

TECHNICAL MEMORANDUM

SUBJECT: **Green River Basin Plan II**
Colorado River Basin Salinity Control Program

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Introduction

Water in the Colorado River and its tributaries has experienced an increase in levels of dissolved solids (or salts, hence the term salinity) almost since man's first use. The basin largely lies on sediments derived from prehistoric seas, so soils naturally contain salts derived from that environment. Naturally occurring salinity comes from erosion of saline soils, saline springs, and snowpack runoff.

Man's influence, through irrigation returns, water exports, reservoir evaporation, and municipal and industrial discharges has served to further elevate salt concentrations. For practical purposes, the terms "total dissolved solids" (TDS) and "salinity" are synonymous and are used interchangeably. Dissolved salts of calcium, magnesium, sodium, chlorine, sulfates, and carbonates all can impair existing uses. The areas most affected involve crop selection, yield, and water requirements in the agricultural sector, and costs of operation and maintenance of facilities in the domestic and industrial sectors. High salinity levels make it difficult to grow winter vegetables and popular fruits. Water containing high TDS will more quickly corrode plumbing and water-using appliances and industrial equipment. Highly saline water has limited value when used for the irrigation of agricultural crops and landscaping vegetation. Economic impacts (reduced crop yield, higher drainage and soil leaching requirements, water treatment costs, equipment repair and replacement, etc.) from the currently quantified damages associated with high use of saline water in the Lower Colorado River Basin are currently estimated at \$376 million per year. Damages suffered in Mexico and many other damages in the United States are presently unquantified.

In 1972, an amendment to the Federal Water Pollution Control Act (the Clean Water Act) set forth a public policy embracing the restoration and maintenance of water quality, pollution effluent discharge limitation, and eventual zero pollution discharge. EPA interpreted the Clean Water Act to require water quality standards, including beneficial use designations, numeric salinity criteria, and a plan of implementation for the Colorado River. EPA promulgated a regulation in December 1974, which set forth a basin-wide salinity control policy for the Colorado River Basin. The regulation specifically stated that salinity control was to be implemented while the Basin states continue to develop their compact-apportioned water. Numeric criteria were subsequently established at three stations by the Colorado River Basin Salinity Control Forum. The criteria and a plan of implementation were adopted by

each of the Basin States and approved by EPA. The criteria, set in terms of milligrams per liter of total dissolved solids (TDS), are as follows:

Table 1 - EPA Salinity Regulations

Location	Annual flow- Weighted Average TDS
	mg/L
Below Hoover Dam	723
Below Parker Dam	747
At Imperial Dam	879

To maintain salinity concentrations in the River below the numeric criteria values, the overall strategy is to prevent salt from entering and mixing with the River's flow. A number of agricultural, point and diffuse sources of salinity have been identified throughout the Basin. The salinity control program is implementing controls or salt loading reduction mechanisms at those sites which contain salt sources that can be intercepted, reduced and/or prevented from entering the River at the least cost.

The Basin states established the Colorado River Basin Salinity Control Forum in 1973. The Forum is composed of representatives from each of the seven Basin states appointed by the governors of the respective states. The Forum was created for interstate cooperation and to provide the states with the information necessary to comply with Section 303(a) and (b) of the Clean Water Act. The Basin states, acting through the Forum, initially responded to this regulation by developing and submitting to the EPA a report entitled: Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control - Colorado River System, dated June 1975.

The Colorado River Basin Salinity Control Act (Public Law 93-320), as amended by Public Laws 98-569, 104-20, 104-127, 106-459 and 110-234 authorizes the Secretaries of the U.S. Departments of Interior and Agriculture to improve the quality of water available in the Colorado River for use in the United States and the Republic of Mexico. Title I of the Act authorized construction of features to enable the United States to deliver water to Mexico having an average salinity no greater than 115 ppm (parts per million or mg/l) +/- 30 ppm over the annual average salinity at Imperial Dam. Title II of the Act authorized specific salinity control units above Imperial Dam which are collectively referred to as the Colorado River Basin Salinity Control Program (CRBSCP).

The Program is a cooperative effort among water users in the Colorado River Basin, the seven-state Colorado River Basin Salinity Control Forum (Forum), the USDA's Natural Resources Conservation Service (NRCS) and the USBR and the U.S. Bureau of Land Management (USBLM). Pursuant to the Salinity Control Act, the USBR has the federal lead for coordination among the three federal agencies (USBR, USBLM and USDA) that are implementing on-the-ground salinity control measures. Each of the three agencies has designated agency-wide coordinators and all three have adjoining offices in the USBR's Upper Colorado Regional office building in Salt Lake City, Utah. The U.S. Geological Survey assists with salinity concentration water quality monitoring and provides other technical advice and scientific expertise in support of this basinwide program. The U.S. Fish & Wildlife Service is consulted as issues of concern to that agency arise.

Congressional actions have specified responsibilities for the Department of the Interior and the USDA for establishing projects and programs to manage the salinity, including salinity contributed from public lands, with substantial cost sharing with state and local government entities. In all cases, cost-effectiveness is a primary tenet of the Program – that is, getting the greatest reduction in salinity concentration for the amount of money spent.

The 1974 Salinity Control Act required 25% cost sharing from the Basin Funds for originally authorized USBR salinity control projects. The Salinity Control Act requires that no more than 15% of the repayment come from the Upper Colorado Basin Fund and that the remainder come from the Lower Colorado River Basin Development Fund. The Advisory Council has consistently recommended that 15% come from the Upper Colorado Basin Fund and historically the USBR has always taken 15% from the Upper Colorado River Basin Fund and 85% from the Lower Colorado Basin Development Fund. With time it was determined that the NRCS efforts that would assist irrigators to be more efficient with the application of irrigation water in high salinity areas could provide cost-effective salinity control. In October 1984, Congress authorized a stand-alone USDA Colorado River Salinity Control Program and directed the Secretary to implement salinity control measures on lands administered by the USBLM.

As additional time elapsed, experience demonstrated that the small USDA salinity control contracts being implemented by the agricultural producers within the private sector were very cost-effective. The USBR's prior salinity control authorizations and efforts had been to build large projects. Generally the cost per ton of salt controlled was greater than the costs associated with the USDA program. Accordingly, the USBR initiated a review of its salinity control program and, working in concert with the Forum, developed a proposal for a basinwide salinity control program that would provide the USBR with the authority to contract with entities in the private section to construct smaller projects. P.L. 104-20 authorized the Basinwide Program and directed the USBR to submit a report to Congress describing how the Basinwide Program was to be implemented before appropriated funding could be expended for this new component of the ongoing salinity control partnership. The USBR's "Report to Congress on the Bureau of Reclamation's Basinwide Program" was submitted to Congress in February 1996. A copy of that report is attached as Appendix C.

When Congress passed the Federal Agriculture Improvement and Reform Act (FAIRA, P.L. 104-127), the comprehensive Farm Bill enacted into law in April 1996, the USDA's stand-alone Colorado River Salinity Control Program was combined with three other conservation programs into the newly created EQIP. These amendments to the Salinity Control Act left in place the requirement of the 30% cost sharing from the Basin Funds. Importantly, FAIRA also provided that the required cost sharing from the Basin Funds could occur as up-front cost-sharing.¹ Upon enactment of the Salinity Control Act amendment included in FAIRA, the Basin Funds could be used directly – up-front and in a "matching funds" manner in the

¹ This was accomplished through the addition of subsection (f) to Section 205 of the Salinity Control Act by P.L. 104-127 which added the following words to the Salinity Control Act: "The Secretary may expend funds available in the Basin Funds referred to in this section to carry out cost-share salinity measures in a manner that is consistent with the cost allocations required under this section."

Program as opposed to only for repayment in the federal fiscal year succeeding the expenditure of appropriated funds for the construction of salinity control measures. While, this cost sharing has been occurring since 1996 and has been extremely helpful in advancing the salinity control effort, the 1996 amendment did not specify how this upfront cost sharing was to occur. The USBR subsequently determined that the cost sharing funds required by USBR salinity control efforts could be moved directly into the USBR program and used with the funds appropriated by Congress for both salinity control measures authorized by Congress before the authorization on the Basinwide Program (e.g., pursuant to P.L. 93-320, as amended by P.L. 98-569) and for the Basinwide Program (pursuant to P.L. 104-20). The Wyoming State Engineer's Office administers the Basin States Cost Sharing Salinity Control Program (sometimes referred to as the "Parallel Program") in Wyoming.

Section 303(d) of the Clean Water Act states in part:

The governor of a state or the state water pollution control agency of such state shall from time to time (but at least once each three-year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Results of such review shall be made available to the Administrator.

Since the states' initial adoption of the water quality standards have been reviewed every three years (1978, 1981, 1984, 1987, 1990, 1993, 1996, 1999, 2002, 2005 and 2008) as required by Section 303 of the Clean Water Act.

The standards require that a plan be developed which will maintain the flow-weighted average annual salinity at or below the 1972 levels while the Basin states continue to develop their compact-apportioned water supply. The plan is not, however, intended to offset the salinity fluctuations that are a result of the River's highly variable annual flows (natural variations in the hydrologic cycle). Analyses have shown that the impact of natural variations in the hydrologic cycle can have a significant impact on salinity. These natural variations in runoff can cause a fluctuation in average annual salinity concentration of as much as 450 mg/L TDS at Imperial Dam.

Recognizing the extreme and well-known variability of the River's annual flow, the plan for maintaining the criteria is developed using a long-term mean water supply of 15 million acre-feet (MAF). When River flows are at or above the long-term average annual flow, and reservoirs are full, then concentrations are expected to be at or below the numeric criteria. When evaluated using this assumption, the flow-weighted average annual salinity is maintained at all times at or below 1972 levels.

The federal regulations provide for temporary increases above the 1972 levels if sufficient control measures are included in the implementation plan. Should additional water development projects take place beyond those anticipated to occur before control measures are brought on line, temporary increases above the numeric criteria could result. However, these increases will be deemed to conform to the standards if appropriate salinity control measures are included in the implementation plan.

In addition to the highly variable annual flow, the frequency, duration, and availability of carryover storage greatly affect the salinity concentrations of water as it flows in the through the Lower Colorado Basin states. It is probable that salinity levels will exceed the numeric criteria in some years, and be below the criteria in others. As long as adequate control measures are included in the plan, periodic increases in salinity above the criteria as a result of reservoir conditions or periods of annual River flow below the long-term mean water supply of 15 MAF will also be in compliance with the standards.

The "2008 Review, Water Quality Standards for Salinity, Colorado River System" report (Colorado River Basin Salinity Control Forum, October 2008) includes the full text of Forum-adopted policies that affect existing and future development of water resources in Wyoming's Green River Basin. While the policies can be examined in their entirety in Appendix B of that document, a capsule review of each of the policies follows:

- **Policy for Implementation of Colorado River Salinity Standards through the NPDES Permit Program.** *This Policy applies to industrial and municipal discharges.*
 - In general, the position on industrial sources is "a no-salt return policy whenever practicable."
 - New sources (post-October 18, 1975) require demonstration that prevention of salt discharge is not practicable before saline discharges are allowed. The no-salt discharge requirement may be waived in cases where the salt load reaching the main stem of the Colorado River is less than one ton per day or 365 tons per year, whichever is less.
 - Existing sources may discharge salt upon satisfactory demonstration that it is not practicable to prevent the discharge of all salt. Demonstration requirements are detailed in the Policy. The no-salt discharge requirement may be waived in those cases where the salt load reaching the main stem of the Colorado River is less than one ton per day or 365 tons per year, whichever is less.
 - For municipal discharges, the policy allows a reasonable increase in salinity for discharges that can impact the lower main stem of the Colorado River. The incremental increase is 400 mg/l or less, on a flow weighted average basis. Discharges in excess of the 400 mg/l limit may be allowed upon satisfactory demonstration that it is not practicable to attain the limit. Demonstration requirements are detailed in the Policy. A similar *de minimus* case also exists for municipal discharges (one ton per day or 365 tons per year).

- **Policy for Use of Brackish and/or Saline Waters for Industrial Purposes.** *This Policy applies to industrial water use, recognizing the Colorado River Basin "contains large energy resources which are in the early stages of development."*
 - The policy encourages the use of brackish and/or saline waters, or brackish return flows from federal irrigation projects in lieu of fresh water sources, for

industrial purposes, except where it would not be environmentally sound or economically feasible.

- **Policy for Implementation of Colorado River Salinity Standards through the NPDES Permit Program for Intercepted Ground Water.** *This Policy applies to mines and wells in the basin which discharge intercepted groundwater.*
 - In general, the position on discharge of intercepted groundwater is ".a no-salt return policy whenever practicable."
 - Consideration should be given to the possibility that the groundwater, if not intercepted, would normally reach the Colorado River System in a reasonable time frame. If it can be demonstrated that the groundwater to be intercepted normally would reach the river system in a reasonable time frame, and would contain approximately the same or greater salt load than if intercepted, and if no significant localized problems would be created, the "no-salt" discharge requirement may be waived.
 - Existing sources may discharge salt from intercepted groundwater upon satisfactory demonstration that it is not practicable to meet the "no-salt" requirement. Demonstration requirements are detailed in the Policy. The no-salt discharge requirement may be waived in those cases where the salt load reaching the main stem of the Colorado River is less than one ton per day or 350 tons per year, whichever is less.

- **Policy for Implementation of Colorado River Salinity Standards through the NPDES Permit Program for Fish Hatcheries.** *This Policy applies to discharges from fish hatcheries.*
 - The basic policy for discharges from fish hatcheries shall permit an incremental increase in salinity of 100 mg/L or less above the flow weighted average salinity of the intake supply water. The incremental increase discharge requirement may be waived in those cases where the salt load reaching the main stem of the Colorado River system is less than one ton per day or 350 tons per year, whichever is less.
 - The permitting authority may permit a discharge in excess of the 100 mg/L incremental increase upon satisfactory demonstration that it is not practicable to attain that limit. Demonstration requirements are detailed in the Policy.

Big Sandy Unit of the U.S. Department of Agriculture's CRSCP

The initial project initiated under authorities provided in 1984 to the U.S. Dept. of Agriculture to implement their Colorado River Salinity Control program (CRSCP) was the Big Sandy Unit, which is reducing salt loading into the Big Sandy River through improving irrigation water application efficiencies (largely through conversion from flood irrigation to center pivot sprinkler irrigation) in the Farson and Eden areas of Wyoming. The Eden Valley Irrigation and Drainage District provides irrigation water to members from the Big Sandy and Eden Reservoirs. Below Big Sandy Reservoir, water is diverted to irrigate lands in the

Bureau of Reclamation-constructed Eden Project. Prior to implementation of this project, irrigation seepage into shallow aquifers near the Big Sandy River below the Eden Project contributed about 116,000 tons of salt, and tributaries contributed about 48,000 tons of salt annually to the Green River.

The USDA Big Sandy River Unit Plan was published in 1988 and implementation of the CRSCP began in 1989. As outlined in the 1986 EIS and Definite Plan Report, the objectives of the Big Sandy Unit were:

- treatment of 15,700 acres with improved irrigation systems
- reduction of salt loads by 52,900 tons/year
- conservation of 20,470 acre-feet of water;
- hayland production increases from 1.6 tons/acre to 4 tons/acre
- replacement of any wetland wildlife values foregone estimated at 860 acres of Type 3, 4, and 10 wetlands (USFWS Circ. 39).

The mechanism for reducing salt loading at this project therefore is to reduce deep percolation by using more efficient on-farm water application techniques; primarily the replacement of traditional uncontrolled flood irrigation methods with other practices that reduce deep percolation. Such practices include the installation of center pivot sprinklers and replacement of open conveyance ditches with gated pipe. Participation in all aspects of salinity control is voluntary on the part of private irrigators. Those who participate receive a cost share from the program such that their contribution is limited to approximately 30 percent of the cost of construction of the improvements.

Progress implementing the salinity control program at the Big Sandy Unit has been quite successful. To date, about 11,900 acres have been treated and about 15,230 acre-feet of deep percolation per year is being avoided. This equates to salt loading reduction of 39,600 tons per year. The collective amortized federal cost per ton of salt loading reduction for the Big Sandy Unit is \$23.60 per ton, which is exceptionally cost-effective.

In addition, in 2005 the Eden Valley Irrigation and Drainage District secured Wyoming Water Development Commission (WWDC) and Parallel Program salinity control funding to convert three laterals within their district from open ditch to pipe. This represented the first phase of an overall project to reduce the salt load to the Colorado River Basin by close to 6,600 tons per year through the reduction of lateral seepage which is estimated to be as high as 50%. Construction of Phase 1 commenced in the Fall of 2007 and is scheduled to be completed in the Spring of 2009.

During the summer 2008, Eden Valley Irrigation and Drainage District submitted a proposal in response to a funding opportunity announcement and was successful in the selection process. The District received a Letter of Commitment for Agreement Award for additional funding (Phase II) from the Bureau of Reclamation's Basinwide Salinity Control Program to replace four existing earth lined laterals with approximately 95,000 lineal feet of pipe ranging in size from 6" to 60". The project will also include new turnout structures, lateral diversion structures with trash cleaning capabilities and Supervisory Control and Data Acquisition (SCADA) system to control and monitor flows at the diversion headgates. The Bureau of

Reclamation funding is a 50% grant match to WWDC funding that was appropriated during the 2009 Wyoming Legislative Session. A consulting engineer will be hired in 2009 to perform design, bidding and construction management of Phase II lateral work with construction to follow during irrigation off-seasons in 2009, 2010 and 2011. The Legislature appropriated \$6,580,000 for Phase II of the Level III rehabilitation project in the form of a 50% grant with the remaining funds to be provided through the Bureau of Reclamation's Basinwide Salinity Control Program.

West Blacks Fork Area

An area of some 28,000 acres of irrigated pasture and hayland near Lyman, Wyoming, contribute salt to the Black Fork River, tributary to the Green River. While a large portion of the geology contributes little salt, about 10,00 acres may contribute significant amounts of salt from canal and ditch seepage and deep percolation from water applied to fields. Further verification of stream data is needed to determine if cost-effective salinity control measures are practical. Reclamation, the U.S. Department of Agriculture's Natural Resources Conservation Service and the U.S. Geological Survey are reviewing historical data to better characterize the salt "pick-up" values from the areas with treatment potential.

McKinnon – Burnt Fork Area

About 21,000 irrigated acres (15,500 acres in Sweetwater and Uinta counties in Wyoming and 5,500 acres in Summit and Daggett counties in Utah) contribute a significant salt load the Henry's Fork (of the Green River). Farmers and ranches in this area have seen the improvements occurring in the adjacent irrigated areas around Manila, Utah, and have expressed their desire to likewise implement EQIP CRBSCP and Parallel Program salinity control projects to improve irrigation efficiencies and reduce salinity loading to the Colorado River system. Initial water quality sampling during the 2008 irrigation season identified that further investigation and planning is warranted. In February 2009, the Colorado River Basin Salinity Control Forum Work Group, on behalf of the Forum, recommended to the Bureau of Reclamation and Natural Resources Conservation Service that they allocate Parallel Program funding to complete a hydrosalinity analysis and environmental assessment in 2009. The desired end result is that these studies will result in designation of the McKinnon-Burnt Fork irrigated lands as an additional salinity control area.

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