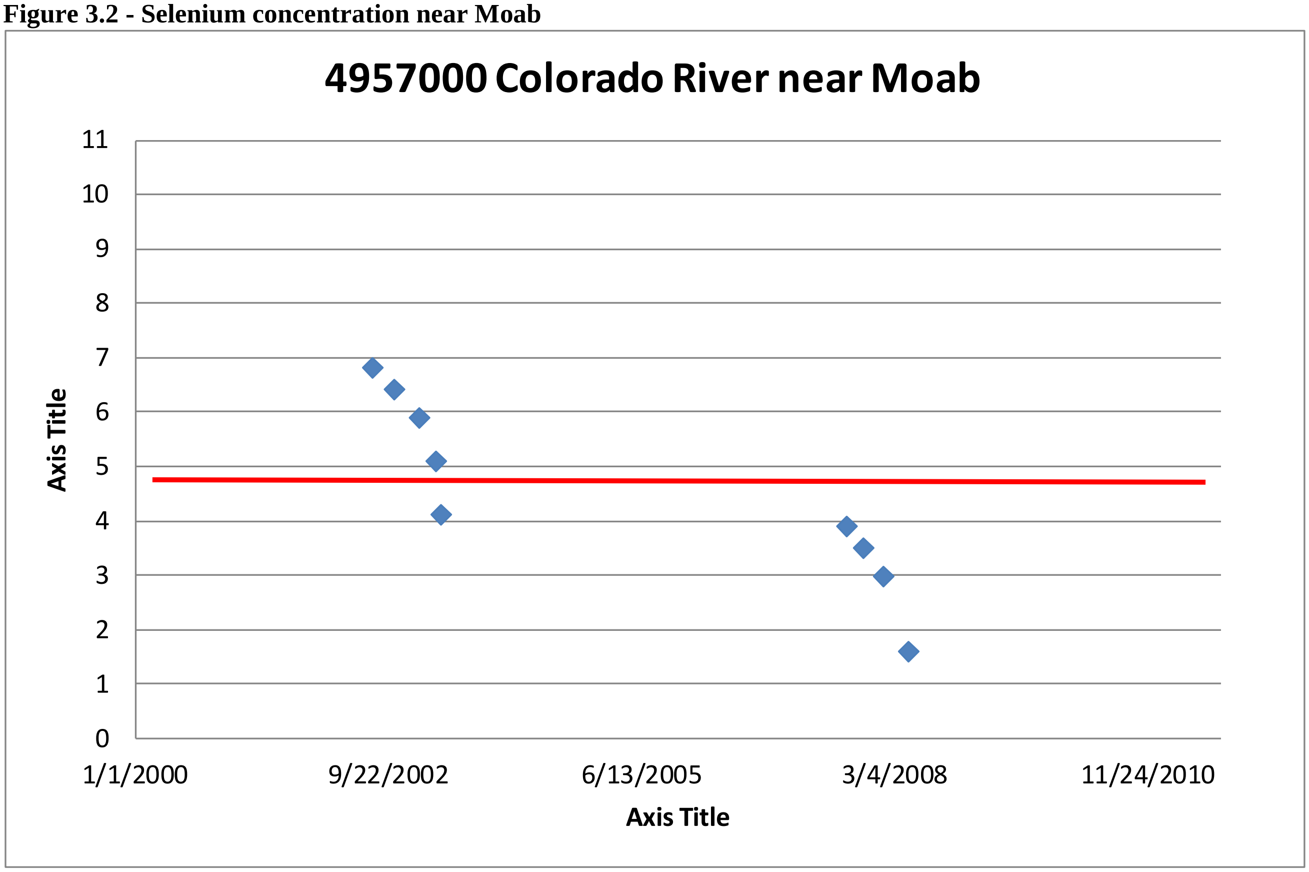


Figure 3.3 - Selenium Concentration at Potash Boat Ramp

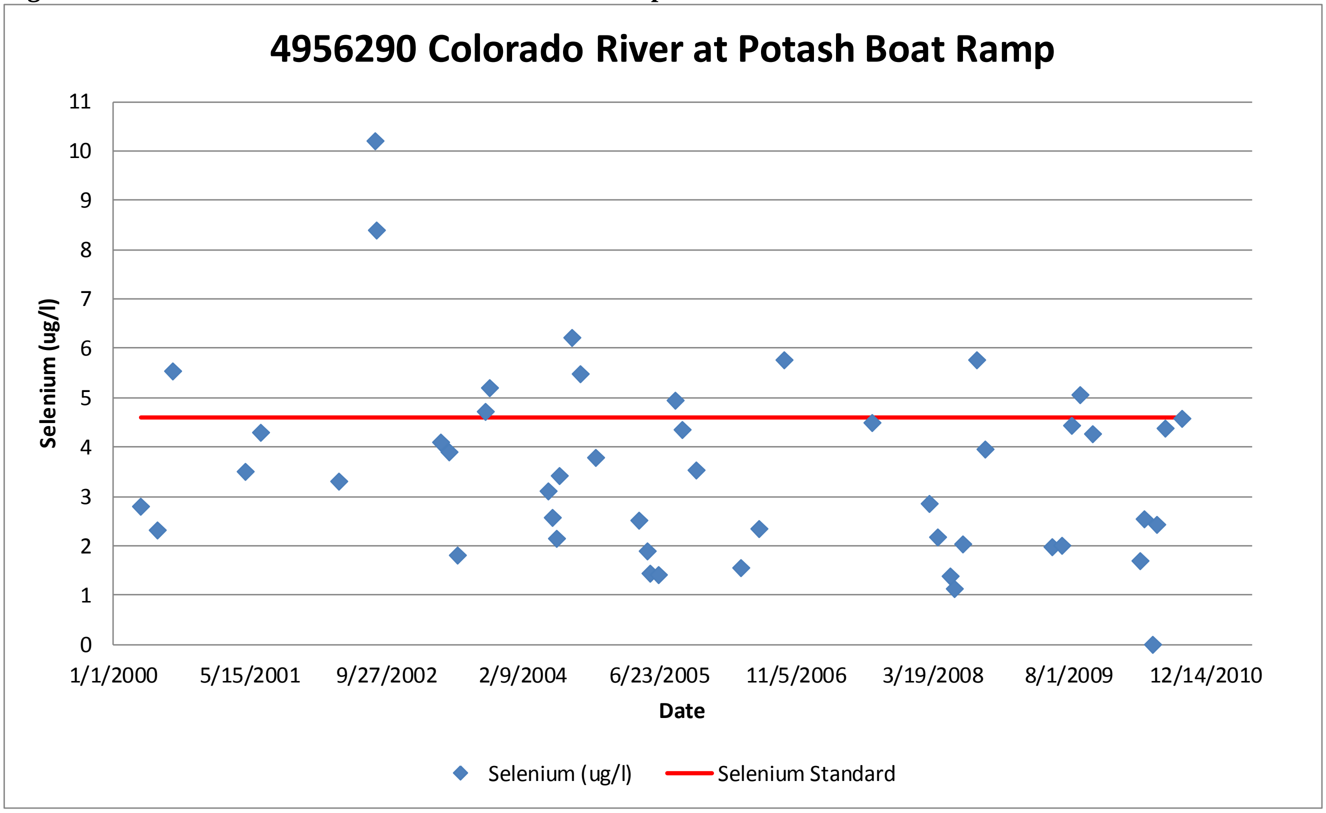
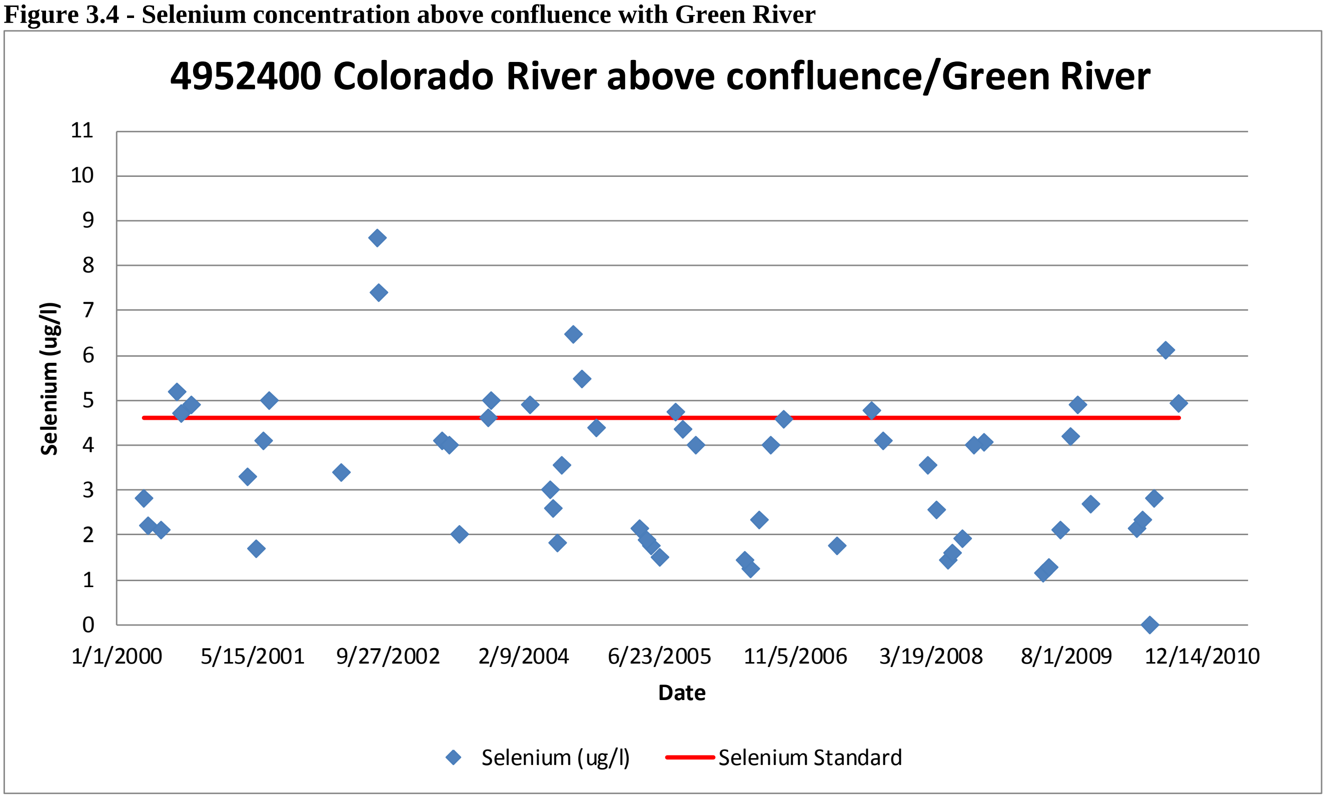


Figure 3.4 - Selenium concentration above confluence with Green River



TMDL Endpoints

A TMDL is the sum of allocated point source loads (wasteload allocation), non-point source loads (load allocation), and natural background loads. In addition, the TMDL must include a margin of safety either implicitly or explicitly, that accounts for the uncertainty in the analysis. Conceptually, this definition is denoted by the equation

$$\textbf{TMDL} = \Sigma\ \textbf{WLAs} + \Sigma\ \textbf{LAs} + \textbf{MOS}$$

Where WLA = wasteload allocation
LA = load allocation
MOS = margin of safety

The TMDL establishes the total loading a stream can assimilate without violating its water quality standard. These analyses will focus on and establish the TMDL for selenium on the Colorado River from the confluence with the Green River upstream to the UT/CO Stateline based on flow. This TMDL is calculated on a daily basis to account for complex and varying hydrology and critical conditions in the river reach and is expressed as a mass loading.

Selenium

Utah's chronic numeric water quality criterion for selenium was used to establish endpoints for TMDL development. The TMDL endpoint is the chronic Warm Water Aquatic Life and Waterfowl Criteria for selenium of 4.6 µg/L. The reductions specified in the TMDL to meet the chronic 4 day average water quality standard will ensure compliance with the acute selenium water quality standard of 18.4 µg/l based upon the current data set.

The TMDL endpoint was established based on the analysis of loading capacity in Section 4 (see table 4.1). The endpoint selected (load Allocation in the Summary Table page 3) is the loading capacity above the confluence with the Green River under low flow conditions less a 10% Margin of Safety.

Load Capacity = 23.75	MOS = 2.375
Load Allocation (TMDL) = 21.349	Waste Load Allocation = 0.0261

The current loading under low flow conditions is 31.06 Kg/day. To reach the endpoint a reduction of 9.675 Kg/day is needed during low flow conditions (the lowest 10% of all flows observed).

4.0 Loading Capacity

This section provides a description of available selenium data and analyses conducted to understand the current water quality conditions in the river. Water quality data has been collected by UDEQ at 4 stations on the Colorado River. Pollutant loads of selenium are presented using load duration curves. The load duration curve approach characterizes water quality concentrations at different flow regimes. The method provides a visual display of the relationship between stream flow and loading capacity, the frequency and magnitude of water quality standard exceedances, allowable loadings, and size of load reductions.

The load duration curve approach is applicable to this reach of the Colorado River because stream flow is an important factor in the determination of loading capacities, as it accounts for how stream flow patterns affect changes in water quality over the course of a year.

Table 4.1 shows the average actual load & load capacity as a function of flow regime. Site 4957000 Colorado River at US191 near Moab was omitted from the analysis because of insufficient data. The selenium loading capacity is calculated based on the State standard for selenium of 4.6 μg/L. Only during dry conditions is the load capacity exceeded at the Dewey Bridge site and only at the low conditions is the capacity exceeded downstream at the Potash and Green River sites. Similarly Table 4.2 shows that the only time of year when the load exceeds the capacity is in the month of August when the majority of the low flow regime occurs.

Figures 4.1 to 4.3 show the load duration curves for each site. At all monitoring locations the selenium loading remains fairly constant or slightly decreases which is a strong indicator that the selenium is from a constant source such as groundwater baseflow.

Figure 4.4 plots average flow at each site and average daily load at each site. As the average flow increases (by over 500 cfs) going downstream, the average daily load decreases (by about 1.5 Kg). The increased flow is serving to dilute the concentration of selenium and minimal if any selenium is being added in the Utah portion of the drainage basin.

Table 4.1 – Average Actual Load & Load Capacity as a function of Flow Regime – Kg/day

Flow Regime	Percent time flow is exceeded	Dewey Bridge		Potash Boat Ramp		Above confluence with Green River	
		Actual Load	Load Capacity	Actual Load	Load Capacity	Actual Load	Load Capacity
High	0 - 10	79.2	305.7	97.9	312.9	95.6	295.5
Moist	10 - 40	58.3	111.6	41.3	116.4	40.4	127.2
Mid Range	40 - 60	47.9	55.3	54.7	64.2	50.1	66.7
Dry	60 - 90	44.4	41.3	38.8	42.8	38.9	42.1
Low	90 - 100	23.6	26.2	35.3	24.0	31.06	23.75

Table 4.2 – Actual Load and Load Capacity by Month

Colorado River above confluence with Green River - Average Daily Selenium Loading (Kg)									
	March	April	May	June	July	August	September	October	November
Actual Load	31.3	38.3	65.9	53.9	44.1	37.7	55.1	38.8	39.1
Loading Capacity	35.7	73.0	178.9	131.5	100.7	35.1	56.7	39.5	45.1

Figure 4.1 - Dewey Bridge Load Duration Curve

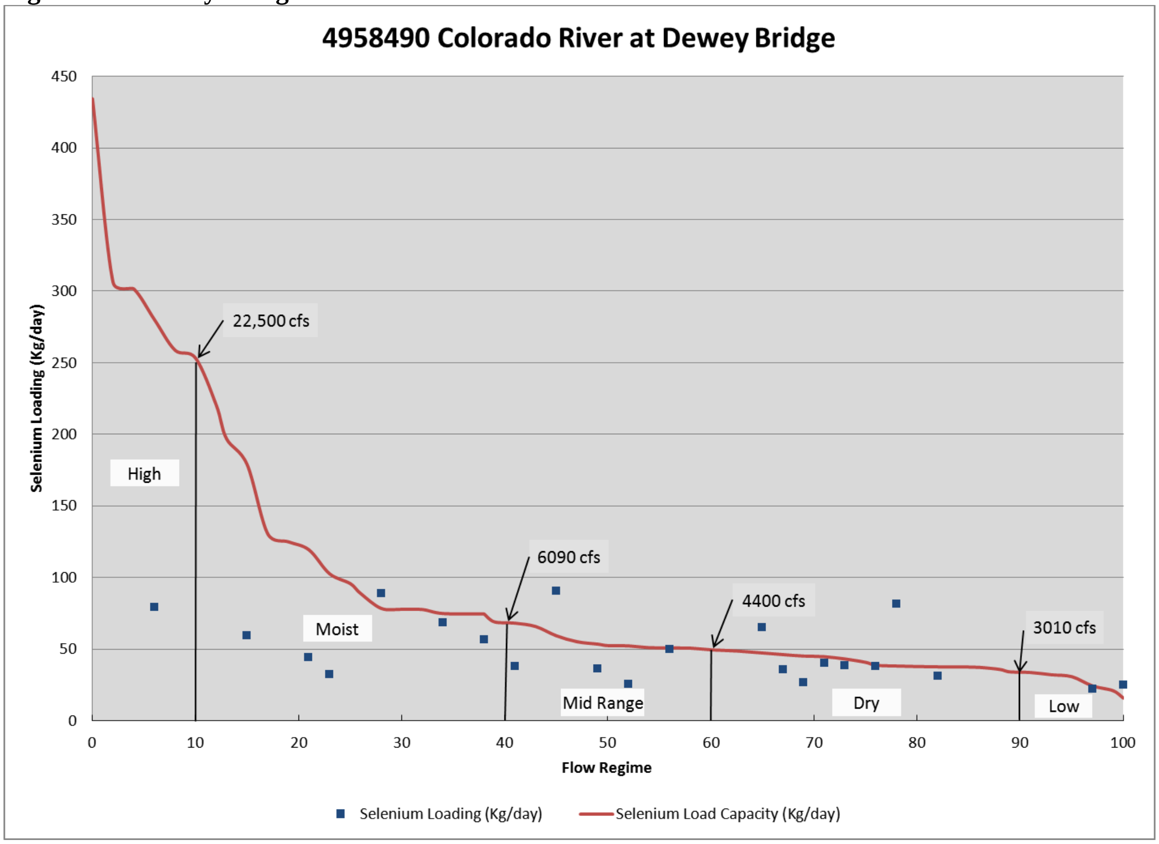


Figure 4.2 - Potash Boat Ramp Load Duration Curve

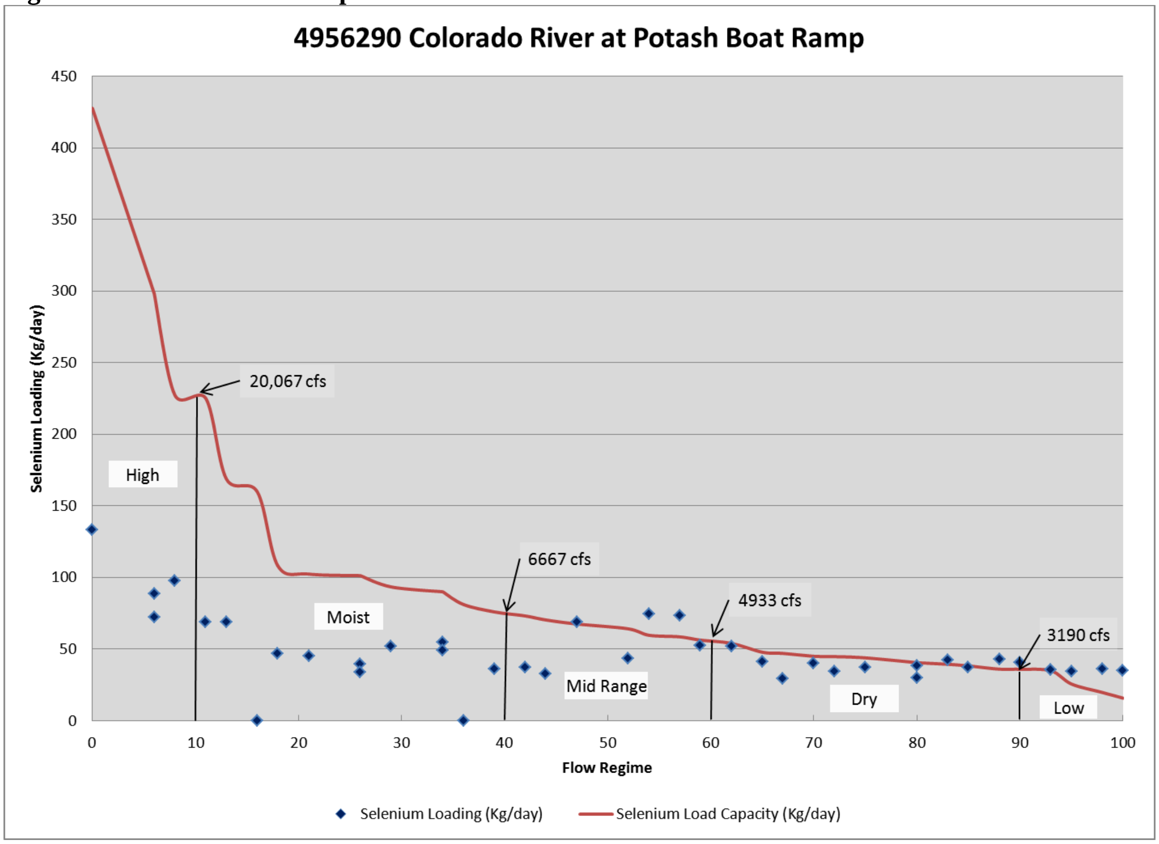


Figure 4.3 - Colorado River above confluence with Green River Load Duration Curve

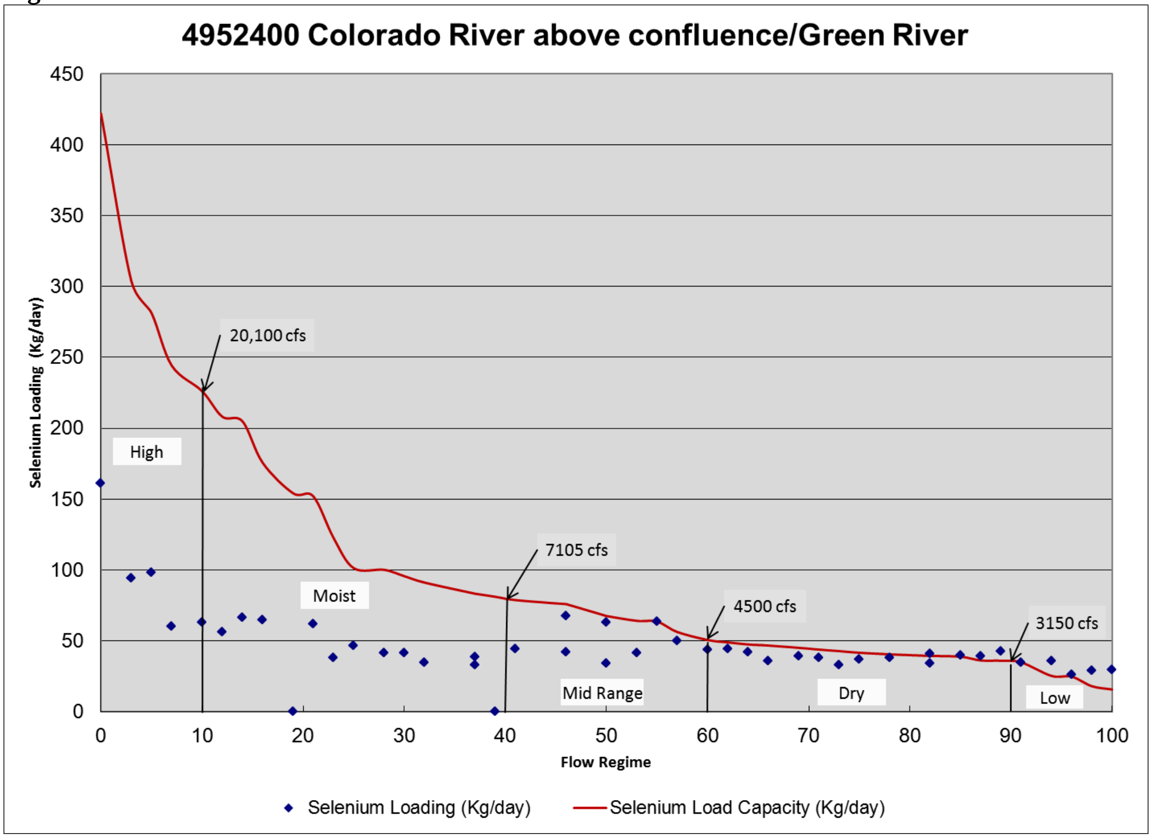
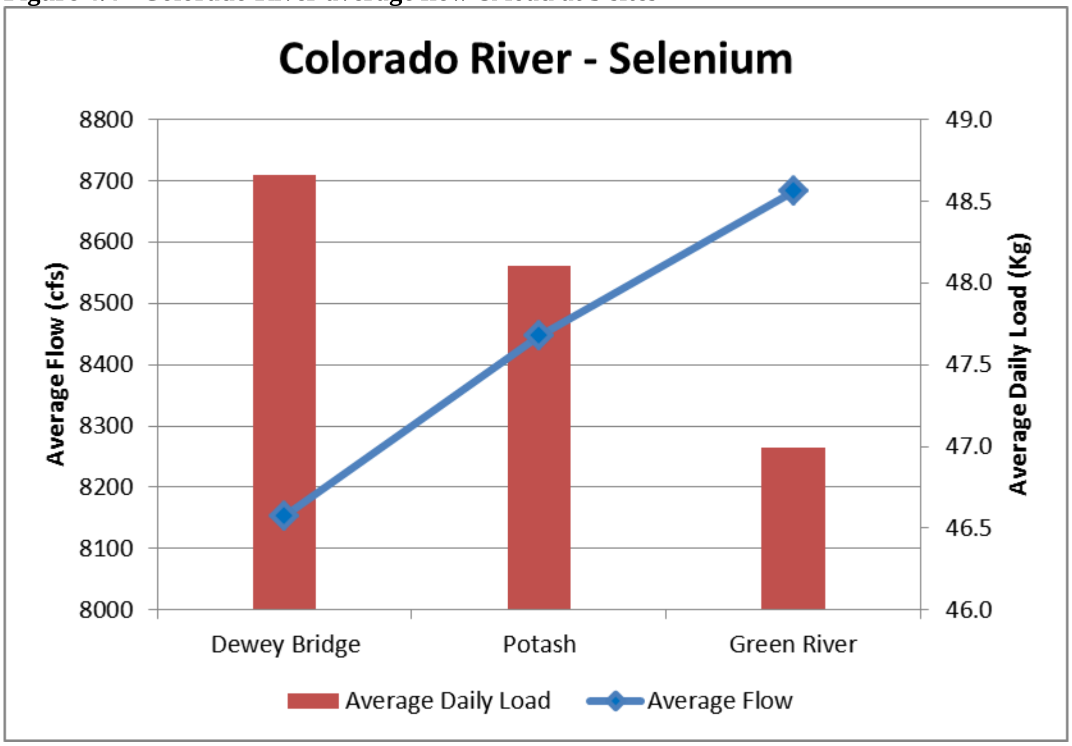


Figure 4.4 - Colorado River average flow & load at 3 sites



5.0 Load Allocations and Waste Load Allocations

The Load allocation was calculated based on the analysis of loading capacity as a function of flow regime minus the MOS and the WLA, The WLA for the Moab WWTP was calculated using the standard of 4.6 ug/L selenium multiplied by the plant capacity of 1.5 mgd and a conversion factor to get a WLA of 26.1 g/day.

23.75(Load Capacity) - 2.375(MOS) - 0.0261(WLA) = 21.349(Load Allocation)

Moab City Waste Water Treatment Plant (Permit ID UT0020419)
Between 2002 and 2008 nine effluent samples were collected from the Moab City wastewater treatment plant by the Division of Water Quality. All selenium samples collected had selenium levels too low to detect. The laboratory detection limit for selenium is 1 μg/L. Average flow from the Moab WWTP is 1.07 million gallons per day (mgd) and plant capacity is 1.5 mgd. The current load estimate for the WWTP was calculated using 1 μg/L concentration times an average flow of 1.07 mgd resulting in 4.04 grams/day loading to the Colorado River. Flow from the Moab WWTP accounts for approximately 0.02 percent of the flow in the Colorado River.

6.0 Margin of Safety

The MOS is a required part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991). Implicit methods incorporate the MOS using conservative model assumptions to develop allocations. Explicit methods specify a portion of the total TMDL as the MOS, allocating the remainder to sources.

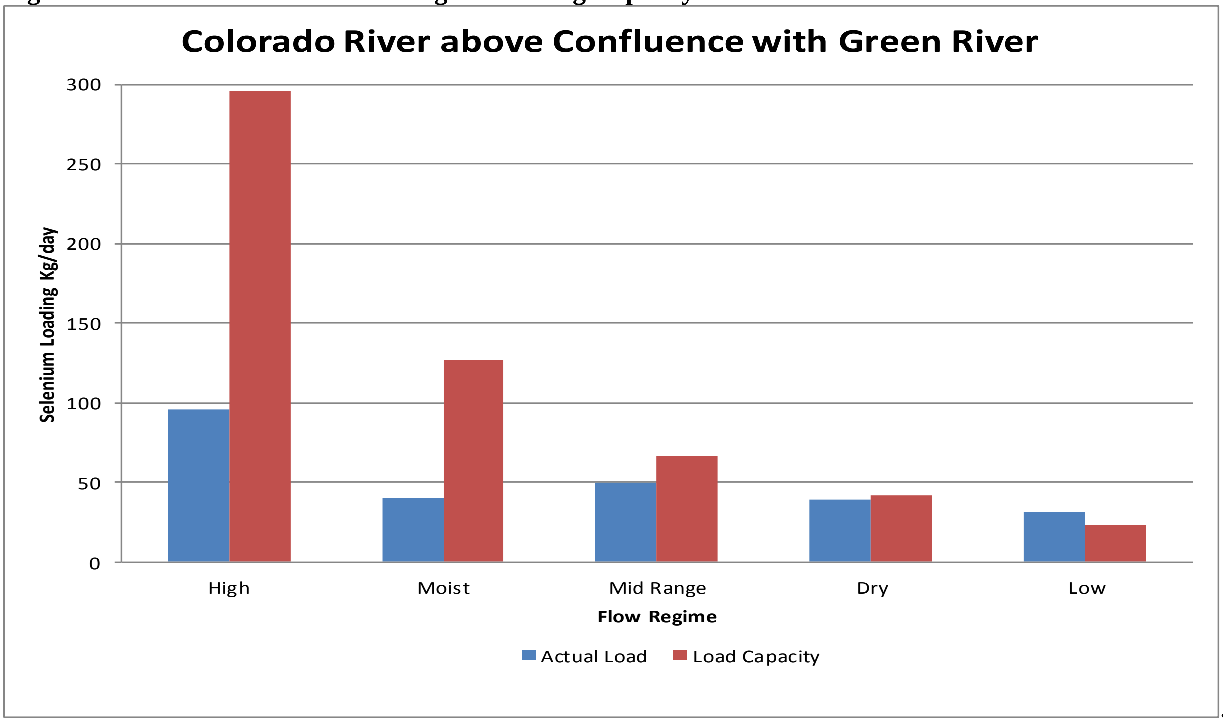
For the Colorado River TMDL, the MOS was included explicitly by allocating 10 percent of the loading capacity to the MOS due to the uncertainties regarding the proportion of natural versus anthropogenic sources and with the data gaps primarily associated with flow.

Margin of Safety = 2.38 Kg/day during low flow conditions.

7.0 Seasonal Variation

Tables 7.1 & 7.2 clearly show that the selenium problem in the Colorado River is seasonal and occurs in predominately low flow conditions in August.

Figure 7.1 - Selenium Current Loading vs. Loading Capacity



In Figure 7.1 the loading capacity is compared to the current load associated with each flow regime. The only category in which the current load exceeds the capacity is in the low flow regime. The only month the current load exceeds the loading capacity is in August where sixty percent of the lowest flows are observed (Figure 7.2).

Figure 7.2 – Average Selenium Loading vs. Loading Capacity by Month

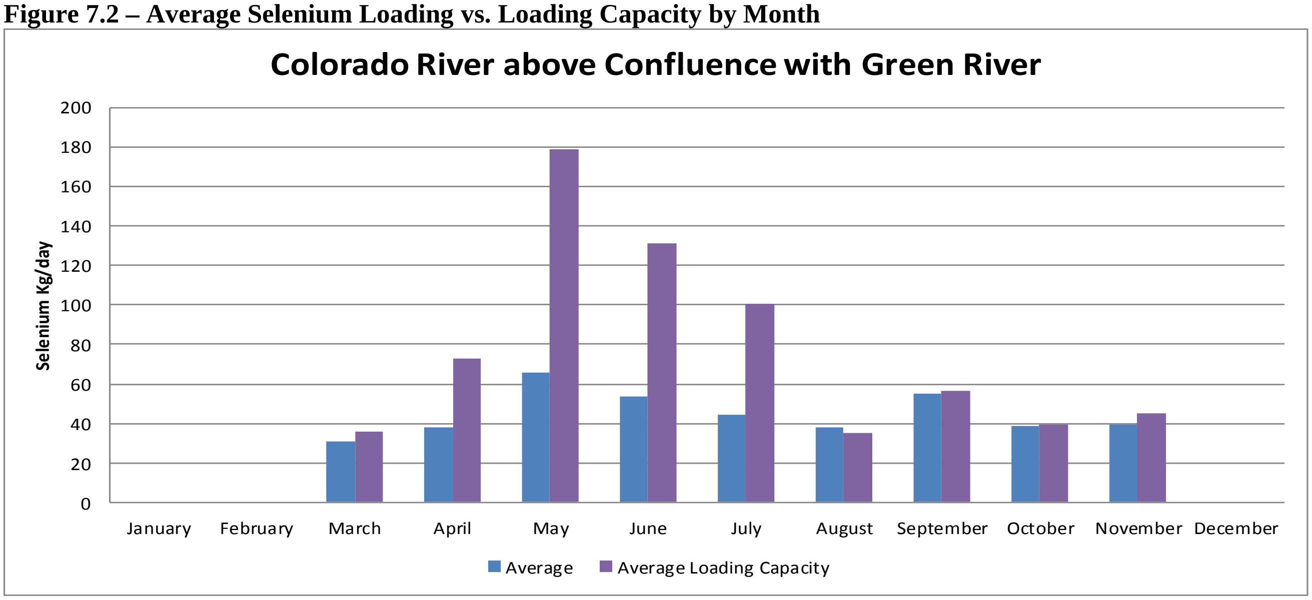
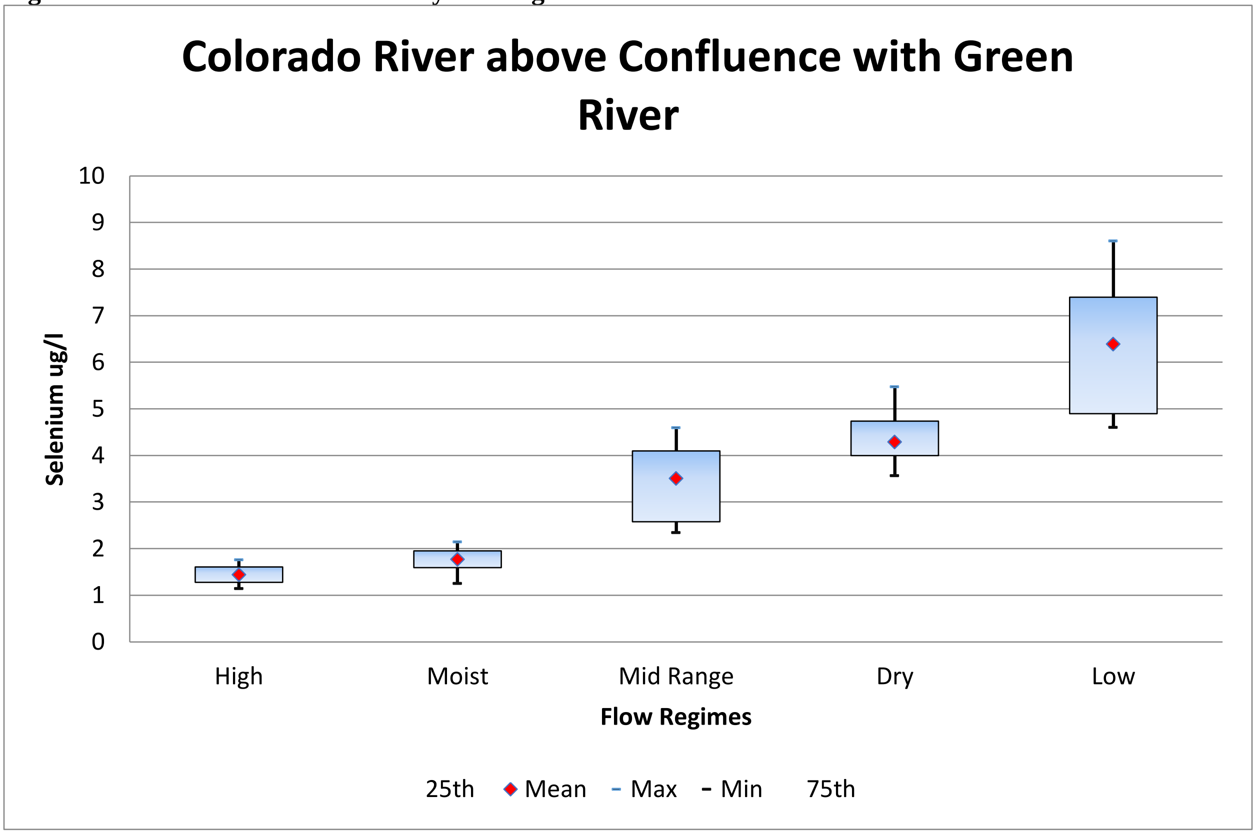


Figure 7.3 shows selenium concentration data distribution by flow regime. Only the low flow regime has an average concentration that exceeds the state standard of 4.6 μg/L. Exceedance of

the standard during low flow conditions is an indication that the source of the impairment is from groundwater inflow that has seeped through Mancos shale soils.

Figure 7.3 - Selenium concentration by flow regime

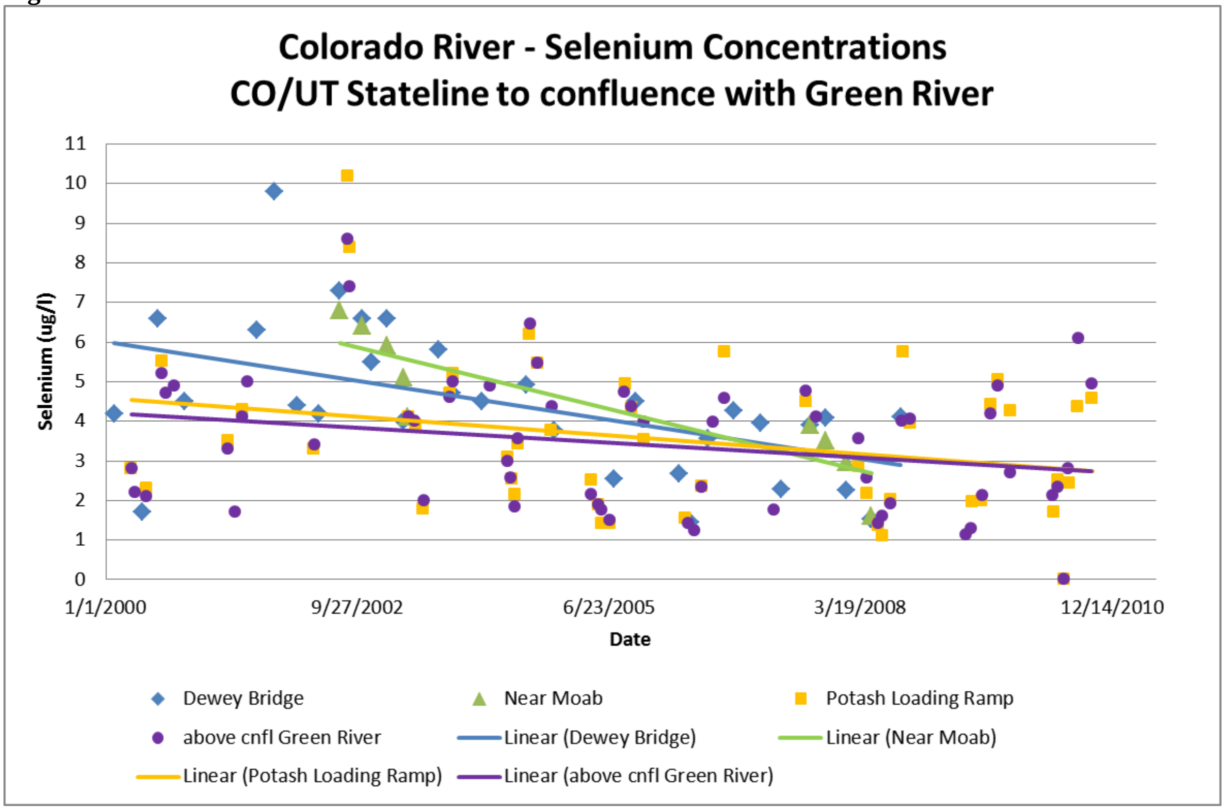


8.0 Reasonable Assurance

It is important to recognize that the control of pollutant loads from both natural and anthropogenic non-point sources is governed by the voluntary implementation of BMPs. The assurance that implementation activities will occur is that implementation is currently ongoing under the cooperative efforts of local agricultural producers, the Colorado River Basin Salinity Control Program, the Selenium Management Program and the National Irrigation Water Quality Program (NIWQP). Although NIWQP has not received funding since 2004 the practices implemented through this program will continue to have benefits to reduced selenium loads. These BMP's are being implemented in Colorado in the Gunnison and Grand Valley basins upstream of the study area.

In figure 8.1 trend lines are added to figure 2.3 to show decreasing concentration trends at all monitoring sites. These decreasing trends are evidence that the Colorado River Basin Salinity Control Program, the Selenium Management Program, the National Irrigation Water Quality Program combined with landowners and citizen groups in the Colorado portion of the watershed are having a positive impact on reducing selenium downstream in the Utah portion of the Colorado River watershed. These proven programs have and will continue to help reduce selenium loading into the system. Mayo, J.W., and Leib, K.J., in their 2012 report state "It was determined that the selenium concentration for the Gunnison River site had a statistically significant downward trend over the study period."

Figure 8.1 - Selenium concentration trends



9.0 Future Monitoring

Long-term monitoring of water quality will be conducted at the four locations used in this study, and will be used to evaluate the effects of BMPs, as well as progress toward meeting water quality goals and supporting beneficial uses.

The water quality monitoring stations used in this TMDL are all located on the main stem of the Colorado River. Data from these stations may include storm flows and runoff events captured during routine monitoring visits; however storm flows are not specifically targeted. Additionally, a large portion of the watershed is drained by dry washes that only flow after storm events. Pollutant loads generated from storm events in these drainages are not captured by the current water quality monitoring strategy.

10.0 Implementation Plan

Conversion of flood irrigation to more efficient sprinkler irrigation is a common BMP in the Colorado River Watershed for reducing TDS and selenium loads. Significant irrigation upgrades have been made in the last two decades. These implementation activities have occurred in the watershed upstream of the UT/CO stateline above the study area. The key to effectively reducing the anthropogenic loads in the Colorado River watershed while maintaining current water rights and irrigation use is to continue to improve and maintain water use efficiency projects and to minimize surface runoff, seepage, and deep percolation. The majority of the irrigated land in the study area is located in Spanish Valley and Castle Valley where Mill Creek and Castle Creek drain to the Colorado River. These two tributaries have negligible loads of selenium to the

Colorado River. It is not expect that conventional irrigation improvements to lands in Castle Valley or Spanish Valley (or elsewhere in the study area) such as are implemented via the Colorado River Basin Salinity Control Program would have a measurable impact on selenium loading to the river reach in this study. Although not guaranteed, it is anticipated that efforts in Colorado will continue and have a positive effect on the concentration of selenium in Utah. Continuance of the Colorado River Basin Salinity Control Program and the Selenium Management Program along with Landowner participation will continue to have a positive effect.

11.0 Public Participation

Local stakeholder participation for the draft TMDL was accomplished through stakeholder meetings with the Moab Area Watershed Partnership (MAWP). These meetings were designed to present the issues and inform stakeholders. The draft TMDL was given to the stakeholders for comments.

Participants include:
- Grand County Water Conservancy District
- San Juan County Soil Conservation District
- Grand County Soil Conservation District
- NRCS
- UDEQ, Division of Water Quality
- USU Extension
- BLM
- SITLA
- USFWS
- UACD
- Spanish Valley Irrigation Company

It is important to have local input to affect water quality improvements and practices. The local stakeholders are actively participating in the MAWP and taking the lead in improving local water quality.

References

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Appendix A

Water Quality Data

Activity Start Date	Activity Start Time	Monitoring Location ID	Monitoring Location Name	Characteristic Name	Result Sample Fraction	Result Value	Result Unit
11/9/2000	9:16:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3440	cfs
4/26/2001	6:29:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3620	cfs
6/28/2001	9:32:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4900	cfs
8/23/2001	9:14:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4200	cfs
11/1/2001	9:27:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3390	cfs
12/12/2001	4:19:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		2730	cfs
4/25/2002	10:34:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		2160	cfs
6/4/2002	3:33:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		4500	cfs
7/19/2002	12:04:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		1400	cfs
8/22/2002	10:52:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		1860	cfs
9/19/2002	11:26:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3360	cfs
11/17/2004	3:33:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		3340	cfs
1/20/2005	12:18:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		2990	cfs
3/31/2005	9:02:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4400	cfs
5/26/2005	8:57:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		38600	cfs
7/14/2005	8:27:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		6050	cfs
9/1/2005	8:46:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3030	cfs
10/6/2005	9:31:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4510	cfs
12/1/2005	8:00:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3330	cfs
2/9/2006	7:48:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		2850	cfs
3/30/2006	8:36:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4010	cfs
5/11/2006	8:41:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		9120	cfs
6/22/2006	1:17:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		6900	cfs
7/20/2006	9:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4100	cfs
9/14/2006	10:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4340	cfs
1/24/2008	11:21:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		4640	cfs
2/19/2008	12:48:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		4300	cfs

3/20/2008	11:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		3180	cfs
4/17/2008	11:40:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		11100	cfs
5/1/2008	12:11:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		15900	cfs
5/15/2008	11:05:00 AM	4958490	COLO R AT DEWEY BRIDGE	Flow		19600	cfs
8/26/2008	2:49:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		3970	cfs
12/9/2008	2:51:00 PM	4958490	COLO R AT DEWEY BRIDGE	Flow		3310	cfs
2/3/2000	10:16:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.54	ppth
3/23/2000	9:29:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.5	ppth
7/27/2000	9:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
9/21/2000	9:25:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
11/9/2000	9:16:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
4/26/2001	6:29:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.4	ppth
6/28/2001	9:32:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.5	ppth
12/12/2001	4:19:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.64	ppth
1/31/2002	10:25:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.7	ppth
4/25/2002	10:34:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.57	ppth
6/4/2002	3:33:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.4	ppth
7/19/2002	12:04:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.7	ppth
8/22/2002	10:52:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.72	ppth
9/19/2002	11:26:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.7	ppth
10/17/2002	10:31:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.8	ppth
11/21/2002	11:16:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.71	ppth
1/23/2003	10:53:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.77	ppth
2/27/2003	11:51:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.76	ppth
3/27/2003	10:32:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.7	ppth
4/17/2003	10:29:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.44	ppth
5/8/2003	10:50:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.4	ppth
5/22/2003	11:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.22	ppth
6/5/2003	3:26:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.2	ppth
6/19/2003	11:31:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.3	ppth
8/14/2003	3:09:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
10/9/2003	10:12:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.59	ppth
2/5/2004	11:45:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.68	ppth

4/1/2004	9:26:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.4	ppth
5/13/2004	9:39:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.24	ppth
7/29/2004	9:18:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
9/9/2004	2:01:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.63	ppth
11/17/2004	3:33:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.61	ppth
1/20/2005	12:18:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppth
3/31/2005	9:02:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.46	ppt
5/26/2005	8:57:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.14	ppt
7/14/2005	8:27:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.38	ppt
9/1/2005	8:46:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppt
10/6/2005	9:31:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.58	ppt
12/1/2005	8:00:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.56	ppt
2/9/2006	7:48:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.52	ppt
3/30/2006	8:36:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.3	ppt
5/11/2006	8:41:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.17	ppt
6/22/2006	1:17:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.34	ppt
7/20/2006	9:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.5	ppt
9/14/2006	10:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.54	ppt
11/2/2006	9:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.55	ppt
12/7/2006	9:17:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.53	ppt
2/15/2007	8:31:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.53	ppt
3/29/2007	8:21:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.31	ppt
7/31/2007	2:11:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.55	ppt
8/30/2007	2:43:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.57	ppt
9/20/2007	1:01:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.55	ppt
11/1/2007	12:43:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.51	ppt
11/28/2007	3:36:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.55	ppt
1/24/2008	11:21:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.49	ppt
2/19/2008	12:48:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.46	ppt
3/20/2008	11:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.52	ppt
4/17/2008	11:40:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.28	ppt
5/1/2008	12:11:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.2	ppt
5/15/2008	11:05:00 AM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.21	ppt

8/26/2008	2:49:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.53	ppt
10/21/2008	4:47:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.55	ppt
12/9/2008	2:51:00 PM	4958490	COLO R AT DEWEY BRIDGE	Salinity	Total	0.6	ppt
2/3/2000	10:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.2	ug/l
5/25/2000	10:06:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	1.7	ug/l
7/27/2000	9:50:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	6.6	ug/l
11/9/2000	9:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.5	ug/l
4/26/2001	6:29:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved		
8/23/2001	9:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	6.3	ug/l
11/1/2001	9:26:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	9.8	ug/l
1/31/2002	10:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.4	ug/l
4/25/2002	10:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.2	ug/l
7/19/2002	12:05:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	7.3	ug/l
10/17/2002	11:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	6.6	ug/l
11/21/2002	11:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	5.5	ug/l
1/23/2003	11:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	6.6	ug/l
3/27/2003	10:22:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4	ug/l
8/14/2003	3:08:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	5.8	ug/l
10/9/2003	10:10:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.7	ug/l
2/5/2004	11:35:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.5	ug/l
7/29/2004	9:15:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.92	ug/l
11/17/2004	3:30:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	3.78	ug/l
7/14/2005	8:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	2.54	ug/l
10/6/2005	9:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.51	ug/l
3/30/2006	8:40:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	2.68	ug/l
5/11/2006	8:40:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	1.45	ug/l
7/20/2006	9:10:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	3.56	ug/l
11/2/2006	9:25:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.27	ug/l
2/15/2007	8:30:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	3.95	ug/l
5/10/2007	8:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	2.29	ug/l
8/30/2007	2:30:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	3.91	ug/l
11/1/2007	12:45:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.08	ug/l
1/24/2008	11:20:00 AM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	2.26	ug/l

5/1/2008	12:10:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	1.53	ug/l
8/26/2008	2:45:00 PM	4958490	COLO R AT DEWEY BRIDGE	Selenium	Dissolved	4.11	ug/l
9/9/1997	10:15:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		6000	cfs
6/16/1999	10:47:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		15600	cfs
6/28/2001	5:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		5000	cfs
6/10/2002	1:58:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		7210	cfs
8/21/2002	1:36:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		1400	cfs
8/28/2002	11:00:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		1600	cfs
4/17/2003	9:35:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3700	cfs
5/15/2003	4:53:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3500	cfs
6/18/2003	2:50:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		8500	cfs
10/1/2003	8:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3100	cfs
10/13/2003	3:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3220	cfs
3/8/2004	4:31:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		2200	cfs
5/18/2004	11:52:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		5700	cfs
5/30/2004	5:34:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		7000	cfs
6/13/2004	7:16:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		7400	cfs
6/28/2004	10:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3800	cfs
8/13/2004	11:46:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		2250	cfs
9/13/2004	3:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3200	cfs
4/13/2005	10:45:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		7400	cfs
5/11/2005	4:50:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		13500	cfs
5/25/2005	11:10:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		37500	cfs
6/27/2005	6:18:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		18200	cfs
8/25/2005	4:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3450	cfs
9/20/2005	1:45:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3600	cfs
11/8/2005	2:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		4010	cfs
5/5/2006	11:38:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		10900	cfs
5/28/2006	2:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		18500	cfs
6/28/2006	10:55:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		6000	cfs
8/12/2006	12:15:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		4500	cfs
9/26/2006	3:51:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		5650	cfs
4/11/2007	11:40:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		8100	cfs

5/17/2007	2:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		13700	cfs
8/17/2007	2:16:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3500	cfs
9/27/2007	9:02:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		6750	cfs
3/11/2008	1:54:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		4150	cfs
4/14/2008	6:25:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		6750	cfs
5/28/2008	11:26:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		27000	cfs
6/13/2008	10:25:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		25000	cfs
7/17/2008	9:34:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		8900	cfs
8/29/2008	11:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		3900	cfs
10/3/2008	9:15:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		4220	cfs
5/14/2009	11:40:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		21700	cfs
6/3/2009	5:15:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Flow		20100	cfs
7/15/2009	7:55:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		9000	cfs
8/18/2009	11:25:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Flow		4350	cfs
7/18/2001	11:33:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Salinity	Total	0.57	ppth
4/12/2000	6:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.8	ug/l
4/26/2000	5:30:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.2	ug/l
6/12/2000	3:20:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.1	ug/l
8/9/2000	2:13:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	5.2	ug/l
8/29/2000		4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.7	ug/l
10/1/2000	12:30:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.9	ug/l
4/30/2001	1:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.3	ug/l
5/29/2001	3:21:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.7	ug/l
6/28/2001	5:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.1	ug/l
7/18/2001	12:40:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	5	ug/l
4/9/2002	10:07:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.4	ug/l
8/21/2002	1:36:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	8.6	ug/l
8/28/2002	11:00:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	7.4	ug/l
4/17/2003	9:35:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.1	ug/l
5/15/2003	4:53:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4	ug/l
6/18/2003	2:50:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2	ug/l
10/1/2003	8:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.6	ug/l
10/13/2003	3:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	5	ug/l

3/8/2004	4:31:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.9	ug/l
5/18/2004	11:52:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3	ug/l
5/30/2004	5:34:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.58	ug/l
6/13/2004	7:16:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.83	ug/l
6/28/2004	10:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.56	ug/l
8/13/2004	11:46:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	6.47	ug/l
9/13/2004	3:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	5.47	ug/l
11/7/2004	10:00:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.37	ug/l
4/13/2005	10:45:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.14	ug/l
5/11/2005	4:50:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.88	ug/l
5/25/2005	11:10:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.76	ug/l
6/27/2005	6:18:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.49	ug/l
8/25/2005	4:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.74	ug/l
9/20/2005	1:45:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.36	ug/l
11/8/2005	2:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.99	ug/l
5/6/2006	11:38:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.43	ug/l
5/28/2006	2:00:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.25	ug/l
6/28/2006	10:55:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.34	ug/l
8/12/2006	12:15:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.99	ug/l
9/26/2006	3:51:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.59	ug/l
4/11/2007	11:45:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.76	ug/l
8/17/2007	2:16:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.76	ug/l
9/27/2007	9:02:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.1	ug/l
3/11/2008	1:54:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	3.56	ug/l
4/14/2008	6:25:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.56	ug/l
5/28/2008	11:26:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.43	ug/l
6/13/2008	10:25:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.61	ug/l
7/17/2008	9:34:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.91	ug/l
8/29/2008	11:50:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.01	ug/l
10/3/2008	9:15:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.07	ug/l
5/14/2009	11:40:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.14	ug/l
6/3/2009	5:15:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	1.28	ug/l
7/15/2009	7:55:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.12	ug/l

8/18/2009	11:25:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.19	ug/l
9/15/2009	4:23:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.89	ug/l
11/4/2009	4:14:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.7	ug/l
4/20/2010	2:05:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.13	ug/l
5/12/2010	7:15:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.34	ug/l
6/7/2010	5:20:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	0	ug/l
6/24/2010	3:16:00 PM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	2.8	ug/l
8/4/2010	9:13:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	6.1	ug/l
9/24/2010	9:00:00 AM	4952400	COLORADO R AB CNFL / GREEN R	Selenium	Dissolved	4.94	ug/l
1/7/1997	5:10:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		4120	cfs
2/13/1997	8:32:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		4660	cfs
6/26/1997	11:29:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		26800	cfs
1/21/1999	12:15:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3750	cfs
2/11/1999	9:49:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3830	cfs
9/30/1999	8:19:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		6130	cfs
4/26/2001	8:35:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3620	cfs
8/23/2001	7:36:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		4200	cfs
11/1/2001	8:46:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3390	cfs
1/31/2002	9:23:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		2600	cfs
4/25/2002	9:26:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		2160	cfs
7/19/2002	9:46:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		1400	cfs
8/21/2002	4:03:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		1680	cfs
11/17/2004	2:47:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3340	cfs
7/14/2005	7:42:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		6050	cfs
1/23/2008	4:54:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		4640	cfs
2/19/2008	3:42:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		4300	cfs
3/20/2008	7:48:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3210	cfs
4/17/2008	8:03:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		11100	cfs
5/1/2008	8:11:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		15900	cfs
5/14/2008	6:44:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		21000	cfs
12/9/2008	5:15:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Flow		3310	cfs
2/3/2000	9:03:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.54	ppth
7/27/2000	8:31:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.6	ppth

4/26/2001	8:35:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.4	ppth
1/31/2002	9:23:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.7	ppth
4/25/2002	9:26:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.57	ppth
7/19/2002	9:46:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.7	ppth
8/21/2002	4:03:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.74	ppth
10/16/2002	4:35:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.77	ppth
1/22/2003	2:01:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.74	ppth
2/26/2003	3:13:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.76	ppth
3/27/2003	8:26:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.7	ppth
4/16/2003	2:20:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.51	ppth
5/8/2003	8:39:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.4	ppth
5/21/2003	3:33:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.24	ppth
6/5/2003	12:35:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.2	ppth
6/19/2003	8:29:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.29	ppth
8/14/2003	1:48:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.6	ppth
10/9/2003	9:15:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.62	ppth
2/5/2004	11:01:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.66	ppth
7/29/2004	8:31:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.7	ppth
11/17/2004	2:47:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.61	ppth
7/14/2005	7:42:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.38	ppt
10/6/2005	7:30:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.6	ppt
3/30/2006	7:58:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.51	ppt
5/11/2006	7:28:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.17	ppt
7/31/2007	11:10:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.58	ppt
8/30/2007	12:01:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.59	ppt
11/1/2007	8:13:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.51	ppt
11/28/2007	1:31:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.55	ppt
1/23/2008	4:54:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.49	ppt
2/19/2008	3:42:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.45	ppt
3/20/2008	7:48:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.54	ppt
4/17/2008	8:03:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.3	ppt
5/1/2008	8:11:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.21	ppt
5/14/2008	6:44:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.2	ppt

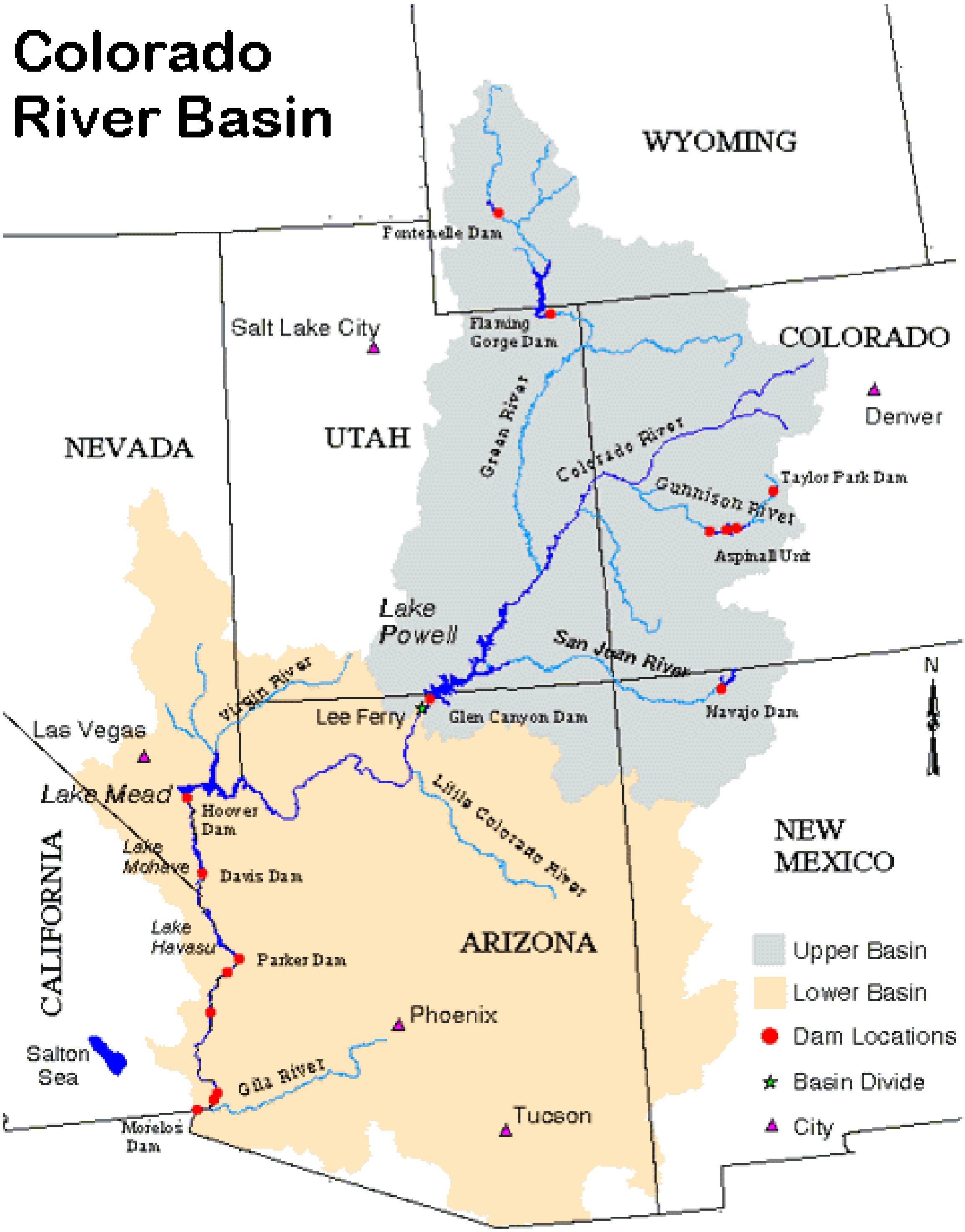
10/21/2008	5:43:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.55	ppt
12/9/2008	5:15:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Salinity	Total	0.61	ppt
7/19/2002	9:45:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	6.8	ug/l
10/16/2002	5:45:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	6.4	ug/l
1/22/2003	2:00:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	5.9	ug/l
3/27/2003	8:25:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	5.1	ug/l
4/16/2003	2:30:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	4.1	ug/l
8/30/2007	12:00:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	3.9	ug/l
11/1/2007	8:15:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	3.5	ug/l
1/23/2008	5:00:00 PM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	2.96	ug/l
5/1/2008	8:10:00 AM	4957000	COLORADO R AT US191 XING NEAR MOAB	Selenium	Dissolved	1.6	ug/l
9/9/1997	9:40:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		6000	cfs
4/11/2000	1:20:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		8000	cfs
6/27/2001	12:30:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		5000	cfs
6/10/2002	8:48:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		7210	cfs
8/19/2002	9:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		1400	cfs
8/26/2002	11:50:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		1750	cfs
4/18/2003	11:55:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		4000	cfs
5/16/2003	12:21:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3900	cfs
6/16/2003	8:55:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		9000	cfs
9/29/2003	10:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3100	cfs
10/12/2003	2:45:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3190	cfs
5/18/2004	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		5700	cfs
5/31/2004	4:24:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		8300	cfs
6/14/2004	12:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		6250	cfs
6/27/2004	10:15:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3600	cfs
8/12/2004	8:45:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		2275	cfs
9/12/2004	9:36:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3200	cfs
4/12/2005	9:50:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		8000	cfs
5/12/2005	12:15:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		15000	cfs
5/25/2005	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		38000	cfs
6/26/2005	9:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		20000	cfs
8/26/2005	11:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3500	cfs

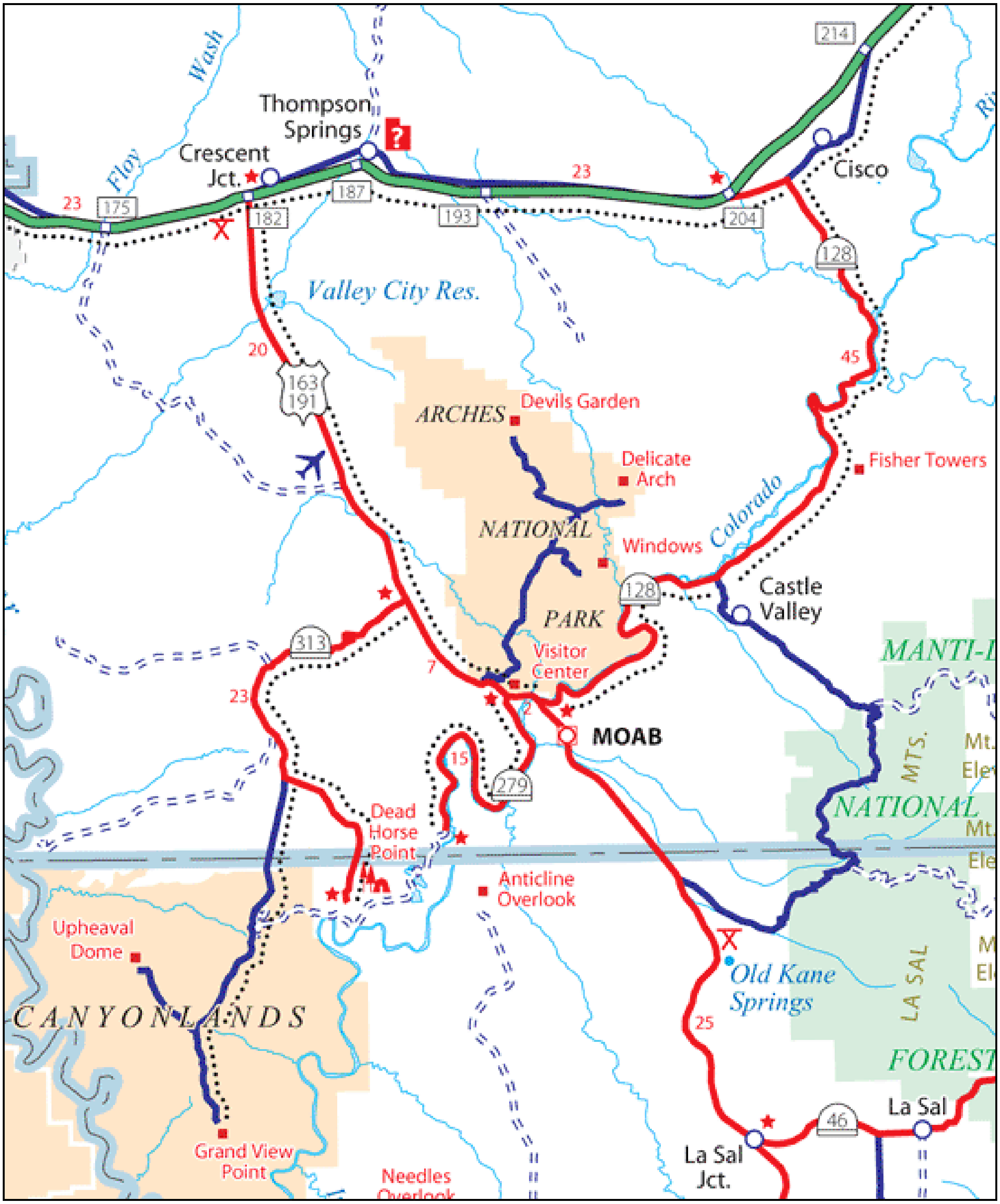
9/19/2005	9:05:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3600	cfs
11/8/2005	11:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3975	cfs
4/24/2006	9:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		9000	cfs
6/26/2006	10:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		6500	cfs
9/26/2006	10:40:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		5300	cfs
5/17/2007	4:59:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		14200	cfs
8/16/2007	3:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		3400	cfs
3/12/2008	2:40:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		4175	cfs
4/14/2008	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		6750	cfs
5/28/2008	9:40:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		26500	cfs
6/13/2008	8:20:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		26500	cfs
7/16/2008	11:52:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		9100	cfs
9/2/2008	10:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		5200	cfs
10/3/2008	1:25:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		4250	cfs
6/4/2009	2:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		20200	cfs
7/13/2009	8:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		9600	cfs
8/17/2009	9:44:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Flow		4800	cfs
4/11/2000	1:20:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.8	ug/l
6/12/2000	12:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.3	ug/l
8/9/2000	10:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.524	ug/l
4/30/2001	8:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.5	ug/l
6/27/2001		4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.3	ug/l
4/8/2002	9:18:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.3	ug/l
8/19/2002	9:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	10.2	ug/l
8/26/2002	11:50:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	8.4	ug/l
4/18/2003	11:55:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.1	ug/l
5/16/2003	12:21:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.9	ug/l
6/16/2003	8:55:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.8	ug/l
9/29/2003	10:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.7	ug/l
10/12/2003	2:45:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.2	ug/l
5/18/2004	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.1	ug/l
5/31/2004	4:24:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.55	ug/l
6/14/2004	12:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.15	ug/l

6/27/2004	10:15:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.42	ug/l
8/12/2004	8:45:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	6.21	ug/l
9/12/2004	9:36:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.47	ug/l
11/4/2004	10:05:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.78	ug/l
4/12/2005	9:50:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.51	ug/l
5/12/2005	12:15:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.88	ug/l
5/25/2005	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.43	ug/l
6/26/2005	9:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.41	ug/l
8/26/2005	11:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.94	ug/l
9/19/2005	9:05:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.34	ug/l
11/8/2005	11:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.53	ug/l
4/24/2006	9:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.54	ug/l
6/26/2006	10:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.35	ug/l
9/26/2006	10:40:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.75	ug/l
8/16/2007	3:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.5	ug/l
3/12/2008	2:40:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.85	ug/l
4/14/2008	4:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.17	ug/l
5/28/2008	9:40:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.37	ug/l
6/13/2008	8:20:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.11	ug/l
7/16/2008	11:52:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.03	ug/l
9/2/2008	10:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.76	ug/l
10/3/2008	1:25:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	3.95	ug/l
6/4/2009	2:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.98	ug/l
7/13/2009	8:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2	ug/l
8/17/2009	9:44:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.43	ug/l
9/15/2009	11:00:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	5.04	ug/l
11/4/2009	12:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.27	ug/l
4/26/2010	1:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	1.7	ug/l
5/12/2010	10:01:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.53	ug/l
6/7/2010	1:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	0	ug/l
6/25/2010	1:00:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	2.43	ug/l
7/28/2010	10:30:00 AM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.38	ug/l
9/25/2010	3:20:00 PM	4956290	COLORADO RIVER AT POTASH BOAT RAMP	Selenium	Dissolved	4.57	ug/l

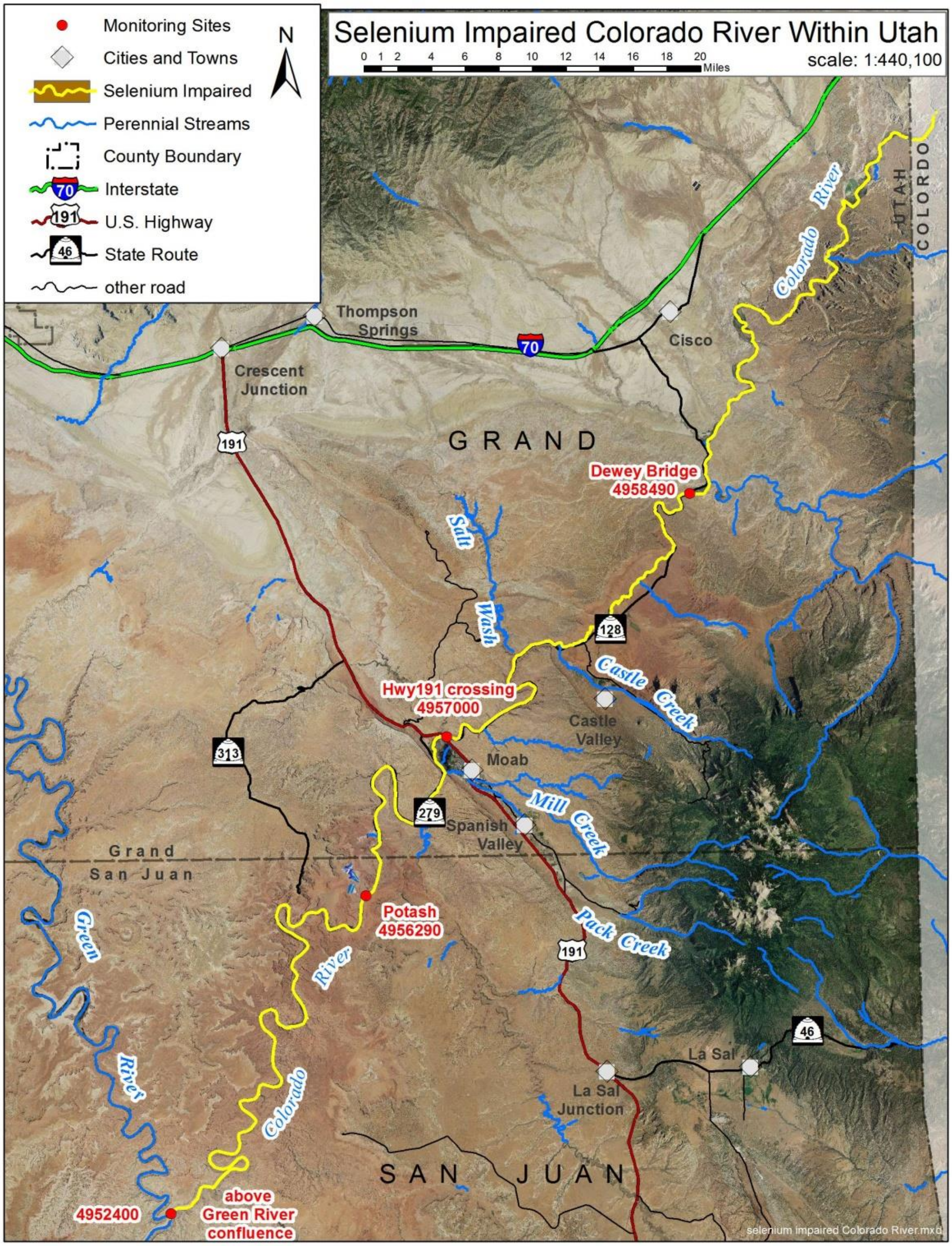
Appendix B

Maps

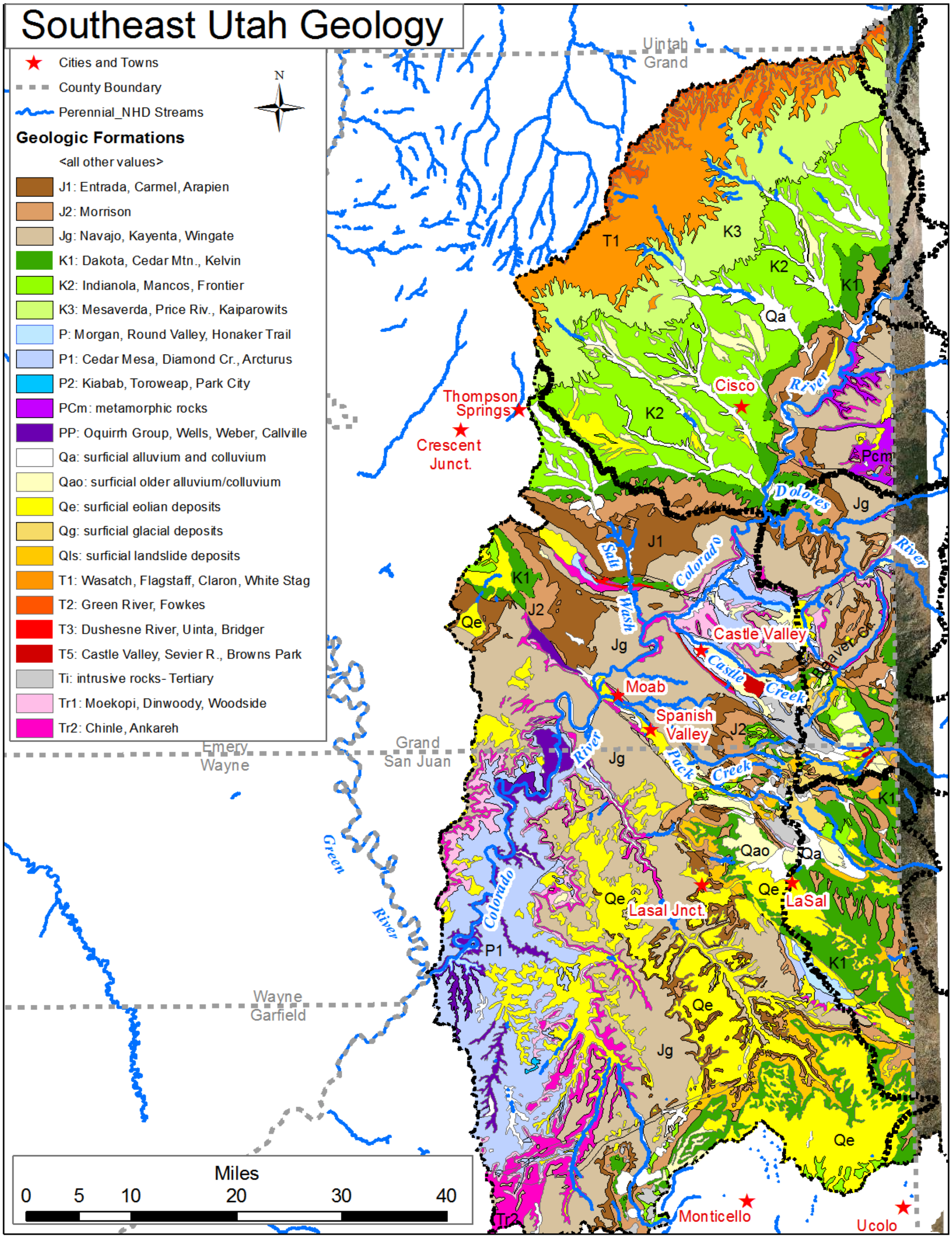




Thompson Springs
Crescent Jct.
Cisco
Valley City Res.
ARCHES
NATIONAL
PARK
Devils Garden
Delicate Arch
Windows
Fisher Towers
Colorado
Castle Valley
Visitor Center
MOAB
Dead Horse Point
Anticline Overlook
Upheaval Dome
CANYONLANDS
Grand View Point
Needles Overlook
Old Kane Springs
La Sal Jct.
La Sal
NATIONAL
FOREST
LA SAL
MTS.
Wash
Floy
214
23
175
182
187
193
204
128
45
20
163
191
313
279
15
7
2
25
46



Selenium Impaired Colorado River Within Utah
scale: 1:440,100
0 1 2 4 6 8 10 12 14 16 18 20 Miles
Monitoring Sites
Cities and Towns
Selenium Impaired
Perennial Streams
County Boundary
Interstate
U.S. Highway
State Route
other road
N
Thompson Springs
Crescent Junction
Cisco
GRAND
Dewey Bridge 4958490
Colorado River
UTAH
COLORADO
Salt Wash
Castle Creek
Castle Valley
Hwy191 crossing 4957000
Moab
Mill Creek
Spanish Valley
Grand
San Juan
Potash 4956290
Pack Creek
Green River
La Sal
La Sal Junction
SAN JUAN
4952400
above Green River confluence
selenium impaired Colorado River.mxd


Southeast Utah Geology
Cities and Towns
County Boundary
Perennial_NHD Streams
Geologic Formations
<all other values>
J1: Entrada, Carmel, Arapien
J2: Morrison
Jg: Navajo, Kayenta, Wingate
K1: Dakota, Cedar Mtn., Kelvin
K2: Indianola, Mancos, Frontier
K3: Mesaverda, Price Riv., Kaiparowits
P: Morgan, Round Valley, Honaker Trail
P1: Cedar Mesa, Diamond Cr., Arcturus
P2: Kiabab, Toroweap, Park City
PCm: metamorphic rocks
PP: Oquirrh Group, Wells, Weber, Callville
Qa: surficial alluvium and colluvium
Qao: surficial older alluvium/colluvium
Qe: surficial eolian deposits
Qg: surficial glacial deposits
Qls: surficial landslide deposits
T1: Wasatch, Flagstaff, Claron, White Stag
T2: Green River, Fowkes
T3: Dushesne River, Uinta, Bridger
T5: Castle Valley, Sevier R., Browns Park
Ti: intrusive rocks- Tertiary
Tr1: Moekopi, Dinwoody, Woodside
Tr2: Chinle, Ankareh
N
Uintah
Grand
Emery
Wayne
Grand
San Juan
Wayne
Garfield
Thompson Springs
Crescent Junct.
Cisco
Castle Valley
Moab
Spanish Valley
Lasal Jnct.
LaSal
Monticello
Ucolo
Miles
0 5 10 20 30 40

Appendix C

Response to Comments

Comment #	Comment	Response	Resultant Change
01 **Nicole Rowan, P.E.** Watershed Section Manager Water Quality Control Division Colorado Department of Public Health and Environment	In Colorado, attainment of the selenium standard (4.6 ug/L) is determined by the 85th percentile of the most recent five years of data where "data sets comprised of four to ten samples where there is overwhelming evidence of non-attainment or data is supported by biological or physical evidence indicating non-attainment, or data sets of more than ten samples indicating any degree of non-attainment, will result in inclusion on the 303(d) List unless it is determined that the data is not representative." In Colorado, the main stem Colorado River was de-listed for selenium on the 2012 303(d) List of Impaired Waters. However, all tributaries to the main stem of the Colorado in the Grand Valley are currently listed. Data is being collected this year for Upper and Lower Colorado Basins, but listing determinations will not be completed as part of the 2014 303(d) List. It should be noted that as part of TMDL development for the tributaries to the Colorado River, the main stem will also be addressed. The WQCD continues to address selenium impairments by working with the Gunnison Basin and Grand Valley Selenium Task Forces on load reductions through implementation of agricultural best management practices. These best management practices are being implemented as part of the Colorado River Basin Salinity Control Program, the Selenium Management Program, and the National Irrigation Water Quality Program. In addition, a watershed based plan for the Lower Gunnison has recently been updated to satisfy the EPA 9 Elements and will be implemented through Colorado Nonpoint Source funding. Our TMDL and NPS staff will be available to assist with response to comments from other parties in Colorado if helpful. Please contact Holly Brown at 303-691-4023 holly.brown@state.co.us or Bonie Pate at 303-692-3557 bonie.pate@state.co.us with any questions or concerns.	Thank you for the information.	No Change

02 **John Weisheit** Conservation Director Colorado Riverkeeper	Thank you for this opportunity to provide comments to reduce selenium loading into the Colorado River in eastern Utah. These comments are provided by Living Rivers & Colorado Riverkeeper based in Moab, Utah; our riverkeeper program is affiliated with the international Waterkeeper Alliance. In general our organization is always concerned and focused on the quantity and quality of all river water that flows from the headwaters of the Upper Basin states before plunging into Lake Powell Reservoir. Besides the state of Utah, reducing selenium loads is also the responsibility of the other 6 states of the Colorado River Basin, and especially for the four states that utilize the watersheds within the Colorado Plateau. This geophysical province is responsible for most of sediment and salinity inputs that harm the quality of the Colorado River and its tributaries. This harm to water quality was first identified by John Wesley Powell in 1875. Controlling the loading of salinity and heavy metals in the Colorado River is the cost of doing business when dams and diversions were built for the purpose of irrigating soils of poor quality, such as the Mancos Shale. Living Rivers understands this problem will likely never be solved, because the Colorado River basin has a management preference for quantity over quality, since the Reclamation Act was passed in 1902. The theme of development scheme of the last 110-years can best be summarized as: let's put this water to beneficial use as quickly and inexpensively as possible and we will deal with the problems this development creates at a later time. Consequently, most of the legislation adopted since then, to specifically mitigate the problems of managing quantity, occurred in the 1970s with such legislation as the Clean Water Act, the Salinity Control Act, and the Endangered Species Act. Obviously, legislation to mitigate the expensive problem of massive sediment accumulation in the reservoirs has yet to be addressed. The mismanagement of water quality includes allowing the entire basin to become over-appropriated, or promising more water than can be delivered. Now that the demand in the basin has surpassed the supply, and because the basin states and Reclamation have decided to continue focusing on meeting future demands, which were arbitrarily contrived during the completion of the final "Basin Study," how could a water quality agency possibly succeed? In other words, the dilution factor (a free ecological service) is no longer available as a management tool for water quality managers, which means such agencies will require huge amounts of financial resources	Thank You for your Comments	No Change

	that will likely be grabbed for solving water quantity issues instead. Therefore, your agency has our sympathy, but you also have our support because we understand your mission is superior. After all, what good is water quantity, if it has no quality? The Salinity Control Act of 1973 has basically succeeded in reducing salinity levels in the last four decades, but helping this success along was the surplus in the system that existed at the time. Without that surplus, it seems very likely that the Salinity Control Act will have to be revised in the near future and also be funded more generously than in the past. Fortunately, it would appear that the seven basin states have finally agreed that the annual average flow at the Compact Point is 14.7 MAF and not 16.5 MAF. Unfortunately, the seven basin states remain unwilling to adjust their demands to this reality, or to give a water right to the river itself so that water quality can be improved throughout the system. Moreover, in 1968, Congress enabled this attitude (quantity over quality) amongst the states and made provisions for the implementation of augmenting the supply from other river basins (or the ocean), which will only serve to harden the demand in the Colorado River basin more than it already is and in turn make water quality mandates all the more difficult to achieve. Since the seven states have yet to fully accept that the age of abundance is indeed over, we are at a loss to provide a suggestion on how to effectively accomplish a successful selenium reduction management plan under the status quo, other than to exhort that the state and national legislative bodies need create laws, regulations and policies based on reality, and to eventually discard the legislation (and etc.) of the 20th century that serves no value other than to ensure that legal conflicts over water rights (quantity) and environmental laws (quality) for the 21st century.		
03 **Travis James** USDA-NRCS Salinity Coordinator	In Section 8.0 **Reasonable Assurance,** **. . . .first sentence -**the meaning of the declaration in the first sentence is unclear. It seems the author is attempting to make a link between the identified load sources and desired control of these loads by voluntary implementation of BMPs. Perhaps the author intends to say that control of load from both natural and anthropogenic non-point sources is governed by the voluntary implementation of BMPs.	Thank you for the comment	Sentence reworded

	. . . .**second sentence –** indeed, implementation activities are ongoing by the entities listed. Presumably the three programs cited along with the actions of individual agricultural producers are contributing solely or predominantly to the decreasing selenium concentration trends. It should be noted, however, that implementation of *salinity control* BMPs under these programs is occurring predominantly in the State of Colorado, outside of Utah's boundaries. For example, to my knowledge, there are no active Colorado River Basin Salinity Control Program measures occurring within the study area. Given that "The majority of the irrigated land in Utah is located in Spanish Valley and Castle Valley where Mill Creek and Castle Creek drain to the Colorado River" and that "These two tributaries have negligible loads of selenium to the Colorado River." (page 3), one would not expect that conventional irrigation improvements to lands in Castle Valley or Spanish Valley such as implemented via the Colorado River Basin Salinity Control Program would have a measurable impact on selenium loading to the river reach under study.	Your statement is correct.	A sentence clarifying that implementation is predominantly upstream of the study area was added.
04 **Nick Williams** Water Quality Specialist Bureau of Reclamation's Salinity Control Program for the Colorado River Basin.	TMDL Summary Table (page 3), current loading, loading allocation, & load reduction – Were these load values explained in the body of the report? How much of the load source is within the watershed and how much occurs upstream? Is it possible to reach the load reduction goal within the watershed? Or must reductions upstream occur for this goal to be reached? TMDL Summary Table (page 3), implementation strategies – The Salinity Control Program has as its goal reduction of TDS (salinity) loading through implementation of cost-effective projects. Selenium is not an authorized target of the salinity program though reduction in selenium from salinity control projects is recognized. Recommend that this is acknowledged and explained. Also, the salinity control implementation is not guaranteed to occur in the Colorado River Watershed (as defined in the TMDL) or upstream of it. Some further explanation of the nature of the salinity program is warranted.	The loads were identified in the report. Rounding decimal places may have made it hard to identify. Upstream load reductions are necessary to meet TMDL endpoints It is recognized that selenium reductions are not guaranteed , however the scientific evidence supports the fact that reductions will occur from implemented salinity BMP's.	Consistency in rounded numbers added. Language added to clarify TMDL endpoint in section 3. Clarification of implementation was added to Section 10.

	TMDL Summary Table (page 3), implementation strategies – Is any work currently happening under the National Irrigation Water Quality Program? Within the Bureau of Reclamation this program has been unfunded for several years. Are you aware of efforts through this program by other agencies? What is the selenium management program and where is it located/implemented?	NIWQP has been unfunded for several years but the data used in this report includes years 2000 to present. The NIWQP effects are most likely seen in the analysis.	NWQIP removed from Summary Table. Remains in Chapter 8.
	Section 2, Pollutant Sources – The report cites an internal report of the Salinity Control Forum showing the sources of selenium upstream of Lake Powell. Recommend the TMDL report clearly state that the majority of selenium sources are upstream of the identified watershed.	The majority of the selenium sources are upstream of the state line and the study area; however they are in the same watershed.	Clarification of study area versus watershed added
	Section 10, Implementation Plan – The plan identifies conversion of flood irrigation to sprinklers as the BMP for reducing TDS and selenium loads in the Colorado River Watershed. Earlier in the report the Colorado River Watershed was defined as the watershed of the Colorado River from the Colorado-Utah Stateline to the Green River confluence. The report stated that most irrigation in the watershed occurs in Spanish and Castle Valleys but that data collected in those tributaries does not indicate these are sources of selenium loading. Salinity control projects which convert flood irrigation to more efficient methods do occur upstream of the defined watershed in the state of Colorado. Are these the BMP projects referenced? If so, recommend the TMDL report state these BMPs are being implemented upstream of the Colorado River Watershed. Also, the implementation plan does not cite any of the programs listed in the implantation strategies from the TMDL summary table (page 3 of report). Why not?	Thank you for the comment.	Clarification of study area versus watershed added.
	Section 11, Public Participation – Do these participants represent the programs listed in the implementation strategies? The Bureau of Reclamation is the lead federal agency for the Colorado River Basin Salinity Control Program. What coordination was done with Reclamation?	The MAWP is a group of stakeholders in Spanish Valley and Castle Valley interested in Watershed Planning and Water Quality. The Bureau of Reclamation has been invited to participate.	No Change.

05 **Sonja Chavez de Baca**, Coordinator Gunnison Basin & Grand Valley Selenium Task Forces	TMDL cover page "Implementation Strategies" - National Irrigation Water Quality Program hasn't been funded since 2004, recommends removing it.	Although the NIWQP has been unfunded for several years, the data used in this report includes years 2000 to present. The NIWQP effects are most likely seen in the analysis.	Reference to NIWQP removed from Summary. Left reference in section 8 with explanation that funding has not been received since 2004.
	Page 7 - "Irrigation practices have been noted to concentrate selenium when irrigation waters evaporate and concentrate the dissolved components (GBSTF 2003)" Recommend replacing "evaporate and concentrate" with dissolution and mobilization. It might read like - Irrigation practices have been noted to concentrate selenium through dissolution and mobilization of the soluble fraction into receiving waters."	Thank you, your recommendation was incorporated.	Page 7 changed as recommended
	Section 8, page 19 - Take out NIWQP reference and specify that the salinity control work is occurring in Gunnison and Grand Valley basins and not Utah. Where it talks about improving long term trends it is also suggested it would be a good place to reference the USGS study she sent by Mayo and Leib who stated "It was determined that the selenium concentration for the Gunnison River site had a statistically significant downward trend over the study period." (Mayo, J.W., and Leib, K.J., 2012, Flow-adjusted trends in dissolved selenium load and concentration in the Gunnison and Colorado Rivers near Grand Junction, Colorado, water years 1986–2008: U.S. Geological Survey Scientific Investigations Report 2012–5088, 33 p)	See comment above concerning NIWQP.	Added statement from Mayo & Leib. Clarified that implementation occurs in Colorado.
	Finally, in Section 10 - Implementation plan again specify that the salinity control work is occurring in the Gunnison / Grand Valley basins so people don't assume it's happening in Utah.	Thank you for the comment.	Clarification that implementation activities are occurring in Colorado.

06 **Julie Kinsey** Life Scientist, TMDL Team USEPA, Region 8, (8EPR-EP) 1595 Wynkoop St. Denver, CO 80202-1129 Office: 303-312-7065	Page 3 - Please include the NPDES or State Permit ID.	Thank you it has been added.	Permit ID added
	Tribal Lands are included in table 2.1. Are any waterbodies on reservation lands a part of the TMDL, and if so, has DWQ consulted with the tribe in the TMDL process?	177 acres of Tribal Lands	Ute Tribe contacted no comments
	Page 9 'Pollutant of Concern' change Normal to Natural.	Comment incorporated.	Changed Normal to Natural
	Page 16 – 'Selenium' Were calculations performed to verify that reductions needed to meet the chronic value would also meet the acute standard? In rare circumstances, we have found that meeting the chronic standard does not in fact meet the acute standard, even though it is intuitive that it should (therefore, calculations need to be applied to show that all standards will be met in relation to a given reduction).	Selenium calculations were done to insure no exceedance of acute standard. No exceedances of acute standard (18.4 ug/L) were observed in the dataset.	No change
	Per the EPA approach to LDCs (see http://www.epa.gov/owow/tmdl/duration_curve_guide_aug2007.pdf), it would be helpful if each flow regime (i.e., hydrologic condition) was defined along the curve (e.g., high/moist/mid/dry/low). Add the delineated hydrologic conditions to the graph (possibly with the flow (cfs) on a second Y-axis on the right-hand side of the graph).	Thank you, your suggestion was incorporated.	Graphs were changed to show flow regimes
	Chapter 5 'Moab City Waste Water Load Allocations' - Please include the NPDES or State Permit ID. Is there any increase in design capacity expected in the foreseeable future? And/or any new discharges anticipated in the watershed in the foreseeable future?	ID has been added. Future growth in Grand County was considered and we feel the use of the plant's max capacity sufficiently accounts for future growth.	Chapter 5 permit ID added.
	Chapter 8 - Has DWQ taken into account future growth in the watershed? The State of Colorado's TMDL for Se in the Gunnison Basin noted that future growth in the area could contribute to future Se loading due to an increase in domestic water use for landscaping. Thus while reductions were currently occurring via BMPs for agricultural areas, future predicted urban growth (and conversion of agricultural lands to urban	Chapter 8 does not include an allocation for future growth. Based upon the Grand County General Plan for 2012 the population growth is	No change.

	areas) could counteract current attempts at loading reductions. Therefore, they added an additional WLA (10% of the TMDL) dedicated to future growth. This allocation can be converted in the future to a LA or a discharger-specific WLA without the need to recalculate and resubmit the TMDL for EPA approval. This scenario may be something DWQ wants to consider adding to the TMDL document to avoid the need to resubmit the TMDL if future dischargers and/or new urban loads should present themselves.	projected to increase by only 1% over the next 50 years. In addition, the loading from Mill Creek and Castle Creek combined is less than 50 grams/day. Because not much future growth is anticipated (and the load from this source is so small), We believe that the current load allocation is sufficient to cover future growth.	