EXECUTIVE SUMMARY

EVALUATION OF THE EFFECTIVENESS OF OPERATION OF AREA VIII OF THE RED RIVER CHLORIDE CONTROL PROJECT

EXECUTIVE SUMMARY

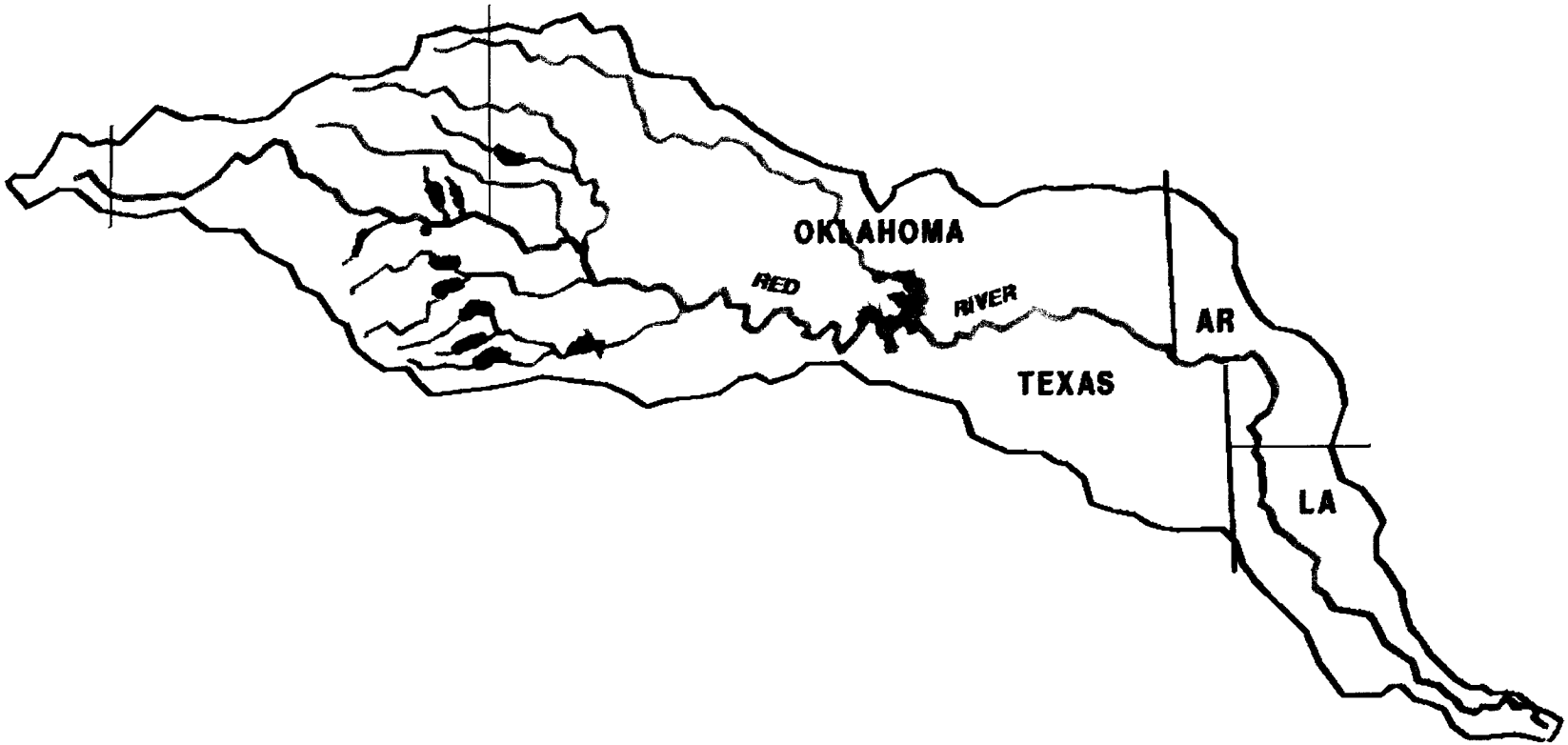
Approximately 3,600 tons of dissolved salt are carried into the Red River each day through natural salt sources located in the upper reaches of the river's drainage area. Of the ten identified natural salt sources, one is located in Oklahoma, and the remaining nine are in Texas. Salt springs along the river have rendered it, and Lake Texoma--which receives an annual average of 3.1 million acre-feet of water--virtually unusable as sources of water for irrigational, industrial, and municipal use. Water use over the Red River Basin (see Figure 1) varies from primarily agricultural irrigation in the upper reaches in Texas and Oklahoma to industrial in Arkansas and Louisiana. Municipal uses are widespread through the basin.

Projected population and industrial growth rates for the basin show that increasing demands for water will exhaust all present sources in the near future, thus requiring the use of Red River water. Currently, virtually all the good quality stream water within the region has been appropriated, thereby limiting further irrigation, municipal and industrial development. Some water for irrigation is presently being taken from the Red River and Lake Texoma. However, use of the poor quality water has reduced the average crop yield and lowered crop values along with damaging land and equipment. Existing industrial and municipal treatment facilities, piping systems, water heaters, and other household appliances are also being damaged by the high chloride level. Millions of acre-feet of groundwater in the shallow alluvium and terrace deposits along the Red River and its tributaries have been polluted due to interaction with stream flows. Control of salt springs in the upper reaches of the river and its tributaries would provide surface water for thousands of irrigable acres along the river and at the same time improve the quality of groundwater supplies. If contributing salt springs are controlled, the Red River could be made usable along its entire reach, thereby diminishing the need to develop other sources of supply.

This report details the evaluation of the operational effectiveness of Area VIII of the Red River Chloride Control Project (see Figure 2). The project's objective is to improve the quality of water in the river by removal of salt pollutants. Area VIII is located on the South Fork of the Wichita River and utilizes a collection and disposal concept designed to intercept and divert 85 percent of the estimated 195 average daily tons of chlorides entering the South Wichita River.

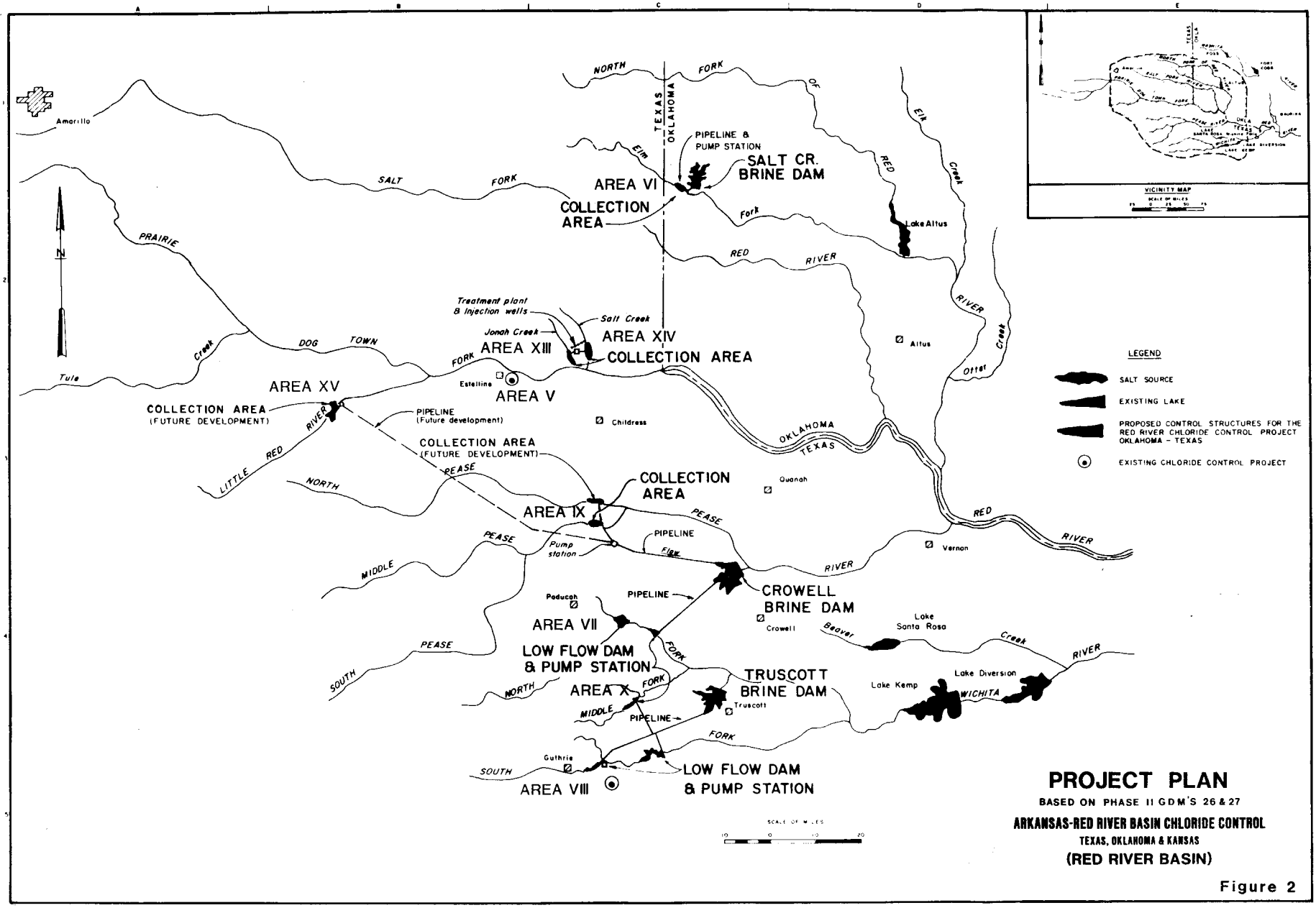
BACKGROUND

Studies to control natural salt pollution in the Arkansas and Red River Basins began in 1957 when Congress directed the U.S. Public Health Service to locate the major sources of natural salt pollution in those basins. In the Red River Basin (Upper Red River and Wichita River), the ten major sources located were identified as Areas V, VI, VII, VIII, IX, X, XI, XIII, XIV, and XV, and the U.S. Army Corps of Engineers was directed to determine the costs and benefits of alternative control plans. A survey report was completed in 1966 that recommended chloride control plans at the salt sources on the



RED RIVER BASIN

FIGURE 1



PROJECT PLAN

BASED ON PHASE II GDM'S 26 & 27

ARKANSAS-RED RIVER BASIN CHLORIDE CONTROL

TEXAS, OKLAHOMA & KANSAS

(RED RIVER BASIN)

Figure 2

C

Wichita River portion which includes Areas VII, VIII, and X. In 1974, the Water Resources Development Act provided special authorization to construct control measures at Area VIII on the Wichita River. Construction of the Bateman Pump Station and Truscott Brine Lake was initiated in 1976. The Water Resources Development Act of 1986 (PL 99-662) amended the previous laws and authorized construction of the remaining elements of the Red River Basin project, subject to a favorable report by a review panel established to evaluate the effectiveness of operation of Area VIII of the Red River Chloride Control Project, and a finding of it being consistent with the project benefits projected in Memorandum No. 25, completed in November 1980. The panel consists of:

Dr. Jack Keller (Panel Chairman)
Department of Agricultural and
Irrigation Engineering
Utah State University

Mr. Jack Rawson (Panel Vice-Chairman)
Associate District Chief,
Texas District, Water Resources Division,
U.S. Geological Survey
Austin, Texas

Dr. Herbert Grubb
Director of Planning
Texas Water Development Board

Mr. Jackson H. Kramer
State/Federal Relations Coordinator
Texas Water Commission

Mr. Glenn Sullivan, Secretary
Department of Natural Resources
State of Oklahoma

PROJECT PLAN

Area VIII is on the South Fork of the Wichita River about 5 miles east of Guthrie near the center of King County, Texas, and is about 4 miles north of U.S. Highway 82. Almost 50 percent of the natural chlorides polluting Lake Kemp come from the springs and seeps of Area VIII. Four springs which emerge from cavernous openings in the gypsum cliffs on the north side of the river have combined flows of approximately two cubic feet per second. Area VIII produces an average daily chloride load of 195 tons.

The plan for Area VIII includes two low-flow collection dams which are required on the South Fork of the Wichita River to collect brine which is to be pumped to Truscott Brine Lake. One completed dam (Bateman), consists of a 5-foot high deflatable weir. The weir impounds a pool to facilitate pumping and deflates during periods of high flows. The Bateman Pump Station transports the brine via 23 miles of pipeline to Truscott Brine Lake for disposal. The second brine collection structure identified in the selected plan would be constructed only as and if needed, and would be located at

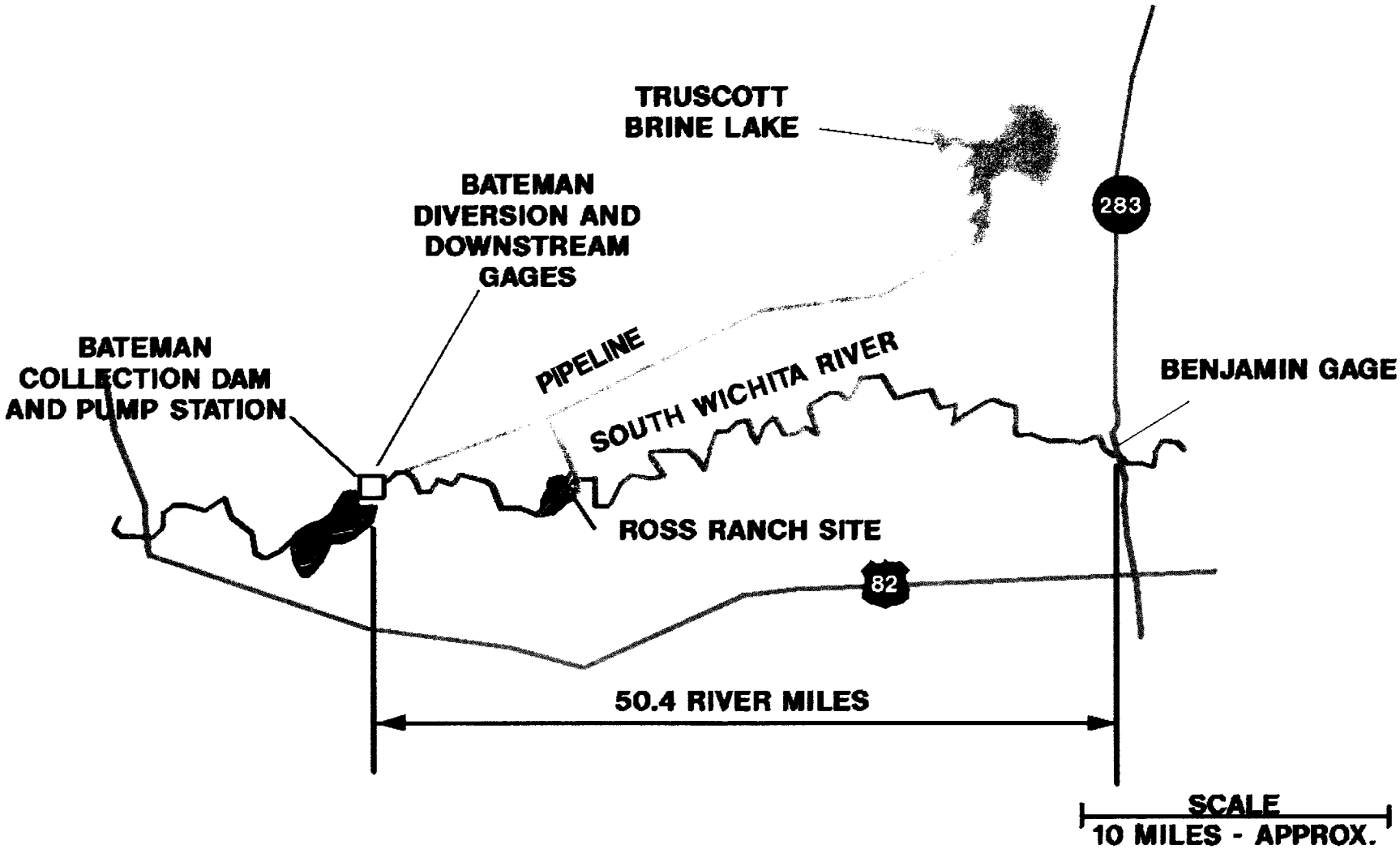
river mile 61.5 (Ross Ranch), with the diverted brine also being pumped to the Truscott Brine Lake.

A network of continuous-record streamflow and water quality stations on streams in the Red River basin has been operated for many years by the U.S. Geological Survey in cooperation with the U.S. Army Corps of Engineers and other Federal, state, and local agencies. Information on the location, drainage area, period of record, and types of instrumentation for stations applicable to the project are summarized in the report. The panel decided that a study of the data collected based on one year of operation of the Bateman Pump Station would be sufficient to adequately assess the effectiveness of its operation. This data quantifies the reduction of chlorides at both the Bateman and Benjamin gages. The records on which the project results are based are for the period from May 1, 1987, through April 30, 1988. Locations of the Bateman Pump Station and the downstream gaging stations are shown on Figure 3. The complete daily records of the quantity and quality of the water diverted and the flow at stations up and downstream from the low-flow dam and near Benjamin are included in the report (Table 1). Monthly summaries are also provided which detail the quantities of flow and the concentrations and loads of chloride in flows diverted by pumpage; the quantities of flow and concentrations and loads of chloride in such flow that passed downstream from the low-flow dam due to minor seepage under and around the dam, due to deflation of the dam during high flows and when breaks were being repaired in the pipeline (spillage); and the quantities of flow and concentrations and loads of chloride at the station near Benjamin. These data were deemed by the panel to be sufficient to allow proper evaluation of the Area VIII operation.

PROJECT RESULTS

A comparison of the records show that diversions of the more saline low flows resulted in an 86-percent reduction of the chloride load in the flow passing downstream from the Bateman Pump Station. This occurred even though an average of more than 138 tons/day of chloride was spilled during the test period when two pipeline breaks occurred reducing the effectiveness of the pumping effort, as well as record high flows in May and June 1987. However, high flow periods will occur from time to time throughout the life of such a project but on average should not constitute a very large portion of the time. Likewise, pipeline breaks will occur during the operational phase, but the total down-time is not expected to rise in future years and may even drop as experience in repairs is acquired. Projected chloride diversions based on the Bateman pumping operations were simulated on older data collected during water years 1971 through 1976. The simulation resulted in an even greater reduction of the chloride load than occurred during the one-year evaluation period.

The water quality records for both the Bateman and Benjamin stations are considered to be representative of the long-term prepumping conditions. During the one-year period, flows at Benjamin averaged 37 cubic feet per second and chloride loads averaged 153 tons/day. According to the Chloride Control Plan for Area VIII, pumpage of an averaged chloride load of 142 tons/day at Bateman would reduce the average chloride load at Benjamin to about 68 tons/day. However, pumpage of an average chloride load of 192 tons/day at Bateman during the one-year period reduced the average chloride



AREA VIII
RED RIVER CHLORIDE CONTROL PROJECT

FIGURE 3

TABLE 1

WATER DISCHARGES AND CHLORIDE CONCENTRATIONS AND LOADS
FOR SELECTED SITES ON THE SOUTH WICHITA RIVER, TEXAS, MAY 1987 - APRIL 1988

	ABOVE BATEMAN			BATEMAN DIVERSIONS			SPILLED BELOW BATEMAN			BELOW BATEMAN NEAR BENJAMIN		
Period	Water discharge (cfs)	Dissolved chloride (Mg/L)	Dissolved chloride (tons/day)	Water discharge (cfs)	Dissolved chloride (Mg/L)	Dissolved chloride (tons/day)	Water discharge (cfs)	Dissolved chloride (Mg/L)	Dissolved chloride (tons/day)	Water discharge (cfs)	Dissolved chloride (Mg/L)	Dissolved chloride (tons/day)
May 1987	58.7	1,960	313	5.7	10,000	155	53	1,100	158	249	920	613
June	14.0	5,890	220	11	6,100	180	3.0	5,100	40	108	1,700	500
July	10.8	7,870	232	8.0	8,600	187	2.8	5,800	45	32	2,800	239
August	7.86	10,000	218	7.1	10,000	197	.76	10,000	21	21	2,400	142
September	7.86	10,000	218	7.8	10,000	217	.06	8,800	1.5	8.2	2,600	60
October	6.96	11,000	201	6.9	11,000	200	.06	9,000	1.4	1.3	5,200	19
November	7.35	11,000	214	7.3	11,000	213	.05	9,400	1.2	1.1	5,900	18
December	7.96	10,000	220	7.7	10,000	145	.26	9,600	6.8	3.6	5,400	52
January 1988	7.30	9,860	200	5.2	10,000	145	2.1	9,500	55	5.6	4,700	71
February	7.45	11,000	218	7.3	11,000	214	.15	11,000	4.1	3.0	5,700	45
March	7.45	11,000	224	7.4	11,000	223	.05	10,000	1.3	3.9	4,100	42
April	6.21	11,000	187	5.4	11,000	163	.81	11,000	24	4.0	3,800	40
May 1987-April 1988	12.5	6,520	222	7.2	9,770	192	5.25	2,100	30	37	1,550	153
October 1970-September 1976	5.25	10,700	154									

load at Benjamin to only 153 tons/day. This discrepancy is readily explainable. As shown in Table 1, flows were exceptionally high during May, June, and July 1987 (May being the wettest month of record). In a way, this was a fortunate event in that it provided both high-flow and low-flow conditions for evaluation of the project's performance at Benjamin. Data indicate the much greater-than-average flows in May and June 1987 (the majority of which originated from flood runoff downstream of Bateman Pump Station) resulted in a significant flushing of chloride from the alluvium along the South Wichita River between Bateman Pump Station and Benjamin. After an initial flushout, dramatically lowered chloride loads accompanying low seasonal flows demonstrated the effectiveness of the Bateman Pump Station Operation.

FINDINGS OF THE PANEL

It is specifically noted and emphasized by the Panel that under the economic reanalysis contained in Memorandum No. 25, no benefits were credited to the project until all project elements of the areas recommended for construction were completed. Water quality benefits were only phased in as Red River water was actually used. The benefits were then allowed to grow as the use of the Red River water increased. The Panel would also observe that the economic reanalysis of 1980 was based upon appropriate concepts and reached appropriate conclusions. Therefore, any reanalysis of the benefits was not only outside the charge and authority of the evaluation Panel, but also impossible because benefits cannot begin accruing until such time as the water is used.

Upon review and evaluation of the data, the Panel concludes that the control system at the Bateman Pumping Station is operating better and more effectively than was predicted in Memorandum No. 25. Chloride removal during the test year actually exceeded projections and the expected level of control over the anticipated life of the project is estimated to be at least 87 percent, which again, exceeds projections.

PURPOSE

The purpose of this document is to present the findings of an effectiveness evaluation study on the operation of Area VIII (Bateman Pump Station portion) of the Red River Chloride Control Project by a five-member review Panel in accordance with paragraph C, Section 1107 of the Water Resources Development Act of 1986 (PL 99-662), 17 November 1986:

> "(c) Construction of remaining elements of the project involving the Red River Basin shall be initiated in accordance with the recommendations regarding general design memorandum numbered 25 by the director of civil works on behalf of the Chief of Engineers, dated August 8, 1977. Such construction shall commence upon transmittal of a report to the Secretary and to the Committee on Environment and Public Works of the Senate and the Committee on Public Works and Transportation of the House of Representatives of a favorable finding on the effectiveness of the operation of area VIII, to be made by a Panel consisting of representatives of the United States Geological Survey and the Texas Water Commission, a person selected by the National Academy of Sciences, and two other qualified persons to be appointed by the Secretary with the concurrence of the Governors of Texas and Oklahoma. The Panel shall assess the improvement in water quality downstream of area VIII to determine its consistency with the water quality assumed in the development of project benefits in the economic reanalysis of the project completed in November 1980. Such report shall be submitted to the Secretary and to such committees no later than three years after the date area VIII commences operation. Cost sharing for construction on the Red River Basin project initiated under this section shall be the same as the cost sharing for Area VIII of the project."