TECHNICAL MEMORANDUM

SUBJECT: **Green River Basin Plan**
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 lays on sediments derived from prehistoric seas, so that the soils naturally contain salts derived from that environment. Naturally occurring salinity comes from erosion of saline soils, saline springs, and normal runoff.

Man's influence, through irrigation returns, water exports, reservoir evaporation, and municipal and industrial discharges has served to further elevate salt concentrations to a point where damages are measured in the hundreds of millions of dollars annually. 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.

The EPA promulgated a regulation in December 1974, which set forth a basinwide 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. This regulation also established a standards procedure, and required the Colorado River Basin states to adopt and submit for approval to the EPA water quality standards for salinity, including numeric criteria and a plan of implementation, consistent with the policy stated in the regulation.

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. Since the states' initial adoption, the water quality standards have been reviewed every three years (1978, 1981, 1984, 1987, 1990, 1993, 1996 and 1999) as required by Section 303(c)(1) of the Clean Water Act.

The Salinity Control Act (Public Law 93-320), as amended by Public Laws 98-569, 104-20 and 104-127, authorizes the Secretaries of the U.S. Departments of Interior and Agriculture 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 II of the Act authorizes specific salinity control units and under this title was born the

Colorado River Basin Salinity Control Program (CRBSCP) and the various components and successors thereof.

All salinity control projects have as their ultimate goal the maintenance of water quality so that numeric criteria (referred to as the 1972 levels) are not exceeded in the lower basin. These criteria are 723 mg/l below Hoover Dam, 747 mg/l below Parker Dam, and 879 mg/l at Imperial Dam. Title I of the Act authorizes 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. The Bureau of Reclamation, the U.S. Department of Agriculture and the Bureau of Land Management are undertaking ongoing salinity control programs. Funding mechanisms that exist for project construction are available from the Upper and Lower Division States' development funds and from the Basin States Cost Sharing Salinity Control funding provided by the 1996 Federal Agriculture Improvement and Reform Act. The Wyoming State Engineer's Office administers the Basin States Cost Sharing Salinity Control Program (sometimes referred to as the "Parallel Program") in Wyoming.

Reports documenting the project include the Colorado River Basin Salinity Control Forum (June 1999) and Colorado River Basin Salinity Control Advisory Council (December 31, 1999). The June 1999 report is the triennial review of water quality standards in the basin prepared pursuant to Section 303(d) of the Clean Water Act, which states in part (from Section 303(c)(1)):

> *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.*

Other related documents not specifically cited are included at the end of the references section.

The federal regulations provide for temporary increases above the 1972 levels if sufficient control measures are included in the plan of implementation. 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 plan.

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 variability of the river, the plan for maintaining the criteria is developed using a long-term mean water supply of 15 million acre-feet. 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.

In addition to the highly variable annual flow, the frequency, duration, and availability of carryover storage greatly affect the salinity of the lower mainstem. Therefore, 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 below long-term average annual river flow will also be in compliance with the standards.

USDA's Colorado River Salinity Control Program (CRSCP) was rolled into the Environmental Quality Incentives Program by statutorial changes created by the 1996 Federal Agriculture Reform and Improvement Act (Public Law 104-127). Since the original salinity control act passed in 1974, Reclamation's and USDA's participation in the plan of implementation has changed in several ways. Both programs were restructured in 1995-96 with changes to their authorizations. Reclamation's program now encourages open competition for all types of salinity control. The USDA salinity control program was incorporated into a larger, national program (Environmental Quality Incentives Program (EQIP)) with multiple purposes. Although Reclamation projects may address any type of effective salinity control, many Reclamation projects concentrate on improving the efficiency of irrigation delivery systems, while the USDA program concentrates on improving on-farm systems. The two programs have purposely been designed to be highly integrated. This has improved the overall performance of the combined program beyond what either agency might have done individually.

The "1999 Review, Water Quality Standards for Salinity, Colorado River System" report (Colorado River Basin Salinity Control Forum, June 1999) outlines 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 these 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. 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.
- 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 350 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 deminimus case also exists for municipal discharges (one ton per day or 350 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

In Wyoming, the only existing component of the Department of Agriculture's CRSCP is the Big Sandy Unit. This unit, headquartered out of Farson, presents an effort to reduce salinity derived from irrigation in the Farson and Eden areas. The USDA Big Sandy River Unit Plan was published in 1988 and implementation of the program at this unit began in 1989. The total salt load reduction total for the Big Sandy Project, as outlined in the 1986 EIS and Definite Plan Report is 52,900 tons of salt per year. Annual progress reports are prepared by the Farson Field Office of the USDA Natural Resources Conservation Service (NRCS, 1999). A map of the Big Sandy Unit project area is given as Figure 1. Currently there are 18,370 acres in the project with water rights.

The 1999 Triennial Review report notes: "The Big Sandy River Unit is located in southwestern Wyoming. Below Big Sandy Reservoir, water is diverted to irrigate lands in the Eden Project. Irrigation seepage into shallow aquifers near the Big Sandy River is the source of saline seeps. These seeps and springs below the Eden Project contribute about 116,000 tons of salt, and tributaries contribute about 48,000 tons of salt annually to the Green River".

Briefly, salinity increases at the Big Sandy Unit are due to the deep percolation of irrigation water historically applied via flood irrigation. The Eden Valley Irrigation and Drainage District provides irrigation water to members from the Big Sandy and Eden Reservoirs. Excess flooding resulted in excess soil moisture, movement of water vertically downward to a shale layer, and horizontal movement of water downgradient to various discharge points. Seepage points are evident near the confluence of Bone Draw and the Big Sandy River some 8.5 miles southwest of Farson. The seeps display the white crust indicative of high salt concentrations. The mechanism for reducing salt loading at this project therefore is to reduce deep percolation by the application of more efficient on-farm water application techniques.

Improvements in irrigation practices on the unit include 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, replacement of open conveyance ditches with gated pipe, construction of border irrigation features and drip systems. 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.

As of February 2000 (Johnson, February 15, 2000), the following data describe implementation of salinity control measures at the Big Sandy Unit:

Constructed Project Components:

➢ Sprinkler Systems:	107	
➢ Improved Surface Systems:	5	
➢ Drip Irrigation Systems:	2	
➢ On-Farm Conveyance Systems:	112	(207,682 feet of pipeline)
➢ Regulating Reservoirs:	54	

Project Goals and Achievements:

	Goal	**Achieved To Date**	
➢ Total Land in Contracts or Treated (acres)	15,700	10,293	(in contracts)
		8,680	(treated)
➢ Percent of Producers Benefiting (130 total producers in District)	110 (85%)	76 (58%)	
➢ Salt Reduction (tons/year)	52,000	32,534	

The NRCS also reports that the irrigation improvements have resulted in an annual average water savings of approximately 12,500 acre-feet. This reduction is due to smaller water calls from storage due to more efficient usage.

West Green River Basin Watershed and Salinity Study Area

The NRCS is in the planning stages for a potential salinity reduction project for the "West Green River Basin Watershed and Salinity Study Area." This project will evaluate salinity reduction measures along the Hams Fork, Blacks Fork, Smith Fork and Henry's Fork drainages in southwest Wyoming and northeast Utah.

Originally applied for in 1990, this project has been recognized as having high potential for salinity reductions through the use of on-farm irrigation improvements. The project also has local support, evidenced at public meetings held at the time of the original application and reiterated at meetings held in the summer of 1999. The project has not been initiated to date due to changes in funding mechanisms over time and to the presence of other salinity control projects of higher priority. A monograph describing the history of this project has been prepared by the Wyoming State Engineer's Office (September 1999).

Phase I and Phase 2 of the salinity study are presently being implemented by NRCS and local conservation district personnel. Inventorying of the existing data, collect of data, water quality sampling and analysis are major parts of phase 1 and 2. The final part of Phase 2 will be to run a basin hydrosalinity model to determine the salt loading by major tributary in the basin. These data will be used to determine if there is a feasible salinity reduction project within discrete parts of the watershed. This analysis will then be reported to the Colorado River Basin Salinity Control Forum and its Work Group. The study would continue with development of feasible alternatives and the preparation of a salinity control plan to be submitted to the Forum and its Work Group in the late fall of 2001. The overall projected cost (including NRCS, conservation districts and local participation) is estimated at $114,000.

In 1991 a preliminary assessment report (NRCS, September 26, 1991) was completed which provided estimates of salt loading, potential salinity reduction and the federal costs to implement the project. The report estimated that of the 657,800 tons of annual salt loading, 75 to 85 percent (or about 526,200 tons) are from irrigated land. Using figures from the previously completed studies for the Big Sandy Unit, NRCS estimated that about 195,000 tons of salt loading reduction could be accomplished at an approximate federal cost of $40.00 per ton (amortized over 25 years at 8 7/8 percent interest).

Renewed need for an additional salinity control unit, in part due to the maturation of the Big Sandy Unit, resulted in the Colorado River Basin Salinity Control Forum recommending to the USDA in 1999 that it initiate planning for the West Green River project. As mentioned, public meetings were held and considerable interest in the project was still in evidence. Following the meetings, NRCS is to initiate a study leading to the preparation of a planning report and preparation of NEPA compliance documents. The preparation of the Green River Basin Water Planning Study will provide data and information useful for completing this proposed salinity control project study.

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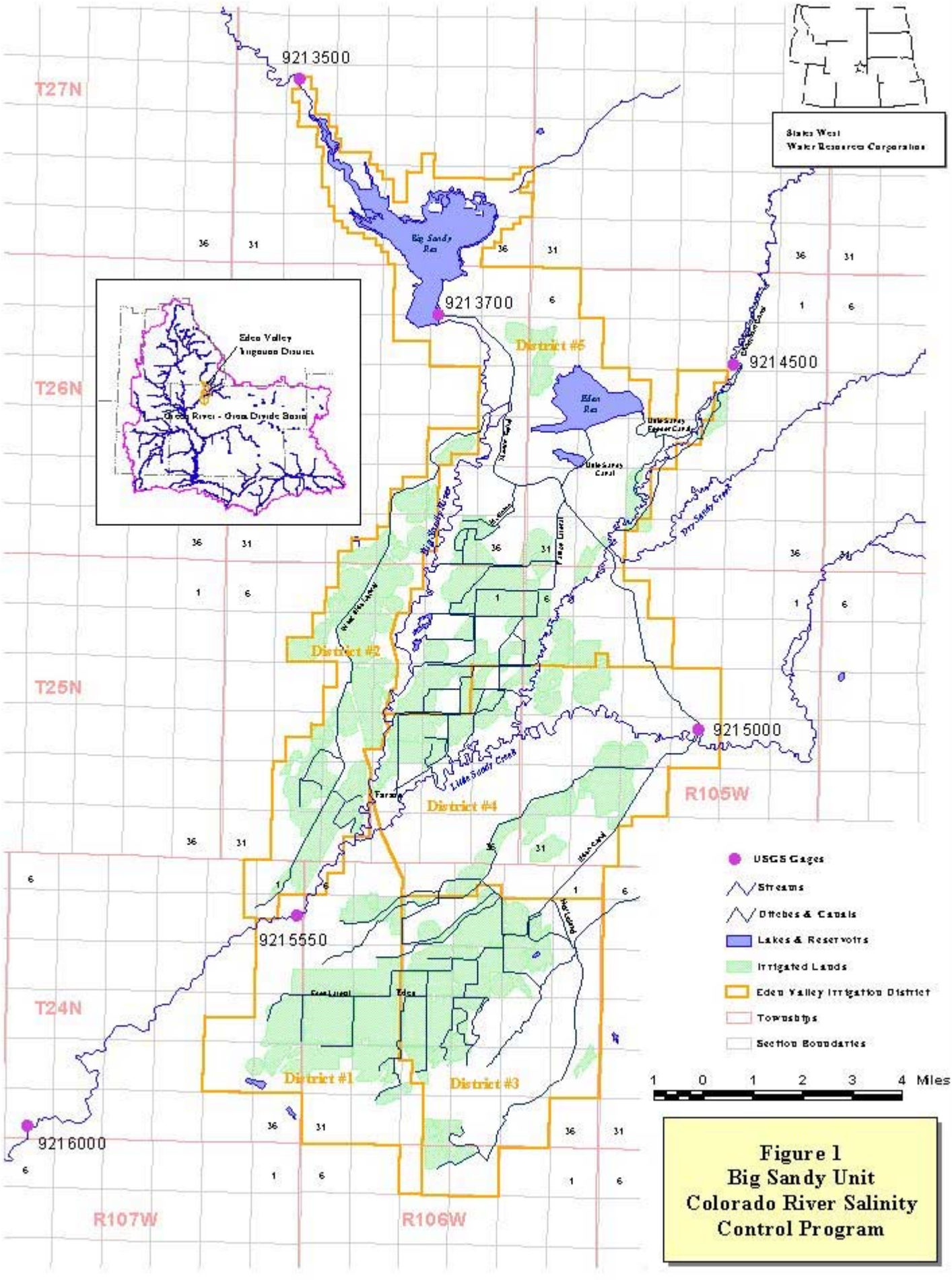

Figure 1
Big Sandy Unit
Colorado River Salinity
Control Program