RECLAMATION

Managing Water in the West

QUALITY OF WATER

COLORADO RIVER BASIN

Progress Report No. 24

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region

2013

Mission Statements

The U.S. Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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SUMMARY

The Colorado River and its tributaries provide water to about 36 million people and irrigation water to nearly 5.5 million acres of land in the United States (Bureau of Reclamation, 2012a; Cohen, 2011). The river also serves about 3.3 million people and 500,000 acres in Mexico (Cohen, 2011). The effect of salinity is a major concern in both the United States and Mexico. Salinity damages in the United States are presently about $295 million per year at 2010 salinity concentrations. This biennial report on the quality of water in the Colorado River Basin is required by Public Laws 84-485, 87-483, and the Colorado River Basin Salinity Control Act (Salinity Control Act) (Public Law 93-320, as amended by Public Laws 98-569, 104-20, 104-127, and 106-459).

Salinity damages to municipal water pipe.

The Salinity Control Act authorizes the Secretaries of the U.S. Department of the Interior (Interior) and U.S. Department of Agriculture (USDA) to enhance and protect the quality of water available in the Colorado River for use in the United States and the Republic of Mexico.

Title I of the Salinity Control Act authorized the construction and operation of a desalting plant, brine discharge canal, and other features to enable the United States to deliver water to Mexico having an average salinity no greater than 115 parts per million (ppm) plus or minus 30 ppm over the annual average salinity of the Colorado River at Imperial Dam. The Title I program (administered by the Bureau of Reclamation [Reclamation]) continues to meet the requirements of Minute No. 242 of the International Boundary and Water Commission, United States and Mexico.

Salinity damages to crop production.

Title II of the Salinity Control Act authorizes the Secretary of the Interior (Secretary) and the Secretary of Agriculture to implement a broad range of specific and general salinity control measures in an ongoing effort to prevent further degradation of water quality to meet the objectives and standards set by the Clean Water Act.

In 1995, Public Law 104-20 authorized an entirely new way of implementing salinity control. Reclamation's Basinwide Salinity Control Program opened the program to competition through a "Request for Proposal" process, which greatly reduced the cost of salinity control by selecting the most cost effective projects. However, the price of salinity control is expected to increase in the future as the more cost effective projects are completed.

The Colorado River Basin Salinity Control Forum (Forum) in accordance with the requirements of the Clean Water Act, prepared the “2011 Review, Water Quality Standards for Salinity, Colorado River System” (Review). The Review reported that by 2030 a target of 1.85 million tons per year of salt will need to be controlled from entering the Colorado River in order to meet the water quality standards in the Lower Basin, below Lees Ferry, AZ. The combined Reclamation, USDA - Natural Resources Conservation Service & BLM salinity reduction reported for 2012 shows that the Colorado River Basin Salinity Control Program (Program) is currently controlling over 1,295,000 tons of salt per year. In order to meet the 1.85 million tons of salt per year goal, it will be necessary to fund and implement potential new measures which ensure the removal of an additional 555,000 tons by 2030. The Forum stated that in order to achieve this level of salt reduction, the federal departments and agencies would require the following capital funding: Reclamation appropriation - $17.5 million per year (bringing the total Reclamation program with $7.5 million cost-sharing to $25 million per year); and USDA EQIP appropriation - $13.8 million per year (bringing the total on-farm program to $19.7 million per year with Basin states parallel program). Beginning in 2005, BLM began a comprehensive program to minimize the salt loading from BLM lands in the Colorado River basin. BLM salinity funding from Congress began in FY 2006.

With the reported existing salt controlled, and assuming no reduction of the existing salinity control projects, then nearly 31,000 tons of new or additional controls will need to be implemented each year to maintain the standards with increased future water development. This Program goal is the combined target for the participating agencies within Interior and USDA. The participating agencies reported to the Colorado River Basin Salinity Control Advisory Council, showing that the agency’s efforts have been able to exceed the program’s target over the past several years.

Since water year 2005, the Upper Colorado River Basin has experienced significant year to year hydrologic variability. The unregulated inflow to Lake Powell, which is a good measure of hydrologic conditions in the Colorado River Basin, has averaged a water year volume of 10.22 maf (94% of average (period 1981-2010)) during the period from 2005 through 2012. The hydrologic variability during this period has been from a low water year unregulated inflow volume of 4.91 maf (45% of average) in water year 2012 to a high water year unregulated inflow volume of 15.97 maf (147% of average) in water year 2011.

Overall reservoir storage in the Colorado River Basin has increased by over 4 maf since the beginning of water year 2005 and this is an improvement over the persistent drought conditions during water years 2000 through 2004. From the beginning of water year 2005 to the end of water year 2012, the total reservoir storage in the Colorado River Basin increased from 29.8 maf (50% of capacity) to 33.9 maf (57 % of capacity).

However, during this time, total Colorado Basin storage experienced year to year increases and decreases in response to wet and dry hydrology. Salinity concentration has varied during this time period (with a downward trend), but has not exceeded the numeric salinity criteria on the Colorado River below Hoover Dam, Parker Dam and at Imperial Dam; 723, 747 & 879 mg/L respectively. Reclamation’s short term future salinity modeling scenarios indicate that the numeric salinity criteria should be maintained even with an additional 1-2 years of drought. The salinity criteria could have been exceeded in 2005 - 2007 without the salinity control program and other salt reductions. Nevertheless, salinity damages are still very high at the 2011 salinity levels. These hydrologic conditions are providing new data, which will eventually reduce the uncertainty in salinity forecasting.

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CHAPTER 1 – INTRODUCTION

The Bureau of Reclamation (Reclamation) of the U.S. Department of the Interior prepared this report in cooperation with State water resource agencies and other Federal agencies involved in the Colorado River Basin Salinity Control Program (Salinity Control Program). This Progress Report 24 is the latest in a series of biennial reports that commenced in 1963.

AUTHORIZATION FOR REPORT

The directive for preparing this report is contained in four separate public laws.

Public Law 84-485 states:

> Section 15 –"The Secretary of the Interior is directed to continue studies and make a report to the Congress and to the States of the Colorado River Basin on the quality of water of the Colorado River,"
>
> Section 5c – "All revenues collected in connection with the operation of the Colorado storage project and participating projects shall be credited to the Basin Fund, and shall be available, without further appropriation, for (1) defraying the costs of operation, maintenance, & replacement of, and emergency expenditures for, all facilities". The ongoing water quality monitoring, studies, and report are considered part of the normal operation of the project and are funded by the Basin Fund."

Public Law 87-483 states:

> Section 15 - "The Secretary of the Interior is directed to continue his studies of the quality of water of the Colorado River System, to appraise its suitability for municipal, domestic, and industrial use and for irrigation in the various areas in the United States in which it is used or proposed to be used, to estimate the effect of additional developments involving its storage and use (whether heretofore authorized or contemplated for authorization) on the remaining water available for use in the United States, to study all possible means of improving the quality of such water and of alleviating the ill effects of water of poor quality, and to report the results of his studies and estimates to the 87th Congress and every 2 years thereafter."

Public Law 87-590 states that January 3 would be the submission date for the report.

Public Law 93-320 states:

> "Commencing on January 1, 1975, and every 2 years thereafter, the Secretary shall submit, simultaneously, to the President, the Congress, and the Advisory Council created in Section 204(a) of this title, a report on the Colorado River salinity control program authorized by this title covering the progress of investigations, planning, and construction of salinity control units for the previous

fiscal year; the effectiveness of such units; anticipated work needed to be accomplished in the future to meet the objectives of this title, with emphasis on the needs during the 5 years immediately following the date of each report; and any special problems that may be impeding progress in attaining an effective salinity control program. Said report may be included in the biennial report on the quality of water of the Colorado River Basin prepared by the Secretary pursuant to section 15 of the Colorado River Storage Project Act (70 Stat. 111; 43 U.S.C. 602n), section 15 of the Navajo Indian Irrigation Project and the initial stage of the San Juan-Chama Project Act (76 Stat. 102), and section 6 of the Fryingpan-Arkansas Project Act (76 Stat. 393)."

LEGAL ASPECTS

Water Quantity

Colorado River water was apportioned by the Colorado River Compact of 1922, the Boulder Canyon Project Act of 1928, the Water Treaty of 1944, the Upper Colorado River Basin Compact of 1948, and the United States Supreme Court (*Arizona* v. *California et al*., 1963).

The Colorado River Compact divided the Colorado River Basin between the Upper and Lower Basins at Lee Ferry (just below the confluence of the Paria River), apportioning to each use of 7.5 million acre-feet (maf) annually. In addition to this apportionment, the Lower Basin was given the right to increase its beneficial consumptive use by 1 maf per year. The compact also contains provisions governing exportation of Colorado River water. The Water Treaty of 1944 obligates the United States to deliver to Mexico 1.5 maf of Colorado River water annually, absent treaty surplus or shortage conditions.

Upper Colorado Use - The Upper Colorado River Basin Compact of 1948 divided and apportioned the water apportioned to the Upper Colorado River Basin by the Colorado River Compact, allocating to **Arizona** 50,000 acre-feet annually, with the remaining water allocated to Upper Colorado River Basin States as follows:

- **Colorado** 51.75 percent
- **New Mexico** 11.25 percent
- **Utah** 23 percent
- **Wyoming** 14 percent

Lower Colorado Use - States of the Lower Colorado River Basin did not agree to a compact for the apportionment of waters in the Lower Colorado River Basin; in the absence of such a compact Congress, through Secretarial contracts authorized by the Boulder Canyon Project Act, allocated water from the mainstem of the Colorado River below Lee Ferry among California, Nevada, and Arizona, and the Gila River between Arizona and New Mexico. This apportionment was upheld by the Supreme Court, in 1963, in the case of Arizona v. California.

As confirmed by the U.S. Supreme Court in 1963, from the mainstem of the Colorado River (i.e., The Lower Basin):

- **Nevada** was apportioned 300,000 acre-feet annually and 4 percent of surplus water available,
- **Arizona** was apportioned 2,800,000 acre-feet annually and 46 percent of surplus water available,
- **California** was apportioned 4,400,000 acre-feet annually and 50 percent of surplus water available.

Water Quality

Although a number of water-quality-related legislative actions have been taken on the State and Federal levels, several Federal acts are of special significance to the Colorado River Basin: the Water Quality Act of 1965 and related amendments, the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), commonly referred to as the Clean Water Act and related amendments, and the Colorado River Basin Salinity Control Act (Salinity Control Act) of 1974 as amended. Also, central to water quality issues are agreements with Mexico on Colorado River System waters entering that country.

The Water Quality Act of 1965 (Public Law 89-234) amended the Federal Water Pollution Control Act and established a Federal Water Pollution Control Administration (now Environmental Protection Agency [EPA]). Among other provisions, it required States to adopt water quality criteria for interstate waters inside their boundaries. The seven Basin States initially developed water quality standards that did not include numeric salinity criteria for the Colorado River primarily because of technical constraints. In 1972, the Basin States agreed to a policy that called for the maintenance of salinity concentrations in the Lower Colorado River System at or below existing levels, while the Upper Colorado River Basin States continued to develop their compact-apportioned waters. The Basin States suggested that Reclamation should have primary responsibility for investigating, planning, and implementing the proposed Salinity Control Program.

The enactment of the Federal Water Pollution Control Act Amendments of 1972 affected salinity control, in that it was interpreted by EPA to require numerical standards for salinity in the Colorado River. In response, the Basin States founded the Colorado River Basin Salinity Control Forum (Forum) to develop water quality standards, including numeric salinity criteria and a basinwide plan of implementation for salinity control. The Basin States held public meetings on the proposed standards as required by the enacting legislation. The Forum recommended that the individual Basin States adopt the report, *Water Quality Standards for Salinity, Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System*. The proposed water quality standards called for maintenance of flow-weighted annual averaged total dissolved solids concentrations of 723 milligrams per liter (mg/L) below Hoover Dam, 747 mg/L below Parker Dam, and 879 mg/L at Imperial Dam. Included in the plan of implementation were four salinity control units and possibly additional units, the application of effluent limitations, industrial use of saline water, and future studies. The standards are to be reviewed at 3-year intervals. All of the Basin States adopted the 1975 Forum-recommended standards. EPA approved the standards.

The Salinity Control Act of 1974 (Public Law 93-320) provided the means to comply with the United States' obligations to Mexico under Minute No. 242 of the International Boundary and Water Commission, United States and Mexico, which included, as a major feature, a desalting plant and brine discharge canal for treatment of Wellton-Mohawk Irrigation and Drainage District (WMIDD) drainage water. These facilities enable the United States to deliver water to Mexico having an average salinity of 115 parts per million (ppm) plus or minus 30 ppm (United States' count) over the annual average salinity of the Colorado River at Imperial Dam. The act also authorized construction of 4 salinity control units and the expedited planning of 12 other salinity control projects above Imperial Dam as part of the basinwide salinity control plan.

In 1978, the Forum reviewed the salinity standards and recommended continuing construction of units identified in the 1974 act, placing of effluent limitations on industrial and municipal discharges, and reduction of the salt-loading effects of irrigation return flows. The review also called for the inclusion of water quality management plans to comply with section 208 of the Clean Water Act. It also contemplated the use of saline water for industrial purposes and future salinity control.

Public Law 98-569, signed October 30, 1984, amended Public Law 93-320. The amendments to the Salinity Control Act authorized the U.S. Department of Agriculture (USDA) Colorado River Salinity Control Program. The amendments also authorized two new units for construction under the Reclamation program.

In 1993, the Dept. of Interior Inspector General concluded that the lengthy congressional authorization process for Reclamation projects was impeding the implementation of cost-effective measures. Consequently, a public review of the program was conducted in 1994. In 1995, Public Law 104-20 authorized Reclamation to implement a basinwide approach to salinity control and to manage its implementation. Reclamation completed solicitations in 1996, 1997, 1998, 2001, and 2004 in which Reclamation requested proposals, ranking the proposals based on their cost and performance risk factors, and awarded funds to the highest ranked projects. The awards from the first three solicitations consumed the available appropriation ceiling of $75 million authorized by Congress to test the new program. In 2000, Public Law 106-459 amended the Colorado River Basin Salinity Control Act to increase the appropriation ceiling for Reclamation's basinwide approach by $100 million ($175 million total). This appropriation authority allowed Reclamation to continue to request new proposals under its Basinwide Salinity Control Program.

In 1996, Public Law 104-127 significantly changed the authorities provided to NRCS. Rather than carry out a separate salinity control program, the Secretary of Agriculture was directed to carry out salinity control measures in the Colorado River Basin as part of the Environmental Quality Incentives Program established under the Food Security Act of 1985. Public Law 104-127 also authorized the Secretary of Agriculture to cost share salinity control activities from the basin funds in lieu of repayment. Cost sharing has been implemented for both USDA and Reclamation programs. Under this new authority, each dollar appropriated by the Congress is matched by $0.43 in cost sharing from the basin funds.

In 2002, Public Law 107-171, Title II, Subtitle D reauthorized the NRCS's Environmental Quality Incentives Program (under which the Secretary of Agriculture carries out salinity control measures). In 2008, Public Law 110-246, again authorized the NRCS's Environmental Quality Incentives Program. PL110-246 also amended the Salinity Control Act to clarify the authority and implementation of the "Basin States Program".

Nothing in this report is intended to interpret the provisions of applicable federal law including, but not limited to, The Colorado River Compact (42 Stat. 171), The Upper Colorado River Basin Compact (63 Stat. 31), The Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Treaty Between the United States of America and Mexico (Treaty Series 994, 59 Stat. 1219), the United States/Mexico agreement in Minute No. 242 of August 30, 1973, (Treaty Series 7708; 24 UST 1968), the 1964 Decree entered by the Supreme Court of the United States in Arizona v. California et al. (376 U.S. 340), as amended and supplemented, The Boulder Canyon Project Act (45 Stat. 1057), The Boulder Canyon Project Adjustment Act (54 Stat. 774; 43 U.S.C. 618a), The Colorado River Storage Project Act (70 Stat. 105; 43 U.S.C. 620), The Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501), The Colorado River Basin Salinity Control Act (88 Stat. 266; 43 U.S.C. 1571), The Hoover Power Plant Act of 1984 (98 Stat. 1333), The Colorado River Floodway Protection Act (100 Stat. 1129; 43 U.S.C. 1600), or The Grand Canyon Protection Act of 1992 (Title XVIII of Public Law 102-575, 106 Stat. 4669).

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CHAPTER 2 – SALINITY CONDITIONS

CAUSES OF SALINITY

The Colorado River System is naturally very saline. Historically at the USGS gauge below Hoover Dam, between 1940 and 1980, an annual average of approximately 9.3 million tons of salt was carried down the river. From 2005 to present, an annual average of approximately 7.7 million tons of salt are being measured in the river, including years of floods and drought, with the trend going down. The flow of the river dilutes this salt, and depending upon the quantity of flow, salinity can be relatively dilute or concentrated. Since climatic conditions directly affect the flow in the river, salinity in any one year may double (or halve) due to extremes in runoff. Because this natural variability is virtually uncontrollable, the seven Basin States adopted a non-degradation water quality standard.

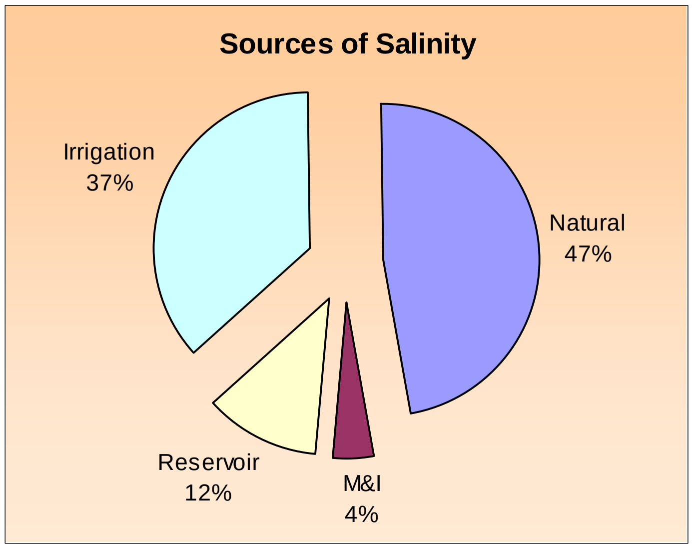

Figure 1

Nearly half of the salinity concentration in the Colorado River System is from natural sources. Saline springs, erosion of saline geologic formations, and runoff all contribute to this background salinity. Irrigation, reservoir evaporation, and municipal and industrial (M&I) sources make up the balance of the salinity problem in the Colorado River Basin. Figure 1 shows the relative amount each source contributes to the salinity problem as estimated by the Environmental Protection Agency (EPA) in 1973. The EPA (EPA, 1971) estimated that the natural salinity in the Lower Colorado River at Imperial Dam was 334 milligrams per liter (mg/L). At the end of 2011 the average annual flow weighted salinity at Imperial Dam was 680 mg/L, a 346 mg/L increase over the estimated natural salinity. Table 1, on the following page, quantifies the salinity from several of these known sources.

Salinity of the Colorado River has increased with the development of water resources in two major ways: (1) the addition of salts from water use and (2) the consumption (depletion) of water. The combined effects of water use and consumption have had a significant impact on salinity in the Colorado River Basin. The basin-wide drought, since 1999, has also had an influence on the present salinity of the Colorado River.

Current information indicates that the present salt levels in the Colorado River system have few if any negative health effects and the EPA's primary drinking water standards are not exceeded. However, the EPA secondary drinking water standards of 500 mg/L for

Table 1 - Quantified Sources of Salt Loading

Source	Type of Source	Salt Loading (tons per year)
Paradox Springs	Springs / point	205,000 [1]
Dotsero Springs	Springs / point	182,600
Glenwood Springs	Springs / point	335,000
Steamboat Springs	Springs / point	8,500
Pagosa Springs	Springs / point	7,300
Sinbad Valley	Springs / point	6,500
Meeker Dome	Springs / point	57,000 [1]
Other minor springs in the Upper Basin	Springs / point	19,600
Blue Springs	Springs / point	550,000
La Verkin Springs	Springs / point	109,000
Grand Valley	Irrigation / non-point	580,000
Big Sandy	Irrigation / non-point	164,000
Uncompahgre Project	Irrigation / non-point	360,000 [1]
McElmo Creek	Irrigation / non-point	119,000
Price-San Rafael	Irrigation / non-point	258,000 [1]
Uinta Basin	mostly irrigation / non-point	240,000
Dirty Devil River Area	Irrigation / non-point	150,000
Price-San Rafael Area	Irrigation / non-point	172,000 [1]
Other, non regulated areas	Various	5,200,000
Total		8,724,000

1- Values listed are pre salinity control project loading

TDS (salinity) and 250 mg/L for sulfate may be exceeded. A regression of sulfate versus TDS shows that sulfate exceeds 250 mg/L when the TDS exceeds 612 mg/L. During dry cycles the secondary drinking water standards for TDS and sulfate are exceeded at many places in the Colorado River in both the Upper and Lower Basins, including the three salinity criteria sites.

ECONOMIC EFFECTS OF SALINITY

The primary negative impact of the Colorado River salinity is economical. Reclamation has developed a model which calculates damages for a given level of salt (FAR, 2012). The Salinity Damages Model estimates the quantitative damages that are incurred in the metropolitan and agricultural areas in the lower Colorado Basin that receive Colorado River water. The model estimates the impacts from salinity levels greater than 500 mg/L TDS on household water using appliances, damages in the commercial sector, industrial sector, water utilities, and agricultural crop revenues. It also estimates the additional costs related to meeting state wide water quality standards for ground water and recycled water use in the MWD service area.

In FY12, presentations to the Salinity Forum, Science Team, and Work Group were made regarding capabilities of the Salinity Damage Model. A request to estimate the economic impact caused by a change in Colorado River water TDS levels if the Paradox Valley Unit (PVU) went offline was received and completed in FY12. The hydrologic analysis showed that TDS levels at Hoover, Parker, and Imperial Dams would increase by 10 mg/L if the PVU went offline. If the PVU is online, and if no additional control measures are implemented over those presently employed between now and 2030, economic damages in the Lower Basin would be approximately $523 million annually. If the PVU was taken offline, the TDS levels would rise by 10 mg/L at Hoover, Parker, and Imperial Dams and economic damages in the Lower Basin would increase an additional $24 million over the $523 million by 2030.

Two scenarios, using 2010 salinity levels, are modeled for salt damage (combining the impacts at Hoover, Parker and Imperial Dams) by 2030, one assumes no more salinity control projects built over those currently in place increasing salt damages by $228,000,000. The second scenario assumes the salinity control program is fully implemented and a total salt damage of $111,000,000 over present levels. Even though the salinity level has fluctuated slightly over the last few years, the salinity impact cost has increased primarily due to increased agricultural damage costs (increase in acreage and crop prices).

Salinity related damages are primarily due to reduced agricultural crop yields, corrosion, and plugging of pipes and water fixtures in housing and industry. Figure 2 breaks down the percentage of total damages. The seven Basin States have agreed to limit this impact and adopted numeric criteria, which require that salinity concentrations not increase (from the 1972 levels) due to future water development. Salinity levels measured in the river may be low or high due to climatic conditions, but the goal of the Water Quality Criteria for the Colorado River Basin and the Colorado River Basin Salinity Control Program (Salinity Control Program) is to offset (eliminate/reduce) the salinity effects of additional water development.

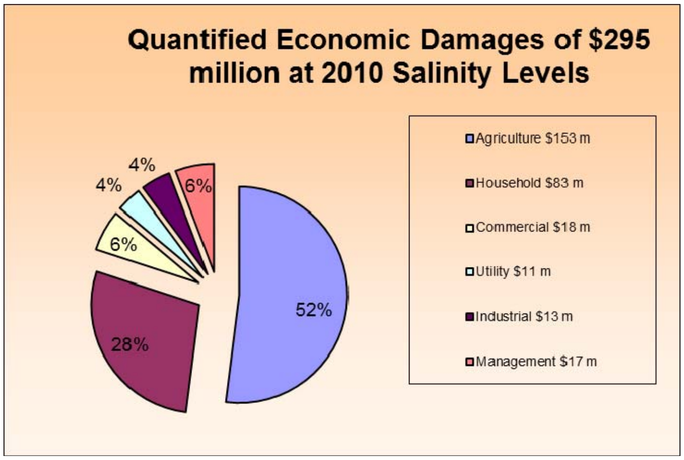

Figure 2 – Percentage of Salinity Damages

HISTORIC SALINITY CONDITIONS

Salinity in the Colorado River is monitored at 20 key stations throughout the Colorado River Basin, Appendix A. Salt loads and concentrations are calculated from daily conductivity and flow records using methods developed jointly between Reclamation and

USGS (Liebermann et al., 1986), Appendix B. Historical annual streamflow, and salinity concentrations from 1940 through 2011 are included in graphical form in Appendix C. Monthly and annual data may be obtained by request from Reclamation, Salt Lake City, Utah or by going to Reclamation's Upper Colorado Regional Office Salinity Program web page; http://www.usbr.gov/uc/progact/salinity/index.html.

The salinity of the 3 lower basin compact points since 1940 is shown in Figure 3. As Figure 3 shows, the last time the TDS exceeded or reached the salinity criteria at any of the compact points, was in 1972 – the year that the salinity standard was established for the Colorado River.

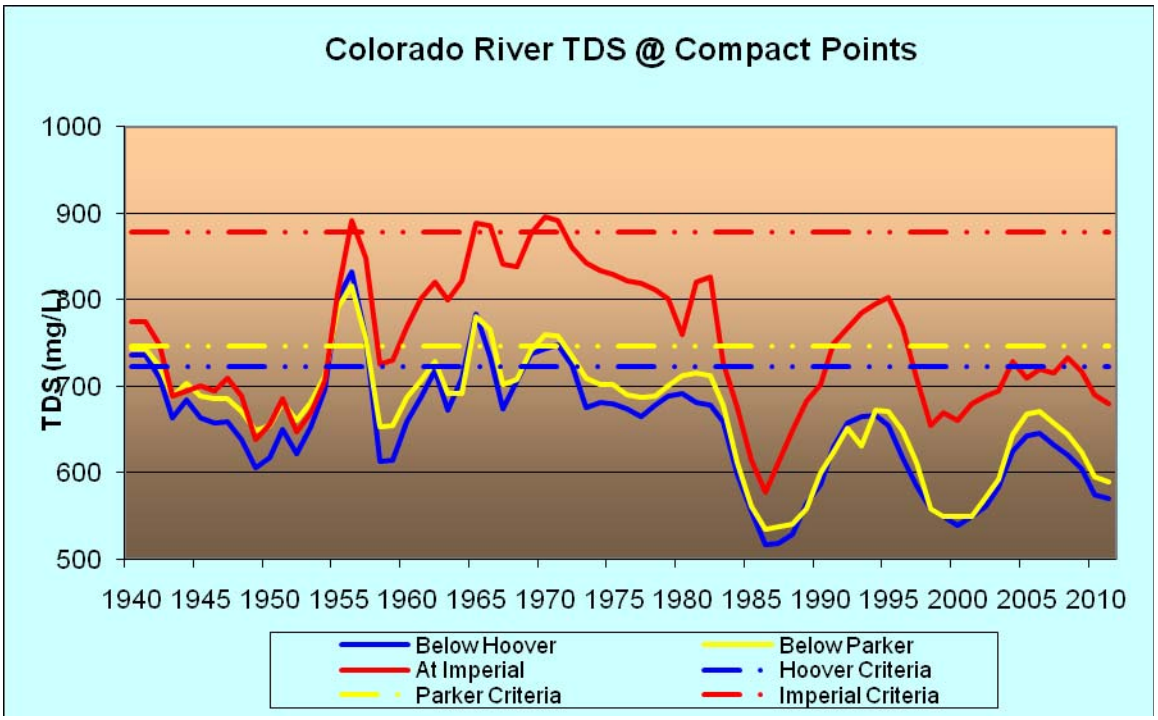

Figure 3 - Colorado River Salinity at Lower Basin Compact Points

FACTORS INFLUENCING SALINITY

Stream flow, reservoir storage, water resource development, salinity control, climatic conditions, and natural runoff directly influence salinity in the Colorado River Basin. Before any water development, the salinity of spring runoff was often below 200 mg/L throughout the Colorado River Basin. However, salinity in the lower mainstem was often well above 1,000 mg/L during the low flow months (most of the year), since no reservoirs existed to catch and store the spring runoff.

Streamflow

Streamflow directly influences salinity. For the most part, higher flows (or reservoir releases) dilute salinity. The top graph in Figure 4 shows streamflow at two key points in the mainstem. In 1983, Lake Powell (Glen Canyon Dam) filled for the first time and spilled.

This spill went through Lake Mead (Hoover Dam) and on downstream through Imperial Dam. In 1983 and on through 1987, flows in the system were again extremely high and sustained, reducing salinity to historic lows. As shown in the bottom graph of Figure 4, returning to average flows in the system after1987 returned the salinity in the reservoir system to average levels.

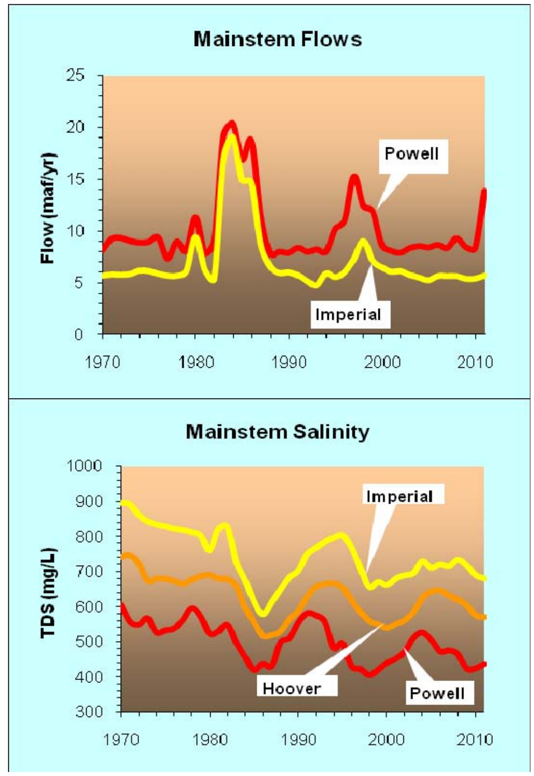

Figure 4 - Mainstem Flow and Salinity.

Reservoir Storage

The Colorado River Storage Project Reservoirs produce not only major hydrologic modifications downstream, but they also significantly alter the salinity variability of the downstream river. The overall long term salinity effects of the reservoirs are beneficial and have greatly reduced the salinity peaks and annual fluctuation (Figure 5). The high concentration low flow waters are mixed with low concentration spring runoff, reducing the month-to-month variation in salinity below dams (Mueller et al., 1988). At Glen Canyon Dam, the pre and post dam peak monthly salinity has been reduced by nearly 600 mg/L. Similar effects can be seen below Flaming Gorge, Navajo, and Hoover Dams, greatly improving the quality of water during the summer, fall and winter.

Large reservoirs like Lake Powell selectively route less saline water while holding more saline waters during low inflow periods. The poorer quality waters are then slowly released after the inflows have begun to increase, which helps to prevent exceeding the salinity criteria during drought years. The large reservoirs selectively retain higher salinity winter inflows in the bottom of the pool and route lower salinity overflow density currents from the spring runoff. The seasonal and long term affects of this selective retention and routing of salt has been shown below Glen Canyon Dam in Figure 5.

Figure 6 further displays this retention. Figure 6 is a long-term depth vs. time profile of salinity in the forebay of Glen Canyon Dam and is an illustrated history of the salinity. The Y (vertical) axis is depth in the water column and the X axis is time in years. The color scale is the change in salinity.

Figures 6 and 7 illustrate that Glen Canyon Dam causes Lake Powell to selectively retain higher salinity water during drier years of drought, and then routes it out with the increased mixing and shorter hydraulic retention times of wetter cycles as seen particularly in 1983 and 1999. During these wetter cycles there is a significant mixing and dilution of these previously stored salts.

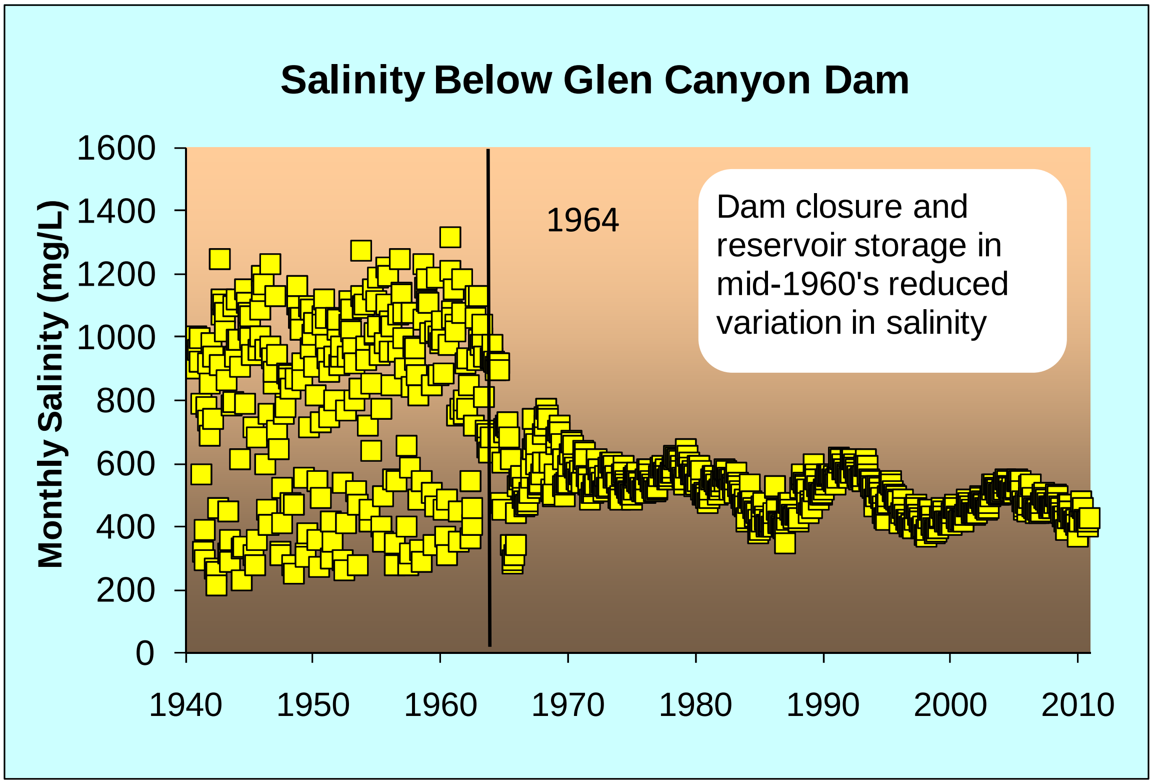

Figure 5 - Effects of Glen Canyon Dam on Colorado River Salinity at Lees Ferry.

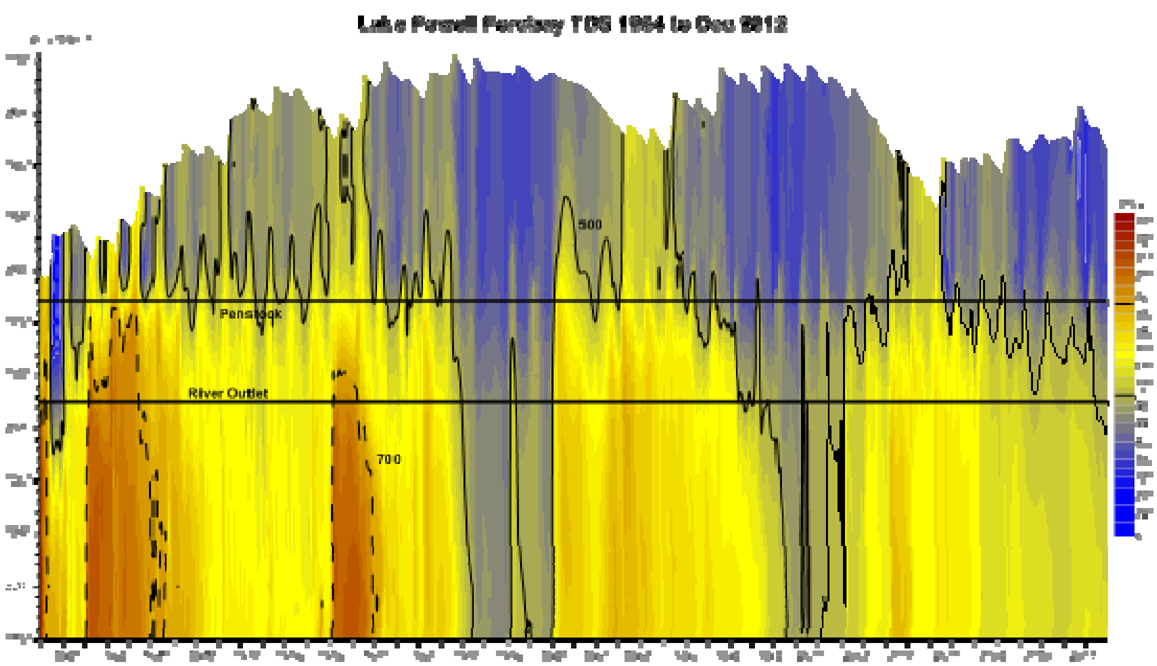

Figure 6 - Lake Powell Forebay, near Dam, Dec 1964 to Dec 2012 Salinity Concentration, mg/L

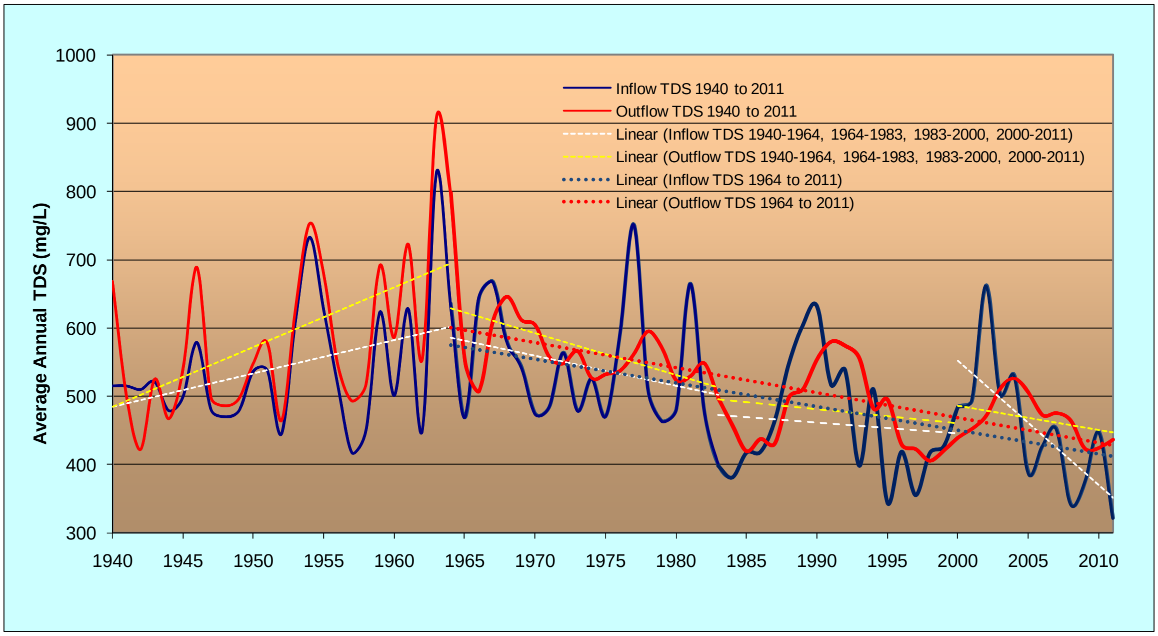

Figure 7 - Lake Powell Inflow and Outflow Salt Concentration, mg/L

There are 4 periods or trends which can be seen in the Colorado River salinity for the inflow to and outflow from Lake Powell which can be seen in Figure 7 (yellow and white trend lines). The overall inflow line (blue) in Figure 7 is the sum of TDS for the inflow stations to Lake Powell; Colorado River at Cisco, Green River at Green River, UT, San Rafael River near Green River and San Juan River near Bluff. The overall outflow line (red) is the TDS at the USGS gauge at Lees Ferry below Glen Canyon Dam. During the pre dam period, 1940 – 1964, the average salinity trend was increasing with divergence between the average annual inflow and outflow salinity levels and the inflow concentration generally being less than the outflow concentration. This difference between outflow and inflow may be impacted by the beginning hydraulic conditions, since the actual annual levels appear to track each other fairly closely. Next there was the dam filling period where Lake Powell and the Upper Basin reservoirs were completed and filling, 1965-1983. The average annual salinity during this time decreased with a convergence occurring between the inflow and outflow concentrations. The outflow concentration decreased more than the inflow concentration, which could be due to the reservoir storing the higher TDS waters. Then there was the period, 1983 to 2000, when the basin hydrology went through both wet and dry periods and the salinity control projects in the upper basin were coming online. The declining trend of the average annual salinity concentration over this time is seen to be constant between the inflow and outflow stations. Since 1980 there appears to be an equilibrium between the salt entering the reservoir and what is being released. The last period, since 2000, covers the basinwide drought. The trend shows that the inflow TDS has declined, while the outflow TDS from Lake Powell has stayed constant with the 1980 to present TDS trend.

Lake Powell (and other reservoirs in the basin) went through an initial filling salt leach out which actually began with temporary water retention behind the coffer dam during construction in the mid 1950’s. Long-term linear regression trend lines on the inflow and outflow salinity concentrations at Lake Powell indicate that internal salt leaching seems to have declined to a minimum by the mid-1990's suggesting a long-term salinity leach out which is approaching a dynamic equilibrium (Figure 7, red and blue dotted trend line).

NATURAL VARIATION IN SALINITY

Although seasonal swings in salinity have been greatly reduced, annual fluctuations in salinity are still observed. Natural climatic variations in rainfall and snowmelt runoff continue to cause large year-to-year differences in both flow and salinity and in some cases nearly doubling the salinity in the river.

The water quality standards require that the flow-weighted average annual salinity not to rise above the 1972 levels using a long-term mean water supply of 15 maf (2011 Review). This means that depending on the hydrology (drought conditions) salinities may actually increase above the numeric criteria and it is not a violation of the standards, but is due to natural variations in the hydrologic conditions. Even with full compliance with the standards, the actual salinities at Imperial Dam (and elsewhere in the Colorado River Basin) will continue to fluctuate with hydrologic conditions in the future. The Salinity Control Program is designed to offset the effects of development, even as salinity varies from year to year in response to the climatic and hydrologic conditions. Assuming continued salinity control and full compliance with the standards, the potential range of annual salinities that might be observed in the future at Imperial Dam is quite wide. With Colorado River basin reservoir storage tempering the natural variability of the system, the range between the high and low salinity values at Imperial Dam has dropped to a monthly average of about 479 mg/L and an annual average around 266 mg/L since 1973.

AGRICULTURAL SOURCES OF SALINITY

Irrigated agriculture is the largest user of water in the Colorado River Basin and a major contributor to the salinity of the system. Iorns (Iorns et al., 1965) found that irrigated lands in the Upper Colorado River Basin contributed about 3.4 million tons of salt per year (37 percent of the salinity of the river). Irrigation increases the salt concentration of the source water by consuming water (evapotranspiration) and by dissolving salts found in the underlying saline soil and geologic formations, usually marine (Mancos) shale.

Irrigation mobilizes the salts found naturally on the soil surface as well as in the soil profile, especially if the lands are over irrigated. Many subbasins experienced significant changes in irrigation following development of available reservoir storage. For example, once late season irrigation supplies were assured, less water was applied to per unit of farmland during the snowmelt runoff, and overall irrigation efficiency increased.

Irrigation development in the Upper Colorado River Basin took place gradually from the beginning of settlement in about 1860, but was hastened by the purchase of tribal lands in the late 1800's and early 1900's. About 800,000 acres were being irrigated by 1905. Between 1905 and 1920, the development of irrigated land increased at a rapid rate, and by 1920, nearly 1.4 million acres were being irrigated. The "Upper Colorado Region

Comprehensive Framework Study, June 1971", reported that more than 1.6 million acres were in irrigation in 1965. Since that time, development of new agricultural lands has leveled off because of physical, environmental, and economic limitations. Reclamation's latest "Colorado River System Consumptive Uses and Losses Report 2006-2010" estimated an average of 1.7 million acres was irrigated in the Upper Colorado River Basin in 2010 (latest data available).

Irrigation development in the Lower Colorado River Basin began at about the same time as in the Upper Colorado River Basin, but was slow due to the difficulty of diverting water from the Colorado River with its widely fluctuating flows. Development of the Gila area began in 1875 and the Palo Verde area in 1879. Construction of the Boulder Canyon Project in the 1930's, and other downstream projects, has provided for a continued expansion of the irrigated area. In 1970, an additional 21,800 acres were irrigated by private pumping either directly from the Colorado River or from wells in the flood plain. In 1980, nearly 400,000 acres were being irrigated along the Colorado River mainstem. Total irrigated lands within the Lower Colorado River Basin using Colorado River water is estimated at over 1 million acres.

Reclamation and the U.S. Geological Survey (USGS) continuously monitor the flow and salinity of the river system through a network of 20 gauging stations (See Appendix A, Figs. A1 & A2; Appendix C Figs. C1 – C5). Reclamation evaluates the data collected to determine if sufficient salinity control is in place to offset the impact of water development. In 2011, the actual salinity in the Colorado River was below the numeric criteria at the established monitoring stations. However, as the impacts of recent and future basin developments work their way through the hydrologic system, or as drought conditions persist, salinity would increase without salinity control to prevent further degradation of the river system. Through salinity control practices, excess salt loading to the river system can be reduced significantly, helping maximize the future beneficial uses of the river.

Most of the irrigation projects that deplete water and increase salt loading to the river were in place before 1965. Moreover, like the newly inundated soils in reservoirs, newly irrigated lands are subject to a leach-out period. In cases where lands with poor drainage stored salt, these areas were taken out of production. In addition, irrigation practices changed significantly with the introduction of canal and lateral lining, sprinkling systems, gated pipe, trickle systems and tile drains (initial operation of tile drains increase salt loading, which decreases after time). These changes have resulted in reduced return flows and salt loading.

WATER USE BY MUNICIPAL & INDUSTRIAL USERS

Salinity levels are directly influenced by depletion (consumption) of water flowing in the river system and salt loading. Agriculture increases salinity by consuming water through evapotranspiration and leaching of salts from soils by irrigation. Municipal and industrial (M&I) use increases salinity by the consumption of the water, thus reducing the dilution of salts in the river or by disposal on land.

Another source of salinity from municipal & industrial use is from an increase in the housing developments within the basin. This brings with it an associated increase in water softening needs, due to the hard water found throughout the basin. One result of the increase of water softening is an increase in the sodium chloride salt discharged into the Colorado River. Another impact of the increased population in the basin is that more roads are paved and developed. During the winter this increase in road mileage impacts the salt discharged into the basin due to the addition of salt on the roads in order to help keep the snow and ice off of the roads. The amount of salt added to the basin from new municipal development has not yet been quantified.

Reclamation continues to monitor water use and adjust future salinity control needs as water development plans may be postponed, delayed, or canceled. The depletion schedules used to project salinity conditions have been updated with multiple demand projection scenarios, so that the implementation needs for the Salinity Control Program can be planned to offset the potential impacts of additional water development (see Tables 2 & 3).

ENERGY DEVELOPMENT

The large amounts of water use once forecasted for steam power generation, coal gasification, oil shale, and mineral development have not yet occurred. The few coal-fired power plants that have been constructed recently have obtained their water from existing agricultural rights rather than from developing additional water. This conversion of use reduces the salt loading to the Colorado River by eliminating the pickup of salt from canal seepage and on farm deep percolation.

Many of the geologic formations of the Colorado River Basin were deposited in marine (saline) or brackish water environments. Sulfates and sodium chloride are prevalent salts in most of these formations. Many of the formations were deposited in drier periods and are capable of transmitting water, but these aquifers are frequently sandwiched between hundreds or even thousands of feet of impermeable shale (aquicludes). These aquifers are, therefore, static and often saline. Many static and saline aquifers are present in the Colorado River Basin. When a path of flow is provided by drilling or mining, these aquifers are mobilized, and brackish or saline waters flow back to the surface.

The development of energy resources, specifically coal, oil, gas, oil shale, and coal bed methane, in the Colorado River Basin may contribute significant quantities of salt to the Colorado River. Salinity of surface waters can be increased by either mineral dissolution or uptake in surface runoff, mobilization of brackish groundwater, or consumption of good quality water. The location of this energy development is associated with marine-derived formations. Any disturbance of these saline materials will increase the contact surfaces, allowing for the dissolution of previously unavailable soluble minerals.

Salinity increases associated with mining coal can be attributed to leaching of coal spoil materials, discharge of saline groundwater, and increased erosion resulting from surface-disturbing activities. Spoil materials have a greater permeability than undisturbed overburden, allowing most of the rain falling on the spoils to infiltrate instead of running off. The water percolates through the spoils, dissolving soluble minerals.

Studies conducted on mining spoils in northwestern Colorado indicate that the resulting salinity of spoil-derived waters ranges from approximately 3,000 mg/L to 3,900 mg/L (Parker, et al., 1983; McWhorter, et al., 1979; and U.S. Department of the Interior, 1985). The variability in concentration depends on water residence time and the chemical and physical properties of the spoil.

Saline water is also a byproduct of oil and gas production in the Colorado River Basin. It is not uncommon to produce several times the amount of saline waters as oil. In one month the oil and gas operators in Colorado produced approximately 25 million barrels of saline water. The salinity of production waters varies greatly from location to location and depends upon the producing formation. Common disposal techniques include evaporation, injection, and discharge to local drainages.

The future development of the oil shale resources in Colorado, Utah, and Wyoming has the potential to increase salt loading to the Colorado River. Salt increases can be attributed to the consumptive use of good quality water, mine dewatering, and, if surface retorting is used, the leaching of spoil materials similar to those of surface coal mining.

Reclamation, BLM and state agencies are attempting to identify abandoned exploration wells that are leaking and develop plans to control the leaks. The Meeker Dome Salinity Control Unit identified and plugged several abandoned wells along the White River to prevent a salt dome (a geologic formation) from discharging saline water into the river.

Oil and Natural Gas – Recent technological advances in well drilling have allowed for more efficient extraction of oil and gas from the formations in which they are found, especially shale formations. This has led to an increase in the number of natural gas and oil wells developed in the Upper Colorado River Basin. The natural gas wells also include coal bed methane wells. This increase in energy development and associated well drilling could result in an increase in the salt loading of the Colorado River if the drilling waste water is discharged on the ground surface and allowed to get into waterways, however most of this saline water is either reinjected or captured in evaporation ponds.

Figure 8 - Photo of natural gas well.

In Utah, oil and gas wells are primarily located in Emery, Carbon, Duchesne, and Uinta counties. The State allows up to 4 wells per section. Most (99%) of existing product wastewater from the wells is reinjected and 1 % is impounded for evaporation. No surface discharges have presently been permitted. It is projected that even with greater development of oil and gas wells, the handling of the produced wastewater will not change.

In Colorado, all the product water from oil and gas development in the San Juan Basin in southwest Colorado is presently, and in the foreseeable future will be, reinjected. New wells are permitted in the northwest part of the State and in Moffat and Rio Blanco

Counties, where new energy developments are being considered. The State averages for product wastewater in the western part of the State are 90 % reinjected, 9.5 % impounded, and 0.5 % surface discharged. Any surface discharged water has to meet the water quality criteria of no more that 1 ton/day salt.

In Wyoming, new oil and gas well development is beginning in the Little Snake River drainage (Carbon County) with only a handful of wells permitted. This energy development has the potential to spread into the whole southwest corner of the State (Sweetwater, Uinta, and Lincoln Counties). Presently, the State will allow surface discharge of up to 1 ton/day per operator (not per well). Oil and gas development in the southwest part of the State will most likely involve reinjection of most if not all of the waste water since the quality of the groundwater found in the geologic formations is highly saline and of poor quality.

FUTURE WATER DEVELOPMENT

Tables 2 and 3 summarize the projected demand scenarios used by Reclamation to evaluate the effects of water use and depletions in the recently completed Colorado River Basin Study (Reclamation, 2012a). These water demand estimates were compiled as an initial step in the evaluation process.

Table 2 summarizes the projected demand by water uses in the Upper Colorado River Basin as adopted for planning purposes in the *Colorado River Basin Water Supply and Demand Study, Technical Report C – Water Demand Assessment December 2012.* Figure 9 illustrates the historic annual consumptive use by water uses in the Upper Basin as reported in Reclamation's *Colorado River System Consumptive Uses and Losses Reports* (CUL), and the total projected demands by water uses in the Upper Basin that are included as input into Reclamation's Colorado River System Simulation (CRSS) model. The consumptive uses and projected demands shown in Figure 9 exclude evaporation losses from Lake Powell, Flaming Gorge Reservoir and the Aspinall Unit reservoirs, which along with evaporation losses from Colorado River mainstem reservoirs in the Lower Basin are modeled within CRSS.

The annual depletions for the Lower Colorado River Basin shown in Table 3 include only depletions resulting from the use of water from the mainstem of the Lower Colorado River. Reclamation's CRSS model does not model or include as input consumptive uses made from tributaries to the Colorado River within the Lower Colorado River Basin. Fixed inflow values are used in the CRSS model for the Lower Basin tributaries. More detailed data on historic Colorado River Basin consumptive uses and losses (including tributary uses in the Lower Basin and reservoir evaporation losses) may be found in Reclamation's *Colorado River System Consumptive Uses and Losses Reports* or on the web at: www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html

Table 2 - Upper Basin Total Projected Depletion Demand Scenarios (1000 af/yr)

UPPER BASIN	2015[1]	2035[1]	2060[1]	2015[2]	2035[2]	2060[2]	2015[3]	2035[3]	2060[3]
Arizona									
Agricultural	0	0	0	0	0	0	0	0	0
Municipal and Industrial	2	2	2	2	2	2	2	2	2
Energy	0	0	0	0	0	0	0	0	0
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Tribal	44	43	43	38	55	71	44	43	43
Total Potential Colorado River Demand	46	46	46	40	57	73	46	46	46
Colorado									
Agricultural	1,875	1,875	1,875	1,875	1,791	1,728	1,875	1,875	1875
Municipal and Industrial	455	617	732	455	579	1,007	455	555	661
Energy	30	78	118	30	65	66	30	51	58
Minerals	32	59	60	32	65	66	31	59	60
Fish, Wildlife and Recreation	0	0	0	0	0	0	0	0	0
Tribal	0	0	0	0	0	0	0	0	0
Total Potential Colorado River Demand	2,391	2,629	2,784	2,391	2,535	2,979	2,391	2,540	2,653
New Mexico									
Agricultural	111	111	111	111	111	111	111	111	111
Municipal and Industrial	141	183	230	141	187	293	141	153	169
Energy	40	42	42	40	42	42	40	42	42
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	5	5	5	5	5	5	5	5	5
Tribal	303	363	367	309	413	529	303	363	367
Total Potential Colorado River Demand	600	703	754	606	758	979	600	673	693
Utah									
Agricultural	457	459	493	457	446	466	457	458	492
Municipal and Industrial	236	311	342	236	341	409	236	280	274
Energy	47	53	60	47	55	66	47	53	60
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	0	0	0	0	0	0	0	0	0
Tribal	259	259	259	272	299	337	170	241	259
Total Potential Colorado River Demand	999	1,082	1,154	1,012	1,141	1,277	911	1,033	1,084
Wyoming									
Agricultural	398	402	406	400	410	423	400	410	423
Municipal and Industrial	30	47	67	30	57	74	28	32	36
Energy	52	65	65	52	103	171	52	65	65
Minerals	29	42	59	34	57	91	29	42	59
Fish, Wildlife and Recreation	2	10	10	2	10	10	2	10	10
Tribal	0	0	0	0	0	0	0	0	0
Total Potential Colorado River Demand	511	566	606	518	637	769	512	559	592

Note 1: These demand scenarios do not attempt to interpret the Colorado River Compact, the Upper Colorado River Basin Compact, or any other element of the "Law of the River." These scenarios should not be construed as an acceptance of any assumption that limits the Upper Colorado River Basin's depletion.
Note 2: These demand scenarios are for planning purposes only. Their estimates do not constitute an endorsement of the Bureau of Reclamation's 2007 Hydrologic Determination and should not be construed as in any way limiting the Upper Division States use of Colorado River water in accordance with the Commission's resolution of 6/5/06.
Note 3: These demand scenarios exclude shared CRSP evaporation.
Option [1]. Scenario A; (Current projected use), continuation of growth, development patterns, and institutions follow long-term trends. *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*.
Option [2]. Scenario C1; (Rapid Growth) Economic resurgence (population and energy) and current preferences toward human and environmental values (greatest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*
Option [3]. Scenario B; (Slow Growth) Slow growth with emphasis on economic efficiency (lowest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*

Table 3 - Lower Basin Depletion Projections (1000 af/yr)

LOWER MAINSTEM	2015[1]	2035[1]	2060[1]	2015[2]	2035[2]	2060[2]	2015[3]	2035[3]	2060[3]
Arizona									
Agricultural	1,124	703	703	1.082	703	703	1,145	724	724
Municipal and Industrial	760	1,099	1,460	816	1,305	2,060	823	1,075	1,164
Energy	1	1	2	1	2	2	1	1	2
Minerals	42	54	55	42	53	54	42	60	60
Fish, Wildlife and Recreation	16	16	16	16	16	16	16	16	16
Tribal	997	1,216	1,215	1,013	1,288	1,337	881	1,100	1,100
Total Potential Colorado River Demand	2,940	3,088	3,447	2,967	3,364	4,170	2,906	2,975	3,064
California									
Agricultural	3,230	3,103	3,159	3,230	3,103	3,159	3,229	3,103	3,158
Municipal and Industrial	1,433	1,589	1,690	1,433	1,591	1,695	1,431	1,581	1,669
Energy	53	108	156	61	171	284	53	108	156
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	124	24	32	124	24	32	124	24	32
Tribal	92	92	92	92	92	92	92	92	92
Other	48	58	75	48	58	75	48	58	75
Total Potential Colorado River Demand	4,979	4,974	5,203	4,987	5,039	5,336	4,977	4,966	5,182
Nevada									
Agricultural	0	0	0	0	0	0	0	0	0
Municipal and Industrial	289	374	506	289	416	589	289	346	479
Energy	0	0	0	0	0	0	0	0	0
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	2	2	2	2	2	2	2	2	2
Tribal	9	9	9	9	9	9	9	9	9
Total Potential Colorado River Demand	300	385	517	300	427	600	300	357	490

Note: In the LC Basin, demands are from mainstem diversions of the Colorado River only. Does not include demands from diversions of Colorado River tributaries or evaporation from mainstem reservoirs.

Option [1]. Scenario A; (Current projected use), continuation of growth, development patterns, and institutions follow long-term trends. *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*.
Option [2]. Scenario C1; (Rapid Growth) Economic resurgence (population and energy) and current preferences toward human and environmental values (greatest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*
Option [3]. Scenario B; (Slow Growth) Slow growth with emphasis on economic efficiency (lowest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*

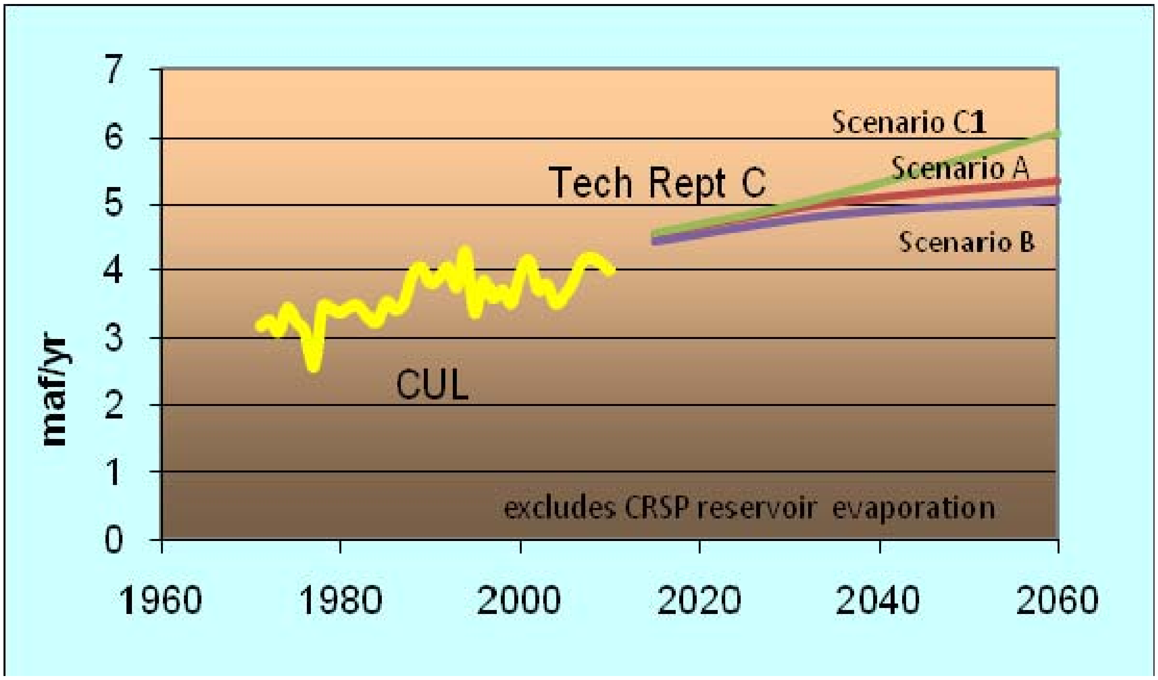

Figure 9 – Historical Water Use and Projected Water Demand.

COMPLIANCE WITH THE SALINITY STANDARDS

Reclamation and the Basin States conducted salt-routing studies for the *2011 Triennial Review of the Water Quality Standards for Salinity, Colorado River Basin*. As part of the triennial review process, Reclamation used the Colorado River Simulation System (CRSS) river system model to evaluate whether sufficient salinity control measures are in place to offset the effects of development. The information provided in the next two sections of the report was used to evaluate compliance with the water quality standards.

In response to the Clean Water Act, the States have adopted water quality (salinity) criteria for the Colorado River Basin and the Environmental Protection Agency (EPA) has approved them at all three locations in the Lower Colorado River Basin. The standards call for maintenance of flow-weighted average annual salinity concentrations (numeric criteria) in the lower mainstem of the Colorado River and a plan of implementation for future controls.

The water quality standards are based on the *Water Quality Standards for Salinity, Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System*, prepared by the Colorado River Basin Salinity Control Forum, June 1975. The document was adopted by each of the Basin States and approved by EPA. A summary of the report follows:

> The numeric criteria for the Colorado River System are to be established at levels corresponding to the flow-weighted average annual concentrations in the lower mainstem during calendar year 1972. The flow-weighted average annual salinity for the year 1972 was used. Reclamation determined these values from daily flow and salinity data collected by the USGS and the Bureau of Reclamation. Based on

this analysis, the numeric criteria are 723 mg/L below Hoover Dam, 747 mg/L below Parker Dam, and 879 mg/L at Imperial Dam.

It should be recognized that the river system is subject to highly variable annual flow. The frequency, duration, and availability of carryover storage greatly affect the salinity of the lower mainstem; and, therefore, it is probable that salinity levels will exceed the numeric criteria in some years and be well below the criteria in others. However, under the above assumptions, the average salinity will be maintained at or below 1972 levels.

Periodic increases above the criteria as a result of reservoir conditions or periods of below normal long-time average annual flow also will be in conformance with the standards. With satisfactory reservoir conditions and when river flows return to the long-time average annual flow or above, concentrations are expected to be at or below the criteria level.

The standards provide for temporary increases above the 1972 levels if control measures are included in the plan. Should water development projects be completed before control measures, temporary increases above the criteria could result and these will be in conformance with the standard. With completion of control projects, those now in the plan or those to be added subsequently, salinity would return to or below the criteria level.

The goal of the Salinity Control Program is to maintain the flow-weighted average annual salinity at or below the numeric criteria of the salinity standards. The program is not, however, intended to counteract the salinity fluctuations that are a result of the highly variable flows caused by climatic conditions, precipitation, snowmelt, and other natural factors.

SALINITY CONTROL

Existing salinity control measures prevent over a million tons of salt per year from reaching the river. In 2012 the salinity control program for Reclamation has controlled approximately 569,000 tons of salt, while the USDA NRCS (NRCS) program has reduced around 600,000 tons of salt, and the BLM has controlled an estimated 126,000 tons of salt per year from entering the Colorado River (Figure 10). Discussions within the Colorado River Salinity Control Forum have determined that salinity control units will need to prevent nearly 1.85 million tons of salt per year from entering the Colorado River by 2030, in order to meet the standard and keep the economic damages minimized. To reach this objective, as shown in Table 4, the program needs to implement 555,000 tons of new controls beyond the existing 1,295,000 tons of salinity control presently in place (2012) as reported by Reclamation, USDA & BLM. About 31,000 tons per year of new salinity control measures must be added each year if the program is to meet the cumulative target of 1,850,000 tons per year by 2030.

To achieve this goal, a variety of salinity control methods are being investigated and constructed. Saline springs and seeps may be collected for disposal by evaporation, industrial use, or deep-well injection. Other methods include both on-farm and off-farm delivery system and irrigation improvements, which reduce the loss of water and reduce salt pickup by improving irrigation practices and by lining canals, laterals, and ditches.

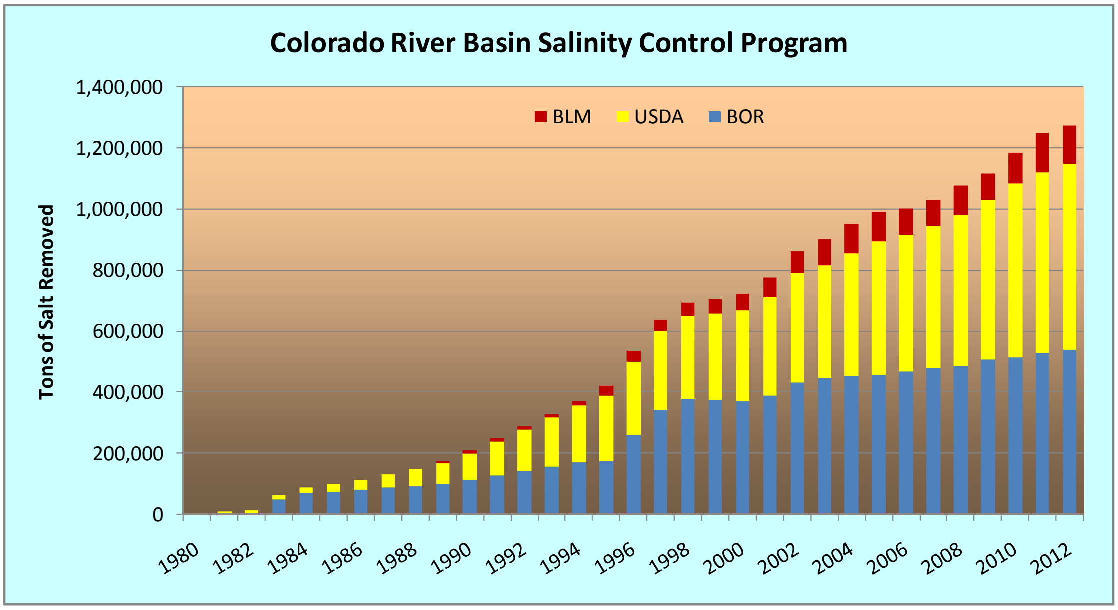

Figure 10 – 2012 Est. Salinity Control Progress; BOR, NRCS & BLM

Table 4 - Salinity Control Requirements and Needs Through 2030

Salinity control needs (2030)	1,850,000 tons
Measures in place (2012)	- 1,295,000 tons
Plan of Implementation Target	555,000 tons

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CHAPTER 3 – TITLE I SALINITY CONTROL PROGRAM

The Colorado River Basin Salinity Control Act (Salinity Control Act), Public Law 93-320, as amended, authorized the Secretary of the Interior (Secretary) to proceed with a program of works of improvement for the enhancement and protection of the quality of water available in the Colorado River for use in the United States and the Republic of Mexico. Title I enables the United States to comply with its obligation under the agreement with Mexico of August 30, 1973 (Minute No. 242 of the International Boundary and Water Commission, United States and Mexico [Minute No. 242]), which was concluded pursuant to the Treaty of February 3, 1944 (TS 994).

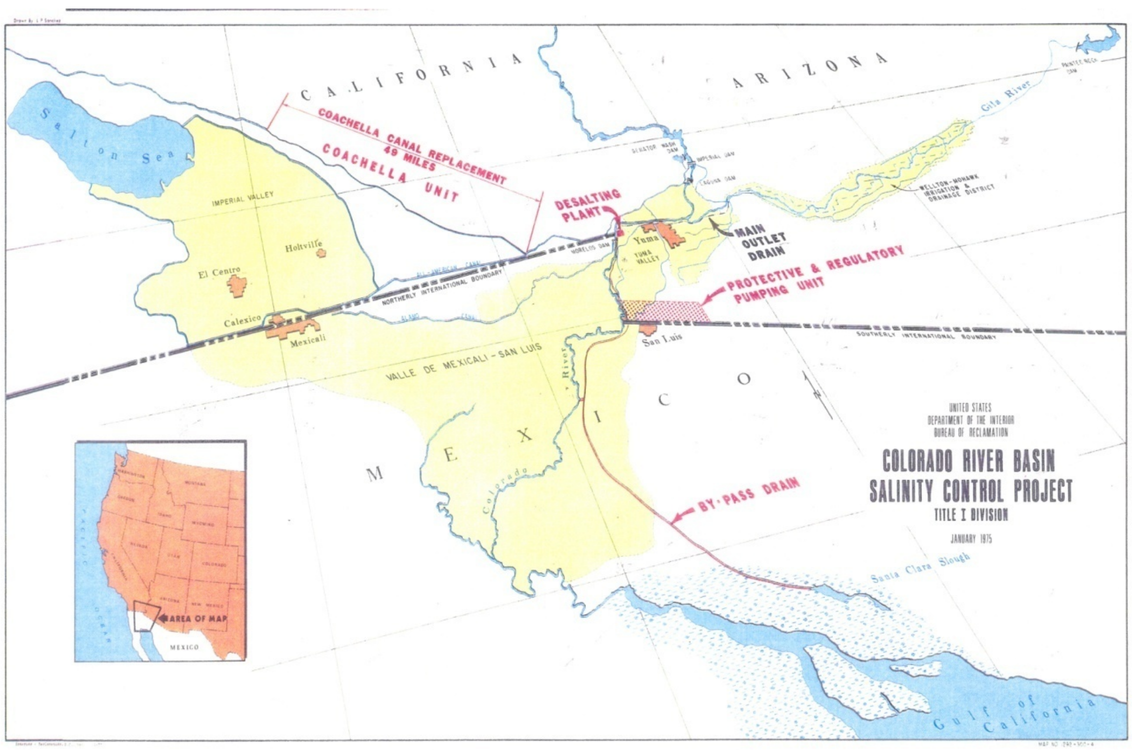

Figure 11 - Map of Title I Projects.

These facilities enable the United States to deliver water to Mexico with an average annual salinity concentration no greater than 115 parts per million (ppm) plus or minus 30 ppm (United States count) over the average annual salinity concentration of the Colorado River water at Imperial Dam.

The background and history of the Title I projects (Coachella Canal Lining, Protective and Regulatory pumping, Yuma Desalting Plant, Wellton-Mohawk Irrigation & Drainage District) can be found in Progress Report 22, chapter 4 at; http://www.usbr.gov/uc/progact/salinity/pdfs/PR22.pdf

Updates for the Title I projects since Progress Report 23 are as follows:

Coachella Canal Lining

No new activity or change since last progress report.

Protective and Regulatory Pumping

No new activity or change since last progress report.

Yuma Desalting Plant

No new activity or change has occurred since the last progress report.

Wellton-Mohawk Irrigation and Drainage District (WMIDD)

Total crop acres have remained relatively stable since the early 1970's because more acreage is double-cropped than when the program was initiated. In particular, more vegetable crops are being grown in the district than in the past. Irrigation efficiency levels and return flow levels for 1990-2011 are shown on the following page, in Table 5.

With the use of monthly groundwater table monitoring using observation well measurements as well as input from land users, WMIDD is able to maintain a drainage-pumping program that sufficiently maintains the agriculture root zone. Land users continue to maintain water efficient farming techniques with the use of dead level, high heads, and short runs.

Table 5 - WMIDD Irrigation Efficiency

Year	Pumped Drainage Return Flow (acre-feet)	Irrigation Efficiency, % (note: data provided by WMIDD)
1990	138,200	-
1991	144,900	68.8
1992	116,200	70.4
1993	8,970	68.8
1994	49,820	65.4
1995	121,500	64.3
1996	119,600	60.4
1997	91,695	62.2
1998	98,972	61.9
1999	94,869	63.0
2000	110,287	59.7
2001	107,908	60.9
2002	119,410	61.2
2003	116,477	57.8
2004	106,002	63.3
2005	110,770	64.6
2006	103,810	62.3
2007	112,910	62.6
2008	120,190	63.0
2009	105,482	62.7
2010	111,170	66.1
2011	108,140	64.9

CHAPTER 4 - TITLE II SALINITY CONTROL PROGRAM

Title II of the Salinity Control Act authorizes the Secretary of the Interior (Secretary) and the Secretary of Agriculture to implement a broad range of specific and general salinity control measures in an ongoing effort to prevent further degradation of water quality in the United States. These efforts are shown on the map below. The NRCS, BOR and BLM have a combined goal of controlling 1.85M tons of salt/per year, by the year 2030. These federal agencies are required to work together under, Public Law 93-320, "Colorado River Basin Salinity Control Act," as amended; with the Bureau of Reclamation being the lead federal agency. The Act also calls for periodic reports on this effort. The report is to include the effectiveness of the units, anticipated work to be accomplished to meet the objectives of Title II with emphasis on the needs during the 5 years immediately following the date of each report, and any special problems that may be impeding an effective salinity control program. Title II also provides that this report may be included in the biennial Quality of Water Colorado River Basin, Progress Report. New activities since the last progress report as well as ongoing and active projects are listed in this report.

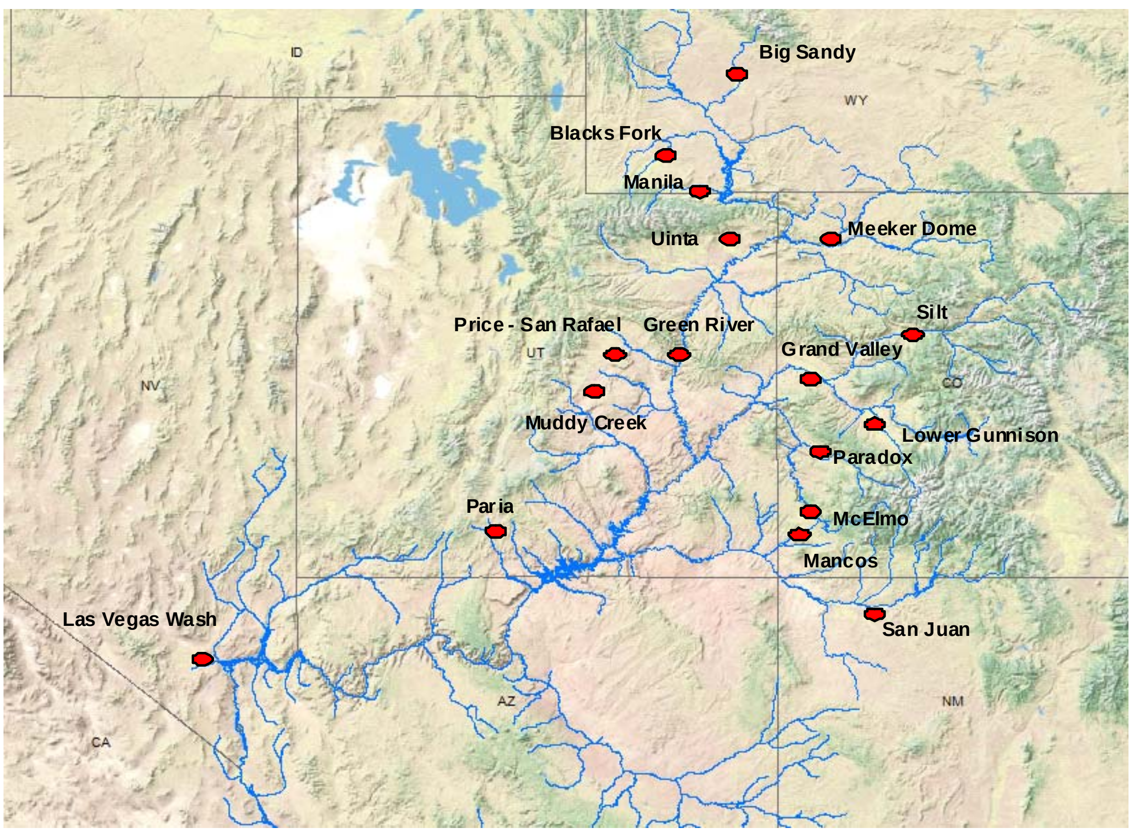

Figure 12 – Map of Title II Salinity Control Project Areas.

U.S. Bureau of Land Management

The BLM administers about 53 million acres of public lands in the Colorado River Basin above Yuma, Arizona. Substantial portions of these public lands are ecologically classified as arid or semiarid rangelands. Point sources of salt on public lands include saline springs, seeps from marine sedimentary formations, abandoned flowing wells, discharge from abandoned mines, and discharge of waters from authorized activities such as oil and gas production or mining. Nonpoint sources of salt include surface runoff, soil erosion, stream sediments, and groundwater discharge to streams. Salts can be transported either in solution or with solids such as soils or coarse fragments. Past studies have indicated that salt loading in rangelands is closely associated with sediment loading.

Salt concentrations on public lands tend to be highest in areas underlain by marine sedimentary rocks such as shales and mudstones that receive less than 8 inches of annual precipitation. Although salt concentrations can be very high in runoff from these lands, the frequency and volume of runoff is low because of the low precipitation and ephemeral nature of stream systems. Runoff from areas with highly saline soils in the Upper Basin is estimated to contribute about one-third of the annual salt load from BLM public lands.

The greatest volume of salt contributed from BLM-administered lands, however, is sourced from areas with moderate to low salt concentrations in soils that are relatively well-covered with perennial vegetation and receive more than 12 inches of annual precipitation. Although salt concentrations in runoff from these lands are low, total loading is relatively large because of higher water yields. These areas comprise about 67 percent of BLM-administered lands in the Upper Basin. Runoff from these areas is estimated to contribute more than half of the annual salt load from BLM-administered lands in the Upper Basin.

The BLM is committed to reducing salinity concentrations in the Colorado River sourced from its public lands as required by amendments to the Colorado River Basin Salinity Control Act of 1974 and mission mandates under the Federal Land Management Policy Act of 1976 (FLPMA). The BLM's primary strategy for reducing salt transport to the Colorado River is to minimize erosion from public lands through its existing land-management policies and practices. These policies and practices are intended to maintain or restore land-health as reflected by key ecological attributes such as soil and site stability, watershed function, and biotic integrity.

The BLM manages public lands according to a multiple-use mandate under the FLPMA. Many land-use activities such as livestock grazing, energy development, mining, recreation, timber production, utility transmission, and road management increase erosion and sediment transport. The BLM attempts to reduce these impacts to help maintain land-health standards by utilizing best-management practices; including terms, conditions, and stipulations in land-use authorizations; and requiring actions to restore lands upon completion of authorized activities. BLM also engages in many activities to restore degraded ecosystems that contribute excessive sediment and salts to Colorado River Basin watersheds. These activities include constructing and maintaining grade-control structures, spreader dikes, and retention structures; emergency stabilization and rehabilitation efforts following wildfires; removal of invasive plant species, channel stabilization and other riparian enhancements; maintaining road culverts; remediation of abandoned mine lands, and fire fuels reduction treatments. Salinity reductions for many of these activities continue to be difficult to quantify and report to the Forum because of factors such as the lack of adequate understanding about mobilization and transport of salts from rangelands and inability to conduct effectiveness monitoring for all projects.

Program Administration

The BLM established a Salinity Coordinator position in 2003 to coordinate activities in state offices, develop and refine approaches and protocols to advance abilities to understand transport mechanisms and quantify reductions achieved from land-management activities, and improve collaboration with the Reclamation Salinity Program Manager and Natural Resource Conservation Service Salinity Program Coordinator.

The BLM allocated $750,000 in FY2012 from its Soil/Water/Air (SWA) subactivity to support projects specifically relating to salinity control program objectives in its Upper Basin State Offices. Project funding is allocated towards proposals submitted by State Offices through the BLM Budget Planning System and prioritized using input from the Salinity Coordinator. Funding is allocated between planning, science, and on-the-ground implementation projects. Projects funded in FY2012 are described below in the State Reports section. Additional funding is allocated each year from the SWA subactivity to support labor and operations for the Salinity Coordinator. The BLM applied an additional $100,000 in lapsed labor funds from the vacant Salinity Coordinator position to initiate a collaborative study with Reclamation, Forum, Agricultural Resource Service, and USGS addressing salt mobilization and transport from rangelands.

In addition to the funding allocated from the SWA subactivity, millions of dollars are expended annually by other BLM programs and authorized users of public lands on watershed management, restoration, and mitigation activities that reduce erosion and contribute to salinity-control efforts. As previously indicated, the BLM is not able to report reductions accomplished through many of these efforts of technical and programmatic issues, but is working to develop approaches needed to quantify reductions.

State Activities since last Progress Report

Each BLM State Office prioritizes the salinity control activities which will provide the best results for their given circumstances and funds available.

Arizona

- Flat Top Dam system, a component of the Fort Pierce flood and salinity control system.
    - Conditions of 5 dikes in upper Clayhole Valley were assessed.
    - Over 150 miles of road maintenance completed, reducing dust and erosion.
    - Range standards and guides assessment reports completed on 25,000 acres of grazing allotments on saline soils. AMP’s are being revised to address problems on the saline soils.

  - Cattle temporarily removed from recently burned allotments.

Colorado

- Badger Wash
  - Study to assess contributions of grazing on Mancos Shale to in-stram salinity.
- Coal mine impact study –
  - Monitor any changes in surface or groundwater quality in the Book Cliff area north of Fruita, CO.
- Piceance Basin
  - Monitor precipitation along with conductivity and flow on sites on the White River, Piceance CK and Yellow Ck. This will help to determine potential impacts from oil and gas development in the basin and understand salinity and selenium loading in the White River.
- Dust Sampling
  - Operating dust samplers in Craig and Grand Junction, CO to study the effects of dust events on the albedo of the snowpack, and any associated changes in runoff and erosion.

New Mexico

- Road improvements
  - Improve local dirt roads on BLM lands to reduce amount of sediment reaching water ways in San Juan River basin.
- Vegetation Treatments
  - Pinyon-Juniper and sagebrush selectively thinned to promote grass and native vegetation production to help curtail soil erosion and improve watershed function in San Juan River basin.
- Silt Traps
  - Roughly 300 silt traps were built to help curtail sediment and salt loading, from oil and gas well pads and road construction, helping to improve the water quality in the San Juan basin.
- Riparian
  - Russian olive trees and saltcedar treated and removed to help native vegetation become reestablished. Noxious exotic weeds inventoried and sprayed. Rock dams constructed to stabilize the drainage, catch sediment and promote establishment of vegetation on newly deposited sediment. The rock dams were designed to reduce amount of sediment and salt reaching the San Juan River.
- La Manga Canyon Watershed Restoration
  - 200 acres of rangeland in the La Manga drainage was cleared for a mow and drill seed project to reduce erosion during snow melt and storm runoff events. Project included recontouring of disturbed hill slopes, construction of sediment retention dam, soil preparation and reseeding. Test plots were monitored and sediment and pasture fences maintained.

Utah

Utah continued to implement the Healthy Lands and Watershed Restoration program, which focused on improving habitat, vegetation, and improving water quality by improving vegetation cover and reducing erosion from BLM lands.

- Utah Watershed Restoration Initiative
    - This is a multi-agency Federal, State, and private partnership treating lands of various ownerships with an emphasis on watershed improvements and long-term habitat restoration. Although the projects are being conducted statewide, approximately 13 of these were located on BLM lands in the Colorado Plateau Ecoregion and have significant potential long-term benefits; reducing runoff, erosion, sedimentation and salinity to the Colorado River Basin. Additionally Moab BLM has entered into an agreement with the Dolores River Restoration Partnership, which has multiple NGOs, private, BLM, and other federal partners focusing efforts on the Dolores River.
    - Over 12,900 acres of BLM lands and 42.44 miles of stream corridor within the Colorado Plateau were treated in 2012 under this program, although total treatment area including other Federal, State and private lands as part of the cooperative effort is well more than 2 to 3 times that number. Treatments include riparian restoration, tamarisk and Russian olive removal, sagebrush restoration (Dixie-harrow and seeding), removal of juniper through bullhog and hand thinning methods, wildlife and rangeland seeding, cheatgrass treatment and reseeding degraded rangelands, and other similar projects.
- Climate Monitoring
    - Utah maintains a long-term climate monitoring program. Data are used in project planning as well as for interpreting results from other monitoring data such as silt fences and sedimentation studies. Soil, Water, Air appropriated funding was used to implement crucial upgrades and maintenance of equipment. This data will be merged with other data sets and used in longer-term climate analyses for the Colorado Plateau as well as interpreting ongoing studies related to salinity and erosion within the state.
    - Study of land use activities and any associated dust impact on snow albedo and the change in snow melt and water loss via evaporation and transpiration.
- Riparian Restoration
    - BLM Utah has been conducting weed treatments, primarily Russian olive and tamarisk removal as well as treatment of noxious weeds such as purple loosestrife, perennial pepperweed, and Russian knapweed in order to improve riparian habitat. Over 750 acres of streamside were treated and over 11,000 acres were surveyed for weeds and riparian improvement needs. Over 24,000 acres were treated and over 93,000 acres surveyed on adjacent uplands.
- Factory Butte OHV impact and soil study
    - ongoing

- Pariette Wetlands
  - Pariette Wetlands are an oasis in the Uinta Basin of northeastern Utah. The system is a large artificially-augmented wetland developed in 1972 to improve waterfowl production and provide seasonal habitat for other wildlife species. It encompasses 9,033 acres, 2,529 of which are classified wetlands or riparian and is the largest BLM wetland development in Utah. Elevated levels of Se have been measured in the wetland and pose concern for wildlife using the wetlands. Management of the Pariette wetlands is a long-term and multi-faceted endeavor. Major components of this include facility operation and monitoring the wetland area for wildlife management and salinity/water-quality control.
  - Completion of facility maintenance including clean-out and removal of sediment from the water diversion structures, rebuilding dikes and invasive weed control.
  - Collection of water quality sampling as part of our cooperative agreement for water quality monitoring with Utah Division of Water Quality. Data collected included flow (cfs), specific conductance (uS/cm), temperature (deg C), pH, dissolved oxygen (mg/l), and salinity (ppt).
  - Salinity program funding is being used to support a study through Utah State University Uintah Basin Hydrology Faculty. This study will help land managers determine whether or not the salt and associated contaminants in the Pariette Draw can be managed. This framework will provide temporal and spatial geochemical data for salt and associated contaminants.
  - The goal of these studies is to determine the processes responsible for regulating bioavailable Se within the wetland, so as to predict, prevent, and mitigate the potentially toxic build-up of bioavailable Se.
- Grazing Exclosures
  - The BLM Moab Field Office used funds to construct grazing exclosures in sensitive soils including those with salinity content, drought intolerant, high wind/water erosion rating, or low productivity. With these and other existing exclosures, most grazing allotments with more than 10 percent saline soils in the Moab Field Office now have a long term reference site in that allotment.
  - These exclosures are good reference sites to better understand impacts to moderately saline soils (>8 mmhos/cm) from grazing activity. Most sites are located adjacent to long term range trend study sites. Data from these long term study sites can help direct grazing management actions to ensure good soil conditions. With stable soil conditions, soil erosion and associated salinity loading to the Colorado River Basin is minimized.

Wyoming

It is recognized that surface disturbance has increased due to BLM approved activities, mostly oil and gas development, and this may reduce the effectiveness of these salinity control projects and related management actions. However, every oil and gas development project includes best management practices to control soil erosion and salt mobilization and reclamation of disturbed areas to promote rapid revegetation and stabilization of site disturbances.

- Progressive soil surveys
  - Improving the quality of soil resource impact analysis and mitigation prescription by BLM in the O&G development activities; in addition, are also providing the O&G industry with planning and assessment tools that will allow companies to prepare better operational plans and Storm-water Pollution Prevention Plans
  - Providing critical input data for the tailoring of the Automated Geographic Watershed Assessment (AGWA) modeling toolkit for the Upper Colorado Basin area. Application of this toolkit allows BLM specialists to identify watersheds most vulnerable to surface disturbing actions and enables users to select the best management options to minimize erosion, runoff and salt loading to waterways.
  - Helping to identify and protect fragile soil areas (that if disturbed, would impact water quality), aid in control of invasive plant species, select appropriate restoration strategies, and select appropriate management strategies. BLM, State regulatory agencies, O&G companies, and landowners will all benefit from the availability of high quality digital spatial and tabular soils data for their respective needs and applications.
- Automated Geographic Watershed Assessment modeling toolkit
  - The BLM is continuing a cooperative project with the University of Wyoming (UW), Wyoming Geographic Information Science Center (WyGISC) and the Department of Renewable Resources to further refine the AGWA modeling toolkit and apply it in environmental impact analysis for oil and gas projects and subsequent project management within the Upper Green (Colorado) River Basin in Wyoming.
  - The objective of this project is to assist in predictive risk modeling of salt mobilization and transport using improved soil salinity mapping and modeling. BLM is working with the University Project Team to perform field research to establish accurate soil salinity and erosion relationships, parameterize existing functional hydrologic models, and develop a mechanistic understanding of salt transport.
  - This team is currently assisting the BLM in using these tools to prepare analysis models for the LaBarge and NPL oil and gas projects. These efforts will provide the quantitative data needed to manage surface disturbing energy development projects in a manner that controls soil erosion and salinity loading.
- Road Maintenance
  - Road construction and use increases erosion and sediment transport. Operators are required to provide the BLM with engineered designs and use best management practices to construct new roads. Additionally, hydrologic analyses are required for properly sizing and placing culverts that are needed in larger, more complex ephemeral and perennial systems.

It is assumed that smaller quantities of sediments and salts are reaching drainages due to these improvements in design.

- Grazing Management
  - Improvements in grazing management on approximately 43,000 acres reduced runoff and erosion, the improvements included the development of 4 impoundments and 3 spring developments that encourage cattle to stay out of riparian areas and concentrate use on upland areas.
  - In response to the larger fires outside of BLM managed lands in 2012, several BLM grazing allotments in the Northern extent of the Green River Basin have been closed. The costs to the government are the loss of the grazing fees and taxes resulting from income by the ranchers. The exact amount of potential salt savings that could occur in the following years is unknown and has a potentially wide variation but the benefits to vegetation and soil stability should be considerable.
- Oil and Gas Activity
  - 19 Wells are plugged and abandoned in the Colorado River Basin. Wells that have been plugged and abandoned are reclaimed with native vegetation and no longer contribute salt and sediment into the watershed. This includes the wellpads as well as the access roads associated with the wellpads.
- Reservoir Repair
  - Nine reservoirs were repaired in FY 2012; no new reservoirs were constructed.

    Due to the historically high runoff rates from the winter and spring, many reservoirs required repairs. It is difficult to quantify the amount of salts being retained within the reservoirs due to different holding capacities, different soils, and variable precipitation and runoff rate. However, most reservoirs are effective in retaining salt if built and maintained sufficiently.
- Vegetation Treatments
  - Approximately 4 miles of stream were planted with willow, current, birch, sedge, rush, and buffalo berry in order to revegetate disturbed banks. The amount of sediment/salt loading to streams will be reduced once this vegetation is established.
  - There were no mechanical vegetation treatments within the Colorado River Basin, but approximately 3000 acres were treated with herbicide in order to encourage new vegetative growth and increase vegetative cover, thereby reducing erosion.

Table 6 – BLM Salt Retention Estimates for Fiscal Years 2006 – 2012

Project Category	SALT RETAINED IN TONS/YEAR[1]						
	FY 2006[4]	FY 2007[4]	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
POINT SOURCE[2]	14,600	14,600	14,600	14,600	14,600	14,600	14,600
NONPOINT SOURCE[3]	71,900	71,900	81,900	71,900	85,300	111,400	111,400
ALL PROJECTS	86,500	86,500	96,500	86,500	99,900	126,000	126,000

1. Rounded to the nearest 100 tons.
2. BLM's Salinity Report to Congress through the year 2002, plus the plugging of 2 wells in Utah during FY 2004 (approximately 5,000 tons/yr).
3. Amount that could be calculated, i.e., this is a minimum.
4. When the program was re-structured in FY 2006, we did not have a complete accounting the 1st year or even the 2nd year. As a result, the tons-of-salt-retained number on BLM administered land in the Upper Colorado River Basin (UCRB) was low. FY 2006 and FY 2007 numbers have been changed to reflect tonnage retained in FY 2009, because after 4 years on the new system, FY 2009 tonnage is probably a better estimate. Projects can become less effective in retaining salt over the years, but there is enough erosion control going on constantly in the UCRB on public land, that the tonnage is probably closer to FY 2009 than it was to the low incomplete numbers originally reported for FY 2006 and FY 2007.

U.S. Department of Agriculture (USDA)

The NRCS of the USDA conducts Colorado River Basin Salinity Control activities primarily under the authorities of the Environmental Quality Incentives Program (EQIP). EQIP was enacted with passage of PL104-127, Federal Agricultural Improvement Act of 1996, a.k.a. "1996 Farm Bill."

EQIP has been reauthorized twice; by PL 107-171, The Farm Security and Rural Investment Act of 2002, the "2002 Farm Bill" and by PL 110-246, The Food, Conservation, and Energy Act of 2008, the "2008 Farm Bill." The 2008 Farm Bill expired September 30, 2012; however, the Consolidate and Further Continuing Appropriations Act of 2012 extended the authorization of EQIP through September 30, 2014.

Through EQIP, NRCS offers voluntary technical and financial assistance to agricultural producers, including Native American tribes, to reduce salt mobilization and transport to the Colorado River and its tributaries. Within the eleven approved salinity project areas, producers may be offered additional financial incentives to implement salinity control measures with the primary goal of reducing offsite and downstream damages and to replace wildlife habit impacted as a result of the salinity measures.

In FY 2012, $12.4 million of appropriated EQIP funding was obligated into new land treatment contracts with agricultural producers in project areas in Colorado, Utah, and Wyoming. These contracts, when fully implemented will provide more than 13,000 tons of annual salt control.

New Salinity Projects and Investigations

Henrys Fork (of the Green River), Wyoming The Henrys Fork Salinity Control Project was adopted by NRCS in May 2013. This project area encompasses 69,929 acres in Sweetwater and Uinta Counties, Wyoming, and Daggett and Summit Counties, Utah. The entire Henrys Fork watershed is about 306,000 acres and is a tributary to the Green River which is a major tributary to the Colorado River.

Of the 20,709 irrigated acres within the project area, NRCS expects to improve on-farm irrigation application systems and reduce deep percolation and salt loading from about 14,000 acres, resulting in a salt load reduction of 6,540 tons annually.

West Black's Fork, Wyoming

An area of some 28,000 acres of irrigated pasture and hayland near Lyman, Wyoming, contribute salt to the Blacks Fork River, tributary to the Green River. While a large portion of the geology contributes little salt, about 10,000 acres may contribute significant amounts of salt from canal and ditch seepage and deep percolation from water applied to fields.

The Wyoming Water Development Commission provided a significant grant to the Austin-Wall Canal Company resulting in a comprehensive plan to modernize the irrigated areas within their service area. NRCS anticipates that, in the near future, the Company will begin replacing earthen canals with buried pipelines that will provide pressure to operate sprinklers on the irrigated lands. NRCS intends to use its regular EQIP authority to assist producers in the area who want to modernize their irrigation systems. Such improved systems will provide significant salt control benefits.

San Juan Basin, New Mexico and Arizona

The first phase of the "Shiprock Pilot Project" to control salt was completed by the San Juan River Dineh Water Users, Inc. (SJRDWU, Inc.) in 2011. A leaky earthen lateral supplied water to 12 Navajo Nation farmers on 168 acres of cropland. The SJRDWU, Inc. completed the construction using their own resources and a grant from the Bureau of Reclamation. The SJRDWU, Inc. also reserved an eight acre parcel of land and has completed practices to replace wildlife habitat values that were lost due to the pipeline installation.

The NRCS has been actively promoting the use of EQIP to improve the on-farm irrigation systems served by the pipeline. EQIP applications have been received but, to date, no installation has occurred. As salt loading is quite high from agriculture along the San Juan River, it is hoped that this pilot project will encourage and accelerate salinity control. The SJRDWU, Inc. has expressed continuing interest in improving the irrigation delivery and application systems within their service area.

Areas Beyond Current Project Boundaries

NRCS has undertaken to identify salt loading and salinity control from irrigated crop, pasture and haylands scattered widely throughout the Upper Colorado River Basin but outside of the existing project areas. With the assistance of the U.S Geological Survey (USGS) and the Bureau of Reclamation, NRCS has been able to make use of the SPARROW model to assess salt loads outside of the existing salinity project areas. While the assessment is ongoing and will require considerable refinement, preliminary analysis indicates that as much as 50,000 tons of salt control has occurred in Utah and Colorado outside the project areas.

In 2012, Colorado and Utah NRCS developed EQIP contracts with water quality benefits including salt control outside of the approved project areas but within the Colorado River Basin.

- Colorado, obligated $166,000 on 264 acres for 281 tons of planned salt control in the counties of La Plata, Archuleta, and Montrose.
- Utah, obligated $1.6 million on 2,420 acres for 1,310 tons of planned salt control; all within Wayne County.

Monitoring and Evaluation

Project offices continue to monitor and evaluate the effectiveness and quantity of salinity control, wildlife habitat, and economic performance replacement in order to improve the overall performance and management of the program. Generally, the program continues to function effectively and economically, though the overall cost per ton of salt control continues to rise in some areas however, when adjusted for inflation the current cost effectiveness compares favorably with the projected costs at the time of the adoption of the respective projects. It is also noted that additional efforts are needed to identify and implement valuable, low-maintenance, sustainable wildlife habitat replacement. The individual Monitoring and Evaluation reports for FY 2011 for each project can be found on the world-wide-web at; http://www.usbr.gov/uc/progact/salinity/index.html

Active Salinity Control Projects

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

Table 7 – Active Salinity Control Projects

		Project Area	
State	Project	(Potential Irrigated Acres)	USDA Servicing Office
Colorado	Grand Valley	50,000	Grand Junction
	Lower Gunnison River	171,000	Delta and Montrose
	McElmo Creek	29,000	Cortez
	Mancos Valley	11,700	Cortez
	Silt	7,400	Glenwood Springs
Utah	Uinta Basin	226,000	Roosevelt, Vernal
	Price/San Rafael Rivers	66,000	Price, Castle Dale
	Muddy Creek	6,000	Castle Dale
	Manila-Washam	8,000	Vernal
	Green River	2,600	Price
Wyoming	Big Sandy River	18,000	Farson
	Henrys Fork	21,000	Lyman
	Total	**616,700**	

Grand Valley, Colorado

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

As of October 2011, the salt reduction goal of 132,000 tons had been exceeded and more than 147,000 tons had been reported as controlled. In 2012, 29 new contracts (of which two were Basin States) were signed on 980 acres that will deliver an additional 1,955 tons of salt control.

While the Grand Valley project has been very successful in reaching its salt control goal, the wildlife replacement goal remains to be met. Approximately 400 acres of additional habitat replacement are required. Negotiations and planning are underway for a 600 acre parcel that would achieve the replacement goal.

Lower Gunnison Basin, Colorado

This project encompasses the irrigated farmland in the Gunnison and Uncompahgre River valleys. With the expansion into the upper headwaters of the Uncompahgre River in 2010, implementation is now proceeding in Delta, Montrose, and Ouray Counties. Implementation was initiated in 1988 in this unit. Nearly 60 percent of the salt control goal has been achieved.

Interest remains high in the project area. Sixty new contracts (six were BSP) for about $4.5 M were developed in 2012 on 2,442 acres for planned salt control of 4,643 tons. About 30 percent of new projects are sprinkler systems, 62 percent are improved surface systems and 7 percent are micro-spray or drip.

Mancos River, Colorado

This project, near the town of Mancos, Colorado, was initiated and approved for funding and implementation by USDA-NRCS in April 2004. Currently, about 50 contracts have been developed with EQIP and Basin States Parallel funds. Five new contracts for $72,000 were developed on 109 acres in 2012. Planned salt control from these new contracts is 85 tons annually. One third of the contracts were sprinkler systems.

McElmo Creek, Colorado

Implementation was initiated in this unit in 1990. Application of salinity reduction and wildlife habitat replacement practices continue to be implemented in this area with sprinkler systems, underground pipelines, and gated pipe being installed. In 2012, 26 new contracts were developed on 507 acres that will provide 646 tons of salt control when fully implemented. Sixty-two percent of the new projects were high-efficiency sprinkler systems. The project has attained slightly over 60 percent of its salt control goal.

Silt, Colorado

The first applications were funded in 2006. The cumulative cost effectiveness for these new contracts is $72 per ton which falls midway among the other active project areas. Several wildlife projects have been identified. Applications are a mix of improved surface and sprinkler irrigation systems.

Uinta Basin, Utah

Implementation began in this unit in 1980. The original salt control goal was reached several years ago but about 60,000 acres might still be improved. Producer participation is exceeding the original projections. Fifty eight EQIP contracts (including one wildlife habitat contract and three Basin States contracts) were reported in 2012. These contracts obligate nearly $1.6M to control about 1,600 tons of salt. All irrigation improvements were either sprinklers, buried pipelines or a combination of the two. Installation of a Reclamation- funded project near the city of Roosevelt accelerated the rate of applications in Duchesne County.

A significant number of systems have reached or are nearing the end of their useful life. While these systems are a lower priority than first-time improvements, NRCS has begun providing incentives for replacement or up-grading. NRCS has also organized a team to analyze the issues raised by the farmer-demand for incentives to replace aging systems. Issues of environmental benefits vs. cost, and program authority must be considered within the larger national framework of administering the EQIP program.

Price-San Rafael, Utah

This project is approaching 60 percent achievement of its salt control goal. In 2012, 37 new contracts (including two wildlife and two Basin States contracts) obligated about $1.9 M on 1,444 irrigated acres. When implemented, these measures will control about 4,000 tons of saltand provide habitat replacement. The on-farm portion of the Huntington-Cleveland Project is in the final two years of contracting. The Cottonwood Creek Irrigation Company service area is the last large untreated area of the Price-San Rafael Salinity Control Project. A large number of applications were received there in 2012 and NRCS anticipates developing numerous contracts there in 2013 and beyond.

Muddy Creek, Utah

There were no new contracts developed in the Muddy Creek area in 2012, however as a portion of the canal serving the area has been piped, NRCS anticipates receiving a few applications in 2013.

Green River, Utah

One EQIP contract was developed in the project area in 2012 that will control 1,310 tons when fully implemented. Interest remains high but off-farm infrastructure improvements are needed to allow on-farm systems to operate properly and efficiently. Irrigation continues to expand, particularly on the plateau to the east of the Green River but, as all of the new irrigation systems are high-efficiency sprinklers, NRCS does not anticipate a significant increase in salt loading to the river. These expansions are not eligible for EQIP assistance.

Manila-Washam, Utah/Wyoming

Astride the Utah-Wyoming border, and adjacent to the shores of Flaming Gorge Reservoir, the Manila-Washam Project is the newest, authorized project area. This area of 11,000 acres of irrigated pasture and hayland contributes about 53,000 tons of salt annually to the Green River. Nearly 2000 acres have been treated or contracted since the first plans were developed in 2007. All new irrigation systems have been some form of sprinkler system, such as side roll, pods, or center pivots.

Big Sandy River, Wyoming

Implementation has been underway in this unit since 1988. Approximately 13,500 acres of the planned 15,700 acres have been treated (86 percent) and about 68 percent of the salt control goal has been reached. Producers also report that the water savings from improvements in irrigation systems now allows a full irrigation season of water for the entire irrigation district. In 2012, no new contracts were developed.

Table 8 - USDA Salinity Control Unit Summary Through 2012

Unit	[1]Controls (tons)	Potential (tons)	Percent of Goal	Costs	Annualized Costs	Projected total cost	[2]Cost/ton
Mancos River, CO	4,325	11,940	36%	$6,849,366	$567,812	$18,909,001	$131
Muddy Creek, UT	61	11,677	1%	$117,812	$9,767	$22,552,307	$160
Manila-Washam, UT	8,149	17,430	47%	$7,027,276	$582,561	$15,030,730	$71
Silt, CO	2,139	3,990	54%	$3,998,487	$331,475	$7,458,608	$155
McElmo Creek, CO	29,289	46,000	64%	$22,420,893	$1,858,692	$35,213,257	$63
Uinta Basin, UT	149, 714	140,500	107%	$111,335,705	$9,229,730	$104,464,820	$62
L. Gunnison, CO	112,987	186,000	61%	$74,120,491	$6,144,589	$122,017,677	$54
Price/San Rafael, UT	88,616	146,900	60%	$43,891,498	$3,638,605	$72,759,559	$41
Grand Valley, CO[3]	148, 440	132,000	112%	$56,713,677	$4,701,564	$50,432,534	$32
Big Sandy, WY	56,810	83,700	68%	$13,560,491	$1,124,165	$19,979,107	$20
Green River, UT	178	6,540	3%	$86,940	$7,207	$3,194,312	$40
Totals	600,735	786,677	76%	$340,122,636	$28,196,167	$472,011,913	$47

[1]Includes Off-farm funded with EQIP or Basin States Parallel funds
[2]Cost per ton based on amortization over 25 years at 6.625% interest.
[3]Grand Valley includes 35,300 tons for on-farm ditches, not part of in-field control.
Since 2010, 5,457 tons of out-of-pocket salt control has been contracted at a weighted cost per ton of $156.

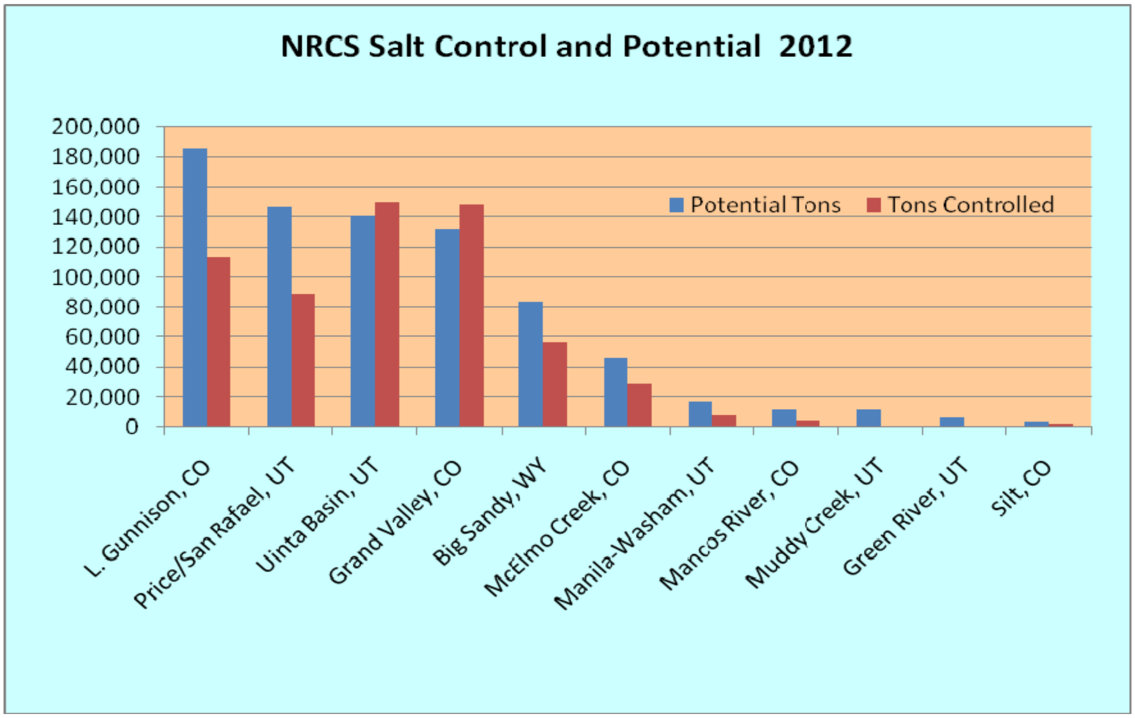

Figure 13 – NRCS On-Farm Salt Control Through 2012

Bureau of Reclamation

Basinwide Salinity Control Program (Basinwide Program)

One of the greatest advantages of the salinity control program comes from the integration of Reclamation's program with USDA's program. Water conservation within irrigation projects on saline soils is the single most effective salinity control measure found in the past 30 years of investigations. By integrating USDA's onfarm irrigation improvements with Reclamation's off-farm improvements, significantly higher efficiencies can be obtained. If landscape permits, pressure from piped delivery systems (laterals) may be used to drive sprinkler irrigation systems at efficiency rates far better than those normally obtained by flood systems. Reclamation now has much greater flexibility (in both timing and funding) to work with USDA to develop these types of projects.

Another significant advantage of the existing salinity program is that projects are "owned" by the proponent, not Reclamation. The proponent is responsible to perform on its proposal. Costs paid by Reclamation are controlled and limited by an agreement. Yet, unforeseen cost overruns can occur. The proponent has several options: the project may be terminated or the proponent may choose to cover the overruns with their own funds or borrow funds from State programs. The proponent may also choose to reformulate the project costs and recompete the project through the entire award process. For example, pipeline bedding and materials costs for the Ferron Project were underestimated in the proposal and subsequent construction cooperative agreement. The proponent was denied permission to award materials contracts for the pipeline, since the costs were beyond those contained in the agreement. After months of negotiations and analysis, the proponents elected to terminate the project, reformulate it, and recompete against other proposals the following year. Their project was found to be competitive at the reformulated cost and was allowed to proceed.

Funding Opportunity Announcement (FOA)

Reclamation's Upper Colorado (UC) Region released a FOA on August 1, 2012, requesting applications for salinity control projects that reduce salinity contributions to the Colorado River system.

Applications were selected through a competitive process under the evaluation criteria set forth in the FOA. Applications were evaluated and ranked by an Application Review Committee (ARC). Reclamation and/or the state agency proceeded to award agreements to the applicants of the highest ranked applications. Starting with those applications with the highest ranking, awards were made until the anticipated available funding for the next 2 to 3 years was awarded.

All salinity projects are required to replace incidental wildlife habitat losses concurrent with construction of salinity features and maintain this habitat for the life of the project.

Price – San Rafael River Basins, Utah

Figure 14 - Price-San Rafael Irrigation Improvements.

Huntington Cleveland Irrigation Company (HCIC) Project: The Project is located in northern Emery County, in and around the towns of Huntington, Lawrence, Cleveland, and Elmo. The Project was selected in the 2004 Request for Proposals (RFP) and awarded a cooperative agreement in September 2004. A new cooperative agreement was executed in November 2006, and was modified again in September 2009. Approximately 350 miles of open earthen canals and laterals are being replaced with a pressurized pipeline distribution system (Distribution System) to accommodate sprinkler irrigation on about 16,000 acres. Funding for this project is being shared between Reclamation's Basinwide Program, HCIC including a loan from the Utah Division of Water Resources, NRCS's EQIP, the Parallel Program, and Rocky Mountain Power, formally known as Utah Power and Light. The last of Reclamation's share of $17,116,336 for the Off-farm Distribution System was obligated in 2008. Reclamation can provide up to an additional $6,000,000 in funding equally 50/50 with HCIC funds for completion of the Distribution System. Since 2009, Reclamation has provided over $4,000,000 in additional funding. The Project, scheduled to be completed in 2013, will result in the annual reduction of 59,000 reportable tons of salt in the Colorado River at an anticipated combined Federal cost of approximately less than $100/ton. Of the 59,000 tons of salt, 13,000 are attributed to the Off-Farm Distribution System and 46,000 tons are attributed to the On-Farm Distribution System and the on-farm salinity control measures (sprinklers).

Cottonwood Creek Irrigation Improvement Project: The $6,509,548 Cottonwood Creek Irrigation Improvement Project is located in Emery County, west of Castledale, Utah. It was selected from the applications received in the 2008 FOA. A Cooperative Agreement was executed in February 2010. Construction began in May 2011, and the project is expected to be operational for the 2013 irrigation season. This project replaced approximately 31 miles of earthen canals and laterals with a pressurized pipeline system resulting in a reduction of 2,094 reportable tons of salt in the Colorado River. It is expected that the pressurized pipeline will induce on-farm improvements resulting in the annual reduction of an additional 9,100 reportable tons of salt. It is anticipated that the project will result in the total annual reduction of 11,194 reportable tons of salt in the Colorado River at an anticipated cost of approximately $59 per ton of salt.

Uintah Basin, Utah


Figure 15 - Salinity in Uinta Basin Unit Area.

Ouray Park Canal Rehabilitation Project: This project is located in Uintah County in the vicinity of Gusher, Utah. It was selected from the applications received in the 2010 FOA. A Cooperative Agreement was executed in September of 2011, for the amount of $2,676,000. This project will replace approximately 5.2 miles of the Ouray Park Canal with irrigation pipe completing a 20.5 mile system. This allows for total abandonment of the 13 mile Ouray Valley Canal which carried storage water for one month per year due to previous salinity control agreements. The project results in the annual reduction of 1,662 reportable tons of salt in the Colorado River at an anticipated cost of approximately $79.82 per ton of salt. The project was begun in the fall of 2011 and will be completed in the spring of 2013.

Hancock-State Road Salinity Reduction Project: This project is located in Duchesne and Uintah Counties in the vicinity of Roosevelt, Utah. It was selected from the applications received in the 2010 FOA and funded with funding from the Basin States Program. A Cooperative Agreement was executed in March of 2012, for the amount of $2,315,250. This project will replace approximately 20.83 miles of earthen canal and laterals with irrigation pipe resulting in the annual reduction of 1,759 reportable tons of salt in the

Colorado River at an anticipated cost of approximately $65.25 per ton of salt. The project was begun in the fall of 2011 and approximately 50 percent was in service for the 2012 irrigation season. Project completion is scheduled for spring of 2013.

Big Sandy Project, Sweetwater County, Wyoming

Eden Valley, Eden Canal, Laterals E-5 and E-6 Project: This project was selected in the 2010 FOA. A Cooperative agreement was executed in September of 2011, for the amount of $1,712,968.50. This project will replace approximately 1.43 miles of earthen laterals with irrigation pipe and line 1.38 miles of the Eden Canal with an impermeable layer resulting in the annual reduction of 1,101 reportable tons of salt in the Colorado River at an anticipated cost of approximately $77.13 per ton of salt. Laterals E-5 and E-6 are completed, and work on the Eden Canal is scheduled to begin in the fall of 2012 and to be completed in the spring of 2013.

Eden Valley, Farson/Eden Pipeline Project: This project was selected in the 2008 FOA. A Cooperative Agreement was executed in February of 2009, for the amount of $6,453,072. This project will replace approximately 24 miles of earthen laterals with irrigation pipe resulting in the annual reduction of 6,594 reportable tons of salt in the Colorado River at an anticipated cost of approximately $52.57 per ton of salt. Laterals E-7, E-8, and E-13 are completed, and work on the West Side Canal is currently being accomplished. The project is scheduled to be completed by 2013.

Gunnison Basin, Colorado

Uncompahgre Valley Water Users Association (UVWUA) Phase 4 Project: As a result of the 2008 FOA, the UVWUA was awarded a cooperative agreement for Phase 4 of the ESL in December 2008. This phase involves an additional 11 miles of laterals under the Selig and East Canal systems and the reduction of about 3,700 tons of salt loading annually at a cost of $29.46 per ton of salt. Approximately $2 million of salinity-control funding will be supplemented with approximately $800,000 from a Section 319 grant obtained through the Colorado Division of Public Health and Environment. Construction of one short lateral was completed in FY 2009. Additional laterals were completed in FY2010-11 and the remaining portions of Phase 4 were completed in 2012.

UVWUA Phase 5 Project: As a result of the 2010 FOA, the UVWUA was awarded a $4.3 million cooperative agreement for Phase 5 of the ESL. This phase involves an additional 19 miles of laterals under the Selig and East Canal systems and the reduction of about 5,034 tons of salt loading annually at a cost of $42.53 per ton of salt removed. Construction began in November 2011 and will continue through 2015.

UVWUA Phase 7 Project: As a result of the 2010 FOA, the UVWUA was awarded a $3.2 million cooperative agreement for Phase 7 of the ESL. This phase involves an additional 12.7 miles of laterals under the Selig and East Canal systems and the reduction of about 3,029 tons of salt loading annually. The cost is estimated at $52.11 per ton of salt. Construction will begin in the fall of 2012 and will continue through 2016.

Grandview Canal and Irrigation Company Project: Awarded from the 2008 FOA, this project involves piping a portion of the Grandview Canal and several laterals in an area tributary to the North Fork of the Gunnison River near Crawford in Delta County. In July 2009, Reclamation entered into an agreement to provide $5.3 million to pipe 4.8

miles of main canal and 5 miles of laterals and convert about 900 acres of currently flood-irrigated farmland to sprinkler irrigation. Construction began in September 2010 with completion expected by late 2012. The remaining work includes habitat mitigation. The project is expected to reduce salt loading by 6,400 tons/year at a cost of $56.84/ton.

Lower Stewart Pipeline Project: Awarded from the 2010 FOA, this project involves piping a portion of the Stewart Ditch & Reservoir Company (SDRC) existing unlined canals in a tributary to the North Fork of the Gunnison River near Paonia, Colorado. In September 2011, Reclamation entered into an agreement to provide up to $6.0 million to pipe 11.5 miles of existing canals with an expected salt load reduction of about 10,920 tons/year with an estimated cost of $27.24/ton. Construction will begin in the fall of 2012.

Minnesota Ditch Irrigation Salinity Control – Project 1: Awarded from the 2010 FOA, this project involves piping a portion of the Minnesota Canal & Reservoir Company (MCRC) existing unlined canals in a tributary to the North Fork of the Gunnison River near Paonia, Colorado. In September 2011, Reclamation entered into an agreement to provide up to $3.94 million to pipe 5.2 miles of existing canals with an expected salt load reduction of about 3,263 tons/year at a cost of $59.91 per ton of salt removed. Construction will begin in the fall of 2012.

C Ditch/ Needle Rock Project: Awarded from the 2010 FOA, this project involves piping a portion of the C Ditch Company (CDC) existing unlined ditches in a tributary to the Cottonwood Creek drainage of the Gunnison River near Crawford, Colorado. In July 2012, Reclamation entered into an agreement to provide up to $1.43 million to pipe 2.5 miles of existing ditches with an expected salt load reduction of about 1,284 tons/year costing $55.4/ton of salt. Construction is anticipated to begin in the fall of 2013.

Clipper Irrigation Salinity Control – Project 4: Awarded from the 2010 FOA, this project involves piping a portion of the Crawford Clipper Ditch existing unlined canals in a tributary to the Cottonwood Creek drainage of the Gunnison River near Hotchkiss, Colorado. In September 2012, Reclamation entered into an agreement to provide up to $1.21 million to pipe 3.4 miles of existing canals with an expected salt load reduction of about 1,038 tons/years. Cost is expected to be $57.99 per ton of salt removed. Construction is anticipated to begin in the fall of 2013.

Reclamation entered into a cooperative agreement in 2008 with the Delta Conservation District to map and collect information on water diversion, canals and laterals, and irrigation practices in the Lower Gunnison Basin. This information has been needed for participation in the FOA process. Mapping in 2012 completed the North Fork, Delta, Tongue, and Surface creeks, and Bostwick and Shinn Park areas. Also, a majority of the canals were mapped in the Colona area. Additional work is needed to complete the Colona and Ridgway areas and finalize the project. The cooperative agreement with Delta Conservation District expired on September 30, 2012. Reclamation is looking into alternatives to finalize the mapping project for the Lower Gunnison Basin.

Grand Valley, Colorado

Grand Valley Irrigation Company (GVIC) Canal Improvement Grant 2010A: As a result of selection under the 2010 FOA, the GVIC was awarded a $2.8 million cooperative agreement to line about 1.9 miles of their main canal and pipe about 4,100 ft of ditch within the Grand Valley. A salt loading reduction of approximately 1,749 tons annually is expected at a cost of $79.96/ton of salt removed. The canal lining will consist of a PVC membrane with a shotcrete cover and the pipe will be concrete. Construction began in December 2011, and will continue through 2015.

Basin State Program

Section 205 of the Act authorizes Reclamation to expend amounts from the Basin Funds to repay the Treasury the reimbursable cost allocation of salinity projects or provide a cost share amount. This includes appropriations expended by the NRCS in their salinity program. The NRCS has questioned its ability to accept Basin Funds for cost sharing directly into its salinity program. Rather than repay the Treasury, the Colorado River Basin States (Basin States), NRCS, and Reclamation developed a "Parallel Program" (PP). Cost share funds from the Basin Funds have been used to accelerate and supplement implementation of the NRCS salinity measures by funding – through state agencies in Colorado, Utah, and Wyoming – salinity control measures that are separate, but parallel to, the salinity control measures implemented by the NRCS. Reclamation, with recommendations from the Basin States, had interpreted the Act to allow funds from the Basin Funds to be expended in the PP to further the general purposes of the Act.

To clarify authority for the administration of the PP, the Basin States prepared and put forth legislation, through then Senator Salazar's - CO office, into the 2008 Farm Bill to amend the Act and create the Basin States Program (BSP). Public Law 110-246 amended the Act and established the BSP. With the creation of the BSP, the PP has been phased out and all funds which were not used by December 30, 2012 in the PP have become part of the BSP.

Reclamation has determined agencies within the Upper Basin states to be appropriate partners and has executed cooperative agreements to utilize the services of these state agencies to assist in seeking and funding cost-effective activities to reduce salinity in the Colorado River system. Activities will also benefit the Upper Basin states by improving water management and increasing irrigation efficiencies. Interagency agreements have been executed with the NRCS in the states of Colorado and Utah to provide the technical assistance for the BSP.

Utah Department of Agriculture and Food (UDAF)

Basin States Program (BSP): Significant changes have occurred in UDAFs salinity control program. During FY 2012, migration was made from the PP to the BSP. With the starting of the BSP, UDAF has moved to close the PP contracts. Early last fall all persons holding PP salinity contracts with UDAF were notified by mail that their agreements would terminate September 15, 2012. UACD field staff employed with salinity technical assistance funds attempted to meet with each agreement holder personally to close all existing contracts.

Progress: UDAF completed the first phase of its web based planning, data collection, and grant/contract management tool. The tool is now being used for planning, contracting, and data management. All of the PP contracts have been entered into the database making the database current. UDAF has also trained planners in field offices to use the software and is receiving contracts prepared using the new program.

Colorado State Conservation Board (CSCB)

Basin States Program (BSP): The BSP began in Colorado during FY 2012. The BSP is made available in the salinity control areas of Silt, Mesa, Grand Valley, Lower Gunnison, McElmo, and Mancos. The Bookcliff, Mesa, Delta, Shavano, Dolores, and Mancos Conservation Districts receive funds from the CSCB through the current agreement with Reclamation that will expire September 30, 2016.

The projects are planned, designed, and certified by NRCS or District employees based upon current NRCS Standards and Specifications. The applications are competitively screened and prepared by the NRCS. All applications meeting NRCS planning standards that result in an annualized cost per ton of less than $150 and that are also not eligible for EQIP are considered for funding depending upon funds available.

The Districts recommend and refer the application for approval to the CSCB BSP coordinator. Upon approval of the application, the Districts enter into a contract with the applicant for the irrigation and/or wildlife improvements based on the current NRCS payment rate. Technical assistance is provided by NRCS utilizing BSP funding. The CSCB is receiving funds from the NRCS for the Districts to provide additional technical assistance for program implementation. Implementation of the BSP follows EQIP procedures and guidelines as applicable.

Upon completion of the project, the NRCS certifies the installation, and the District provides a payment to the landowner or entity. CSCB provides payments to the Districts and periodically requests reimbursement from Reclamation for these payments. Each participant signs an operation and maintenance agreement to remain in effect for the life of the irrigation improvements installed. The participant is also required to perform proper Irrigation Water Management on the fields in which irrigation improvements were installed. Participants receive a financial incentive for performing Irrigation Water Management.

Progress: Reclamation provided $2,000,000 in funding to Colorado in the current agreement. $1,073,783 has been obligated in new BSP projects that when completed will result in salt control of 2,156 tons and treat and/or serve 611.5 acres at an average cost effectiveness of $51.37/ton. One wildlife-only project is planned for 2 acres of wildlife habitat replacement. Projects were competitively ranked through the NRCS EQIP ranking procedure in 2012.

CSCRB is currently working with the Colorado Parks and Wildlife to fund approximately 600 acres of wildlife improvements along the Colorado River in the Grand Valley for an estimated cost of about $800,000. The completion of this project would satisfy the remaining acres of habitat replacement required for the Grand Valley Salinity Unit.

Paradox Valley Unit

The Paradox Valley Unit was authorized for investigation and construction by the Salinity Control Act (Public Law 93-320) of 1974. The unit is located in southwestern Colorado along the Dolores River in the Paradox Valley, formed by a collapsed salt dome (Figure16).

Groundwater in the valley comes into contact with the top of the salt formation where it becomes nearly saturated with sodium chloride. Salinities have been measured in excess of 250,000 mg/L, by far the most concentrated source of salt in the Colorado River Basin. Groundwater then surfaces in the Dolores River.

The project continues to intercept and dispose of 100,000+ tons of salt annually (Figure 17). The pressure necessary to inject the brine into the disposal formation at 14,000 feet is increasing (Table 9). Modification of the facility to operate at a higher injection pressure to extend the life of the injection well was completed in 2009, but at the current rate of injection pressure increase, the current maximum pressure limit could be reached in 3 to 5 years or sooner.

Seismicity associated with the injection process varies with the frequency and magnitude being relatively low (Table 9).

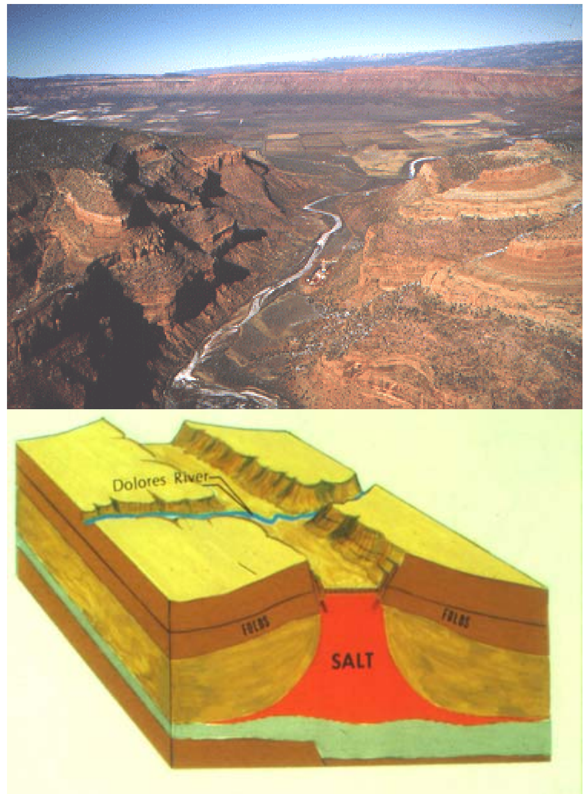

Figure 16 - Paradox Valley.

Modeling Salinity Without Paradox Unit

The CRSS model was used to estimate the impacts to the Colorado River system if all the salt from the PVU were to enter the river in a without PVU scenario. In summary, by 2030 salinity would increase by 9-10 mg/L at all three numeric criteria sites in the lower Colorado River, with or without the plan of implementation. The probability of exceeding the numeric criteria increases by 3% for the "without additional controls" scenario and by about 1 percent for the "with plan of implementation" scenario.

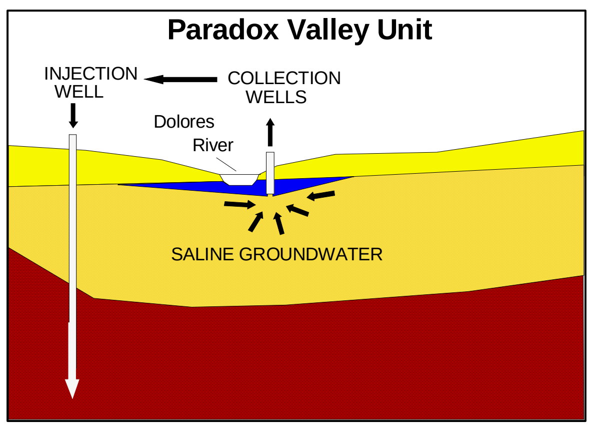

Figure 17 - Schematic of Paradox Project.

The CE-QUAL-W2 model of Lake Powell was used to assess the timing of increase in salinity below Glen Canyon Dam. If PVU ceased controlling salt then TDS would increase by 0.5 mg/L after one year, by 4.5 mg/L after two, and by 7 to 10 mg/L thereafter. Similar modeling for Lake Mead and Hoover Dam was not completed but it was estimated to take approximately another two years for the full increase in concentration to be realized below Hoover Dam. If PVU operations ceased, it would take approximately 4 years to see the full effects in the Lower Basin.

Table 9 - Paradox Well Injection Evaluation

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

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

The effects of losing PVU in the Colorado River upstream of Lake Powell and in the Dolores River were examined using historic river concentrations and PVU injection rates. In the Dolores River reach from Paradox Valley downstream to the first significant tributary, San Miguel River, the increase in TDS was estimated to be over 700 mg/L (2x increase in TDS for this reach). From the Dolores River at its confluence with the San Miguel downstream to the Colorado River the increase is estimated to be 237 mg/L. The increase in the concentration of the Colorado River from the confluence with the Dolores River to the confluence with the Green River is estimated to be 20 mg/L. While the increases in TDS in the Dolores River are significant no current water quality standards in Colorado or Utah would be violated.

Alternative Study

In its definite plan report (September 1978), Reclamation recommended that a series of wells be drilled on both sides of the Dolores River to intercept the brine before it reached the river. The brine would then be pumped to an evaporation pond in Dry Creek Basin. A draft environmental statement was prepared for this plan and made public on May 11, 1978; a final statement was filed with EPA on March 20, 1979. Due to the potential for environmental impacts, EPA recommended that Reclamation investigate deep-well injection as an alternative method of disposal. Now with potential issues with the salt injection well, this evaporation pond process is being reviewed.

At the request of the Salinity Control Forum, Reclamation began exploring and development of a pilot study to evaluate evaporation ponds as a viable method for salt disposal at Paradox. In 2012, Reclamation continued to have meetings and discussion with the BLM, Service, EPA, and Colorado Department of Public Health and Environment. Major issues continue to be compliance with the Migratory Bird Treaty Act, permitting requirements for disposal of the brine evaporate and pond liner, and high levels of hydrogen sulfide. Initial cost estimates are dependent on site selection and environmental regulatory requirements. Reclamation continues to work to find a suitable site for the pilot study and refine cost estimates. Implementation of the pilot study is also dependent on obtaining a land withdrawal from BLM

Reclamation also began the process of beginning an alternative study/environmental impact statement for alternatives to replace the existing injection well. A Notice of Intent was published in the Federal Register on September 10, 2012 and public scoping meetings were held in Paradox, Montrose, and Grand Junction on September 25-27, 2012. Reclamation will prepare a Scoping Summary Report for review in 2013.

Colorado River Basin Salinity Control Program Summary Data

The following tables summarize the salinity control program using the latest available data.

Table 10 – Summary of Federal Salinity Control Programs (2012)

Salinity Unit		Tons / Year Removed
MEASURES IN PLACE BY RECLAMATION		
Basinwide Program		206,600
Basin States Program	1/	12,200
Meeker Dome		48,000
Las Vegas Wash Pitman		3,800
Grand Valley		122,300
Paradox Valley	2/	112,100
Lower Gunnison Winter Water (USBR)		41,400
Dolores		23,000
Reclamation Subtotal		569,000
MEASURES IN PLACE BY USDA/BSP	3/	
Grand Valley		148,400
Price-San Rafael		88,600
Uinta Basin		149,700
Big Sandy River		56,800
Lower Gunnison		113,000
McElmo Creek		29,300
Mancos		4,300
Muddy Creek		100
Manila		81,000
Silt		2,100
Green River		200
Tier 2	4	5,500
USDA/BSP Subtotal		601,000
MEASURES IN PLACE BY BLM		
Nonpoint Sources	5/	111,600
Well-Plugging		14,600
BLM Subtotal		126,000
Measures in Place Total		1,296,000
GOALS TO REACH TARGET		
Reclamation Basinwide Program		336,900
Price-San Rafael (USDA/BSP)		58,300
Grand Valley (USDA/BSP)	6/	0
Uinta Basin (USDA/BSP)	7/	7,600
Big Sandy River (USDA/BSP)		26,900
Lower Gunnison (USDA/BSP)		73,000
McElmo Creek (USDA/BSP)		16,700
Mancos River (USDA/BSP)		7,600
Muddy Creek (USDA/BSP)		11,600
Manila (USDA/BSP)		9,300

Silt (USDA/BSP)	6/	1,900
Green River (USDA/BSP)		6,400
Tier 2 (USDA)	4/	14,500
New Well Plugging and Nonpoint Source (BLM)		0
Goals Subtotal		571,000
Target Total (Measures in Place + Goals)		1,867,000
Target by 2030		1,850,000

1/ Off-farm projects funded by Basin States Program
2/ Paradox injection well capacity estimated to decline beginning in 2020; assumed continuation of well or alternative control methods after 2020
3/ May include off-farm controls that were not goaled.
4/ Measures in areas outside approved projects.
5/ BLM non-point source are estimates.
6/ Original goal attained.
7/ Estimated; original goal attained.

Table 11 – Summary of Colorado River Basin Salinity Control Program Funding for Federal Agencies (In 1,000 Dollars)

Federal Fiscal Year	Bureau of Reclamation	USDA - NRCS	Upfront Cost Sharing from Basin Funds[1]	Bureau of Land Management[2]	Total
1988	20,783	3,804		500	25,087
1989	16,798	5,452		500	22,750
1990	14,185	10,341		700	25,226
1991	24,984	14,783		873	40,640
1992	34,566	14,783		873	50,222
1993	33,817	13,783		866	48,466
1994	32,962	13,783		800	47,545
1995	13,622	4,500		800	18,922
1996	17,420	9,561	0	800	27,781
1997	3,464	3,100	4,197	800	11,561
1998	12,306	2,894	5,749	800	21,749
1999	15,651	4,016	7,432	800	30,948
2000	16,637	3,805	16,372	800	37,614
2001	14,136	5,785	1,100	800	21,821
2002	14,944	10,451	8,196	800	34,391
2003	11,315	12,714	11,845	800	36,674
2004	12,409	19,488	13,064	800	45,761
2005	11,301	19,798	8,523	800	40,422
2006	11,953	19,661	14,465	751	46,830
2007	12,223	19,667	14,685	800	47,375
2008	11,630	17,611	12,184	800	42,225
2009	21,363	18,551	16,601	800	57,315
2010	12,015	14,697	7,405	800	34,917
2011	12,647	17,500	8,053	750	38,950
2012	11,932	12,400	7,000	850	32,182

1. Prior to 1996 Basin Funds were used to repay the reimbursable portion of Reclamation's Salinity Control Projects within a fifty-year period or within a period equal to the estimated life of the project, whichever is less.
2. Funds expended by BLM for salinity control cannot accurately be determined. This amount reflects what has been reported as having been designated within the BLM budget.

Table 12 – Reclamation Salinity Control Unit Summary (P.L. 93-320 and 98-569)

Unit/Study	Implementation	Controls (tons/y)	Reclamation Capital Cost	Annual O&M Costs	Cost per Ton[1]
Meeker Dome	1980-1983	48,000	$3,100,000	$0	$5
Las Vegas Wash	1978-1985	3,800	$1,757,000	$0	$28
Grand Valley	1980-1998	127,500	$160,900,000	$1,417,000	$83
Paradox Valley	1988-1996	110,000	$66,199,000	$2,497,000	$60
Dolores Project	1990-1996	23,000	$44,700,000	$613,000	$185
Lower Gunnison	1991-1995	41,380	$24,000,000	$0	$35
Total		353,680	$300,656,000	$4,016,000	$66

1. Cost per ton based on amortization over 50 years at the project authorized interest rate.

Table 13 - UCRB Agriculture Salinity Control Summary (tons) - 2012

Project Area	Total Salt Load	Total Ag. Load	Total Controls	Remaining Ag. Load
Big Sandy	157,500	124,900	69,081	55,819
Grand Valley	580,000	559,100	276,154	282,946
Green River	15,700	15,700	178	15,522
Lower Gunnison	1,440,000	840,000	178,744	661,256
Mancos	43,000	26,000	4,325	21,675
Manila	49,000	40,000	13,548	26,452
McElmo	164,075	99,960	53,242	46,718
Muddy Creek	90,000	14,980	61	14,919
Price-San Rafael	430,000	244,000	139,463	104,537
Rifle - Silt	NA	24,700	2,139	22,561
San Juan[1]	NA	62,530	48,329	14,201
Uinta	500,000	328,120	190,876	137,244
Paria (Tropic)[1,2]	NA	1,829	1,829	0
Tier 2-Unidentified[3]	NA	NA	5,457	
Total	3,469,275	2,381,819	983,426	1,403,850

1. Off-farm load shown only. On-farm loads have not been estimated for the San Juan and Paria areas
2. Agricultural load for Paria only represents the conveyance systems which were piped as part of the Tropic Project
3. Areas outside existing project boundaries.

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APPENDIX A

SALINITY MONITORING STATION INFORMATION

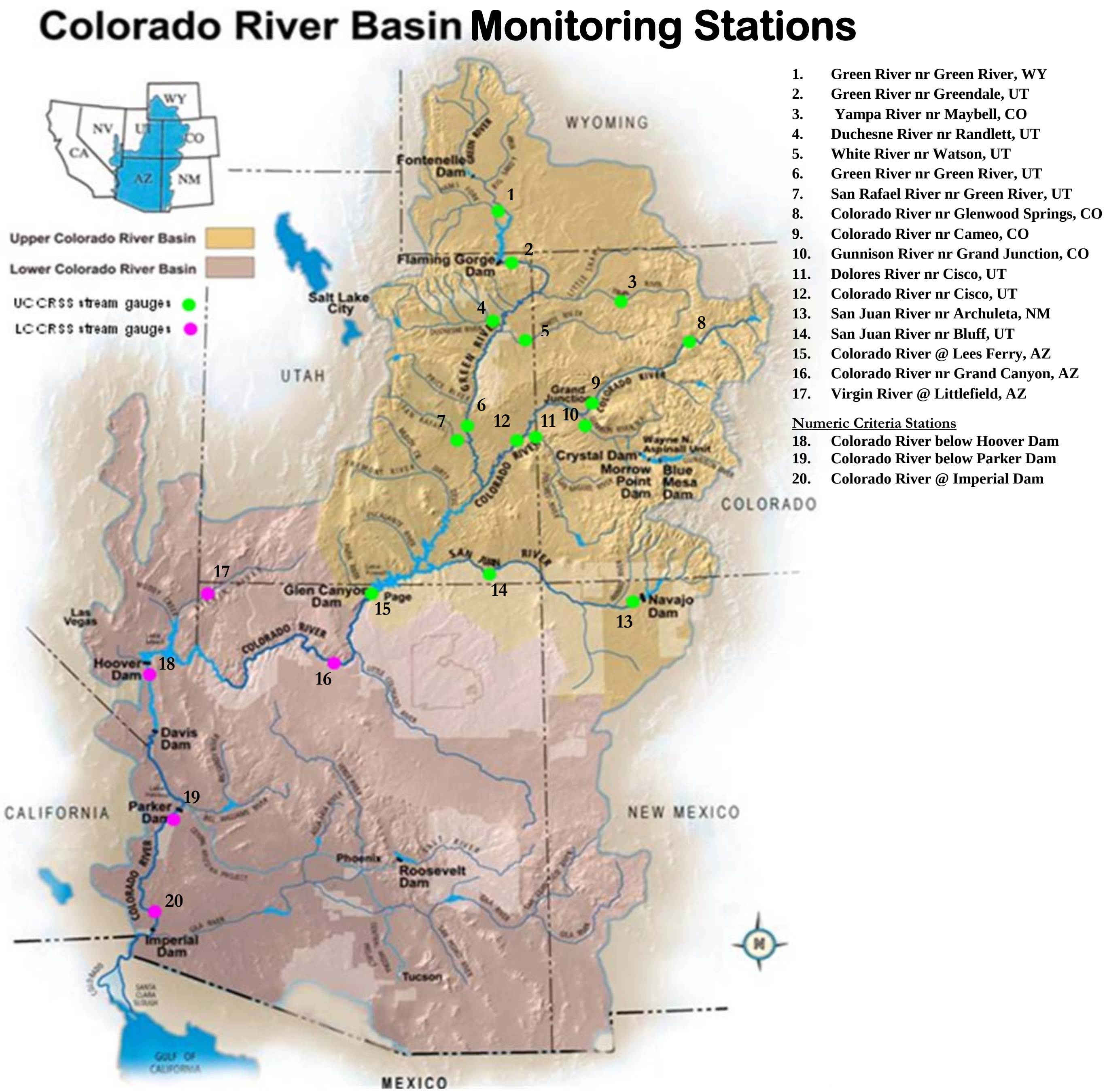
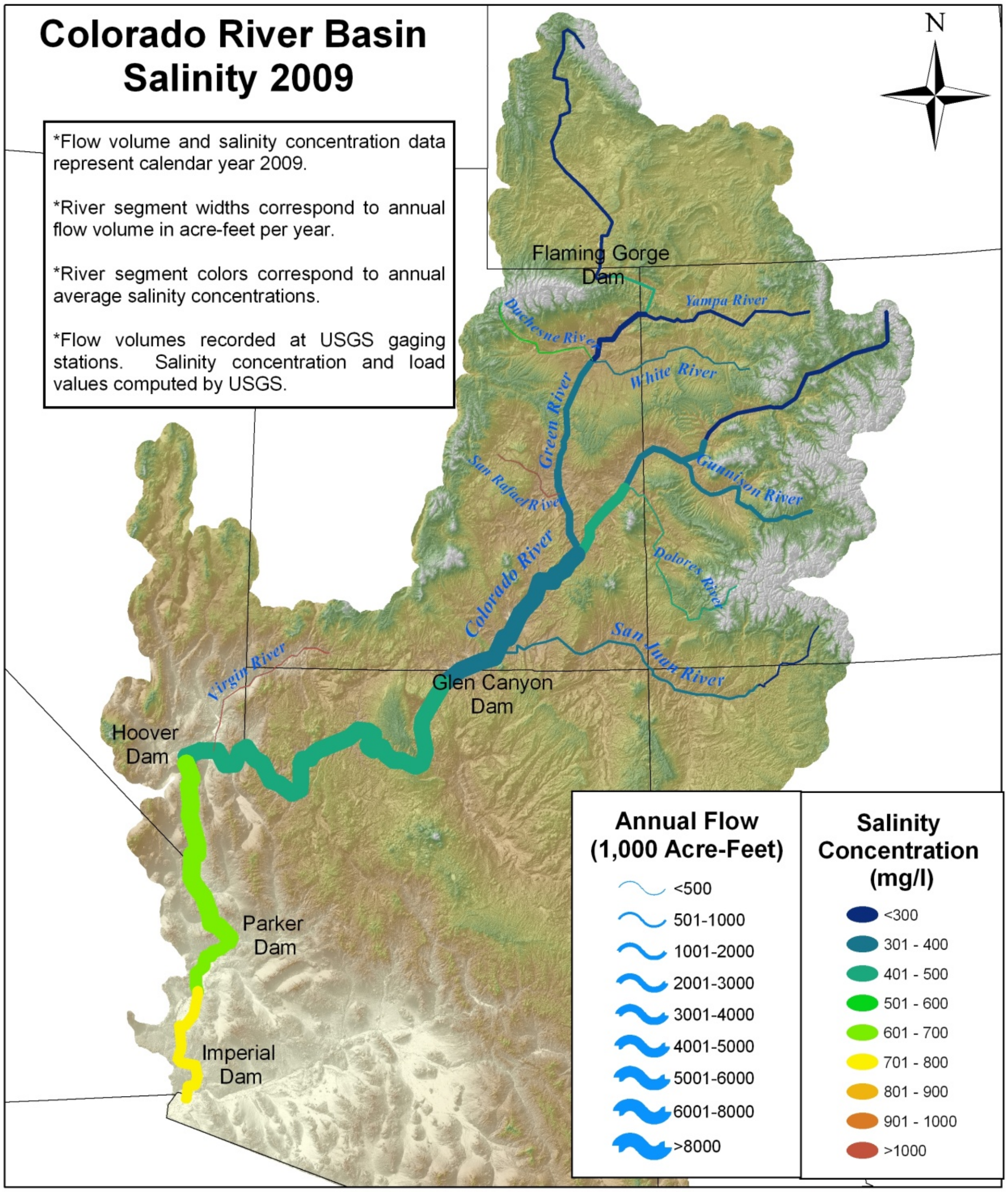


Figure A1 - Colorado River Water Quality Monitoring Stations.

Table A1. Characteristics of the 20 Salinity Streamflow-gaging Stations in the Colorado River Basin.
[NA, indicates not applicable; Latitude and Longitude datum: NAD83; Elevation datum: NGVD29.]

U.S. Geological Survey streamflow-gaging station number	U.S. Geological Survey streamflow-gaging station name	Site short name	Latitude, in decimal degrees	Longitude, in decimal degrees	Elevation, in feet above sea level	Drainage area, in square miles
09217000	Green River near Green River WY	GRWY	39.5589	-107.2909	5,760	4,556
09234500	Green River near Greendale, UT	GDALE	39.2391	-108.2662	4,814	7,986
09251000	Yampa River near Maybell, CO	YAMPA	38.9833	-108.4506	4,628	7,923
09302000	Duchesne River near Randlett, UT	DUCH	38.7972	-109.1951	4,165	4,580
09306500	White River near Watson, UT	WHITE	38.8105	-109.2934	4,090	24,100
09315000	Green River at Green River, UT	GRUT	41.5164	-109.4490	6,060	14,000
09328500	San Rafael River near Green River, UT	SANRAF	40.9083	-109.4229	5,594	19,350
09071750	Colorado River above Glenwood Springs, CO	GLEN	40.5027	-108.0334	5,900	3,383
09095500	Colorado River near Cameo, CO	CAMEO	40.2103	-109.7814	4,756	3,790
09152500	Gunnison River near Grand Junction, CO	GUNN	39.9789	-109.1787	4,947	4,020
09180000	Dolores River near Cisco, UT	DOLOR	38.9861	-110.1512	4,040	44,850
09180500	Colorado River near Cisco, UT	CISCO	38.8583	-110.3701	4,190	1,628
09355500	San Juan River near Archuleta, NM	ARCH	36.8019	-107.6986	5,653	3,260
09379500	San Juan River near Bluff, UT	BLUFF	37.1469	-109.8648	4,048	23,000
09380000	Colorado River at Lees Ferry, AZ	LEES	36.8647	-111.5882	3,106	111,800
09402500	Colorado River near Grand Canyon, AZ	GRCAN	36.1014	-112.0863	2,419	141,600
09415000	Virgin River at Littlefield, AZ	VIRGIN	36.8916	-113.9244	1,764	5,090
09421500	Colorado River below Hoover Dam, AZ-NV	HOOVER	36.0153	-114.7386	675	171,700
09427520	Colorado River below Parker Dam, AZ-CA	PARKER	34.2956	-114.1402	301	182,700
09429490	Colorado River above Imperial Dam, AZ-CA	IMPER	32.8837	-114.4674	183	188,500



RECLAMATION
Managing Water in the West

Figure A2 – Colorado River Flow and Salinity

APPENDIX B

SALT LOAD 2012 UPDATE FOR THE 20 STATIONS

(Updates calendar years 2008 through 2011)

STATION CLASSIFICATIONS

U.S. Geological Survey
Colorado Water Science Center
Western Colorado Office

September 17, 2012

INTRODUCTION

Methodology

Three Statistical Analyses System (SAS) computer programs, FLAGIT, DVCOND, and SLOAD are use to estimate dissolved-solids concentrations and loads from existing data. The program FLAGIT retrieves data from the daily-values (DV) file and water-quality file (QW) of the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE) (Hutchinson, 1975), examines the data, deletes incomplete observations, and flags possible errors in the remaining observations. FLAGIT also produces the data base used by the programs DVCOND and SLOAD. The program DVCOND fills in missing values in the daily specific-conductance record by linear interpolation. DVCOND needs to be used only when the flow at a streamflow-gaging station is extensively regulated.

The program SLOAD derives regression relations from water-quality data, modeling dissolved solids and six major ions as functions of specific conductance and discharge (Q). SLOAD then applies these relations to the daily specific conductance and discharge data and computes daily loads of dissolved solids and the other six major ions. The computed daily loads are summed by month and by year. Monthly and annual dissolved-solids and major ion concentrations are computed from the monthly and annual loads and streamflows. Monthly, annual, and seasonal concentrations and loads, in addition to regression statistics, are printed and saved on SAS data sets. Separate versions of SLOAD enable annual summation either by water year (WY) or calendar year (CY) (Lieberman and others, 1987).

The computerized method can be used for streamflow-gaging stations that have a complete record of DV Q and periodic QW analyses. The reliability of the estimate is considerably increased if DV specific conductance (SC) also is available. Water-quality analysis that includes total dissolved solids (TDS) with major ion analysis (also referred to as sum of constituents or SOC/SUM; herein referred to as SOC) is preferred over residue on evaporation at 180 degrees Celsius (ROE). SOC enables SLOAD calculations of the 8 major constituents normally present in natural streams: Calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), silica (Si), chloride (Cl^{-}), sulfate (SO_4^{2-}), and carbon, expressed as carbonate equivalent (Liebermann and others, 1987).

Classification Criteria

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

Types of Specific Conductivity

Specific Conductivity at the sites is classified into several types:

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

CLASS A

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

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

CLASS B

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

- There are fewer than 6 QW samples per WY which include some type of TDS.
- Daily Q (SLOAD allows no days with missing Q). Missing Q values may be interpolated from surrounding values.
- SC may be mean daily (with up to 60 missing days), seasonal, intermittent (more than 60 missing days), instantaneous from observers, or non-existant.

CLASS C

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

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

Improvements and Declines in Class

The classification is shown by year for each site in the tables. This is helpful to see the trend in classifications.

A judgment call must be made for the final year classification. The final year has incomplete data, and the data have not been finalized by USGS. The final year classification will be shown as "provisional" if the criteria for the class are being met as of the cutoff date for the data. For example, if sufficient QW records exist to suggest that 6 observations will be made by the end of the WY, and if daily SC is being recorded, then A (provisional) will be given. The pattern of QW observations for the previous years is taken to project the QW for the final year. The final year will not be shown as provisional if no daily SC is being recorded, (the class is clearly B), or, if no QW records are available, (the class is clearly C).

#1 GRWY - STATION 09217000 Green River near Green River, WY

Water Year	**2008**	**2009**	**2010**	**2011**	**2012 (thru 6-10)**
QW Observations	9	12	12	12	7 (thru 4-20)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Seasonal (144 missing)	Seasonal (124 missing)	Seasonal (118 missing)	Seasonal (136 missing)	Seasonal (127 missing)
TDS Method	9 ROE & SOC pairs (3 SOC missing)	12 ROE & SOC pairs (0 missing)	12 ROE & SOC pairs (0 missing)	12 ROE and SOC pairs (1 SOC missing)	7 ROE and SOC pairs (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes	Missing SC > 60/yr	Missing SC > 60/yr	Missing SC > 60/yr	Missing SC > 60/yr	Missing SC > 60/yr

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding sources: USGS NSIP $15,900 (streamflow), SC and period QW monitoring funding through Wyoming Landscape Conservancy Initiative – the amount and whether any of this funding is matched by USGS CWP funding has not been reported from Wyoming WSC yet.

#2 GDALE - STATION 09234500, Green River near Greendale, UT

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	0	0	0	0	0
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	None	None	None	None	None
Class by Year	**C**	**C**	**C**	**C**	**C**
Notes	No QW, No TDS	No QW, No TDS	No QW, No TDS	No QW, No TDS	No QW, No TDS

Daily Q only, no SC, no QW with TDS. Water quality data ended 08/30/2000. Due to insufficient data, SLOAD computations cannot be run for this station. Salt loads were calculated using a linear regression equation derived from old Q and TDS data (1/1990 through 8/2000.)

Operation is by USGS for daily Q. 2012 Funding Sources: USGS NSIP - $15,600 (streamflow), Continuous SC is monitored at the dam, upstream of the gage by USBR. In FY2013 USBR restarted funding for USGS to operate continuous SC at this gage.

#3 YAMPA – STATION 09251000, Yampa River near Maybell, CO

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	6	6	6	3 (thru 3-26)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (1 missing)	Daily (13 missing)	Daily (44 missing)	Daily (34 missing)	Daily (11 missing)
TDS Method	8 SOC (0 missing)	6 SOC (0 missing)	6 SOC (0 missing)	6 SOC (0 missing)	3 SOC (0 missing)
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $16,200 (streamflow), USGS CWP - $9,130 (QW), Col. Riv. Water District - $15,890 (QW), Local cooperator TDS Program - $1,420 (QW).

#4 DUCH – STATION 09302000, Duchesne River near Randlett, UT

Note class improvement for 2009.

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	9	11	8	8	5 (thru 4/10)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	No (366 missing)	Daily (23 missing)	Daily (5 missing)	Daily (59 missing)	Daily (0 missing)
TDS Method	9 SOC (0 missing)	9 SOC (2 missing)	8 ROE & SOC pairs (2 ROE missing)	8 ROE & SOC pairs (0 missing)	5 ROE & SOC pairs (0 missing)
Class by Year	**B**	**A**	**A**	**A**	**A (provisional)**
Notes	Missing SC > 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS CWP - $7,020 (streamflow), USGS CWP - $1,160 (QW), USBR - $14,770 (QW), Central Utah Water Con. District - $8,580 (streamflow), $1,420 (QW).

#5 WHITE – STATION 09306500, White River near Watson, Utah

Note decline number of QW samples in 2009-10.

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	8	8	8	6
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	6 ROE and 2 SOC (0 missing)	1 ROE & SOC pair, 7 SOC (0 missing)	8 ROE & SOC pairs (0 missing)	8 ROE & SOC pairs (0 missing)	6 ROE & SOC pairs (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes					

Operation is by USGS for daily Q and periodic QW. 2012 Funding Sources: USGS NSIP - $15,600 (Streamflow), USBR - $4,800 (QW).

#6 GRUT – STATION 09315000, Green River at Green River, UT

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	8	8	9	3 (thru 5/29)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	Partial (1/1 thru 3/31) from observer
TDS Method	8 SOC (0 missing)	1 ROE & SOC pair, 7 SOC (0 missing)	8 ROE & SOC pairs (0 missing)	9 ROE & SOC pairs (0 missing)	3 SOC (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes					

Operation is by USGS for daily Q and periodic QW. For SC, a sample bottle is collected once a day by an observer, and is measured in 30 day batches at the Moab office using a YSI handheld probe. 2012 Funding Sources: USGS NSIP - $15,600 (streamflow), USBR - $17,350.

#7 SANRAF – STATION 09328500, San Rafael River near Green River, UT

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	6	8	8	9	4 (thru 6/06)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	6 SOC (0 missing)	1 ROE & SOC pair, 6 SOC (0 missing)	7 ROE & SOC pairs, 1 ROE (0 missing)	9 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes					

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $15,600, USBR - $17,350 (QW)

#8 GLEN – STATION 09071750, Colorado River above Glenwood Springs, CO

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	6	6	6	4 (thru 6/7)
Daily Q	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)
SC	Daily (6 missing)	Daily (15 missing)	Daily (32 missing)	Daily (15 missing)	Daily (2 missing)
TDS Method	8 SOC (0 missing)	6 SOC (0 missing)	6 SOC (0 missing)	6 SOC (0 missing)	4 SOC (0 missing)
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Notes					

This station has an SC monitor but no stream gage. Flow is computed as the difference between station 09085100 (Colorado River below Glenwood Springs, CO) and station 09085000 (Roaring Fork River at Glenwood Springs, CO).

Operation is by USGS for estimated Q, daily SC and periodic QW. 2012 Funding Sources: USGS NSIP - $32,400 (streamflow), USBR - $24,360 (QW).

#9 CAMEO - STATION 09095500, Colorado River near Cameo, CO

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	5	5	4	5	3 (thru 5/09)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (0 missing)	Daily (36 missing)	Daily (34 missing)	Daily (38 missing)	Daily (25 missing)
TDS Method	5 SOC (0 missing)	5 SOC (0 missing)	4 SOC (0 missing)	5 SOC (0 missing)	3 SOC (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes	QW observations < 6	QW observations < 6	QW observations < 6	QW observations < 6	

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $16,200, USGS CWP - $1,150 (QW), Col.Water Riv. District - $1,993 (QW), USBR - $23,480 (QW).

#10 GUNN - STATION 09152500, Gunnison River near Grand Junction, CO

Note improvement in class for 2011.

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	5	5	5	7	5 (thru 5/258)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Intermittant (68 missing)	Daily (6 missing)	Daily (9 missing)	Daily (37 missing)	Daily (1 missing)
TDS Method	5 SOC (0 missing)	5 SOC (0 missing)	5 SOC (0 missing)	7 SOC (0 missing)	5 SOC (0 missing)
Class by Year	**B**	**B**	**B**	**A**	**A (provisional)**
Notes				QW samples > 6	

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $16,200 (streamflow), USGS CWP - $1,150 (QW), Col. Riv. Water District - $1,993 (QW), USBR - $31,860 (QW).

#11 DOLOR - STATION 09180000, Dolores River near Cisco, UT

Note improvement in class after 2008.

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	9	8	8	5 (thru 5-14)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Intermittent (64 missing)	Daily (13 missing)	Daily (12 missing)	Daily (29 missing)	Daily (4 missing)
TDS Method	8 SOC (0 missing)	7 SOC, 2 ROE & SOC pairs (0 missing)	8 ROE & SOC pairs (1 SOC missing)	8 ROE & SOC pairs (0 missing)	5 ROE & SOC pairs (0 missing)
Class by Year	**B**	**A**	**A**	**A**	**A (provisional)**
Notes	SC missing > 60				

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $15,600 (streamflow), USBR - $17,350 (QW).

#12 CISCO - STATION 09180500, Colorado River near Cisco, UT

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	6	9	8	8	4 (thru 5/16)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (26 missing)	Daily (7 missing)	Daily (13 missing)	Daily (2 missing)	Daily (7 missing)
TDS Method	6 SOC (0 missing)	7 SOC, 2 ROE & SOC pairs (0 missing)	8 ROE & SOC pairs (1 ROE missing)	8 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Notes					

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $15,600 (streamflow), USBR - $17,350 (QW).

#13 ARCH - STATION 09355500, San Juan River near Archuleta, NM

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	0	4	3	3	2
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	None	3 ROE & SOC pairs, 1 SOC (0 missing)	2 ROE, 1 ROE & SOC pair (0 missing)	1 ROE, 2 ROE & SOC pairs (0 missing)	1 ROE, 1 ROE & SOC pair (0 missing)
Class by Year	**C**	**B**	**B**	**B**	**B (provisional)**
Notes					

Due to insufficient data SLOAD computations cannot be run for this station. Salt loads were calculated using a linear regression equation derived from old Q and TDS data (1/1990 through 7/2007.) Due to improvements in QW observations starting in 2009, it may be possible to use SLOAD for the update in 2014.

Operation is by USGS for daily Q and periodic QW. 2012 Funding Sources: USGS CWP $7,218 (streamflow), USGS CWP $2,780 (QW), NM Interstate Stream Comm. - $13,062 (streamflow), NM Dept. of Ag - $$2780 (QW), USBR - $11,620 (QW).

#14 BLUFF - STATION 09379500, San Juan River near Bluff, UT

Note class improvement starting in 2009.

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	8	8	9	9	5 (thru 5/30)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Intermittant (70 missing)	Daily (12 missing)	Daily (9 missing)	Daily (6 missing)	Daily (2 missing)
TDS Method	8 SOC (0 missing)	6 SOC, 2 ROE & SOC pairs (0 missing)	9 ROE & SOC pairs (0 missing)	9 ROE & SOC pairs (0 missing)	5 ROE & SOC pairs (0 missing)
Class by Year	**B**	**A**	**A**	**A**	**A (provisional)**
Notes		Class improvement			

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $15,600 (streamflow), $17,350 (QW)

#15 LEES - STATION 09380000, Colorado River at Lees Ferry, AZ

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	4	4	4	4	3 (thru 2-14)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (0 missing)	Daily (23 missing)	Daily (16 missing)	Daily (0 missing)	Daily (2 missing)
TDS Method	4 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)	2 ROE & SOC pairs, 1 SOC (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes	QW observations < 6	QW observations < 6	QW observations < 6	QW observations < 6	

Operation is by USGS for daily Q, daily SC, and periodic QW. 2012 Funding Sources: USGS NSIP - $15,000 (streamflow), USBR-Boulder - $2,700 (streamflow), USBR/GCMRC - $15,000 (QW)

#16 GRCAN - STATION 09402500, Colorado River near Grand Canyon, AZ

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	None	None	None	None	None
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	None	None	None	None	None
Class by Year	**C**	**C**	**C**	**C**	**C**
Notes					

Daily Q only, no SC. There has been no water quality sampling since late 1980's. Salt loads are computed with a special version of SLOAD by using the load at station 09380000 (Colorado River at Lees Ferry, AZ) and the flow difference between the 2 stations.

Operation is by USGS for daily Q. 2012 Funding Sources: USBR Boulder - $23,700 (streamflow), USBR GCMRC - $$4,100 (streamflow).

#17 VIRGIN - STATION 09415000, Virgin River at Littlefield, AZ

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	4	4	2	4	2 (thru 3-15)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	4 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)	2 ROE & SOC pairs (0 missing)	4 ROE & SOC pairs (0 missing)	2 ROE & SOC pairs (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Notes	QC observations < 6	QC observations < 6	QC observations < 6	QC observations < 6	

Operation is by USGS for daily Q and periodic QW. 2012 Funding Sources: USGS CWP - $10,800 (streamflow), USGS CWP - $18,600 (QW), Southern Nevada Water Authority - $10,800 (streamflow), Southern Nevada Water Authority - $18,600 (QW). (Operated by USGS Nevada WSC)

#18 HOOVER – STATION 09421500, Colorado River below Hoover Dam, AZ-NV

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	14	14	12	15	10 (thru 5/23)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (1 missing)	Daily (0 missing)	Daily (3 missing)	Daily (11 missing)	Daily (51 missing)
TDS Method	13 ROE & SOC pairs. 1 ROE (0 missing)	14 ROE & SOC pairs (0 missing)	12 ROE & SOC pairs (0 missing)	15 ROE & SOC pairs (0 missing)	10 ROE & SOC pairs (0 missing)
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Notes	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data

Operation is by USGS for daily Q and periodic QW and by BOR for daily SC and periodic QW. 2012 Funding Sources: USGS CWP - $18,900 (QW), Southern Nevada Water Authority - $18,900 (QW).

#19 PARKER - STATION 09427520, Colorado River below Parker Dam, AZ-CA

Water Year	2008	2009	2010	2011	2012 (thru 6-10)
QW Observations	28	24	29	28	18 (thru 5/21)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
TDS Method	28 ROE & SOC pairs (0 missing)	24 ROE & SOC pairs (0 missing)	29 ROE & SOC pairs (0 missing)	28 ROE & SOC pairs (0 missing)	18 ROE & SOC pairs (0 missing)
Class by Year	**B**	**B**	**B**	**B**	**B**
Notes	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data

Operation is by USGS for daily Q and periodic QW and by BOR for periodic SC and periodic QW. 2012 Funding Source: USGS NSIP - $15,310 (streamflow), Metropolitin Water - $1,140 (streamflow, AZ DEQ - $10,000 (QW)

#20 IMPER - STATION 09429490, Colorado River above Imperial Dam, AZ-CA

Water Year	**2008**	**2009**	**2010**	**2011**	**2012 (thru 6-10)**
QW Observations	36	56	30	27	18 (thru 6/4)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)
TDS Method	14 ROE & SOC pairs, 22 ROE (0 missing)	4 ROE & SOC pairs, 52 ROE (0 missing)	4 ROE & SOC pairs, 26 ROE (0 missing)	4 ROE & SOC pairs, 23 ROE (0 missing)	2 ROE & SOC pairs, 16 ROE (0 missing)
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Notes	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data	Incl BOR data

Operation is by USGS for daily Q and quarterly QW and by BOR for daily SC and additional QW. 2012 Funding Sources: USGS NSIP - $16,450 (streamflow).

References

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

1. STATION 09217000 (GRWY) Green River near Green River, WY

STATION 09217000 Green River near Green River, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	33	9.1	0.0
2	2009	33	9.1	0.0
3	2010	36	2.8	0.0
4	2011	31	3.2	0.0
5	2012	31	3.2	0.0

STATION 09217000 Green River near Green River, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	33	0.89785	0.13462	1.85800	0.69252	30	0.99292	0.03788	-7.1797	0.97862	1.15325
2	Calcium	30	0.33606	0.13381	4.98663	-0.16617	27	0.81674	0.07287	-2.4239	0.06838	0.94480
3	Magnesium	30	0.51084	0.12572	4.29890	-0.22426	27	0.90736	0.05754	-3.1614	0.01044	0.95319
4	Chloride	30	0.48740	0.22210	4.04927	-0.37803	27	0.96462	0.06214	-10.1318	0.06328	1.81960
5	Sulfate	30	0.68508	0.20801	8.23544	-0.53553	27	0.98289	0.05171	-5.2378	-0.11599	1.72819
6	Carbonate	30	0.47489	0.08370	5.41086	-0.13893	27	0.84104	0.04827	0.8108	0.00619	0.58714
7	Sodium +K	30	0.73587	0.15896	6.59458	-0.46313	27	0.92803	0.08882	-2.3095	-0.18832	1.14604

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	33	0.89785	0.13462	1.85800	0.69252	30	0.99292	0.03788	-7.1797	0.97862	1.15325
9	Calcium	30	0.33606	0.13381	4.98663	-0.16617	27	0.81674	0.07287	-2.4239	0.06838	0.94480
10	Magnesium	30	0.51084	0.12572	4.29890	-0.22426	27	0.90736	0.05754	-3.1614	0.01044	0.95319
11	Chloride	30	0.48740	0.22210	4.04927	-0.37803	27	0.96462	0.06214	-10.1318	0.06328	1.81960
12	Sulfate	30	0.68508	0.20801	8.23544	-0.53553	27	0.98289	0.05171	-5.2378	-0.11599	1.72819
13	Carbonate	30	0.47489	0.08370	5.41086	-0.13893	27	0.84104	0.04827	0.8108	0.00619	0.58714
14	Sodium +K	30	0.73587	0.15896	6.59458	-0.46313	27	0.92803	0.08882	-2.3095	-0.18832	1.14604

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	36	0.89182	0.15724	1.36254	0.76702	33	0.99618	0.03119	-6.8111	0.98028	1.09061
16	Calcium	35	0.17748	0.15788	4.71935	-0.12312	32	0.87232	0.06509	-2.8640	0.07927	1.00535
17	Magnesium	35	0.32865	0.14498	3.96911	-0.17029	32	0.93188	0.04878	-3.2575	0.02054	0.96090
18	Chloride	35	0.31647	0.27269	3.66785	-0.31150	32	0.88851	0.11674	-9.3013	0.02551	1.73256
19	Sulfate	35	0.59617	0.22808	7.78828	-0.46522	32	0.97390	0.06128	-3.7854	-0.16182	1.54229
20	Carbonate	35	0.20336	0.11161	5.13144	-0.09466	32	0.84664	0.05175	-0.1445	0.04496	0.70110
21	Sodium +K	35	0.63575	0.18636	6.29213	-0.41331	32	0.92185	0.09149	-2.1923	-0.19488	1.13645

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	31	0.80230	0.15724	1.34406	0.77395	30	0.99396	0.02843	-6.7762	0.97039	1.09654
23	Calcium	30	0.09040	0.15738	4.72263	-0.11958	29	0.89010	0.05676	-3.0205	0.07221	1.03958
24	Magnesium	30	0.22283	0.13700	4.06372	-0.17680	29	0.94222	0.03877	-2.8493	-0.00578	0.92847
25	Chloride	30	0.20532	0.26875	3.85198	-0.32922	29	0.86117	0.11613	-8.8215	-0.01827	1.70591
26	Sulfate	30	0.42414	0.22941	7.89247	-0.47448	29	0.96073	0.06216	-3.6893	-0.18891	1.55689
27	Carbonate	30	0.04407	0.10963	4.88576	-0.05673	29	0.82796	0.04823	-0.3243	0.07256	0.69913
28	Sodium +K	30	0.46087	0.19617	6.48632	-0.43710	29	0.85790	0.10388	-2.1022	-0.22777	1.15812

2. STATION 09234500 (GDALE) Green River Near Greendale, UT, NO REGRESSION STATS

This site has daily Q only and no daily SC. Water quality sampling ended on 08/30/2000. Insufficient data for SLOAD computations. Salt loads were calculated using a linear regression equation derived from old data (01/1990 through 08/2000.) See spreadsheet gdale12regression.xlsx

3. STATION 09251000 (YAMPA) Yampa River near Maybell, CO

STATION 09251000 Yampa River near Maybell, CO UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	20	0.0	0.0
2	2009	20	0.0	0.0
3	2010	18	0.0	0.0
4	2011	15	0.0	0.0
5	2012	15	0.0	0.0

STATION 09251000 Yampa River near Maybell, CO UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	20	0.76611	0.51679	1.47379	0.72421	20	0.99858	0.04140	-7.05775	1.00882	1.09444
2	Calcium	20	0.33679	0.37483	4.91773	-0.20683	20	0.97866	0.06919	-1.18846	-0.00313	0.78331
3	Magnesium	20	0.29171	0.56153	4.72305	-0.27904	20	0.99498	0.04866	-4.54243	0.03005	1.18859
4	Chloride	20	0.65542	0.49871	5.81078	-0.53257	20	0.98341	0.11258	-2.24616	-0.26380	1.03355
5	Sulfate	20	0.23324	0.72612	6.53417	-0.31010	20	0.98916	0.08882	-5.40446	0.08817	1.53150
6	Carbonate	20	0.56138	0.29723	5.90401	-0.26038	20	0.96554	0.08572	1.17935	-0.10277	0.60609
7	Sodium +K	20	0.45151	0.58042	6.13109	-0.40777	20	0.99177	0.07315	-3.40775	-0.08955	1.22365

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	20	0.76611	0.51679	1.47379	0.72421	20	0.99858	0.04140	-7.05775	1.00882	1.09444
9	Calcium	20	0.33679	0.37483	4.91773	-0.20683	20	0.97866	0.06919	-1.18846	-0.00313	0.78331
10	Magnesium	20	0.29171	0.56153	4.72305	-0.27904	20	0.99498	0.04866	-4.54243	0.03005	1.18859
11	Chloride	20	0.65542	0.49871	5.81078	-0.53257	20	0.98341	0.11258	-2.24616	-0.26380	1.03355
12	Sulfate	20	0.23324	0.72612	6.53417	-0.31010	20	0.98916	0.08882	-5.40446	0.08817	1.53150
13	Carbonate	20	0.56138	0.29723	5.90401	-0.26038	20	0.96554	0.08572	1.17935	-0.10277	0.60609
14	Sodium +K	20	0.45151	0.58042	6.13109	-0.40777	20	0.99177	0.07315	-3.40775	-0.08955	1.22365

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	18	0.84945	0.39546	1.15001	0.77740	18	0.99895	0.03411	-7.31909	1.02027	1.12566
16	Calcium	18	0.32720	0.28539	4.67261	-0.16471	18	0.97454	0.05734	-1.34360	0.00783	0.79964
17	Magnesium	18	0.25815	0.43141	4.32099	-0.21061	18	0.98988	0.05205	-4.88703	0.05346	1.22387
18	Chloride	18	0.72764	0.34879	5.41399	-0.47180	18	0.98544	0.08329	-1.87875	-0.26266	0.96931
19	Sulfate	18	0.19921	0.56924	6.08418	-0.23496	18	0.98448	0.08184	-6.03030	0.11245	1.61018
20	Carbonate	18	0.53521	0.23631	5.60494	-0.20986	18	0.92485	0.09814	0.95505	-0.07651	0.61804
21	Sodium +K	18	0.48516	0.42440	5.67621	-0.34095	18	0.98493	0.07500	-3.31016	-0.08324	1.19441

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	15	0.90449	0.33536	0.76352	0.84345	15	0.99894	0.03675	-7.37448	1.02049	1.13459
23	Calcium	15	0.23745	0.23995	4.36738	-0.10943	15	0.92373	0.07899	-1.18739	0.01140	0.77444
24	Magnesium	15	0.18515	0.36694	3.94035	-0.14296	15	0.98195	0.05684	-4.91420	0.04966	1.23449
25	Chloride	15	0.73148	0.30287	5.03278	-0.40856	15	0.98280	0.07979	-2.11735	-0.25302	0.99686
26	Sulfate	15	0.11146	0.48962	5.53251	-0.14173	15	0.97137	0.09147	-6.22141	0.11396	1.63872
27	Carbonate	15	0.48433	0.20185	5.32293	-0.15988	15	0.83713	0.11807	1.24885	-0.07125	0.56800
28	Sodium +K	15	0.45283	0.36058	5.21474	-0.26810	15	0.98937	0.05231	-3.49846	-0.07855	1.21478

4. STATION 09302000 (DUCH) Duchesne River near Randlett, UT

STATION 09302000 Duchesne River near Randlett, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	26	0.0	0.0
2	2009	26	0.0	0.0
3	2010	25	0.0	0.0
4	2011	21	0.0	0.0
5	2012	21	0.0	0.0

STATION 09302000 Duchesne River near Randlett, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	26	0.82713	0.27536	2.85264	0.57299	25	0.99421	0.05010	-6.99656	1.01850	1.08150
2	Calcium	26	0.68560	0.22528	5.95298	-0.31648	25	0.97407	0.06753	-1.79775	0.03286	0.85222
3	Magnesium	26	0.66871	0.30175	5.87296	-0.40783	25	0.98129	0.07473	-4.89976	0.08147	1.18107
4	Chloride	26	0.78301	0.30361	6.53177	-0.54864	25	0.96435	0.12810	-3.46286	-0.09789	1.09869
5	Sulfate	26	0.70815	0.34748	8.30186	-0.51490	25	0.98832	0.07242	-4.15904	0.05022	1.36695
6	Carbonate	26	0.65480	0.20412	6.35715	-0.26744	25	0.91030	0.10854	-0.00349	0.01996	0.69872
7	Sodium +K	26	0.76147	0.31080	7.37390	-0.52826	25	0.97667	0.10126	-3.29603	-0.04645	1.17237

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	26	0.82713	0.27536	2.85264	0.57299	25	0.99421	0.05010	-6.99656	1.01850	1.08150
9	Calcium	26	0.68560	0.22528	5.95298	-0.31648	25	0.97407	0.06753	-1.79775	0.03286	0.85222
10	Magnesium	26	0.66871	0.30175	5.87296	-0.40783	25	0.98129	0.07473	-4.89976	0.08147	1.18107
11	Chloride	26	0.78301	0.30361	6.53177	-0.54864	25	0.96435	0.12810	-3.46286	-0.09789	1.09869
12	Sulfate	26	0.70815	0.34748	8.30186	-0.51490	25	0.98832	0.07242	-4.15904	0.05022	1.36695
13	Carbonate	26	0.65480	0.20412	6.35715	-0.26744	25	0.91030	0.10854	-0.00349	0.01996	0.69872
14	Sodium +K	26	0.76147	0.31080	7.37390	-0.52826	25	0.97667	0.10126	-3.29603	-0.04645	1.17237

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	25	0.89780	0.26014	2.75651	0.59377	24	0.99555	0.05332	-6.47475	0.98404	1.03146
16	Calcium	25	0.75567	0.21590	5.85102	-0.29239	24	0.98478	0.05610	-1.62750	0.02256	0.83686
17	Magnesium	25	0.71648	0.30171	5.70801	-0.36935	24	0.98765	0.06535	-5.15770	0.09293	1.21110
18	Chloride	25	0.83811	0.28794	6.30936	-0.50454	24	0.97339	0.12062	-3.23724	-0.10097	1.06672
19	Sulfate	25	0.83100	0.31058	8.37836	-0.53038	24	0.98127	0.10705	-2.16827	-0.08541	1.17936
20	Carbonate	25	0.64747	0.22387	6.20948	-0.23364	24	0.91694	0.11306	-0.96871	0.07109	0.80077
21	Sodium +K	25	0.83938	0.28574	7.25125	-0.50303	24	0.98507	0.09014	-2.54857	-0.08955	1.09583

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.89869	0.25314	2.56462	0.62536	20	0.99859	0.02808	-6.88066	0.99800	1.07928
23	Calcium	21	0.68108	0.21026	5.64607	-0.25486	20	0.95976	0.07750	-1.60853	0.02839	0.83205
24	Magnesium	21	0.64776	0.29331	5.48490	-0.32991	20	0.98729	0.05738	-5.51534	0.10877	1.25208
25	Chloride	21	0.80695	0.28141	6.14545	-0.47723	20	0.97540	0.10229	-3.73580	-0.08814	1.12989
26	Sulfate	21	0.79617	0.30770	8.22065	-0.50441	20	0.97766	0.10423	-2.56581	-0.08210	1.23592
27	Carbonate	21	0.55988	0.23372	6.13123	-0.21865	20	0.90471	0.11308	-1.71200	0.09189	0.89508
28	Sodium +K	21	0.80726	0.27541	7.01161	-0.46751	20	0.98954	0.06529	-3.07667	-0.06907	1.15232

5. STATION 09306500 (WHITE) White River near Watson, UT

STATION 09306500 White River near Watson, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	23	26.1	0.0
2	2009	23	26.1	0.0
3	2010	22	0.0	0.0
4	2011	20	0.0	0.0
5	2012	20	0.0	0.0

STATION 09306500 White River near Watson, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	23	0.92129	0.16870	1.77749	0.72504	22	0.96361	0.11985	-5.8983	0.99955	0.92996
2	Calcium	17	0.70785	0.09553	5.46765	-0.21484	17	0.81333	0.07904	1.7934	-0.08778	0.45042
3	Magnesium	17	0.71084	0.15321	5.24942	-0.34707	17	0.88188	0.10136	-2.2933	-0.08625	0.92466
4	Chloride	17	0.74437	0.25928	6.22128	-0.63926	17	0.91810	0.15191	-7.4608	-0.16613	1.67729
5	Sulfate	17	0.67842	0.25128	8.17862	-0.52733	17	0.88337	0.15664	-4.6620	-0.08331	1.57413
6	Carbonate	17	0.67986	0.08959	5.82456	-0.18863	17	0.78194	0.07653	2.5863	-0.07665	0.39698
7	Sodium +K	17	0.66243	0.28289	7.13379	-0.57256	17	0.91033	0.15092	-8.3840	-0.03596	1.90232

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	23	0.92129	0.16870	1.77749	0.72504	22	0.96361	0.11985	-5.8983	0.99955	0.92996
9	Calcium	17	0.70785	0.09553	5.46765	-0.21484	17	0.81333	0.07904	1.7934	-0.08778	0.45042
10	Magnesium	17	0.71084	0.15321	5.24942	-0.34707	17	0.88188	0.10136	-2.2933	-0.08625	0.92466
11	Chloride	17	0.74437	0.25928	6.22128	-0.63926	17	0.91810	0.15191	-7.4608	-0.16613	1.67729
12	Sulfate	17	0.67842	0.25128	8.17862	-0.52733	17	0.88337	0.15664	-4.6620	-0.08331	1.57413
13	Carbonate	17	0.67986	0.08959	5.82456	-0.18863	17	0.78194	0.07653	2.5863	-0.07665	0.39698
14	Sodium +K	17	0.66243	0.28289	7.13379	-0.57256	17	0.91033	0.15092	-8.3840	-0.03596	1.90232

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	22	0.90853	0.17687	1.89009	0.70812	22	0.97998	0.08489	-6.8822	0.99322	1.08852
16	Calcium	22	0.75162	0.09964	5.52915	-0.22019	22	0.87494	0.07254	1.5892	-0.09214	0.48889
17	Magnesium	22	0.62562	0.17844	4.94539	-0.29304	22	0.88611	0.10098	-3.4074	-0.02157	1.03646
18	Chloride	22	0.71169	0.28126	5.78176	-0.56137	22	0.93214	0.14000	-8.0196	-0.11282	1.71255
19	Sulfate	22	0.63989	0.27838	7.89352	-0.47141	22	0.91410	0.13949	-5.7385	-0.02837	1.69154
20	Carbonate	22	0.51863	0.10543	5.52826	-0.13902	22	0.73420	0.08038	1.5688	-0.01034	0.49131
21	Sodium +K	22	0.51917	0.33221	6.35404	-0.43853	22	0.90495	0.15155	-10.3449	0.10419	2.07210

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	20	0.92153	0.15837	1.69493	0.73806	20	0.99366	0.04631	-7.6621	1.00940	1.19520
23	Calcium	20	0.74345	0.09140	5.47378	-0.21160	20	0.90152	0.05827	1.0526	-0.08339	0.56473
24	Magnesium	20	0.56765	0.16638	4.72289	-0.25927	20	0.92721	0.07025	-4.6274	0.01188	1.19434
25	Chloride	20	0.66319	0.26817	5.46402	-0.51176	20	0.94555	0.11096	-9.6674	-0.07297	1.93278
26	Sulfate	20	0.61340	0.25003	7.61544	-0.42830	20	0.96459	0.07786	-7.0698	-0.00245	1.87579
27	Carbonate	20	0.46297	0.10077	5.45227	-0.12724	20	0.71271	0.07584	1.2174	-0.00444	0.54093
28	Sodium +K	20	0.45385	0.29624	5.89715	-0.36725	20	0.90117	0.12967	-10.6245	0.11185	2.11035

6. STATION 09315000 (GRUT) Green River at Green River, UT

STATION 09315000 Green River at Green River, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	18	0.0	0.0
2	2009	18	0.0	0.0
3	2010	23	0.0	0.0
4	2011	20	0.0	0.0
5	2012	20	0.0	0.0

STATION 09315000 Green River at Green River, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	18	0.77624	0.12945	4.6446	0.43999	18	0.98089	0.03907	-6.31529	0.97648	1.01957
2	Calcium	18	0.77965	0.12226	7.3778	-0.41970	18	0.94166	0.06497	-1.90334	0.03461	0.86340
3	Magnesium	18	0.78970	0.17031	7.9845	-0.60231	18	0.97788	0.05705	-6.27861	0.09587	1.32686
4	Chloride	18	0.88060	0.14441	8.7202	-0.71571	18	0.98539	0.05217	-3.25674	-0.12944	1.11419
5	Sulfate	18	0.84696	0.17291	11.0617	-0.74238	18	0.98836	0.04924	-3.65358	-0.02207	1.36892
6	Carbonate	18	0.66948	0.13569	7.4268	-0.35243	18	0.68934	0.13586	4.48193	-0.20828	0.27395
7	Sodium +K	18	0.87664	0.14108	9.5941	-0.68638	18	0.98897	0.04357	-2.32483	-0.10295	1.10878

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	18	0.77624	0.12945	4.6446	0.43999	18	0.98089	0.03907	-6.31529	0.97648	1.01957
9	Calcium	18	0.77965	0.12226	7.3778	-0.41970	18	0.94166	0.06497	-1.90334	0.03461	0.86340
10	Magnesium	18	0.78970	0.17031	7.9845	-0.60231	18	0.97788	0.05705	-6.27861	0.09587	1.32686
11	Chloride	18	0.88060	0.14441	8.7202	-0.71571	18	0.98539	0.05217	-3.25674	-0.12944	1.11419
12	Sulfate	18	0.84696	0.17291	11.0617	-0.74238	18	0.98836	0.04924	-3.65358	-0.02207	1.36892
13	Carbonate	18	0.66948	0.13569	7.4268	-0.35243	18	0.68934	0.13586	4.48193	-0.20828	0.27395
14	Sodium +K	18	0.87664	0.14108	9.5941	-0.68638	18	0.98897	0.04357	-2.32483	-0.10295	1.10878

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	23	0.93532	0.17145	2.7016	0.68708	23	0.99789	0.03171	-6.64977	0.99673	1.04559
16	Calcium	23	0.68483	0.15357	5.9764	-0.23856	23	0.95714	0.05803	-1.93950	0.02356	0.88509
17	Magnesium	23	0.58698	0.22990	5.5108	-0.28883	23	0.97647	0.05623	-6.86990	0.12113	1.38431
18	Chloride	23	0.84304	0.18661	6.7044	-0.45575	23	0.98249	0.06387	-3.04947	-0.13278	1.09060
19	Sulfate	23	0.75415	0.22615	8.5105	-0.41739	23	0.99422	0.03552	-3.88213	-0.00704	1.38564
20	Carbonate	23	0.60221	0.14776	6.1625	-0.19159	23	0.75312	0.11928	1.11535	-0.02447	0.56434
21	Sodium +K	23	0.80779	0.19005	7.4061	-0.41059	23	0.98646	0.05170	-2.75525	-0.07412	1.13616

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	20	0.93877	0.17100	2.5178	0.70918	20	0.99842	0.02827	-6.83286	1.00538	1.06155
23	Calcium	20	0.66526	0.14728	5.8290	-0.21990	20	0.95238	0.05716	-1.72795	0.01947	0.85792
24	Magnesium	20	0.54366	0.22537	5.2876	-0.26052	20	0.96938	0.06007	-6.77183	0.12147	1.36907
25	Chloride	20	0.83447	0.18579	6.6096	-0.44181	20	0.98018	0.06615	-3.04763	-0.13591	1.09635
26	Sulfate	20	0.72267	0.22625	8.2614	-0.38681	20	0.99055	0.04297	-4.05760	0.00341	1.39854
27	Carbonate	20	0.54456	0.15690	6.0767	-0.18171	20	0.72509	0.12544	0.60383	-0.00835	0.62132
28	Sodium +K	20	0.79647	0.18055	7.1207	-0.37828	20	0.98940	0.04239	-2.61827	-0.06979	1.10563

7. STATION 09328500, San Rafael River near Green River, UT

STATION 09328500 San Rafael River near Green River, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	21	4.8	0.0
2	2009	21	4.8	0.0
3	2010	24	4.2	0.0
4	2011	21	4.8	0.0
5	2012	21	4.8	0.0

STATION 09328500 San Rafael River near Green River, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	21	0.78861	0.27532	3.17694	0.57218	21	0.99483	0.04424	-6.82318	0.95724	1.10180
2	Calcium	20	0.75370	0.22321	6.69419	-0.42440	20	0.87800	0.16165	0.80749	-0.18831	0.64353
3	Magnesium	20	0.63252	0.30149	6.25602	-0.42991	20	0.91800	0.14655	-3.60870	-0.03427	1.07841
4	Chloride	20	0.76040	0.29730	6.04072	-0.57565	20	0.97835	0.09195	-4.48564	-0.15347	1.15074
5	Sulfate	20	0.67266	0.33497	8.89906	-0.52191	20	0.99206	0.05367	-3.38457	-0.02925	1.34285
6	Carbonate	20	0.08412	0.20847	5.24132	-0.06867	20	0.08427	0.21450	5.14365	-0.06475	0.01068
7	Sodium +K	20	0.56640	0.34958	7.15689	-0.43426	20	0.94202	0.13154	-4.92184	0.05018	1.32045

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	21	0.78861	0.27532	3.17694	0.57218	21	0.99483	0.04424	-6.82318	0.95724	1.10180
9	Calcium	20	0.75370	0.22321	6.69419	-0.42440	20	0.87800	0.16165	0.80749	-0.18831	0.64353
10	Magnesium	20	0.63252	0.30149	6.25602	-0.42991	20	0.91800	0.14655	-3.60870	-0.03427	1.07841
11	Chloride	20	0.76040	0.29730	6.04072	-0.57565	20	0.97835	0.09195	-4.48564	-0.15347	1.15074
12	Sulfate	20	0.67266	0.33497	8.89906	-0.52191	20	0.99206	0.05367	-3.38457	-0.02925	1.34285
13	Carbonate	20	0.08412	0.20847	5.24132	-0.06867	20	0.08427	0.21450	5.14365	-0.06475	0.01068
14	Sodium +K	20	0.56640	0.34958	7.15689	-0.43426	20	0.94202	0.13154	-4.92184	0.05018	1.32045

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	24	0.91322	0.27988	3.11073	0.60559	24	0.99652	0.05735	-7.77380	1.01978	1.19813
16	Calcium	23	0.63441	0.32537	6.33261	-0.28823	23	0.84332	0.21827	-3.57760	0.09738	1.08479
17	Magnesium	23	0.83678	0.26989	6.23758	-0.41094	23	0.94150	0.16556	-2.47312	-0.07200	0.95349
18	Chloride	23	0.86819	0.29047	5.85465	-0.50132	23	0.96023	0.16350	-3.92505	-0.12079	1.07051
19	Sulfate	23	0.77056	0.38078	8.76808	-0.46927	23	0.98423	0.10228	-6.03819	0.10684	1.62072
20	Carbonate	23	0.41809	0.25822	5.57393	-0.14719	23	0.46308	0.25417	8.46704	-0.25976	-0.31669
21	Sodium +K	23	0.85491	0.29744	7.35691	-0.48552	23	0.96539	0.14885	-3.10134	-0.07859	1.14478

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.89908	0.30280	3.13435	0.60646	21	0.99707	0.05299	-7.85383	1.02349	1.20737
23	Calcium	20	0.59906	0.34323	6.35369	-0.28647	20	0.83862	0.22407	-3.60498	0.10342	1.08568
24	Magnesium	20	0.80446	0.30530	6.32089	-0.42281	20	0.93289	0.18404	-2.96638	-0.05921	1.01248
25	Chloride	20	0.86183	0.30031	5.98010	-0.51212	20	0.96214	0.16176	-3.62452	-0.13610	1.04708
26	Sulfate	20	0.73878	0.40950	8.80841	-0.47023	20	0.98495	0.10113	-6.11349	0.11397	1.62676
27	Carbonate	20	0.42062	0.27274	5.63125	-0.15867	20	0.44871	0.27376	7.88536	-0.24692	-0.24574
28	Sodium +K	20	0.83420	0.32124	7.41855	-0.49200	20	0.96517	0.15151	-3.29837	-0.07243	1.16834

8. STATION 09071750 (GLEN) Colorado River above Glenwood Springs CO

STATION 09071750 Colorado River above Glenwood Springs, CO UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	20	0.0	0.0
2	2009	20	0.0	0.0
3	2010	18	0.0	0.0
4	2011	16	0.0	0.0
5	2012	16	0.0	0.0

STATION 09071750 Colorado River above Glenwood Springs, CO UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	20	0.96948	0.07697	3.6189	0.49123	20	0.99765	0.021958	-6.78092	1.01427	1.02902
2	Calcium	20	0.95210	0.06231	6.2100	-0.31456	20	0.98152	0.039823	-0.65685	0.03079	0.67944
3	Magnesium	20	0.86611	0.11718	4.8200	-0.33748	20	0.93875	0.081557	-7.31722	0.27293	1.20093
4	Chloride	20	0.98456	0.10836	11.4559	-0.97967	20	0.98970	0.091052	2.66069	-0.53734	0.87025
5	Sulfate	20	0.93933	0.10805	7.8025	-0.48140	20	0.98293	0.058979	-5.07689	0.16634	1.27436
6	Carbonate	20	0.87360	0.07511	5.7140	-0.22358	20	0.94686	0.050113	-2.32664	0.18080	0.79559
7	Sodium +K	20	0.98370	0.09346	9.9954	-0.82207	20	0.99088	0.071936	1.27268	-0.38338	0.86308

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	20	0.96948	0.07697	3.6189	0.49123	20	0.99765	0.021958	-6.78092	1.01427	1.02902
9	Calcium	20	0.95210	0.06231	6.2100	-0.31456	20	0.98152	0.039823	-0.65685	0.03079	0.67944
10	Magnesium	20	0.86611	0.11718	4.8200	-0.33748	20	0.93875	0.081557	-7.31722	0.27293	1.20093
11	Chloride	20	0.98456	0.10836	11.4559	-0.97967	20	0.98970	0.091052	2.66069	-0.53734	0.87025
12	Sulfate	20	0.93933	0.10805	7.8025	-0.48140	20	0.98293	0.058979	-5.07689	0.16634	1.27436
13	Carbonate	20	0.87360	0.07511	5.7140	-0.22358	20	0.94686	0.050113	-2.32664	0.18080	0.79559
14	Sodium +K	20	0.98370	0.09346	9.9954	-0.82207	20	0.99088	0.071936	1.27268	-0.38338	0.86308

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	18	0.96932	0.07460	3.7740	0.47372	18	0.99437	0.033020	-7.48367	1.05557	1.09275
16	Calcium	18	0.95600	0.06320	6.3518	-0.33279	18	0.97737	0.046813	-1.00421	0.04740	0.71402
17	Magnesium	18	0.89572	0.11153	5.0625	-0.36923	18	0.93641	0.089946	-6.57433	0.23221	1.12954
18	Chloride	18	0.97840	0.12513	11.2994	-0.95141	18	0.98857	0.094035	-3.03701	-0.21043	1.39158
19	Sulfate	18	0.96574	0.08377	7.9675	-0.50237	18	0.98688	0.053531	-3.02372	0.06571	1.06688
20	Carbonate	18	0.89084	0.07718	5.9166	-0.24906	18	0.95413	0.051669	-3.89939	0.25828	0.95280
21	Sodium +K	18	0.97673	0.11040	9.9317	-0.80798	18	0.98848	0.080244	-3.16796	-0.13092	1.27154

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	16	0.93389	0.10178	3.7644	0.47439	16	0.99383	0.032270	-8.22199	1.09714	1.15992
23	Calcium	16	0.88477	0.09931	6.4019	-0.34127	16	0.96622	0.055804	-3.92474	0.19525	0.99930
24	Magnesium	16	0.85575	0.12662	5.1427	-0.38244	16	0.94448	0.081519	-7.13908	0.25566	1.18851
25	Chloride	16	0.97258	0.12393	11.0598	-0.91530	16	0.98550	0.093515	0.53640	-0.36856	1.01835
26	Sulfate	16	0.89250	0.13715	7.8493	-0.49008	16	0.97366	0.070452	-6.88984	0.27569	1.42630
27	Carbonate	16	0.86366	0.08542	6.0483	-0.26662	16	0.95335	0.051856	-2.52073	0.17858	0.82922
28	Sodium +K	16	0.96491	0.11832	9.6520	-0.76945	16	0.98872	0.069608	-2.40322	-0.14312	1.16658

9. STATION 09095500 (CAMEO) Colorado River near Cameo, CO

STATION 09095500 Colorado River near Cameo, CO UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	14	0.0	0.0
2	2009	14	0.0	0.0
3	2010	14	0.0	0.0
4	2011	12	0.0	0.0
5	2012	12	0.0	0.0

STATION 09095500 Colorado River near Cameo, CO UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	14	0.96681	0.06639	5.0627	0.39782	14	0.99514	0.026530	-6.66857	1.00164	1.02668
2	Calcium	14	0.97769	0.04740	6.8771	-0.34835	14	0.98577	0.039535	1.42120	-0.06753	0.47748
3	Magnesium	14	0.93581	0.09368	5.8244	-0.39708	14	0.95831	0.078852	-4.78275	0.14888	0.92830
4	Chloride	14	0.98934	0.09497	12.8853	-1.01580	14	0.99493	0.068420	-0.26474	-0.33896	1.15084
5	Sulfate	14	0.98081	0.08037	9.6852	-0.63778	14	0.99330	0.049593	-2.71575	0.00051	1.08529
6	Carbonate	14	0.85885	0.08364	6.1535	-0.22903	14	0.88045	0.080393	-0.10378	0.09304	0.54761
7	Sodium +K	14	0.99022	0.07871	11.5208	-0.87921	14	0.99647	0.049357	-0.51833	-0.25955	1.05362

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	14	0.96681	0.06639	5.0627	0.39782	14	0.99514	0.026530	-6.66857	1.00164	1.02668
9	Calcium	14	0.97769	0.04740	6.8771	-0.34835	14	0.98577	0.039535	1.42120	-0.06753	0.47748
10	Magnesium	14	0.93581	0.09368	5.8244	-0.39708	14	0.95831	0.078852	-4.78275	0.14888	0.92830
11	Chloride	14	0.98934	0.09497	12.8853	-1.01580	14	0.99493	0.068420	-0.26474	-0.33896	1.15084
12	Sulfate	14	0.98081	0.08037	9.6852	-0.63778	14	0.99330	0.049593	-2.71575	0.00051	1.08529
13	Carbonate	14	0.85885	0.08364	6.1535	-0.22903	14	0.88045	0.080393	-0.10378	0.09304	0.54761
14	Sodium +K	14	0.99022	0.07871	11.5208	-0.87921	14	0.99647	0.049357	-0.51833	-0.25955	1.05362

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	14	0.98221	0.05192	5.1847	0.38460	14	0.99557	0.027046	-5.04707	0.91589	0.88735
16	Calcium	14	0.98273	0.05113	7.1496	-0.38457	14	0.98343	0.052311	4.80608	-0.26288	0.20324
17	Magnesium	14	0.98555	0.05459	6.2429	-0.44946	14	0.98745	0.053138	1.74400	-0.21586	0.39016
18	Chloride	14	0.98897	0.10394	12.6573	-0.98124	14	0.99531	0.070764	-5.26442	-0.05065	1.55426
19	Sulfate	14	0.98871	0.06963	9.7949	-0.64978	14	0.99477	0.049529	-1.79934	-0.04774	1.00551
20	Carbonate	14	0.97440	0.04615	6.5921	-0.28388	14	0.97579	0.046876	4.14842	-0.15699	0.21193
21	Sodium +K	14	0.99142	0.08230	11.5627	-0.88208	14	0.99540	0.062938	-1.18297	-0.22025	1.10537

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	12	0.95896	0.07619	5.2210	0.37765	12	0.99649	0.023499	-5.35006	0.93193	0.91285
23	Calcium	12	0.97729	0.05942	7.2461	-0.39973	12	0.98257	0.054875	3.08852	-0.18173	0.35902
24	Magnesium	12	0.98216	0.06129	6.3709	-0.46632	12	0.98636	0.056500	2.05788	-0.24017	0.37244
25	Chloride	12	0.98550	0.11605	12.6518	-0.98114	12	0.99547	0.068353	-1.31350	-0.24889	1.20596
26	Sulfate	12	0.97663	0.09909	9.8130	-0.65685	12	0.99530	0.046853	-3.03774	0.01696	1.10971
27	Carbonate	12	0.98653	0.03328	6.6515	-0.29205	12	0.98855	0.032336	4.78036	-0.19394	0.16158
28	Sodium +K	12	0.98966	0.08800	11.5458	-0.88268	12	0.99701	0.049890	0.78077	-0.31823	0.92960

10. STATION 09152500 (GUNN) Gunnison River near Grand Junction, CO

STATION 09152500 Gunnison River near Grand Junction, Co UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	15	0.0	0.0
2	2009	15	0.0	0.0
3	2010	17	0.0	0.0
4	2011	17	0.0	0.0
5	2012	17	0.0	0.0

STATION 09152500 Gunnison River near Grand Junction, Co UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	15	0.71131	0.19451	4.6604	0.42188	15	0.99489	0.02693	-6.95283	0.98442	1.11542
2	Calcium	15	0.70369	0.22099	7.9531	-0.47057	15	0.97042	0.07268	-4.67757	0.14125	1.21314
3	Magnesium	15	0.85937	0.17521	7.7851	-0.59848	15	0.97929	0.06999	-1.96157	-0.12636	0.93614
4	Chloride	15	0.90059	0.15537	6.8137	-0.64613	15	0.93143	0.13430	1.60021	-0.39359	0.50074
5	Sulfate	15	0.83706	0.24428	11.2737	-0.76502	15	0.99232	0.05520	-3.09087	-0.06921	1.37967
6	Carbonate	15	0.73688	0.13502	6.7231	-0.31222	15	0.90411	0.08484	0.23857	0.00189	0.62281
7	Sodium +K	15	0.86632	0.18817	8.7967	-0.66188	15	0.97075	0.09161	-1.22197	-0.17658	0.96226

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	15	0.71131	0.19451	4.6604	0.42188	15	0.99489	0.02693	-6.95283	0.98442	1.11542
9	Calcium	15	0.70369	0.22099	7.9531	-0.47057	15	0.97042	0.07268	-4.67757	0.14125	1.21314
10	Magnesium	15	0.85937	0.17521	7.7851	-0.59848	15	0.97929	0.06999	-1.96157	-0.12636	0.93614
11	Chloride	15	0.90059	0.15537	6.8137	-0.64613	15	0.93143	0.13430	1.60021	-0.39359	0.50074
12	Sulfate	15	0.83706	0.24428	11.2737	-0.76502	15	0.99232	0.05520	-3.09087	-0.06921	1.37967
13	Carbonate	15	0.73688	0.13502	6.7231	-0.31222	15	0.90411	0.08484	0.23857	0.00189	0.62281
14	Sodium +K	15	0.86632	0.18817	8.7967	-0.66188	15	0.97075	0.09161	-1.22197	-0.17658	0.96226

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	17	0.68657	0.21568	3.5710	0.57250	17	0.99400	0.03090	-6.78438	0.98444	1.09021
16	Calcium	17	0.36011	0.24092	6.9036	-0.32415	17	0.93744	0.07797	-4.19060	0.11718	1.16799
17	Magnesium	17	0.66000	0.19432	6.9777	-0.48558	17	0.96624	0.06338	-1.96297	-0.12992	0.94128
18	Chloride	17	0.83982	0.14485	6.4322	-0.59485	17	0.90321	0.11655	2.01459	-0.41912	0.46508
19	Sulfate	17	0.53117	0.26815	9.4293	-0.51192	17	0.98982	0.04089	-3.42888	-0.00042	1.35371
20	Carbonate	17	0.63628	0.13284	6.7603	-0.31512	17	0.85948	0.08547	1.71527	-0.11443	0.53114
21	Sodium +K	17	0.66577	0.21066	7.8561	-0.53324	17	0.93782	0.09405	-1.35774	-0.16671	0.97003

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	17	0.71795	0.19963	3.2612	0.60983	17	0.99109	0.03672	-6.56751	0.97242	1.07307
23	Calcium	17	0.30925	0.22158	6.5745	-0.28387	17	0.91767	0.07918	-3.82975	0.09994	1.13590
24	Magnesium	17	0.65543	0.17774	6.8422	-0.46936	17	0.95091	0.06944	-1.39259	-0.16558	0.89904
25	Chloride	17	0.81922	0.13517	6.0765	-0.55095	17	0.90978	0.09884	1.29016	-0.37438	0.52256
26	Sulfate	17	0.47299	0.25539	9.0238	-0.46326	17	0.98669	0.04201	-3.59150	0.00212	1.37730
27	Carbonate	17	0.69548	0.10897	6.7543	-0.31531	17	0.83923	0.08195	3.00864	-0.17713	0.40894
28	Sodium +K	17	0.62380	0.19289	7.3872	-0.47559	17	0.93653	0.08201	-1.41187	-0.15099	0.96065

11. STATION 09180000 (DOLOR) Dolores River near Cisco, UT

STATION 09180000 Dolores River near Cisco, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	23	4.3	0.0
2	2009	23	4.3	0.0
3	2010	25	4.0	0.0
4	2011	21	4.8	0.0
5	2012	21	4.8	0.0

STATION 09180000 Dolores River near Cisco, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	23	0.77776	0.29150	3.51376	0.47390	23	0.99355	0.05088	-5.99828	0.96697	0.96203
2	Calcium	22	0.76891	0.22137	6.32233	-0.34389	22	0.84545	0.18573	1.94579	-0.11917	0.44584
3	Magnesium	22	0.87761	0.21304	5.87470	-0.48585	22	0.95870	0.12698	-0.08228	-0.17998	0.60684
4	Chloride	22	0.74619	0.57642	9.56336	-0.84171	22	0.90555	0.36077	-6.12695	-0.03606	1.59838
5	Sulfate	22	0.79684	0.33428	8.34168	-0.56381	22	0.85453	0.29021	2.22256	-0.24961	0.62336
6	Carbonate	22	0.64243	0.14522	5.30976	-0.16577	22	0.71032	0.13410	3.13598	-0.05415	0.22144
7	Sodium +K	22	0.76507	0.46722	8.63561	-0.71806	22	0.94550	0.23087	-5.43046	0.00419	1.43292

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	23	0.77776	0.29150	3.51376	0.47390	23	0.99355	0.05088	-5.99828	0.96697	0.96203
9	Calcium	22	0.76891	0.22137	6.32233	-0.34389	22	0.84545	0.18573	1.94579	-0.11917	0.44584
10	Magnesium	22	0.87761	0.21304	5.87470	-0.48585	22	0.95870	0.12698	-0.08228	-0.17998	0.60684
11	Chloride	22	0.74619	0.57642	9.56336	-0.84171	22	0.90555	0.36077	-6.12695	-0.03606	1.59838
12	Sulfate	22	0.79684	0.33428	8.34168	-0.56381	22	0.85453	0.29021	2.22256	-0.24961	0.62336
13	Carbonate	22	0.64243	0.14522	5.30976	-0.16577	22	0.71032	0.13410	3.13598	-0.05415	0.22144
14	Sodium +K	22	0.76507	0.46722	8.63561	-0.71806	22	0.94550	0.23087	-5.43046	0.00419	1.43292

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	25	0.77801	0.26403	3.45492	0.48071	25	0.99165	0.05237	-5.96292	0.96708	0.95830
16	Calcium	24	0.72701	0.22134	6.31101	-0.34462	24	0.80167	0.19310	1.84651	-0.11622	0.45747
17	Magnesium	24	0.87797	0.19162	5.88152	-0.49039	24	0.94524	0.13139	0.39373	-0.20964	0.56233
18	Chloride	24	0.71563	0.53250	9.35103	-0.80595	24	0.88810	0.34190	-6.64495	0.01240	1.63910
19	Sulfate	24	0.75760	0.33540	8.35587	-0.56571	24	0.80975	0.30413	2.35535	-0.25873	0.61487
20	Carbonate	24	0.74778	0.11486	5.43042	-0.18869	24	0.76449	0.11360	4.28995	-0.13035	0.11686
21	Sodium +K	24	0.74029	0.42685	8.43517	-0.68756	24	0.93466	0.21913	-5.80837	0.04113	1.45953

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.71965	0.28160	3.68608	0.44419	21	0.99092	0.05208	-5.92463	0.96127	0.95840
23	Calcium	20	0.70518	0.23996	6.39675	-0.35783	20	0.80317	0.20175	1.36539	-0.09079	0.50662
24	Magnesium	20	0.87606	0.19566	5.95783	-0.50157	20	0.95326	0.12364	0.34167	-0.20350	0.56551
25	Chloride	20	0.71309	0.58960	9.88475	-0.89622	20	0.89469	0.36756	-7.17496	0.00920	1.71779
26	Sulfate	20	0.75273	0.34965	8.50090	-0.58820	20	0.82432	0.30326	1.65853	-0.22505	0.68898
27	Carbonate	20	0.87800	0.09183	5.74152	-0.23753	20	0.88781	0.09061	4.79442	-0.18726	0.09537
28	Sodium +K	20	0.73730	0.45819	8.74908	-0.74011	20	0.93592	0.23285	-5.74062	0.02892	1.45901

12. STATION 09180500 (CISCO) Colorado River near Cisco, UT

STATION 09180500 Colorado River near Cisco, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	22	0.0	0.0
2	2009	22	0.0	0.0
3	2010	24	0.0	0.0
4	2011	19	0.0	0.0
5	2012	19	0.0	0.0

STATION 09180500 Colorado River near Cisco, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	22	0.74565	0.11570	6.1889	0.32592	22	0.97842	0.03457	-7.1547	1.01326	1.09399
2	Calcium	22	0.79206	0.15350	8.6044	-0.49286	22	0.92220	0.09633	-6.0350	0.26123	1.20023
3	Magnesium	22	0.93540	0.10289	8.6716	-0.64415	22	0.98958	0.04240	-2.6885	-0.05898	0.93137
4	Chloride	22	0.91069	0.18505	12.6451	-0.97218	22	0.93322	0.16418	1.4411	-0.39506	0.91857
5	Sulfate	22	0.87621	0.17444	11.8645	-0.76353	22	0.95398	0.10912	-4.8039	0.09508	1.36658
6	Carbonate	22	0.71761	0.12486	7.2194	-0.32747	22	0.84136	0.09602	-2.7448	0.18580	0.81693
7	Sodium +K	22	0.93937	0.13173	11.6529	-0.85303	22	0.96202	0.10696	1.9454	-0.35298	0.79588

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	22	0.74565	0.11570	6.1889	0.32592	22	0.97842	0.03457	-7.1547	1.01326	1.09399
9	Calcium	22	0.79206	0.15350	8.6044	-0.49286	22	0.92220	0.09633	-6.0350	0.26123	1.20023
10	Magnesium	22	0.93540	0.10289	8.6716	-0.64415	22	0.98958	0.04240	-2.6885	-0.05898	0.93137
11	Chloride	22	0.91069	0.18505	12.6451	-0.97218	22	0.93322	0.16418	1.4411	-0.39506	0.91857
12	Sulfate	22	0.87621	0.17444	11.8645	-0.76353	22	0.95398	0.10912	-4.8039	0.09508	1.36658
13	Carbonate	22	0.71761	0.12486	7.2194	-0.32747	22	0.84136	0.09602	-2.7448	0.18580	0.81693
14	Sodium +K	22	0.93937	0.13173	11.6529	-0.85303	22	0.96202	0.10696	1.9454	-0.35298	0.79588

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	24	0.85581	0.09587	6.0441	0.34547	24	0.99060	0.02506	-6.8076	1.00227	1.05699
16	Calcium	24	0.82686	0.15172	8.5967	-0.49042	24	0.93515	0.09504	-8.0400	0.35983	1.36828
17	Magnesium	24	0.93835	0.10538	8.3772	-0.60809	24	0.98807	0.04745	-4.7440	0.06249	1.07916
18	Chloride	24	0.95793	0.13797	12.6973	-0.97384	24	0.95858	0.14012	10.3137	-0.85202	0.19604
19	Sulfate	24	0.88268	0.18446	11.7541	-0.74837	24	0.96584	0.10187	-9.7789	0.35211	1.77098
20	Carbonate	24	0.93076	0.05877	7.1668	-0.31873	24	0.95066	0.05078	2.7992	-0.09551	0.35921
21	Sodium +K	24	0.97392	0.09317	11.5832	-0.84209	24	0.97688	0.08977	7.2273	-0.61947	0.35824

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	19	0.82244	0.11553	5.7751	0.37434	19	0.99391	0.02205	-7.1290	1.02306	1.07849
23	Calcium	19	0.77203	0.16876	8.3791	-0.46756	19	0.92942	0.09679	-7.5585	0.33366	1.33201
24	Magnesium	19	0.90456	0.12613	8.1604	-0.58459	19	0.98572	0.05029	-5.0595	0.08000	1.10488
25	Chloride	19	0.95516	0.13646	12.4602	-0.94819	19	0.95745	0.13701	8.9518	-0.77182	0.29322
26	Sulfate	19	0.84457	0.20523	11.4873	-0.72024	19	0.97293	0.08828	-9.7111	0.34545	1.77169
27	Carbonate	19	0.93396	0.05520	7.1100	-0.31252	19	0.96575	0.04098	2.7569	-0.09369	0.36381
28	Sodium +K	19	0.97495	0.08451	11.1395	-0.79371	19	0.98405	0.06950	5.3489	-0.50261	0.48396

13. STATION 09355500 (ARCH) San Juan River near Archuleta, NM

Note: no QW samples were collected for this site in WY 2008. QW samples for this site were taken in WY 2006 and 2007, and starting again in WY 2009.
Because of the 3 year sliding method used by SLOAD, the missing 2008 QW data caused the SLOAD salt load results for WY 2008 to be unusable (very low value = 12).
The manual regression spreadsheet (arch12regression.xlsx) which was used for update 2010 was therefore used again for the 2012 update to manually compute salt loads for WY 2008-2011.
If the sampling program which started in WY 2009 continues, sufficient data should exist to compute accurate salt loads using SLOAD for update 2014.

The SLOAD regression statistics are included here for reference, despite the fact that they were not used for the published loads.

STATION 09355500 San Juan River near Archuleta, NM UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2009	10	10.0	0.0
2	2010	10	10.0	0.0
3	2011	8	25.0	0.0
4	2012	8	25.0	0.0

STATION 09355500 San Juan River near Archuleta, NM UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	10	0.99702	0.043156	-0.93831	1.00324	10	0.99724	0.044399	-2.28154	1.00211	0.24548
2	Calcium	9	0.02222	0.046991	3.28431	0.00859	9	0.22628	0.045151	0.80776	0.00436	0.45564
3	Magnesium	9	0.37162	0.036427	1.45983	0.03398	9	0.37791	0.039148	1.03917	0.03326	0.07739
4	Chloride	9	0.11659	0.062600	0.78469	0.02758	9	0.11755	0.067578	0.54636	0.02718	0.04385
5	Sulfate	9	0.03686	0.030666	3.67486	-0.00728	9	0.14604	0.031190	4.86598	-0.00524	-0.21915
6	Carbonate	9	0.18203	0.025626	3.77686	0.01466	9	0.51223	0.021374	5.65522	0.01787	-0.34558
7	Sodium +K	9	0.20304	0.048548	2.45968	0.02972	9	0.29562	0.049298	4.36867	0.03298	-0.35122

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	10	0.99702	0.043156	-0.93831	1.00324	10	0.99724	0.044399	-2.28154	1.00211	0.24548
9	Calcium	9	0.02222	0.046991	3.28431	0.00859	9	0.22628	0.045151	0.80776	0.00436	0.45564
10	Magnesium	9	0.37162	0.036427	1.45983	0.03398	9	0.37791	0.039148	1.03917	0.03326	0.07739
11	Chloride	9	0.11659	0.062600	0.78469	0.02758	9	0.11755	0.067578	0.54636	0.02718	0.04385
12	Sulfate	9	0.03686	0.030666	3.67486	-0.00728	9	0.14604	0.031190	4.86598	-0.00524	-0.21915
13	Carbonate	9	0.18203	0.025626	3.77686	0.01466	9	0.51223	0.021374	5.65522	0.01787	-0.34558
14	Sodium +K	9	0.20304	0.048548	2.45968	0.02972	9	0.29562	0.049298	4.36867	0.03298	-0.35122

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	8	0.99788	0.043054	-0.88697	0.99737	8	0.99922	0.028677	-8.09591	1.00784	1.29622
16	Calcium	6	0.02639	0.038286	3.29914	0.00609	6	0.44146	0.033484	-2.44094	0.00829	1.04098
17	Magnesium	6	0.73867	0.021264	1.45342	0.03454	6	0.73867	0.024553	1.46885	0.03454	-0.00280
18	Chloride	6	0.00221	0.049998	0.99468	0.00227	6	0.25895	0.049754	-4.82881	0.00451	1.05611
19	Sulfate	6	0.01894	0.033119	3.65823	-0.00445	6	0.09343	0.036762	1.56281	-0.00364	0.38001
20	Carbonate	6	0.41650	0.016093	3.79588	0.01314	6	0.41752	0.018566	3.94992	0.01308	-0.02793
21	Sodium +K	6	0.13244	0.063656	2.51233	0.02403	6	0.37126	0.062574	-5.15634	0.02698	1.39074

14. STATION 09379500 (BLUFF) San Juan River near Bluff, UT

STATION 09379500 San Juan River near Bluff, UT UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	23	0.0	0.0
2	2009	23	0.0	0.0
3	2010	24	0.0	0.0
4	2011	21	0.0	0.0
5	2012	21	0.0	0.0

STATION 09379500 San Juan River near Bluff, UT UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	23	0.66630	0.29334	2.94656	0.58275	23	0.99486	0.03731	-7.11909	0.99633	1.12060
2	Calcium	23	0.39941	0.27948	6.41598	-0.32041	23	0.88995	0.12259	-2.31828	0.03847	0.97238
3	Magnesium	23	0.58577	0.26623	5.77977	-0.44508	23	0.82093	0.17937	-1.15687	-0.16007	0.77225
4	Chloride	23	0.67747	0.28185	6.48655	-0.57429	23	0.95381	0.10930	-2.53528	-0.20359	1.00440
5	Sulfate	23	0.47090	0.39159	8.75215	-0.51937	23	0.98787	0.06076	-4.63327	0.03062	1.49019
6	Carbonate	23	0.66806	0.15266	6.40134	-0.30448	23	0.73336	0.14021	4.05981	-0.20827	0.26068
7	Sodium +K	23	0.53235	0.37893	7.63742	-0.56839	23	0.89912	0.18034	-3.96730	-0.09157	1.29195

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	23	0.66630	0.29334	2.94656	0.58275	23	0.99486	0.03731	-7.11909	0.99633	1.12060
9	Calcium	23	0.39941	0.27948	6.41598	-0.32041	23	0.88995	0.12259	-2.31828	0.03847	0.97238
10	Magnesium	23	0.58577	0.26623	5.77977	-0.44508	23	0.82093	0.17937	-1.15687	-0.16007	0.77225
11	Chloride	23	0.67747	0.28185	6.48655	-0.57429	23	0.95381	0.10930	-2.53528	-0.20359	1.00440
12	Sulfate	23	0.47090	0.39159	8.75215	-0.51937	23	0.98787	0.06076	-4.63327	0.03062	1.49019
13	Carbonate	23	0.66806	0.15266	6.40134	-0.30448	23	0.73336	0.14021	4.05981	-0.20827	0.26068
14	Sodium +K	23	0.53235	0.37893	7.63742	-0.56839	23	0.89912	0.18034	-3.96730	-0.09157	1.29195

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	24	0.54291	0.29211	2.83134	0.60330	24	0.99388	0.03459	-7.30646	1.01617	1.12948
16	Calcium	24	0.21148	0.27478	6.07738	-0.26968	24	0.87482	0.11206	-2.72847	0.08894	0.98109
17	Magnesium	24	0.51412	0.27336	6.40307	-0.53287	24	0.74918	0.20103	-0.24014	-0.26233	0.74014
18	Chloride	24	0.55402	0.28078	6.65888	-0.59307	24	0.93010	0.11378	-2.35019	-0.22617	1.00373
19	Sulfate	24	0.29977	0.38092	8.47989	-0.47233	24	0.99193	0.04185	-4.75275	0.06658	1.47429
20	Carbonate	24	0.66184	0.13039	6.65961	-0.34569	24	0.79920	0.10284	3.75608	-0.22744	0.32349
21	Sodium +K	24	0.38307	0.38716	7.73753	-0.57815	24	0.86522	0.18522	-4.22139	-0.09112	1.33238

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.62805	0.25623	1.59887	0.79109	21	0.99388	0.03376	-7.18531	0.99111	1.13855
23	Calcium	21	0.02711	0.25503	4.97261	-0.10116	21	0.78223	0.12397	-2.79415	0.07570	1.00668
24	Magnesium	21	0.27077	0.26691	5.43110	-0.38644	21	0.52978	0.22021	-0.06771	-0.26122	0.71272
25	Chloride	21	0.43004	0.20489	5.57377	-0.42285	21	0.88265	0.09551	-0.73763	-0.27914	0.81804
26	Sulfate	21	0.06617	0.32774	6.73482	-0.20729	21	0.98404	0.04403	-4.49739	0.04847	1.45584
27	Carbonate	21	0.56948	0.12844	6.69966	-0.35099	21	0.77040	0.09637	3.66650	-0.28192	0.39314
28	Sodium +K	21	0.13583	0.33504	6.02228	-0.31560	21	0.72470	0.19429	-3.53816	-0.09790	1.23916

15. STATION 09380000 (LEES) Colorado River at Lees Ferry, AZ

STATION 09380000 Colorado River at Lees Ferry, AZ UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	12	0.0	0.0
2	2009	12	0.0	0.0
3	2010	12	0.0	0.0
4	2011	11	0.0	0.0
5	2012	11	0.0	0.0

STATION 09380000 Colorado River at Lees Ferry, AZ UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	12	0.97376	0.06660	-0.74986	1.09785	12	0.99882	0.014902	-6.80822	1.01248	1.04104
2	Calcium	12	0.21259	0.07327	3.17293	0.10301	12	0.72648	0.045521	-2.33708	0.02537	0.94681
3	Magnesium	12	0.25935	0.05261	2.19803	0.08423	12	0.61764	0.039846	-1.20820	0.03624	0.58531
4	Chloride	12	0.14825	0.09918	2.67582	0.11196	12	0.76001	0.055496	-5.14861	0.00171	1.34451
5	Sulfate	12	0.23435	0.08274	4.00267	0.12385	12	0.94720	0.022902	-3.42869	0.01914	1.27696
6	Carbonate	12	0.09550	0.03058	4.13038	0.02689	12	0.63056	0.020601	1.94100	-0.00396	0.37621
7	Sodium +K	12	0.16154	0.08559	3.12042	0.10165	12	0.87002	0.035523	-4.20363	-0.00155	1.25852

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	12	0.97376	0.06660	-0.74986	1.09785	12	0.99882	0.014902	-6.80822	1.01248	1.04104
9	Calcium	12	0.21259	0.07327	3.17293	0.10301	12	0.72648	0.045521	-2.33708	0.02537	0.94681
10	Magnesium	12	0.25935	0.05261	2.19803	0.08423	12	0.61764	0.039846	-1.20820	0.03624	0.58531
11	Chloride	12	0.14825	0.09918	2.67582	0.11196	12	0.76001	0.055496	-5.14861	0.00171	1.34451
12	Sulfate	12	0.23435	0.08274	4.00267	0.12385	12	0.94720	0.022902	-3.42869	0.01914	1.27696
13	Carbonate	12	0.09550	0.03058	4.13038	0.02689	12	0.63056	0.020601	1.94100	-0.00396	0.37621
14	Sodium +K	12	0.16154	0.08559	3.12042	0.10165	12	0.87002	0.035523	-4.20363	-0.00155	1.25852

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	12	0.96702	0.05031	-0.15673	1.03311	12	0.99659	0.017051	-7.72330	1.02931	1.15681
16	Calcium	12	0.00915	0.05580	3.94689	0.02033	12	0.59099	0.037790	-2.84422	0.01692	1.03826
17	Magnesium	12	0.13111	0.03422	2.50827	0.05040	12	0.68779	0.021624	-1.84223	0.04822	0.66512
18	Chloride	12	0.00693	0.09948	3.42426	0.03151	12	0.68492	0.059066	-9.63019	0.02496	1.99583
19	Sulfate	12	0.05563	0.05288	4.68124	0.04866	12	0.85583	0.021780	-3.04975	0.04479	1.18195
20	Carbonate	12	0.07925	0.03036	4.70516	-0.03378	12	0.58088	0.021594	1.14581	-0.03556	0.54417
21	Sodium +K	12	0.09470	0.07130	3.22922	0.08743	12	0.88319	0.026996	-7.33825	0.08213	1.61560

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	11	0.89251	0.09244	0.28351	0.98462	11	0.99636	0.018050	-6.27778	1.00440	0.97468
23	Calcium	11	0.00351	0.08225	3.94077	0.01804	11	0.70982	0.047077	-1.05963	0.03312	0.74281
24	Magnesium	11	0.00010	0.05781	3.00701	-0.00210	11	0.84058	0.024482	-0.82015	0.00943	0.56852
25	Chloride	11	0.01787	0.17940	4.55211	-0.08945	11	0.96940	0.033586	-8.19942	-0.05101	1.89424
26	Sulfate	11	0.00033	0.11244	5.03520	0.00757	11	0.97462	0.019005	-2.98081	0.03173	1.19078
27	Carbonate	11	0.09970	0.03833	4.82974	-0.04715	11	0.79512	0.019396	2.39688	-0.03982	0.36140
28	Sodium +K	11	0.00006	0.12475	4.00605	0.00345	11	0.93153	0.034624	-4.68841	0.02966	1.29156

16. STATION 09402500 (GRCAN) Colorado River near Grand Canyon, AZ – NO REGRESSION STATS

No QW since late 1980's. Alternate method from Mueller calculates GRCAN load from Lees Ferry load and the flow difference between GRCAN and LEES. See no.15 STATION 09380000 (LEES) Colorado River at Lees Ferry, AZ

COLORADO RIVER NEAR GRAND CANYON-09402500- MONTHLY Q, LOAD, TDS DATA, JAN 2009-DECEMBER 2011

Obs	YEAR	MONTH	WMONTH	GCQ	GCLOAD	MTDS
16	2009	1	Jan	856,004	519,766	447
17	2009	2	Feb	651,350	444,304	502
18	2009	3	Mar	706,739	514,361	535
19	2009	4	Apr	654,548	478,810	538
20	2009	5	May	637,619	451,811	521
21	2009	6	Jun	706,119	474,189	494
22	2009	7	Jul	856,345	556,193	478

Obs	YEAR	MONTH	WMONTH	GCQ	GCLOAD	MTDS
23	2009	8	Aug	852,439	554,049	478
24	2009	9	Sep	641,436	430,431	494
25	2009	10	Oct	659,002	441,353	493
26	2009	11	Nov	724,479	464,116	471
27	2009	12	Dec	944,463	547,910	427
28	2010	1	Jan	966,158	551,831	420
29	2010	2	Feb	679,142	447,495	485
30	2010	3	Mar	670,935	484,356	531
31	2010	4	Apr	703,227	518,730	543
32	2010	5	May	647,749	465,964	529
33	2010	6	Jun	636,192	429,961	497
34	2010	7	Jul	852,635	547,679	472
35	2010	8	Aug	917,345	586,185	470
36	2010	9	Sep	533,721	360,483	497
37	2010	10	Oct	543,087	376,024	509
38	2010	11	Nov	840,643	546,872	478
39	2010	12	Dec	899,046	581,923	476
40	2011	1	Jan	1,036,542	652,517	463
41	2011	2	Feb	1,009,377	662,826	483
42	2011	3	Mar	1,088,747	763,138	516
43	2011	4	Apr	1,006,243	731,122	534
44	2011	5	May	1,211,860	835,743	507
45	2011	6	Jun	1,415,469	940,555	489
46	2011	7	Jul	1,533,417	1,001,864	481
47	2011	8	Aug	1,537,255	967,317	463
48	2011	9	Sep	998,567	627,771	462
49	2011	10	Oct	1,014,408	618,341	448
50	2011	11	Nov	1,127,689	662,007	432
51	2011	12	Dec	1,257,872	676,321	395

17. STATION 09415000 (VIRGIN) Virgin River at Littlefield, AZ

STATION 09415000 Virgin River at Littlefield, AZ UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	10	0.0	0.0
2	2009	10	0.0	0.0
3	2010	10	0.0	0.0
4	2011	8	0.0	0.0
5	2012	8	0.0	0.0

STATION 09415000 Virgin River at Littlefield, AZ UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	10	0.99224	0.02762	2.24450	0.89732	10	0.99570	0.02198	-4.1260	0.97891	0.74469
2	Calcium	10	0.75261	0.03421	6.46321	-0.17139	10	0.79162	0.03357	1.7725	-0.11131	0.54833
3	Magnesium	10	0.74465	0.03789	5.35507	-0.18584	10	0.78783	0.03692	-0.0246	-0.11694	0.62886
4	Chloride	10	0.05972	0.05935	5.72697	0.04296	10	0.33011	0.05355	-5.2615	0.18368	1.28451
5	Sulfate	10	0.85208	0.03886	8.07968	-0.26783	10	0.92488	0.02960	-1.3315	-0.14730	1.10013
6	Carbonate	10	0.28471	0.08687	4.33295	0.15740	10	0.32859	0.08997	11.7620	0.06226	-0.86843
7	Sodium +K	10	0.59254	0.04165	5.05647	0.14424	10	0.61571	0.04324	1.6275	0.18816	0.40083

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	10	0.99224	0.02762	2.24450	0.89732	10	0.99570	0.02198	-4.1260	0.97891	0.74469
9	Calcium	10	0.75261	0.03421	6.46321	-0.17139	10	0.79162	0.03357	1.7725	-0.11131	0.54833
10	Magnesium	10	0.74465	0.03789	5.35507	-0.18584	10	0.78783	0.03692	-0.0246	-0.11694	0.62886
11	Chloride	10	0.05972	0.05935	5.72697	0.04296	10	0.33011	0.05355	-5.2615	0.18368	1.28451
12	Sulfate	10	0.85208	0.03886	8.07968	-0.26783	10	0.92488	0.02960	-1.3315	-0.14730	1.10013
13	Carbonate	10	0.28471	0.08687	4.33295	0.15740	10	0.32859	0.08997	11.7620	0.06226	-0.86843
14	Sodium +K	10	0.59254	0.04165	5.05647	0.14424	10	0.61571	0.04324	1.6275	0.18816	0.40083

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	10	0.92601	0.08186	3.63992	0.59617	10	0.99510	0.02252	-7.8306	1.04566	1.16677
16	Calcium	10	0.85452	0.07453	7.35762	-0.37185	10	0.94446	0.04923	-1.1399	-0.03886	0.86436
17	Magnesium	10	0.90382	0.05094	5.97392	-0.32149	10	0.95203	0.03846	0.7440	-0.11655	0.53198
18	Chloride	10	0.78159	0.12804	8.27252	-0.49864	10	0.92994	0.07752	-7.0297	0.10101	1.55653
19	Sulfate	10	0.93230	0.06477	9.13761	-0.49483	10	0.98250	0.03520	1.0498	-0.17789	0.82269
20	Carbonate	10	0.00189	0.18174	4.92101	0.01628	10	0.63134	0.11808	-16.0073	0.83639	2.12881
21	Sodium +K	10	0.64896	0.13400	7.47620	-0.37509	10	0.93514	0.06158	-10.0685	0.31243	1.78463

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	8	0.91372	0.08490	3.81812	0.56255	6	0.99982	0.00525	-7.4043	1.01442	1.13348
23	Calcium	8	0.81271	0.08615	7.33125	-0.36538	6	0.93717	0.07005	-1.4813	-0.01794	0.89385
24	Magnesium	8	0.89131	0.05572	5.99481	-0.32484	6	0.95697	0.04887	-0.0502	-0.08230	0.61121
25	Chloride	8	0.86178	0.11502	8.72548	-0.58474	6	0.97618	0.06511	-3.5324	-0.09054	1.23700
26	Sulfate	8	0.93433	0.06823	9.29482	-0.52396	6	0.99512	0.02565	0.2422	-0.15655	0.91306
27	Carbonate	8	0.01516	0.20071	4.73992	0.05071	6	0.71324	0.14640	-18.6706	0.98790	2.36786
28	Sodium +K	8	0.79202	0.11260	7.84869	-0.44735	6	0.98898	0.03578	-6.2847	0.11920	1.42860

18. STATION 09421500 (HOOVER) Colorado River below Hoover Dam, AZ-NV

STATION 09421500 Colorado River below Hoover Dam, AZ UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	39	0.0	0.0
2	2009	39	0.0	0.0
3	2010	40	0.0	0.0
4	2011	37	0.0	0.0
5	2012	37	0.0	0.0

STATION 09421500 Colorado River below Hoover Dam, AZ UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	39	0.99035	0.040140	0.59336	0.98994	39	0.99737	0.021261	-5.35045	0.99073	0.86071
2	Calcium	39	0.01254	0.047268	4.47141	-0.01297	39	0.28619	0.040742	0.15013	-0.01239	0.62575
3	Magnesium	39	0.00232	0.091012	3.38639	-0.01068	39	0.36545	0.073584	-6.14909	-0.00942	1.38081
4	Chloride	39	0.01032	0.050545	4.54602	-0.01257	39	0.52056	0.035665	-1.75662	-0.01173	0.91267
5	Sulfate	39	0.00002	0.052863	5.46705	-0.00053	39	0.77906	0.025191	-2.63590	0.00054	1.17337
6	Carbonate	39	0.00521	0.031364	4.47747	-0.00553	39	0.19840	0.028542	2.07721	-0.00521	0.34758
7	Sodium +K	39	0.05537	0.051780	4.84289	-0.03051	39	0.23582	0.047215	0.91265	-0.02999	0.56913

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	39	0.99035	0.040140	0.59336	0.98994	39	0.99737	0.021261	-5.35045	0.99073	0.86071
9	Calcium	39	0.01254	0.047268	4.47141	-0.01297	39	0.28619	0.040742	0.15013	-0.01239	0.62575
10	Magnesium	39	0.00232	0.091012	3.38639	-0.01068	39	0.36545	0.073584	-6.14909	-0.00942	1.38081
11	Chloride	39	0.01032	0.050545	4.54602	-0.01257	39	0.52056	0.035665	-1.75662	-0.01173	0.91267
12	Sulfate	39	0.00002	0.052863	5.46705	-0.00053	39	0.77906	0.025191	-2.63590	0.00054	1.17337
13	Carbonate	39	0.00521	0.031364	4.47747	-0.00553	39	0.19840	0.028542	2.07721	-0.00521	0.34758
14	Sodium +K	39	0.05537	0.051780	4.84289	-0.03051	39	0.23582	0.047215	0.91265	-0.02999	0.56913

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	40	0.98615	0.045296	0.67247	0.97798	40	0.99222	0.034392	-5.81572	0.98498	0.93513
16	Calcium	40	0.00077	0.060921	4.36394	-0.00433	40	0.29361	0.051910	-2.76848	0.00337	1.02798
17	Magnesium	40	0.00590	0.070169	3.37055	-0.01383	40	0.20286	0.063678	-3.38420	-0.00654	0.97355
18	Chloride	40	0.03002	0.047456	4.59704	-0.02136	40	0.31570	0.040395	-0.97279	-0.01535	0.80277
19	Sulfate	40	0.02201	0.069480	5.66875	-0.02668	40	0.40747	0.054807	-3.76473	-0.01649	1.35963
20	Carbonate	40	0.00793	0.026707	4.47290	-0.00611	40	0.08175	0.026039	2.89739	-0.00441	0.22707
21	Sodium +K	40	0.07696	0.060765	4.94427	-0.04490	40	0.17398	0.058255	0.68378	-0.04030	0.61406

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	37	0.99320	0.038850	0.55166	0.98788	36	0.99459	0.035665	-3.90892	0.98520	0.65566
23	Calcium	37	0.00046	0.051289	4.32410	-0.00231	36	0.01477	0.052224	2.77970	-0.00361	0.22740
24	Magnesium	37	0.00055	0.052098	3.23358	-0.00257	36	0.00298	0.053587	3.88839	-0.00214	-0.09630
25	Chloride	37	0.00075	0.045330	4.38794	-0.00262	36	0.24139	0.040668	-1.26986	-0.00610	0.83173
26	Sulfate	37	0.01480	0.060564	5.52729	-0.01562	36	0.16654	0.057326	-0.52014	-0.01927	0.88893
27	Carbonate	37	0.00059	0.043751	4.43636	-0.00223	36	0.00840	0.044868	5.42176	-0.00155	-0.14494
28	Sodium +K	37	0.05196	0.068714	4.80861	-0.03386	36	0.30823	0.060013	-4.23450	-0.03897	1.32891

19. STATION 09427520 (PARKER) Colorado River below Parker Dam, AZ-CA

STATION 09427520 Colorado River below Parker Dam, AZ UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	81	0.0	0.0
2	2009	81	0.0	0.0
3	2010	81	0.0	0.0
4	2011	75	0.0	0.0
5	2012	75	0.0	0.0

STATION 09427520 Colorado River below Parker Dam, AZ UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	81	0.99474	0.039218	0.58160	0.99384	81	0.99804	0.024067	-5.78481	0.99589	0.91687
2	Calcium	81	0.01208	0.056721	4.22505	0.01156	81	0.27230	0.048992	-1.73744	0.01347	0.85870
3	Magnesium	81	0.00690	0.092536	3.46413	-0.01422	81	0.49759	0.066239	-9.85848	-0.00993	1.91869
4	Chloride	81	0.00132	0.050325	4.51549	-0.00337	81	0.38714	0.039675	-1.89128	-0.00131	0.92269
5	Sulfate	81	0.00303	0.050419	5.55281	-0.00513	81	0.59542	0.032324	-2.40753	-0.00257	1.14643
6	Carbonate	81	0.00279	0.035927	4.36534	0.00350	81	0.17494	0.032888	1.30793	0.00449	0.44032
7	Sodium +K	81	0.11282	0.050874	4.91004	-0.03343	81	0.18461	0.049085	1.94604	-0.03248	0.42687

2009

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	81	0.99474	0.039218	0.58160	0.99384	81	0.99804	0.024067	-5.78481	0.99589	0.91687
9	Calcium	81	0.01208	0.056721	4.22505	0.01156	81	0.27230	0.048992	-1.73744	0.01347	0.85870
10	Magnesium	81	0.00690	0.092536	3.46413	-0.01422	81	0.49759	0.066239	-9.85848	-0.00993	1.91869
11	Chloride	81	0.00132	0.050325	4.51549	-0.00337	81	0.38714	0.039675	-1.89128	-0.00131	0.92269
12	Sulfate	81	0.00303	0.050419	5.55281	-0.00513	81	0.59542	0.032324	-2.40753	-0.00257	1.14643
13	Carbonate	81	0.00279	0.035927	4.36534	0.00350	81	0.17494	0.032888	1.30793	0.00449	0.44032
14	Sodium +K	81	0.11282	0.050874	4.91004	-0.03343	81	0.18461	0.049085	1.94604	-0.03248	0.42687

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	81	0.98864	0.044529	0.55570	0.99282	81	0.99583	0.027150	-7.88084	1.00310	1.21063
16	Calcium	81	0.04809	0.061740	4.00742	0.03316	81	0.49714	0.045160	-6.09113	0.04546	1.44913
17	Magnesium	81	0.06930	0.070970	3.69810	-0.04628	81	0.44861	0.054975	-7.09172	-0.03313	1.54833
18	Chloride	81	0.00694	0.048452	4.54170	-0.00968	81	0.21307	0.043407	-0.71530	-0.00327	0.75437
19	Sulfate	81	0.00767	0.063298	5.57736	-0.01330	81	0.55905	0.042464	-5.65922	0.00039	1.61244
20	Carbonate	81	0.05255	0.028688	4.24545	0.01615	81	0.06169	0.028732	3.57457	0.01696	0.09627
21	Sodium +K	81	0.07541	0.060394	4.94778	-0.04122	81	0.36710	0.050287	-3.13064	-0.03137	1.15924

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	75	0.99366	0.033669	0.50404	0.99570	75	0.99574	0.027769	-6.08101	1.00451	0.94679
23	Calcium	75	0.04648	0.049099	4.05899	0.02561	75	0.07705	0.048640	1.06141	0.02963	0.43099
24	Magnesium	75	0.10203	0.059491	3.67510	-0.04739	75	0.15804	0.058004	-1.39067	-0.04061	0.72835
25	Chloride	75	0.00070	0.044878	4.45566	-0.00280	75	0.05771	0.043880	0.80102	0.00209	0.52546
26	Sulfate	75	0.00124	0.051726	5.45748	-0.00432	75	0.28967	0.043925	-4.02002	0.00837	1.36267
27	Carbonate	75	0.05698	0.030842	4.23400	0.01792	75	0.10713	0.030218	6.65894	0.01467	-0.34866
28	Sodium +K	75	0.05608	0.061324	4.86620	-0.03532	75	0.36292	0.050728	-7.05492	-0.01937	1.71401

20. STATION 09429490 (IMPER) Colorado River above Imperial Dam, AZ-CA

STATION 09429490 Colorado River above Imperial Dam, AZ UPDATE 2012
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2008	122	0.0	0.0
2	2009	122	0.0	0.0
3	2010	113	0.0	0.0
4	2011	74	0.0	0.0
5	2012	74	0.0	0.0

STATION 09429490 Colorado River above Imperial Dam, AZ UPDATE 2012
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

2008

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	122	0.96696	0.043285	1.75685	0.87780	122	0.98722	0.027032	-5.43980	0.99096	0.87572
2	Calcium	122	0.14503	0.056468	5.20661	-0.08718	122	0.31378	0.050801	-0.11973	-0.00342	0.64813
3	Magnesium	122	0.04985	0.089912	4.11846	-0.07720	122	0.36982	0.073531	-6.95946	0.09699	1.34801
4	Chloride	122	0.42289	0.055622	6.27387	-0.17848	122	0.74637	0.037028	-2.56759	-0.03945	1.07587
5	Sulfate	122	0.24441	0.047309	6.53250	-0.10086	122	0.61262	0.034016	-0.47921	0.00940	0.85322
6	Carbonate	122	0.43648	0.031159	5.43525	-0.10279	122	0.75320	0.020707	0.47554	-0.02480	0.60352
7	Sodium +K	122	0.40693	0.058836	6.41807	-0.18268	122	0.58218	0.049590	-0.37242	-0.07591	0.82630

2009

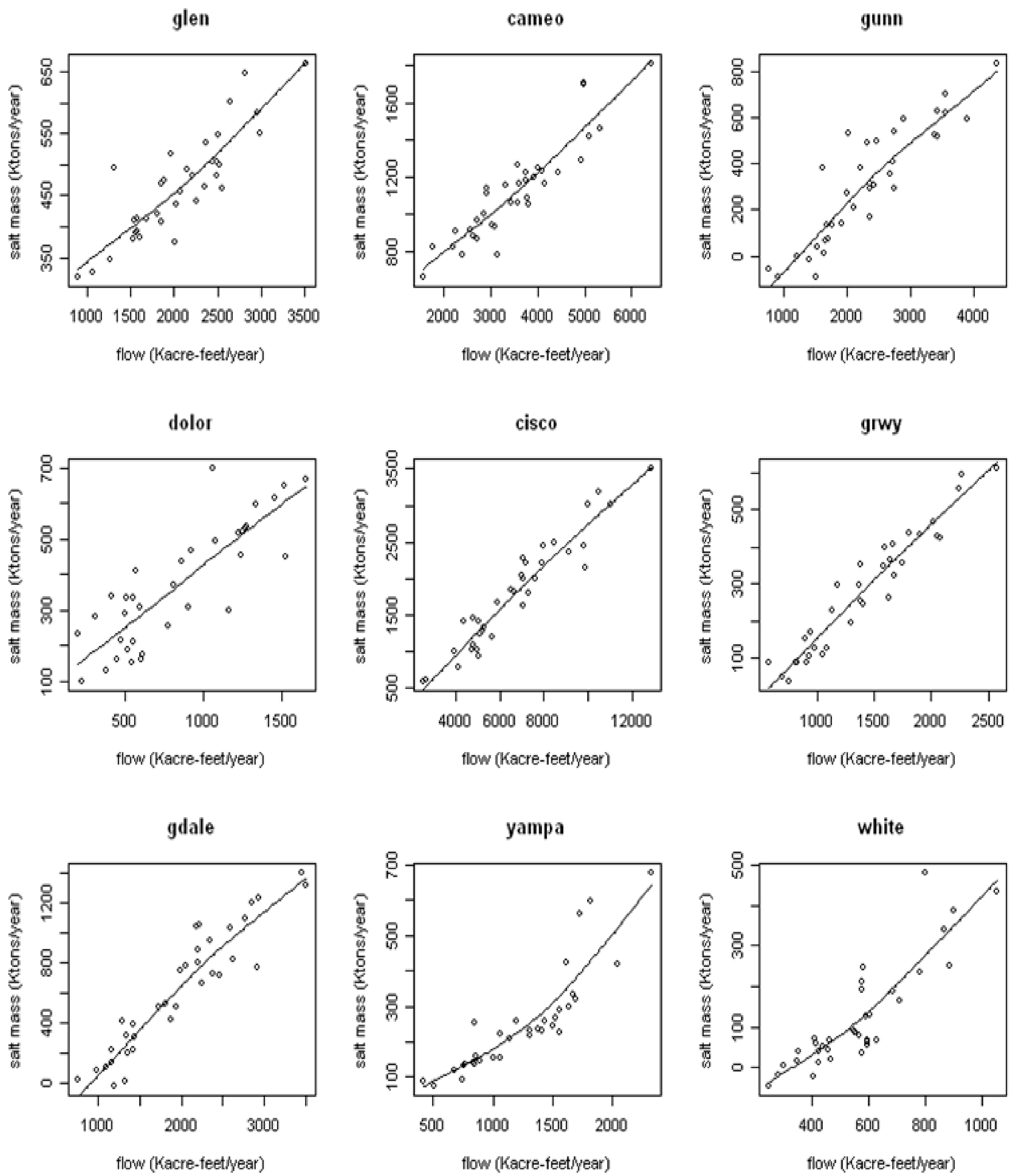
Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	122	0.96696	0.043285	1.75685	0.87780	122	0.98722	0.027032	-5.43980	0.99096	0.87572
9	Calcium	122	0.14503	0.056468	5.20661	-0.08718	122	0.31378	0.050801	-0.11973	-0.00342	0.64813
10	Magnesium	122	0.04985	0.089912	4.11846	-0.07720	122	0.36982	0.073531	-6.95946	0.09699	1.34801
11	Chloride	122	0.42289	0.055622	6.27387	-0.17848	122	0.74637	0.037028	-2.56759	-0.03945	1.07587
12	Sulfate	122	0.24441	0.047309	6.53250	-0.10086	122	0.61262	0.034016	-0.47921	0.00940	0.85322
13	Carbonate	122	0.43648	0.031159	5.43525	-0.10279	122	0.75320	0.020707	0.47554	-0.02480	0.60352
14	Sodium +K	122	0.40693	0.058836	6.41807	-0.18268	122	0.58218	0.049590	-0.37242	-0.07591	0.82630

2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	113	0.96449	0.042476	2.09477	0.83783	113	0.99295	0.019008	-7.17582	1.01504	1.09186
16	Calcium	113	0.17852	0.058986	5.34903	-0.10407	113	0.48758	0.046798	-3.47111	0.06454	1.03881
17	Magnesium	113	0.20232	0.073200	4.64248	-0.13952	113	0.51975	0.057055	-6.61444	0.07566	1.32581
18	Chloride	113	0.53137	0.054976	6.63693	-0.22155	113	0.79936	0.036136	-3.49783	-0.02782	1.19364
19	Sulfate	113	0.43121	0.048341	7.02984	-0.15930	113	0.77991	0.030207	-2.19725	0.01708	1.08674
20	Carbonate	113	0.47107	0.030391	5.47924	-0.10854	113	0.72525	0.022002	0.34336	-0.01037	0.60489
21	Sodium +K	113	0.46339	0.059482	6.63838	-0.20919	113	0.68973	0.045435	-2.77921	-0.02917	1.10918

2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	74	0.96985	0.040981	2.24272	0.81885	74	0.99483	0.017096	-7.88208	1.02962	1.17383
23	Calcium	74	0.25602	0.054008	5.39717	-0.11161	74	0.46188	0.046255	-2.31460	0.04892	0.89407
24	Magnesium	74	0.30203	0.063125	4.66607	-0.14629	74	0.56724	0.050054	-5.89642	0.07359	1.22457
25	Chloride	74	0.59504	0.057370	6.82831	-0.24500	74	0.83238	0.037170	-5.09383	0.00318	1.38221
26	Sulfate	74	0.55044	0.046033	7.17922	-0.17945	74	0.82981	0.028522	-2.67126	0.02561	1.14203
27	Carbonate	74	0.53353	0.034516	5.67134	-0.13004	74	0.78950	0.023349	-1.26909	0.01443	0.80465
28	Sodium +K	74	0.54324	0.060148	6.81818	-0.23109	74	0.76322	0.043610	-4.51247	0.00478	1.31363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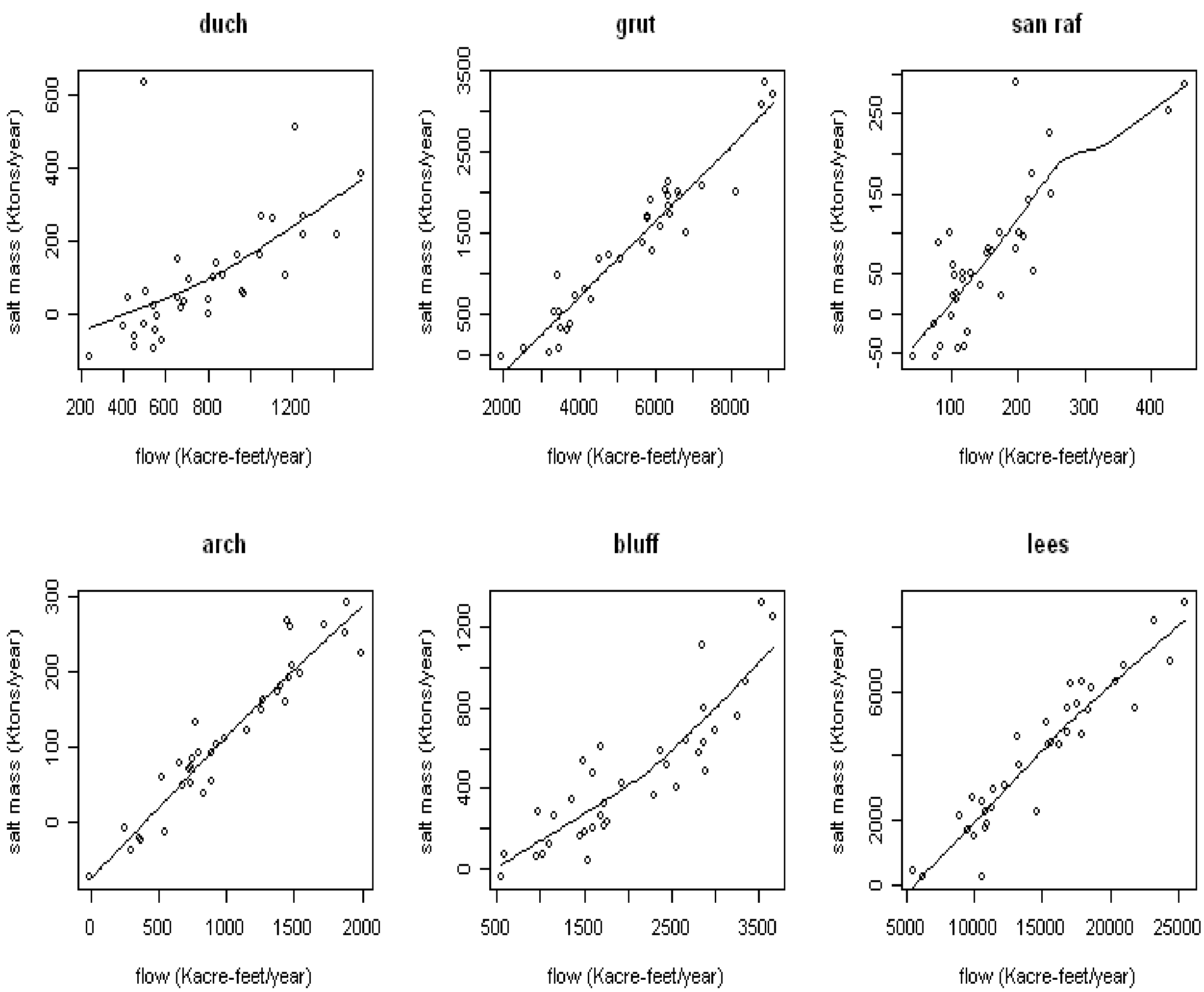
grwy
gdale
yampa
white
salt mass (Ktons/year)
flow (Kacre-feet/year)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grut
san raf
arch
bluff
lees
salt mass (Ktons/year)
flow (Kacre-feet/year)
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2000 4000 6000 8000
-50 0 50 150 250
100 200 300 400
0 100 200 300
0 500 1000 1500 2000
0 400 800 1200
500 1500 2500 3500
0 2000 6000
5000 10000 15000 20000 25000

Table B1. Salinity load regression model coefficients and statistical diagnostics at selected U.S. Geological Survey streamflow-gaging stations within the Colorado River Basin.

U.S. Geological Survey streamflow-gaging	Site name	Site Short Name	Y-axis intercept		Streamflow		Specific Conductance		Statistical diagnostics						
			Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Model p-value	PRESS statistic	Adjusted R^2	N	Bias correction factor (Smearing)	Standard error of the model, in units of Ln(load)	Residual variance, in units of Ln(load)
09071750	Colorado River above Glenwood Springs, CO	Glen	-7.487	0.584	1.056	0.031	1.093	0.056	<0.0001	0.061	0.994	66	1.000	0.029	0.055
09095500	Colorado River near Cameo, CO	Cameo	-5.263	0.816	0.927	0.043	0.906	0.070	<0.0001	0.029	0.995	50	1.000	0.024	0.027
09152500	Gunnison River near Grand Junction, CO	Gunn	-6.899	0.218	0.988	0.011	1.104	0.022	<0.0001	0.059	0.993	61	1.000	0.030	0.053
09180000	Dolores River near Cisco, UT	Dolor	-6.030	0.196	0.969	0.011	0.967	0.020	<0.0001	0.263	0.991	91	1.001	0.053	0.252
09180500	Colorado River near Cisco, UT	Cisco	-6.486	0.391	1.005	0.021	1.060	0.032	<0.0001	0.053	0.989	88	1.000	0.989	0.049
09217000	Green River near Green River WY	Grwy	-6.865	0.149	0.981	0.006	1.099	0.019	<0.0001	0.109	0.996	132	1.000	0.029	0.102
09251000	Yampa River near Maybell, CO	Yampa	-7.287	0.088	1.017	0.004	1.124	0.012	<0.0001	0.073	0.999	66	1.000	0.032	0.066
09302000	Duchesne River near Randlett, UT	Duch	-6.632	0.189	0.991	0.009	1.049	0.021	<0.0001	0.204	0.996	91	1.001	0.048	0.191
09306500	White River near Watson, UT	White	1.901	0.161	0.704	0.025	na	na	<0.0001	2.342	0.908	82	1.014	0.167	0.027
09315000	Green River at Green River, UT	Grut	2.746	0.190	0.680	0.022	na	na	<0.0001	2.655	0.917	85	1.014	0.175	0.030
09328500	San Rafael River near Green River, UT	SanRaf	3.118	0.087	0.599	0.021	na	na	<0.0001	7.029	0.902	88	1.038	0.279	0.077
09379500	San Juan River near Bluff, UT	Bluff	-7.302	0.125	1.013	0.008	1.132	0.013	<0.0001	0.098	0.995	88	1.001	0.032	0.089
09380000	Colorado River at Lees Ferry, AZ	Lees	-7.758	0.375	1.028	0.010	1.164	0.054	<0.0001	0.009	0.996	44	1.000	0.014	0.008
09402500	Colorado River near Grand Canyon, AZ	Grcan	0.060	0.315	1.011	0.033	na	na	<0.0001	0.113	0.957	34	1.001	0.049	0.002
09415000	Virgin River at Littlefield, AZ	Virgin	3.664	0.144	0.592	0.030	na	na	<0.0001	0.186	0.924	34	1.002	0.072	0.005
09421500	Colorado River below Hoover Dam, AZ-NV	Hoover	-5.430	0.619	0.990	0.007	0.872	0.088	<0.0001	0.151	0.993	144	1.000	0.032	0.146
09427520	Colorado River below Parker Dam, AZ-CA	Parker	-7.427	0.402	1.002	0.004	1.146	0.057	<0.0001	0.226	0.996	301	1.000	0.027	0.222
09429490	Colorado River above Imperial Dam, AZ-CA	Imper	-7.248	0.230	1.015	0.006	1.102	0.027	<0.0001	0.140	0.993	399	1.000	0.019	0.138

APPENDIX C

20 Station Flow and Salt over Time

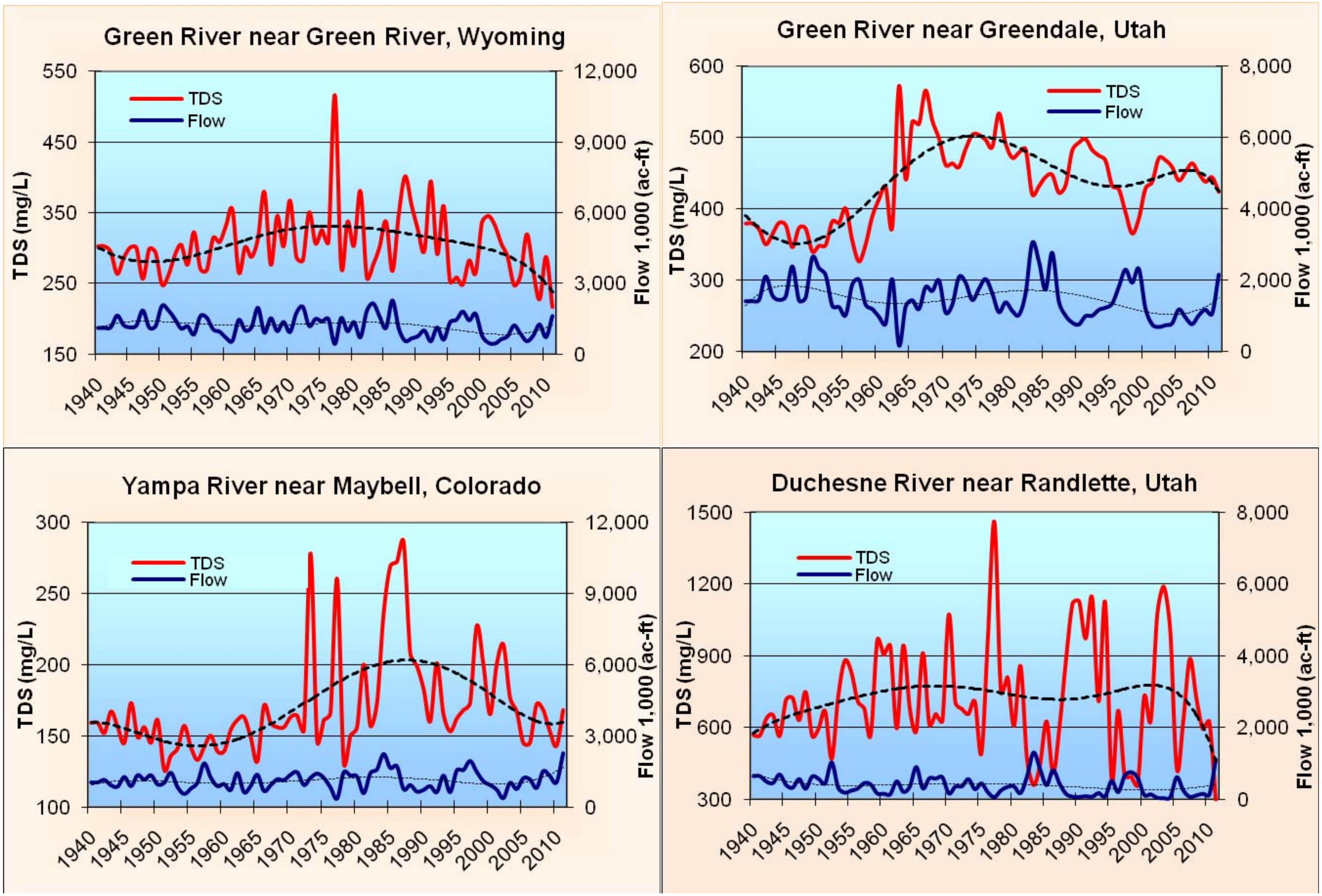

Figure C1 – Flow and TDS over time for sites 1-4.

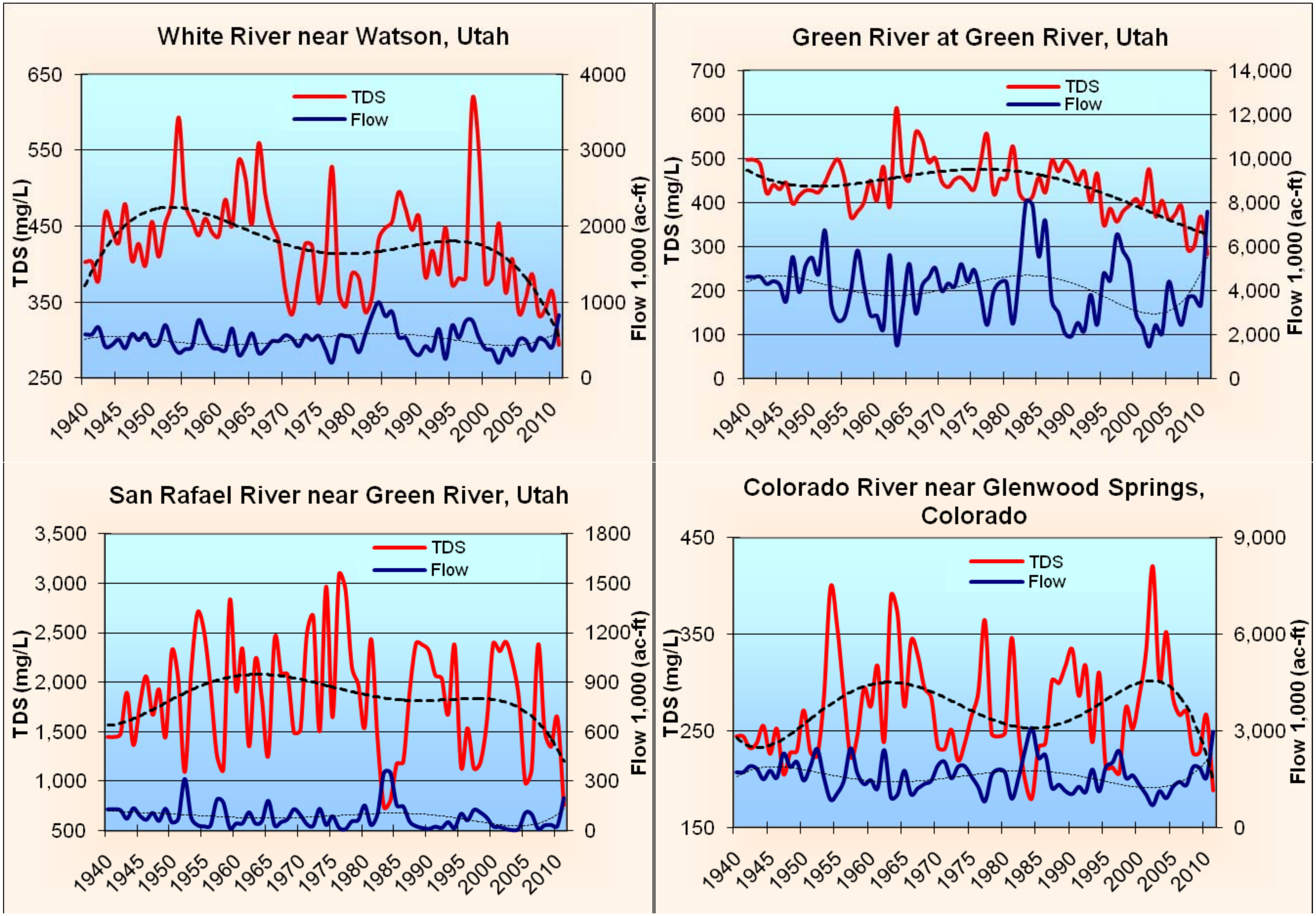

Figure C2 - Flow and TDS over time for sites 5-8.

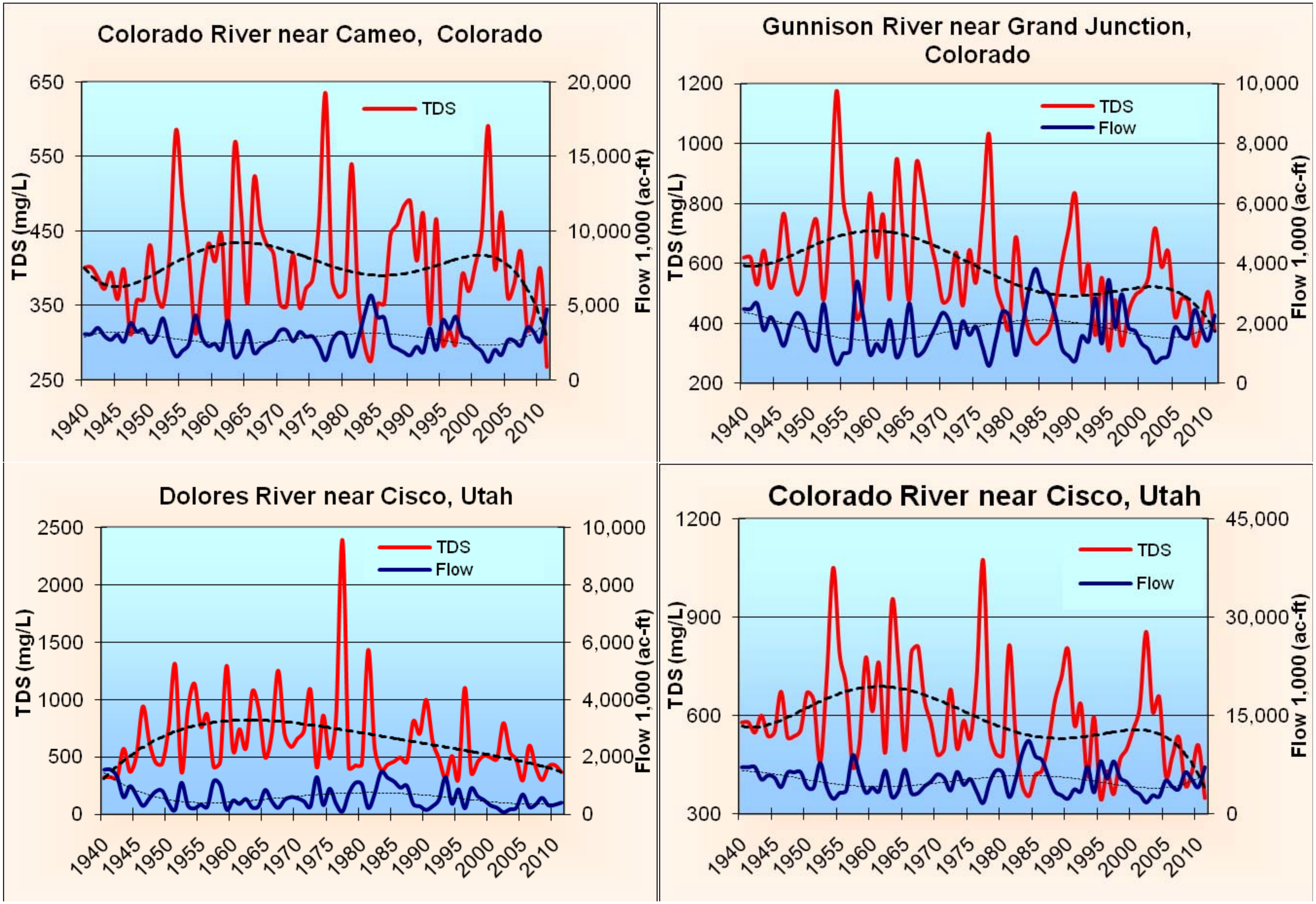

Figure C3 - Flow and TDS over time for sites 9-12.

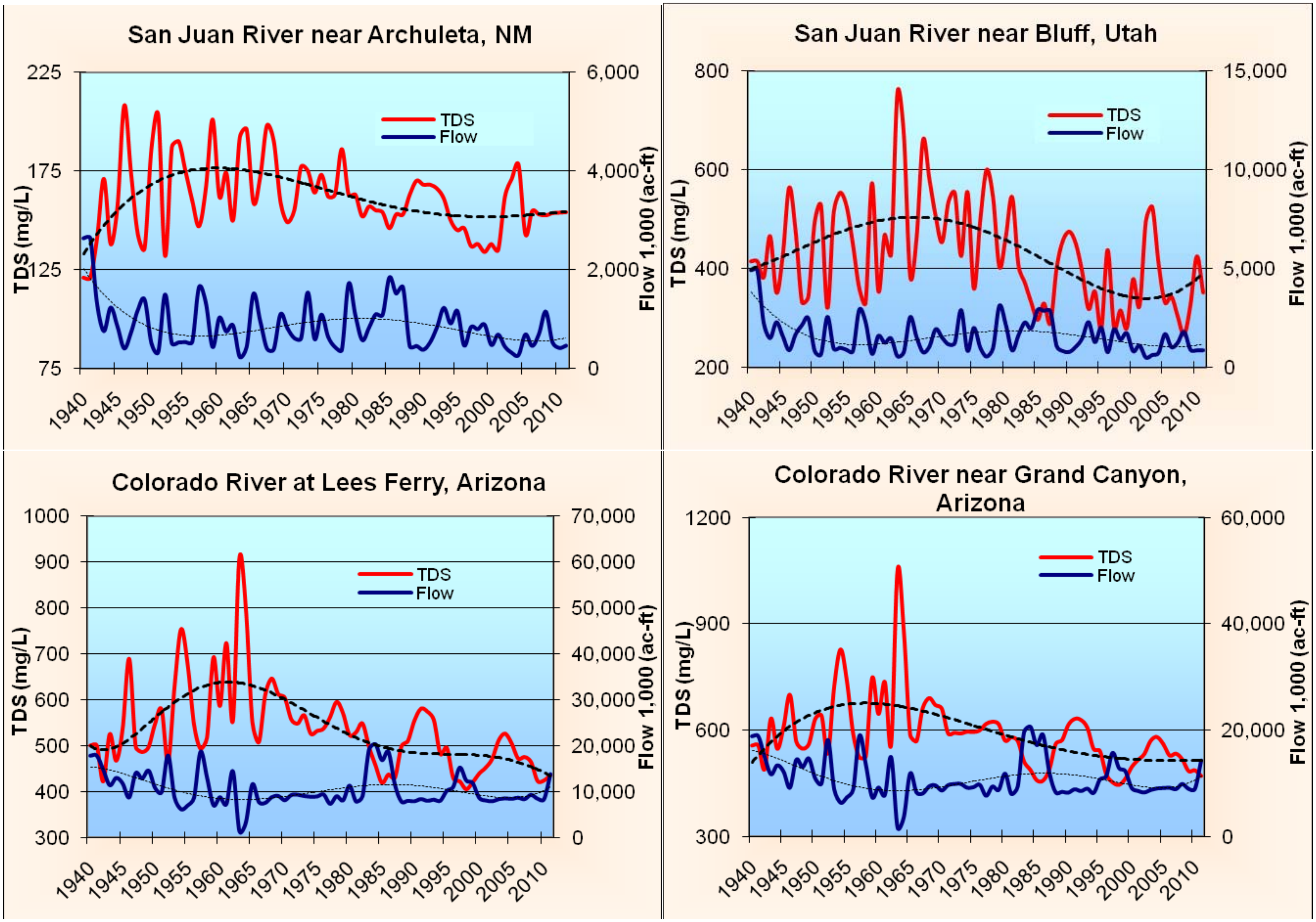

Figure C4 - Flow and TDS over time for sites 13-16.

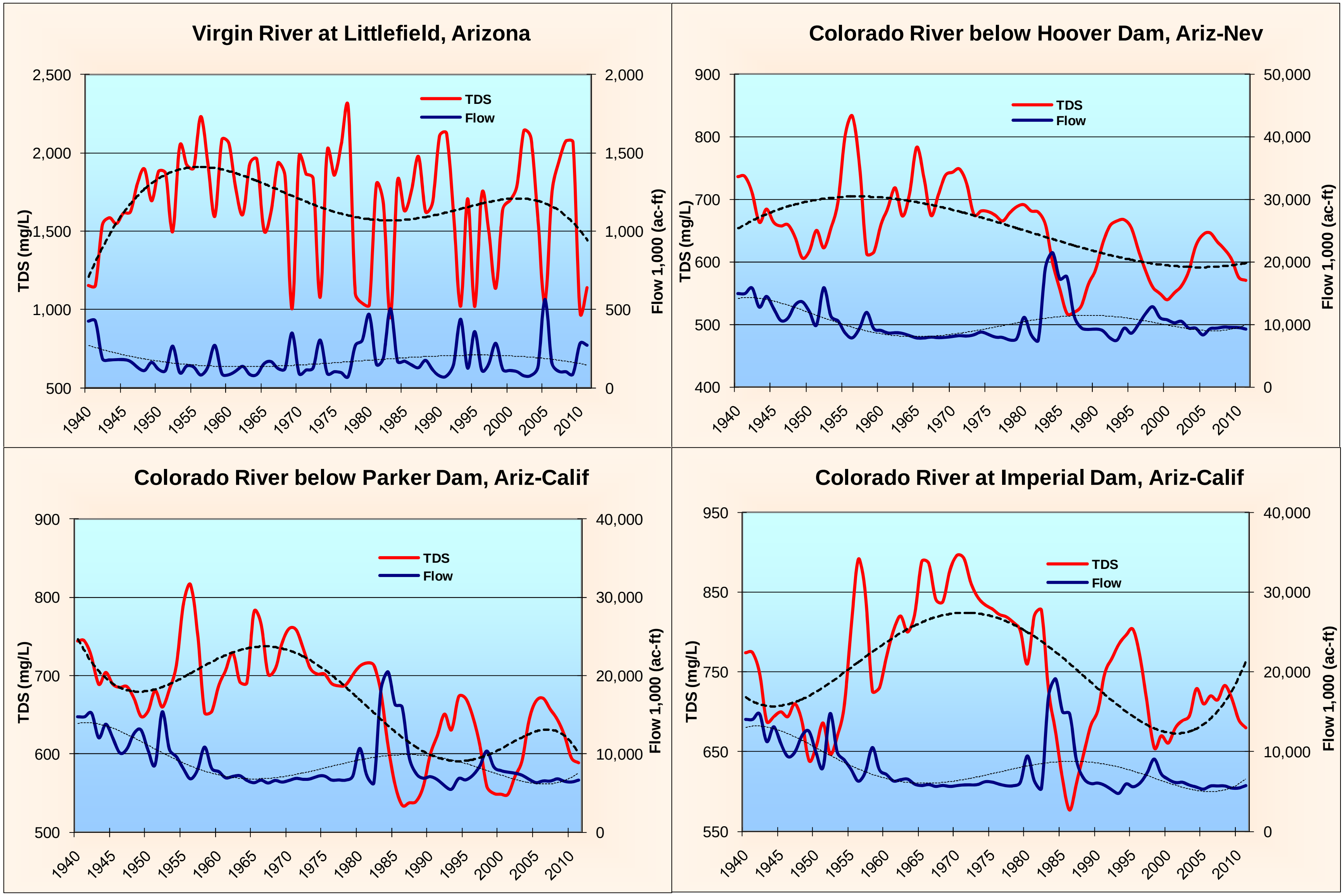

Figure C5 - Flow and TDS over time for sites 17-20.